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Diplomarbeit

Implementation of a New Electrochemical Technique for Drinking Water, Process Water and Waste Water Treatment in Chile

erstellt für

Department of Sustainable Waste Management and Technology

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Kurzfassung

Implementation of a New Electrochemical Technique for Drinking Water, Process Water and Waste Water Treatment in Chile

(Implementierung einer neuen elektrochemischen Wasserbehandlungstechnologie für Trinkwasser, Prozesswasser und Abwasser in Chile)

Die Entwicklung von BDD-Elektroden eröffnete neue Möglichkeiten in der Behandlung von Trinkwasser, Prozesswässern und kommunalen bzw. industriellen Abwässern. Chile stellt einen interessanten, stetig wachsenden Markt für Abwasserbehandlungsanlagen dar. Modernem Know-how und verfügbaren Technologien steht eine Wirtschaft gegenüber, die sich an die gesetzlichen und normativen Rahmenbedingungen im Umweltbereich wenig gebunden fühlt. Die Tatsache, dass seitens staatlicher Institutionen kaum Kontrollen durchgeführt werden, führt zu erheblichen Umweltbelastungen.

Das elektro-chemische Wasserbehandlungssystem des Instituts für nachhaltige Abfallwirtschaft und Entsorgungstechnologie der Montanuniversität Leoben stellt durch seine Vorzüge vor allem in Kombination mit einer nachfolgenden biologischen Stufe eine interessante neue Möglichkeit in Chile dar.

Daher wurden 2 Proposals für von der EU kofinanzierte Projekte erstellt und weitere Möglichkeiten zur Finanzierung eines Transfers dieser Technologie nach Chile untersucht.

Abstract

Implementation of a New Electrochemical Technique for Drinking Water, Process Water and Waste Water Treatment in Chile

The recent development of BDD-electrodes opens new possibilities in the treatment of potable water, process waters and municipal and industrial waste waters. Chile presents an interesting, constantly growing market for waste water treatment plants. Modern know-how and available technologies oppose an economy that hardly respects the legal and normative frame conditions in the environmental sector. The fact that governmental institutions hardly ever realize controls leads to severe environmental problems.

The electrochemical water treatment technology of the Department for Sustainable Waste Management and Technology of the University of Leoben represents due to its advantages especially in combination with a posterior biological treatment an interesting new possibility in Chile.

Due to this, 2 proposals for projects co-financed by the EU were prepared and further possibilities for financing a technology transfer were analyzed.

Contents

Page

1 Introduction

Worldwide 97% of the water resources are salt water. Of the remaining 3% sweet water, 79% is ice, mainly polar ice and glaciers. Further 20% are ground water. Just 1% of the sweet water is surface water. Water resources are becoming more and more important, especially in the so called developing countries the conscience of the importance of this resource is raising.

In Chile the high water consumption and the growing demand for water in the productive sector puts this resource under high pressure. According to official statistics of the DGA, the Chilean Water Directive, the water resources in the 8 northern regions of the country, where 80% of the population lives, are totally used.

1.1 Problem

The development of electrodes that are coated with boron doped industrial diamond offers new possibilities in water treatment. The Department for Sustainable Waste Management and Technology of the University of Leoben and the SME Pro aqua are realizing research and development activities in this area.

The South American continent represents a huge future market for water treatment facilities and therefore nowadays offers rapidly growing possibilities and a high potential for European institutions with the aim of implementing their water treatment technologies there. In Chile a constant availability of water is facing a rapidly growing demand that is caused by a growing population, new economic and productive schemes and changes in the urban lifestyle.

Considering the advantages of the electrochemical water treatment technique of the IAE there are several interesting fields of application for this technology in South America.

Considering furthermore that the IAE traditionally has good connections to South American institutions like the Chilean Universidad de la Frontera and that experience in EU-projects with partners from this region already exists, projects to transfer and implement this technology with South American partners pose an interesting option.

An important question that remained open was the financing of the transfer and implementation.

So, by this thesis the frame conditions in Chile were analyzed, possibilities for co-financing and assistance highlighted, 2 proposals for funding by the 6th Framework Programme created and the legal framework for the proposed projects created.

1.2 Objective

The objective of this thesis is to create a proposal for a research project in the 6th Framework Programme of the European Union. To reach this aim, the following activities have been realized:

- Research on the frame conditions in Chile
- Comparison of these conditions with the technological potential of the proposed technology
- Preparation of a proposal for EU-funding

2 Electrochemical Water Treatment

Electrochemical waste water treatment is an extension to redox detoxification. It is of increasing importance due to several logistic, technical and ecological advantages over chemical redox detoxification.

2.1 General Aspects of Electrochemical Water Treatment

Chemical redox reaction is specified by a change of the oxidation state of the substances involved. Representative application in waste water purification is detoxification of dichromate according to the reaction:

$$Cr_2O_7^{2-} + 3\ SO_2 + 2\ H^+ \rightarrow 2\ Cr^{3+} + 3\ SO_4^{2-} + H_2O \qquad (1)$$

Chemical detoxification of dichromate is carried out under homogeneous conditions. As shown by the above mentioned equation, the process needs additives with reducing properties. After detoxification the products of reaction have to be separated from the effluent.

The reaction can also be carried out heterogeneously in an **electrochemical** reactor, according to the electrode reactions:

Cathode reaction: $Cr_2O_7^{2-} + 6\ e^- + 14\ H^+ \rightarrow 2\ Cr^{3+} + 7\ H_2O$ (2)

Anode reaction: $2\ H_2O - 4\ e^- \rightarrow O_2 + 4\ H^+$ (3)

The electrodes do not participate in the reaction. They have to transfer the electrons needed. Transfer of electrons from the electrode to the substance is observed at the cathode and transfer of electrons from the substance to the electrode is observed at the anode.

Electrodes can act in several ways such as:

- Transfer of electrones without interaction with the electrolyte.

  Example: $Cr_2O_7^{2-} + 6\ e^- + 14\ H^+ \rightarrow 2\ Cr^{3+} + 7\ H_2O$ (4)

- Participation in the redox reaction.

  Example: $Zn^{2+} + 2\ e^- \rightarrow Zn\downarrow$ (5)

- Formation or consumption of gaseous substances.

  Example: $Cl_2 + 2\ e^- \rightarrow 2\ Cl^-$ (6)

In waste water purification electrochemical processes are applied in:

- Precipitation of metals from several effluents
- Upgrading of process liquors
- Detoxification by oxidation or reduction

Compared with chemical processes the cost of investment is the major disadvantage of electrochemical processes. Application needs extended tests with the effluent which has to be treated according to individual electrode/solute properties.

Metal ions can be separated from effluents by precipitating the metal on the surface of electrodes of the same substance. Carrier electrodes can be used too. In latter application the metalleous precipitate is stripped off from the carrier electrode.

Beside application in metal precipitation, detoxification by reduction or oxidation, like the anodic oxidation process, is of increasing importance.

Two types of electrodes are used:

- *Plate type electrodes:* The electrodes have the form of differently shaped plates. The so called Swiss-roll is specified by the largest specific electrode area per volume.
- *Particle type electrodes:* In this case the electrode area is increased by applying particles instead of plate type electrodes. We have to distinguish between packed bed electrodes, fluidised bed electrodes with electrically conductive particles and fluidised bed electrodes with inert particles.

2.2 Electrochemical Water Treatment Processes

The following list displays the existing electrochemical water treatment processes:

- **Elektrolysis (Membrane elektrolysis):**

  a) *Cathodic reduction* and complete precipitation: Change of the oxidation state by reduction.

  b) *Anodic oxidation* by direct electron transfer or by formation of the oxidising substance at the anode.

- **Membrane electrolysis:**

  Chloride containing electrolytes for example will form chlorine at the anode, which acts as strong oxidizer. Formation of chlorine can be avoided by separating the anode from the electrolyte with a cation exchange membrane or diaphragm. The electrolyte in contact with the anode can be kept free of chloride. Membrane electrolysis is often used for the removal of heavy metals from, for instance, bioleaches from contaminated sediments.

- **Elektro dialysis:**

  Separation of charged particles (ions) from the carrier effluent by migration under electrical field force. In this membrane process the feed flux is separated from the diluate flux and the concentrate flux by ion exchange membranes. Industrial applications include producing fresh water from brackish water and sea water, and demineralization of readily treated waste waters. Figure 1 shows an electro dialysis. [1], [2]

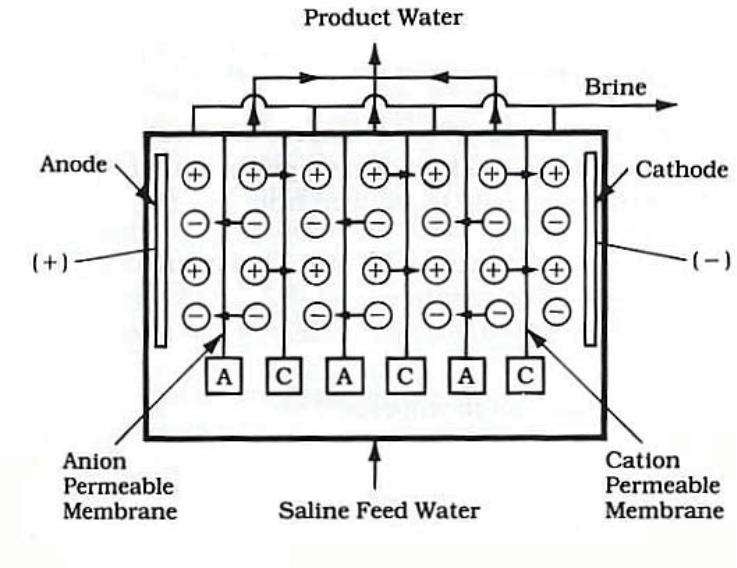

Figure 1: Electro dialysis [1]

- **Electro osmosis:**

  Separation of the mobile (aqueous) solvent from the immobile solid solute phase. Water migrates towards the negative electrode. Simultaneously, the region near the anode is dried. Electro osmosis is used for instance in dewatering waste water treatment plants´ sludges.

- **Electro flotation:**

  Splitting of emulsions. Dispersed particles are removed from liquid using gas bubbles. The gas bubbles are obtained through the electrolysis of water. The electrodes are arranged at the bottom of a tank filled with the aqueous solution containing the dispersed solids. Electrolyzing the water produces bubbles of hydrogen and oxygen gas. As the bubbles float to the top of the tank, they collide with particles suspended in the water on the way up, adhere to them and float them to the surface of the water. Dispersed particles accumulate at the surface of the tank in the form of foam called flotosludge. The foam is then skimmed off the surface of the tank with a bladed transport system or skimmer. Figure 2 shows a schematic electro flotation process. A typical industrial application is the separation of oil from oil-water emulsions. Removal of Ni, Zn, Pb, Cu and cyanide by electroflotation for groundwater decontamination is possible, too.

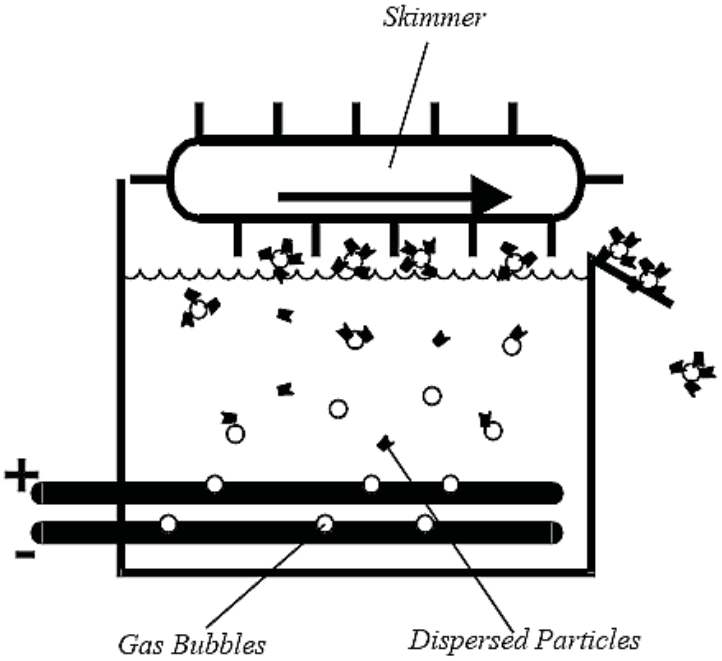

Figure 2: Electro flotation [3]

- **Electrophoresis**

  Separation of colloidal solid solutes from the solute. Typically, electrphoresis is not used in waste water treatment but in biotechnology.

- **Electrocoagulation and Electroflocculation**

  Electrochemical formation of coagulants by anodic dissolution of metals (using sacrificial electrodes, usually made from Aluminium). [4], [5] Electroflocculation can be considered the combination of an oxidation , a flocculation and a flotation. Industrial applications include pollutant and color removal from textile dye and water treatment in galvanization plants.

2.3 General Aspects of Anodic Oxidation

Oxidative electrochemical processes promising versatility, environmental compatibility and cost effectiveness have a continuously growing importance both in selective organic synthesis and in the electrochemical incineration (ECI) of organic pollutants in aqueous media. In the case of organic electrosynthesis selectivity is to be enhanced and in the electrochemical incineration process the aim is the mineralization or primary degradation of the toxic and non-biocompatible pollutants with high current efficiency.

Anodic oxidation of organics proceeds by several mechanisms including direct and indirect oxidation.

In direct electrochemical oxidation, electron exchange occurs between the organic species and the electro-catalytic electrode surface. A typical example is the oxidation of organic compounds on platinum anodes at low anodic potentials. The main problem with electro-catalytic anodes of platinum group metals is the decrease of the catalytic activity during use when proceeding oxidation of organics at a fixed anodic potential, before oxygen evolution. This is mainly due to the adsorption of reaction intermediates (mainly CO) at the anode surface, commonly called poisoning effect.

In indirect electrochemical oxidation, the organics do not exchange with the surface directly but through intermediation of some electroactive species.

The electrode material is an important parameter when optimizing such processes since the mechanisms and the products of several anodic reactions are known to depend on the anode material. For example the anodic oxidation of phenol yields hydroquinone and benzoquinone at Ti/IrO_2 anodes and mainly carbon dioxide at Ti/SnO_2-Sb_2O_5 anodes. [6] The electrode material influences strongly both the selectivity and the efficiency of the process.

A comprehensive model for anodic oxidation including competition with oxygen evolution is displayed in the following figure. This model permits to distinguish between 2 limiting cases: active and non-active anodes.

The non-active anodes have been defined as the electrodes, which do not provide any catalytic active site for adsorption of reactants and/or products in aqueous media. At non-active electrodes the only possible anode reactions are, in principle, outer sphere reactions (when the reactant and product do not interact strongly with the electrode surface) and water discharge (since the electrode is considered to be covered by at least one adsorbed layer of water molecules). Intermediates such as hydroxyl radicals produced by water discharge at non-active anodes (Reaction 1 in Figure 3) are considered to be involved in the oxidation of

organic compounds in aqueous media. This can result in the electrochemical incineration of the organic compounds (Reaction 5 in Figure 3). BDD-anodes are non-active anodes.

Besides direct oxidation with “non-active” electrodes, organic pollutants can also be treated by indirect electrolysis using “active” electrodes in the presence of inorganic mediators of the oxidation. Although a large number of mediators can be used, such as Fenton’s reagent or ozone, active chlorine is the most traditional one and the most widely employed. The mechanism of its electrogeneration in solution containing chloride ions is given by the following reactions: [7]

$$2\ Cl^- \rightarrow Cl_2 + 2e^- \quad (7)$$

$$Cl_2 + H_2O \rightarrow HOCl + H^+ + Cl^- \quad (8)$$

$$HOCl \rightarrow H^+ + OCl^- \quad (9)$$

Electrogenerated active chlorine has been efficiently used in the treatment of landfill leachate and textile effluent and is highly effective in the removal of ammonia and COD.

Figure 3 shows the anodic oxidation of organic compounds on “active” anodes (Reactions 1, 2, 3, 4 in this figure) and on “non-active” anodes (Reactions 1, 5, 6 in this figure). M is the anode material, R are organic compounds.

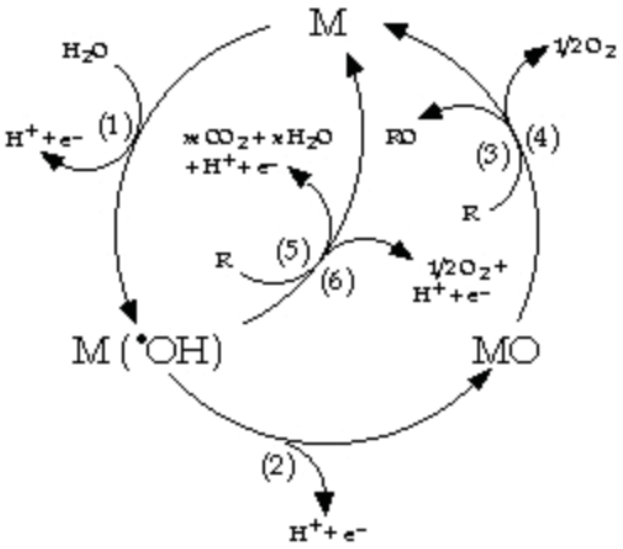

Figure 3: Scheme of the anodic oxidation of organic compounds on active (1,2,3,4) and non-active anodes (1,5,6) [8], [9]

(1) Water discharge to hydroxyl radicals and adsorbtion of the hydroxyl radicals to the anode material M:

$$M + H_2O \rightarrow M(OH^{\bullet})_{ads} + H^+ + e^- \quad (10)$$

(2) Formation of higher metal oxide:

$$M(OH^{\bullet})_{ads} \rightarrow MO + H^+ + e^- \quad (11)$$

(3) Partial (selective) oxidation of organic compound, R, via the higher metal oxide:

$$R + MO \rightarrow RO + M \quad (12)$$

(4) Oxygen evolution by chemical decomposition of the higher metal oxide:

$$MO \rightarrow M + 0{,}5\ O_2 \quad (13)$$

(5) Combustion of the organic compound via hydroxyl radicals:

$$R + M(OH^{\bullet})_{ads} \rightarrow CO_2 + x\ H^+ + x\ e^- + M \quad (14)$$

(6) Oxygen evolution by electrochemical oxidation of hydroxyl radicals:

$$M(OH^{\bullet})_{ads} \rightarrow 0{,}5\ O_2 + H^+ + e^- + M \quad (15)$$

To give an example of the degradation reactions of organic compounds using non-active anodes (for instance BDD-anodes) in the following the oxidation of a carboxylic acid is shown. Oxidation on this type of electrode, in the potential region of decomposition of water, involves the formation of hydroxyl radicals by water discharge (Equation 16), which may be either electrochemically oxidized to dioxygen (Equation 17) or assist in to the complete oxidation of organic compounds. For example acetic acid is oxidized to CO_2 (Equation 18), small amounts of formic acid and traces of oxalic acid are formed. These are oxidized to CO_2, too. The generated hydrogen ions are transformed to hydrogen on the cathode (Equation 19):

$$H_2O \rightarrow (OH^{\bullet})_{ads} + H^+ + e^- \quad (16)$$

$$(OH^{\bullet})_{ads} \rightarrow 0{,}5\ O_2 + H^+ + e^- \quad (17)$$

$$CH_3COOH + 2\ OH^- + 2\ H^+ \rightarrow 2\ CO_2 + 8\ H^+ + 8e^- \quad (18)$$

$$2\ H^+ + 2\ e^- \rightarrow H_2 \uparrow \quad (19)$$

Other oxidants formed on the diamond surface (peroxodisulphuric acid, O_3) can also participate in the oxidation of organic compounds near the electrode surface and/or in the bulk of the electrolyte. The generation of peroxodisulphuric acid is shown in the following equation (Equation 5): [6]

$$2\ H_2SO_4 + 2\ (OH^{\bullet})_{ads} \rightarrow H_2S_2O_8 + 2\ H_2O \quad (20)$$

Cyanide is decontaminated as follows:

$$CN^- + 2\ OH^- \rightarrow OCN^- + H_2O + 2\ e^- \quad (21)$$

$$OCN^- + 4\ OH^- \rightarrow NO_3^- + 2\ H_2O + 4\ e^- \quad (22)$$

$$NO_3^- + 6\ H_2O + 8\ e^- \rightarrow NH_3 + 9\ OH^- \quad (23)$$

Cyanide is contained in the water mainly as chelated cyanide with iron, nickel, chrome and copper. These chelates are less poisonous than free cyanide but are partially dissociated when exposed to solar radiation and thus generate free cyanide.

2.4 Conventional Anodic Oxidation Processes

Classic anode-materials for anodic oxidation comprise the following. All these electrodes are active electrodes. Often, stainless steel is used as cathode.

2.4.1 Titan/Metal-oxide Anodes (Dimensionally Stable Anodes)

Dimensionally stable anodes (DSA) were developed in the mid-1960's for the chlor-alkali industry. They are called dimensionally stable because they utilize precious metal containing electrocatalysts, like RuO_2, coated on titanium. The titanium substrate is corrosion resistant in the chlorine generating environment which allows for the structure to maintain its dimensional tolerance during its life unlike the graphite anodes they replaced. The traditional DSA-coating material is RuO_2, newer developments are SnO_2- and IrO_2- or mixed coatings. Further common elements for coating as oxides are Pt, Sn, Sb, As, Nb, Zr and Pb.

Ti/IrO_2-electrodes have the advantage that they are not degraded like lead-electrodes. The main reason why they are not suitable in technical waste water treatment is the fact that they, similar to platinum electrodes, show high activity in the formation of chloro organic compounds. [10]

Ti/IrO_2- and Ti/RuO_2-anodes favour incomplete conversion not to CO_2 but to carboxylic acids as final products. Their current-efficiencies are low. Contrary, Ti/SnO_2 anodes give high current efficiency and favour total degradation to CO_2. [9]

Ti/IrO_2/SnO_2-Sb_2O_5-anodes are produced by coating Ti/IrO_2 anodes with SnO_2 and Sb_2O_5. Their electrochemical behaviour lies between Ti/IrO_2-anodes and Ti/SnO_2-Sb_2O_5-anodes, but their lifetime is significantly higher.

Nowadays these electrodes have found economic application in chlorate generation, water disinfection, pool chlorinators, organic destruction, electrogalvanizing, electrotinning, electroflotation and metal plating. Industrial applications include treatment of textile dyes.

2.4.2 Platinum-Anodes

Pt-anodes are used for the production of peroxodisulfuric acid $H_2S_2O_8$. $H_2S_2O_8$ is prepared by electrolysis of H_2SO_4. The main problem in the peroxodisulfate production process using Pt-anodes is that the electrolyte must be purified from the corrosion product of the Pt-anode before recycling. Furthermore additives in the electrolyte (NH_4SCN) are required. These 2 problems can be avoided using BDD-anodes. BDD-anodes have higher current efficiency, too. [10]

Pt-anodes favour incomplete conversion not to CO_2 but to carboxylic acids as final products. Their current-efficiency is low. [9]

2.4.3 Lead-Dioxid- and Tin-Dioxid-Anodes

PbO_2-anodes have relatively high oxygen-overpotential, leading to good efficiency. They have proven to provide good COD-removal rates and have shown good properties in the decontamination of cyanide-containing waste waters. [11], [12]

Lead dioxid anodes are used for instance in electroflotation processes.

Problems are caused by the potential contamination of the treated water by dissolving electrodes. Special design of the used electrolytic cells and adding chloride-ions and/or copper ions helps mitigating the concentration of lead in the water. [12]

SnO_2-electrodes have similar properties to PbO_2-electrodes. The main reason why PbO_2- and SnO_2-electrodes are not common as anode materials In advanced oxidation processes is that their current efficiency for OH^- production is much too low. [13]

2.4.4 Graphit- and other Carbon-Based Anodes

The use of graphite or other carbon-based electrodes with relatively high overvoltages for oxygen production leads to the formation of carbon dioxide as a by-product and consequently to a continuous degradation of the electrode material. [13]

Experiments with graphit anodes in treatment of municipal waste water have shown that they are not suitable for this application due to the extreme corrosion of the electrodes. [10]

Anodic oxidation of phenol on graphite electrodes has been documented (Awad and Abuzaid 2000).

2.4.5 Stainless Steel- and Cu-Anodes

These types of anodes have very short lifetimes.

2.5 Anodic Oxidation using BDD-Electrodes

2.5.1 General Aspects

This new electrochemical advanced oxidation process (EAOP) became possible due to the recent development of large area doped diamond electrodes.

What differences BDD-electrodes from classical electrode materials are their unique electrochemical properties: Electrodes made of boron-doped diamond thin films deposited on self-passivating metals show the largest overvoltage for oxygen production from water ever found for an electrode material. This means that the electrolysis of water to H2 and O2, the side reaction that costs most energy in the electrochemical water treatment, does not occur at the theoretical thermodynamic decomposition-potential of water – 1,23 V – but at higher potential of over 2 V. Mainly molecular oxygen is produced during water electrolysis if the oxygen overvoltage is not high enough. So boron-doped diamond anodes allow to directly produce OH- radicals from water electrolysis with very high current efficiencies.

Boron-doped diamond electrodes exhibit a high mechanical and chemical stability. Diamond is an ideal electrode material – it is chemically and mechanically stable, offers good electrical conductivity and electrochemical characteristics. This means that BDD-electrodes are, contrary to electrodes used in processes like electrocoagulation and electroflocculation, not sacrificial; so no electrolytic addition of coagulating metal ions appears. They are stable in the presence of large amounts of hydroxyl radicals.

For the production of BDD-electrodes, Ti as base material is the most common due to its good mechanical properties. A TiC-interlayer has proven to ensure good electrical contact between the Ti substrate and the diamone coating. Other materias, such as niobium and p-Si may be used as base material, too.

BDD electrodes normally are produced by hot filament chemical vapor deposition technique (HF CVD). The boron-doped diamond films are synthesised on the surface of the base material.

The following figure shows an SEM-image (scanning electron microscope) of the surface of a polycrystalline BDD-electrode.

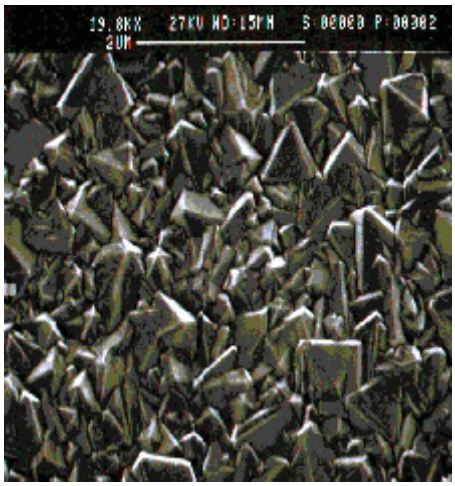

Figure 4: SEM-image of the surface of a polycrystalline BDD-electrode. [14]

BDD-electrodes can be used in the preparation of powerful oxidants like the production of persulfate $S_2O_8^{2-}$, in electro-organic synthesis, in the incineration of organic compounds and in the electro-analysis of phenolic compounds.

The blockage of the active spots on the electrode surface, commonly called “poisoning effect”, does not occur on BDD-electrodes.

The disinfection effect of anodic oxidation is based on direct oxidation of the micro organisms and on formation of partially highly effective disinfectants like chlorine, ozone, persulfate, peroxodicarbonate and hydrogen peroxide. The treated water is, contrary to UV-disinfection, biologically stable.

The fact that in anodic oxidation using BDD-electrodes no additional costs for chemicals, logistics and disposal of residues occur and that the maintenance of the plants is easy, is of high importance for the industrial application. The technology can be used for liquids with temperatures around 90°C, too.

The possibility of cathodic recovery of heavy metals exists.

The formation of unwanted by-products such as chlorate and nitrate can constitute a major disadvantage of anodic oxidation. However, it is well known that diamond electrodes also posess a high overvoltage for the cathodic hydrogen production, thus enabling cathodic reactions which are impossible by use of other electrode materials. The unspecific oxidation of all substances by the hydroxyl radicals leads to side reactions. Unwanted substances such

as nitrite, nitrate, chlorate and other oxidation products can be formed. This has to be considered when designing electrochemical water treatment devices with diamond anodes.

2.5.2 Side Reactions

In dealing with anodic oxidation, the consideration of possible side reactions is very important. A multitude of side reactions is possible due to the extremely high reactivity of OH-radicals. Some of them can produce unwanted highly toxic compounds. The most relevant side reactions are the production of chlorinated organic compounds, the oxidation of amines to nitrate and the oxidation of chloride to chlorate and perchlorate.

2.5.2.1 AOX Formation and Decomposition

If chloride ions are present in the electrolyzed solution, AOX is formed during the initial stages of COD removal by anodic oxidation. The chlorinated organic compounds are also eventually destroyed by OH•radicals, thus finally reducing the AOX value.

2.5.2.2 Formation of Nitrate

The oxidation of amines by OH• radicals can result in the formation of nitrite and nitrate.

2.5.2.3 Cathodic Reduction of By-Procucts by Use of Diamond Cathodes

The formation of unwanted by-products such as chlorate and nitrate can constitute a major disadvantage of anodic oxidation. However, diamond electrodes also posess a high overvoltage for the cathodic hydrogen production, thus enabling cathodic reactions which are impossible by use of other electrode materials. So it is possible to eliminate unwanted oxidised substances, like nitrate and nitrite, from polluted waters by the use diamond cathodes. Thus for instance nitrate and nitrite can be eliminated by electrochemical reduction.

Therefore it is advantageous to use both diamond anodes and cathodes if undesired by-products can be formed in the anodic half-reaction. [13]

2.5.3 Combination with Biological Treatment

By far the most important method for removal of the biodegradable fraction of the chemical oxygen demand of wastewaters is biological treatment, well-established and relatively cheap. But unfortunately not all substances which are responsible for COD are easily biodegradable. Toxic substances can inactivate the microorganisms and biological processes are relatively slow.

The combination of anodic oxidation with a subsequent biological treatment stage offers important advantages. The electrochemical treatment does not have to be complete. Not or only difficultly biodegradable substances (e.g. phenols) are degraded to easily biodegradable substances, mainly carboxylic acids like formic acid. The molecular weight of these carboxylic acids decreases with the treatment time in the electrochemical stage. The effluent is disinfected, too. These now easily biodegradable substances can then be completely degraded in the biological stage.

By this combination the size of the electrochemical treatment plant and the energy consumption can be reduced to 20% to 33% of the necessary values for total degradation by anodic oxidation. The treatment time in the biological stage can be reduced drastically. [15]

The anodic oxidation with BDD-electrodes is perfectly apt for adding an electrochemical treatment stage to already existing facilities.

2.5.4 Industrial Application of BDD-Electrodes

BDD-electrodes can industrially be used for the following purposes and waters:

- Elimination of COD in the treatment of process waters, municipal and industrial waste water, and landfill leaches.
- Disinfection of drinking water, swimming pool water, process waters, municipal and industrial waste water, and landfill leaches.
- Electro-organic synthesis.

BDD-electrodes have proven to be capable of effectively treating oil-containing waters from different processes like alkaline washing waters in the steel industry, water from the paper and pulp industry, waters containing strong complexing agents like malic acid and EDTA, waste water from the pigment industry and landfill leaches. Furthermore boron doped diamond electrodes are suitable for the preparation of chemicals like peroxodisulfuric acid. In

the application as disinfection devices they can be used in drinking water production, in the treatment of swimming pool water, disinfection of ships´ ballast water and for disinfecting waste water treatment plants´ effluents.

BDD-electrodes are successfully used for the treatment of drinking water in German cities and hospitals.

2.5.5 Anodic Oxidation Process of the IAE and pro aqua

The SME pro aqua Diamantelektroden Produktion GmbH develops and produces the BDD-electrodes. The process is a classical anodic oxidation using BDD-electrodes.

The base material of these electrodes is Ti. Contrary to other BDD-electrodes the boron doped diamond layer is not continuous. The randomly arranged microcrystals have a size from up to 250 µm (the size of the diamond crystals of other BDD-electrodes can be as small as 0,1 µm). pro aqua does not use the HF-CVD process (hot filament-chemical vapour deposition) for the production of its electrodes.

Figure 5 shows a BDD-electrode made by pro aqua.

Figure 5: BDD-electrode produced by pro aqua

2.5.6 Important Parameters and Energy Demand

The most important parameter is the amount of TOC that shall be eliminated. For the removal of 10 g TOC/h about 0,5 m^2 electrodes are needed. A further important parameter is the electric conductivity of the water. It determines the distance between the electrodes and thus the electric resistance [16]. An example for the calculation of energy consumption and electrode surface is given in chapter 3.2.2.

For the complete degradation of 1 kg TOC to CO_2 theoretically 9000 Ampere hours are needed. The potential is 3,5 V. The efficiency of the treatment varies from 25% to 50%. According to this the energy demand varies from 60 kWh to 150 kWh per kilogram completely degraded TOC.

If the anodic oxidation is combined with a posterior biological treatment as well the necessary electrode surface as the energy demand are reduced to a third to a fifth of the mentioned values.

Generally the treatment costs are higher than for a biological treatment, but by anodic oxidation hardly biodegradable substances can be eliminated or prepared for a successful bio-elimination [15].

2.5.7 Pilot Plant

Location: VA Stahl, Linz

Capacity: 100 l/h

Investment costs: 8000 €

Dimensions: Length: 1200 mm

Width: 300 mm

Height: 700 mm

The electrode-chamber itself is just about 200 mm high. The rest of the space is required by a degasification chamber to reduce the produced foam.

Electrodes: Material: BDD; 25 anodes and 25 cathodes, all in the dimensions 100 x 100 mm. Double sided coated with BDD. The use of both BDD-anodes and BDD-cathodes allows easy cleaning of lime by reversing the polarity. In former experiments, cathodes made of stainless steel were used. Here lime was deposited on the cathodes that had to be dissolved with acid.

Area of Application: Recycling of alkaline washing water (closed cycle) in the surface cleaning of steel. The water contains NaOH and mineral oils.

Figure 6 and Figure 7 show the pilot plant.

Figure 6: Pilot plant in Austria

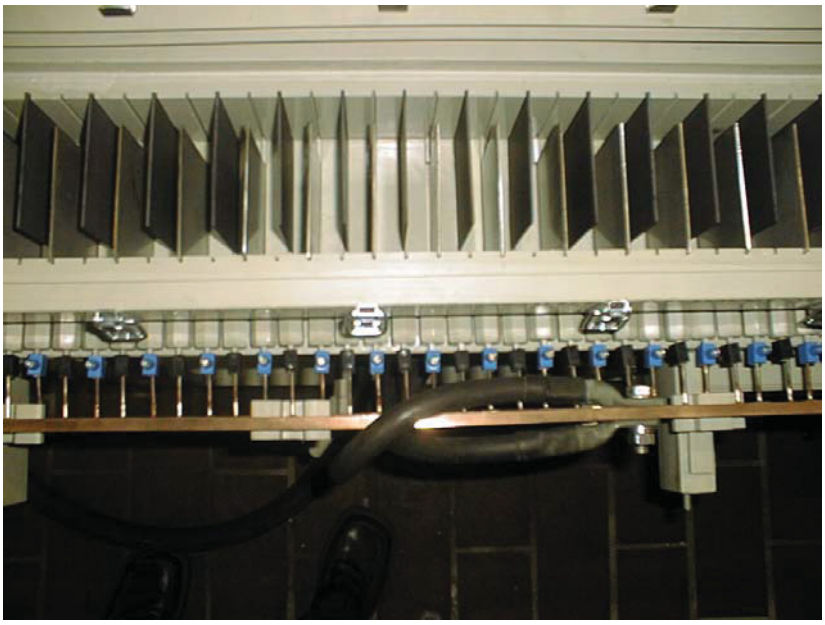

Figure 7: Electrode chamber of the Austrian pilot plant

3 Situation in Chile

3.1 General Situation

Chile, situated in the very south western part of South America, is a country of extreme contrasts. The ever-dry Atacama dessert in the North opposes the rainy, water rich regions of the South.

Politically and economically stable, it poses an interesting option for enterprises from the Northern hemisphere.

Chile is divided into 13 regions – 12 regions that are numbered from I. to XII. beginning in the North and the metropolitan region (R.M.) of Santiago de Chile, the capital. The following figure shows the geographic distribution of the regions in Chile.

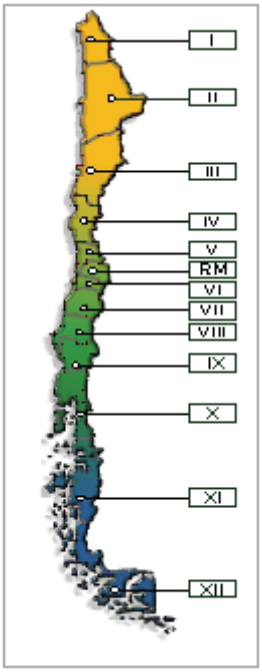

Figure 8: Geographic distribution of the regions in Chile

Approximately 40 % of the 15 million Chilean inhabitants live in Santiago.

Chile's ecosystems and natural surroundings are extremely different from each other. This means that living conditions and specific problems differ extremely between the North and the South. The available amount of water per year is 60 times higher in the X., XI. and XII. Region than in the most Northern regions.

The following table (Table 1) displays the principal problems of the regions. As 12 of the 13 Chilean regions have long coasts with the Pacific Ocean, the specific problems have been divided into marine contamination and continental water.

Table 1: Specific problems of the Chilean regions

Region	Continental Water	Main Reasons for Marine Contamination
I (Tarapacá)	High grades of salinity and presence of arsenic in the ground water (naturally). In the case of the river San José, the main reasons for the contaminations are irrigation and mining activities.	Mining activities and waste water originating from fisheries and the production of fish meal. One of the main contaminants of the off water of the fish meal production are oils that are directly or indirectly deposited at the beaches.
II (Anto-fagasta)	The principal rivers in this dry region are the rivers Loa and San Salvador. 8 big sources of contaminations were detected. The most significant the city of Calama. Main contaminants are delivered by the saltpetre mine of Chuquicamata, more or less degraded pesticide and fertilizer derivates from agriculture and municipal waste waters. Up to 134 l/s municipal waste water are being disposed of in the river body, leading to severe bacteriological, physical and chemical contamination.	Similar problems due to intense mining and fishing industry like in the I. Region.

Table 1: Specific problems of the Chilean regions (Continuation)

III (Atacama)	5 sites in this region have severe problems with contamination of ground water. 4 of them due to dissolved solid matter – chlorine, magnesia, ammonia nitrogen. The most important rivers – the river Copiapó is contaminated mainly by municipal waste waters. When the water level is low, the problem is even more intense. Agricultural and mining chemicals pose an important problem.	Due to the mining industry several heavy metals like copper, mercury, cadmium, nickel and zinc. The beach of Chañaral is considered to be one of the worst contaminated sites of the world.
IV (Co-quimbo)	11 sites with contaminated ground water, mainly nitrate, nitrite, iron, chlorine and manganese The main contaminations of the rivers Limarí and Cogotí are caused by the cities of Combarbalá and Ovalle (6,8 l/s). Combarbalá has a treatment plant, Ovalle disposes untreated water.	The pollutions are mainly caused by the cities of Coquimbo – La Serena dispose of their waste waters untreated. Agricultural chemicals that reach the river mouth.
V (Val-paraíso)	The main sources of contamination in the river Maipo are municipal waste water, waste water of cellulose and textile industry, various activities associated to the mining industry, chemical industry, electro-metallurgy, irrigation. In the surroundings of the river Aconcagua there are 51 sources of contamination, among them 6 important mines, 6 slaughter houses, 2 factories producing smoked meat, 3 factories producing tinned foods, 1 foundry, 2 bottling plants. 3 sites have contaminated ground water (nitrates, iron).	The well-developed forest-industry and industry in this region cause severe contaminations that are transported to the sea. Valparaíso and Viña del Mar now have a common collection system for municipal waste water. The collected waters a disposed of in the Pacific Ocean 2 kilometres from the coast without further treatment.

Table 1: Specific problems of the Chilean regions (Continuation)

RM (Región Metro-politana)	With a population of 6 millions and a population density of 390 persons/km^2 the amounts of municipal waste water pose an enormous problem. The river Maipo crosses this territory, as well as the river Mapocho. The contaminations in these rivers originate in mining activities, municipal and industrial waste waters and tourism. The main contaminants that exceed the normative for irrigation water are choliforme bacteria, sulphates, iron, boron, mercury and copper. Some chemicals are present in high concentrations for which norms still do not exist in Chile. The use of ground water as drinking water is limited in several sites due to high presence of nitrates. Just 36 % of all industrial enterprises in this region have treatment plants. It is estimated that approximately only 70 % of the industrial enterprises in this region comply with the off water normative. Further problems are created by the extremely fast growth of the population of this area.	The Metropolitan Region does not have access to the ocean.
VI (Libertador General Bernardo O´Higgins)	16 sites have problems with contamination of ground water. The crucial contaminants are nitrites, iron, manganese and mercury. The main sources of contaminations in the river Rapel are industrial pig farms, fruit juice producing industry, various agricultural industries, production of whine, important copper production and municipal waste water.	The forest industry and agricultural activities lead to high contaminations that are transported to the sea by rivers. As there are no big cities situated at the coast, this is not considered as a severe problem by Chilean experts.

Table 1: Specific problems of the Chilean regions (Continuation)

VII (Maule)	21 sites with problems in ground water as drinking water. 15 due to nitrites, 6 due to iron and manganese. The rivers are mainly contaminated by the well developed forest industry, municipal and industrial waste waters. It is important to note the high number of landfill sites that have already reached the end of their life time, but continue receiving waste due to the lack of new landfill sites. This poses a potentially dangerous situation for ground and river water.	The forest industry and agricultural activities lead to high contaminations that are transported to the sea by rivers. As there are no big cities situated at the coast, this is not considered as a severe problem by Chilean experts.
VIII (Bío Bío)	The main reasons for contaminations in this region are the forest industry and related activities, industrial and municipal waste waters. Ground water is contaminated by diffuse sources. The prevailing contaminating industries are chemical and petrochemical plants, cellulose and paper industries, producers of glass and ceramics, leather-industries and metallurgical enterprises. Problematic in the river Bío Bío is that the naturally high aluminium level in the water is raised by the cellulose and paper industry in its surroundings.	The intense industrial fishery and the production of fishmeal, leads to oil-contaminations. Further problems are caused by contaminants emitted diffusely by households, sewage systems and rain water.
IX (Arau-canía)	Main contaminants originate from agriculture (pesticides and heavy metals), forest industry, industries (hydrocarbons) and biological contamination by municipalities.	Problems are caused by the strong fishery industry and rural, agricultural and industrial contaminants that are transported to the sea.

Table 1: Specific problems of the Chilean regions (Continuation)

X (Los Lagos)	Mainly responsible for contaminations of rivers, lakes and ground water in this region are insufficient or totally lacking treatment and deposition of liquid and solid municipal and industrial wastes. Further problems are caused by the strong agricultural sector and petroleum mining industry. Especially the lake Llanquihue is affected.	Problems are caused by the strong fishery industry and rural, agricultural and industrial contaminants that are transported to the sea.
XI (Aysén del General Carlos Ibáñez del Campo)	With only 0,9 inhabitants/km^2 this region is the most sparsely settled of Chile. 75 % of the inhabitants concentrate in 3 cities. Difficult access leads to isolated settlements. Problems are caused by forest industry, agriculture and fishing industry. There is an important petroleum mining industry. This region has high potential for hydro energy. Water is abundant.	Relatively light impacts due to forest and fishing industry and agriculture.
XII (Mag-allanes y Antártica Chilena)	84 % of the population is concentrated in 2 cities. Problems in rivers, lakes and ground water are caused by mining (petroleum, carbon, gas, gold), forest and fishing industry, and, in the densely populated areas, by the municipalities.	Contaminations near the population centres due to municipal and industrial off waters (fisheries, mining activities)

In the I., II. and III. Region the predominating mining industry is the copper mining. In the South, important mining activities concentrate on petroleum and gas.

Each of the 13 regions is the working area of an “Empresa Sanitaria” (“sanitary enterprise”) with the duty to provide safe drinking water, and collect and treat the municipal waste waters. The formerly state-owned empresas sanitarias were privatized in 1988 and 1989. The next table (Table 2) displays which empresa sanitaria is responsible for which region.

Table 2: Chilean sanitary enterprises

Region	Empresa Sanitaria
I	ESSAT
II	Aguas de Antofagasta S.A.
III	EMSSAT
IV	ESSCO
V	ESVAL
VI	ESSEL
VII	ESSAM
VIII	ESSBIO
IX	ESSAR
X	ESSAL
XI	EMSSA
XII	ESMAG
R.M.	EMOS

Today, 8 of these empresas sanitarias are controlled by foreign enterprises. E.g. ESSBIO and ESSEL are controlled by the British Thames Water, part of the German group RWE. The remaining 7 are state-run.

According to SISS, the Superintendencia de Servicios Sanitarios (the state institution which has to control and fiscalize the public sanitary services and control the industrial waste waters), by 2002 42% of the waste waters of the Metropolitan Region were treated. By 2004 this number would raise to 75% and by 2009 to 100% of the waste waters produced in this area can be recuperated and re-used in agricultural irrigation.

About 77% of the industrial plants in Chile comply with the Chilean normative for industrial waste water. This means that an important part of the Chilean industry disposes off waters that do not comply with the legislative demands. These norms will be discussed in chapter 3.3.

A severe problem is the lack of waste water treatment plants. So, most Chilean communities dispose their waste waters insufficiently or merely untreated into water bodies. Due to this fact, the ocean near the mouths of all important rivers is contaminated. Most Chilean coast towns lack even most basic treatment facilities, too. In these cases all waste waters are disposed off in the sea, mostly at sea level and close to the coast.

The use of water can be divided into consumptive and non-consumptive use of water. Consumptive use of water means total exploitation of the used water, a use that does not allow re-use of the water or its return to water bodies in the same condition as it was before the use. Non-consumptive use refers to the cases in which the used water is returned to the

normal water cycle. An example for consumptive use is untreated waste water, non-consumptive use is e.g. use in hydro-electric plants.

In 1999 in Chile approximately 2000 m^3/s were consumed totally. Only 32,2 % of this amount consumptive. The most important sectors of consumptive use are:

- Agriculture (irrigation)
- Mining activities
- Industries
- Drinking water

The distribution among these sectors is displayed in the following diagram (Figure 9: Consumptive water use in Chile [18]) “Drinking water” refers to all waters for domestic use.

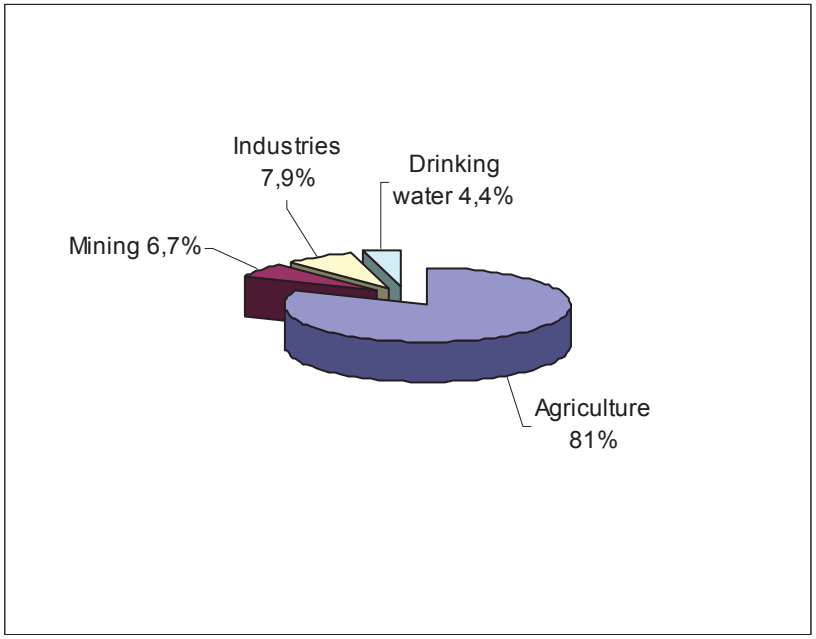

Figure 9: Consumptive water use in Chile [18]

These percentages mirror the national average, but can vary due to the predominating sector.

Non-consumptive use of water occurs mainly in the VI., VII., VIII. and X. Region, where major hydro-electric power plants are situated.

The most impacting industrial sectors are:

- Mining industry
- Chemical industry, production of leather and textiles
- Metallurgical and metal-processing industry
- Wood processing industry, production of cellulose and paper
- Agriculture and food production (among them the fishery industry)

A significant problem is the poor situation in landfills. Generally, the industrial wastes are disposed of in the municipal landfill sites without any previous treatment. An exception is posed by the big industries that have to store transport and dispose their generated waste in special sites. Hazardous waste is partially or in some cases totally treated. This procedure implicates high risk in the cases in which the waste is disposed without adequate or incomplete treatment and/or transported to landfill sites that are not apt for this type of waste, especially municipal landfill sites.

In 1999 22,6% of the Chilean municipal waste water was processed. It is estimated that up to 80% will be treated by 2006.

In rural areas ground water is the main source for drinking water, providing about about 77% of the necessary amount. In urban areas about 40% of the demand is covered by subterranean water [19]. The demand for drinking water is raising 2% each year. A major problem in this sector is posed by the distribution system: 29% of the produced potable water is lost on the way to the consumers due to damaged piping.

June 2003 SISS registered 331 enterprises with a waste water treatment plant that was authorized by the Ministry of Public Buildings (MOP). They are classified in the following table (Table 2):

Table 2: Industrial enterprises with treatment plant for waste waters authorized by Ministry of Public Building (MOP) [17]

INDUSTRIAL ENTERPRISES WITH TREATMENT PLANT FOR WASTE WATERS AUTHORIZED BY MINISTRY OF PUBLIC BUILDING (MOP)							
	Type of Disposal						
	Sewage System	Water Course or Superficial and/or Ground Water Body					Total
		Superficial Water	Infiltration System	Irrigation	Treatment by Third Party	Others	
Number of Enterprises	**170**	**87**	**18**	**50**	**3**	**3**	**331**
Percentage of Industries	51%	26%	5%	15%	1%	1%	100%
Number of Industries per Type of Disposal	170	161					331

In the following table (Table 3) they are broken down to the 13 Chilean regions:

Table 3: Industrial enterprises with treatment plant for waste waters authorized by Ministry of Public Building (MOP) [17]

INDUSTRIAL ENTERPRISES WITH TREATMENT PLANT FOR WASTE WATERS AUTHORIZED BY MINISTRY OF PUBLIC BUILDING (MOP)							
Region	Type of Disposal						Total
	Sewage System	Water Course or Superficial and/or Ground Water Body					
		Superficial Water	Infiltration System	Irrigation	Treatment by Third Party	Others	
I	1	0	0	0	0	0	1
II	2	0	0	0	0	0	2
III	0	0	0	0	0	0	0
IV	2	1	0	1	0	0	4
V	9	7	2	7	0	0	25
VI	2	9	0	10	0	0	21
VII	5	7	0	4	0	0	16
VIII	12	9	1	1	1	0	24
IX	3	3	0	0	0	0	6
X	11	20	6	2	0	0	39
XI	1	1	0	0	0	0	2
XII	4	1	2	0	0	0	7
M.R.	118	29	7	25	2	3	184
TOTAL	**170**	**87**	**18**	**50**	**3**	**3**	**331**

A complete and up to date listing of the mentioned enterprises can be found in the www under the URL http://www.siss.cl/Riles.htm. This information can be very valuable in a later project stage to find possible buyers for the transferred water treatment technology.

3.2 Technological Situation in Off-Water Treatment in Chile

Since relatively short time, electrochemical water treatment technologies of other enterprises are becoming available in Chile. The German enterprise Dinotec (www.dinotec.de) now is offering a membrane cell water treatment device based on BDD-electrodes for drinking water disinfection. The disinfection is based on the production of chlorine from sodium-chloride in an electrolysis-cell. Among the advantages of this system are light weight, small size and high capacities – a portable device is able to disinfect the drinking water for 1 million consumers. The consumption of salt is moderate, the dosage is very exact. Devices like this are used in German big cities.

No type of centralized information on the water treatment technologies that are currently used in Chile exists. Thus it was very difficult to get information on this theme. This chapter serves for giving a general overview of the mainly applied processes and technology.

3.2.1 Industrial Waste Water Treatment Plants

3.2.1.1 Physical Stage

In the physical stage first basic treatments are realized that prepare the water for the following stages. Big solid matter, sand, etc. is separated.

Systems that are common in Chile include:

- Manual and/or automatic separation of big solid matter (rakes, sieves)
- Removal of sand (slurry tanks)
- Separation of fats and oils (oil traps)

The composition of the collected solid matter in this stage allows its disposal in municipal landfill.

3.2.1.2 Physical-Chemical Stage

In this stage matters that cannot be treated in the biological stage are treated (e.g. remaining oils and fats, metals, and excessive high loads of contaminants that are generally treated in the biological stage. Typically 70 to 90% of the contaminants and more than 95% of the oils and fats can be removed. Insoluble contaminants are eliminated by chemical agents like salts of iron and aluminium and polymers of different molecular weights. The basic treatment consists in coagulation, flocculation and physical separation. Processes for physical separation are floatation and/or sedimentation.

A typical floatation is the Pressurized Air Process, generating bubbles of a diameter smaller than 100 micrometers. A typical process generates bubbles of 30 micrometers using pressurizes air at 100 PSI. Advantages are low space requirement and low operational costs. According to [4] this type of floatation is not recommended in waste water treatment.

Sedimentation is realized in sedimentation tanks continuously (e.g. vertical settlers) or using batch sedimentators. The generated mud is often treated in filter presses to reduce the water contents (typically the mud contains less than 60% humidity after pressing).

The choice of the processes strongly depends on the specific parameters of the waste water.

3.2.1.3 Biological stage

This treatment stage is aimed at eliminating the dissolved and solid organic load, reducing the biological oxygen demand (BOD_5), phosphor, nitrogen (e.g. ammoniac) etc.

In Chile this stage often is the only treatment stage. In industries like production of whine, etc. – in areas where the contaminants are mainly non toxic organic compounds that are easily biodegradable – this can be an effective, cheap treatment method. If the biological stage is the only treatment for waste waters from industries with heavy environmental impact, e.g. production of cellulose and paper, like it is the case in Chile often, the effluents pose an environmental problem.

In the treatment of Chilean industrial waste waters the most promising option seems to be the implementation of the BDD-water treatment device together with a biological treatment and mainly using it for cracking difficultly biodegradable substances.

3.2.2 Cellulose and Paper Industry

This industry is important in the Southern regions of Chile.

The prevailing bleaching process in the production of paper and cellulose is the elemental chlorine free (ECF) process. In this process ClO_2 is used, but no Cl_2. In the present, the Chilean cellulose and paper industry is experiencing a technological leap to the total chlorine free (TCF) process. In this process H_2O_2 and O_3 are used as bleaching agents. The problematic compounds are primarily AOX, phenols, and chelating agents like EDTA.

In this sector it would be of advantage to treat just the water flow that originates in the chlorine using bleaching so that the contained difficultly biodegradable substances can be degraded to more easily biodegradable compounds. Thus the total decomposition in the following biological treatment can be reached.

Due to the high TOC and the big waste water quantities a total degradation by the electrochemical method is economically not recommendable. In this case a combination with a following biological treatment is promising.

Additional advantages of the proposed technique in this area are the degradation of pigments and eventually the removal of metals.

For a Chilean paper plant data on the composition of the bleached kraft mill waste water was available. The main contaminants are phenols, pigments, tannins and lignin. A biological treatment stage already exists, but does not remove heavily biodegradable contaminants satisfactorily. The chemical oxygen demand (COD) is 1,2 g/l. Approximately 300 m^3/h off water have to be treated. The specific energy demand for the electrochemical treatment is estimated with 100 kWh/kg TOC for total degradation. In the case of a mere preparation for a following biological treatment the specific energy demand is 20 kWh/kg to 33 kWh/kg TOC.

The weight of 1 mol O_2 is 32 g.

COD = 1,2 g O_2/l = 0,0375 mol O_2/l

To determine the COD the whole C in the sample was oxidized to CO_2. So the following applies:

0,0375 mol O_2/l = 0,0375 mol C/l

C has the molecular weight of 12 g/mol.

0,0375 mol C/l = 0,45 g C/l = TOC

300 m^3/h off-water are produced. This corresponds to a production of TOC:

300 m^3/h = 300000 l/h

*300000 l/h * 0,45 g TOC/l = 135000 g TOC/h = 135 kg TOC/h*

The specific energy demand for the preparation of off water for biological treatment is 20 kWh/kg TOC to 33 kWh/kg TOC. So the minimum and maximum **energy consumption** is:

*Minimum: 20 kWh/kg * 135 kg TOC/h =* ***2700 kWh per hour***

*Maximum: 33 kWh/kg * 135 kg TOC/h =* ***4455 kWh per hour***

Currents of 300 to 500 Ampere can be applied to BDD electrodes. The applied potential is 3,5 Volt.

In the case that 500 Ampere are applied to the electrodes and the efficiency of the treatment is 25%, 1 m^2 electrode can treat 0,014 kg TOC per hour. The necessary **electrode surface** is:

Efficiency 25%: 135 kg TC/h / 0,014 kg TOC/h = ***9650 m^2***

If the treatment efficiency is 50%, 1 m^2 electrode can treat 0,028 kg TOC per hour. The necessary electrode surface is:

Efficiency 50%: 135 kg TC/h / 0,028 kg TOC/h = ***4825 m^2***

As these plant parameters differ strongly, it is important to realize experiments on real or simulated bleached kraft mill waste water to estimate important plant parameters like energy consumption and electrode surface.

Interesting options for an implementation of the electrochemical water treatment technology are posed by the fishing and fish meal industry, and by service stations for automotives.

The fishing industry produces waste waters with high contents of oils, fats and organic compounds. These off waters that are generally disposed of with no or insufficient treatment cause problems in the coastal regions throughout Chile. The waste waters of service stations generally contain high amounts of hydrocarbons, oils and fats. Current treatment facilities are sedimentation chambers, oil traps, chemical desemulsification and mechanical desemulsification (membrane filters). In this area the high investment and treatment costs could pose a major problem.

3.2.3 Municipal Waste Water Treatment Plants

The common treatment of municipal waste water consists of 3 steps:

3.2.3.1 Physical Treatment

The physical treatment stage in municipal waste water treatment is similar to the physical stage in industrial waste water treatment: Filtration of solid matter by rakes and sedimentation, removal of sand and separation of fats and oils. Eventually chemicals are used to improve the decantation.

3.2.3.2 Biological Treatment

The most common aerobic processes are processes with suspended biomass, mainly aerated basins (lagunas aireadas) and activated sludge basins (lodos activados).

Aerated basins are ponds or basins demanding big surfaces. They are aerated by superficial or submerged aeration devices. The normal permanence time is 3 to 6 days. In the following, the flocculated biomass has to be decanted (6-12 hours). The quality of the product is worse than in the activated sludge basins. They remove 65-75% BOD

Activated sludge basins are smaller devices. The water is biologically treated in a basin. After passing this bassin, the sludge of flocculated organic matter that contains high quantities of micro organisms is decanted. A part of the sludge is pumped back to the basin. This procedure reduces the time of permanency to approximately 6 hours.

Anaerobic processes are mostly used as primary purifying stage or as preparation for treatment. A major disadvantage is the bad odour so that this type can not be used closer than 500 metres to inhabited areas. They can reduce 20-60% BOD

Due to its flexibility a very common biological treatment is the aerobic/facultative treatment basin. It is designed so that aerobic and facultative aerobic/anaerobic micro organisms both can strive. This type consumes less space than aerobic processes and does not produce bad odours like the anaerobic. They can reduce 60-85% BOD.

3.2.3.3 Tertiary Treatment and Advanced Treatment

The effluent of the biological treatment can be used for irrigation or is disposed of in superficial water bodies after disinfection. The disinfection is normally realized by chlorination (refer to chapter 3.2.4.1).

Further treatments to remove smell, colour, remaining phosphates, nitrates or detergents may be applied but are not very often used.

Advanced treatment is aimed at producing water of drinking water quality and is sheldomly applied.

Municipal waste water treatment plants have to disinfect their treated effluents. This is discussed in chapter 3.2.4.

In rural areas waste water treatment by “fosas septicas” is very common, too. This system is described in the chapter “3.2.6 Landfill sites”.

In the case of treatment of municipal waste waters with the electrochemical water treatment technology, the application as end of pipe disinfection system is the most promising option. This is discussed in the following chapter.

3.2.4 Disinfection Systems

Disinfection devices are used for disinfection of drinking water, process waters, municipal and industrial waste waters, and landfill leaches to clear these waters from pathogens.

Contrary to waste water treatment plants in Europe, Chilean waste water treatment facilities must to disinfect their readily treated off waters before disposing them into the recipient. The reason for this is that in Chile river water is used for irrigation in agriculture, so that the content of pathogens has to be small. In Europe ground water is used for irrigation purposes.

An important advantage of the electrochemical water treatment technology in this area is that (contrary to UV disinfection) turbid waters can be treated with constant efficiency. Using UV disinfection devices pathogens can survive in shadow zones in turbid water.

Different interesting side reactions, like reduction of the TOC, improvement of the biodegradability and detoxifying reactions occur.

The treated water is – contrary to the UV disinfection – biologically stable. The sustainability of the disinfection effect in the further pipe system is given.

It has to be considered that the Chilean Drinking Water Norm lays down that the minimum residual concentration of free chlorine in the drinking water has to be equal to or higher than 0,2 mg/l in every point of the drinking water net. The disinfection effect of the anodic oxidation is stable, but is based on the generation of various differently effective disinfectants, not only on chlorine. Special attention has to be set on the issue, if the concentration of free chlorine in the treated water complies with the norm. This will depend on the composition of the raw water, too. A possible solution could be adding sodium chloride to the raw water.

To add weight to eventual experiments with a pilot plant, a local hygiene specialist should attend the experiments.

The following table (Table 4) compares the costs for disinfection of ballast water of ships using 3 different treatment technologies. The basis are 18000 m^3 ballast water, an average travel time of 72 hours, 12 hours for deballasting and 90 voyages per year. The calculation is based on an energy demand of the electrochemical technique of 0,04 kWh/m^3 (DiaCell®) and a capacity of 12,5 m^3 per hour. The investment cost refers to 5 DiaCells® [20].

Table 4: Comparison of treatment costs for disinfection of ballast water

Treatment	Energy Demand/(Costs)	Costs for Chemicals	Maintenance Costs	Investment Costs	Total Operation Costs
	[kWh/m^3] [€/m^3] 1)	[€/m^3]	[€/m^3]	[€]	[€/m^3]
Ultra-Violet	0,09 (0,013)	0	0,034	400.000	**0,047**
Chemical (peracetic acid)	0,01 (0,001)	0,28	-	25.000	**0,281**
Electrochemical	0,08 (0,011)	0	0,01	75.000	**0,021**

1) Energy costs: 1 kWh=0,14 €

3.2.4.1 Disinfection Based on Chlorine

The chlorination of waters is a very effective and economic type of disinfection. This disinfection has a remaining effect on the water, so that it can be used for waters that are distributed by long piping systems, too. It is apt for most types of waters – drinking water, municipal and industrial waste water.

The disinfection effect depends on the concentration of free chlorine in the water. As will be shown in chapter 3.3.5 the Chilean norm for drinking water demands a minimum residual concentration of free chlorine in every point of the drinking water net equal to or higher than

0,2 mg/l. No maximum concentration for free chlorine is set. The over dosage of chlorine in drinking water can have negative effects on the populations health.

Active chlorine in one of its forms (e.g. sodium hypochlorite NaOCl) is added to the water. The concentration of active chorine in the water decreases after adding it to the water. The difference between the theoretical concentration and the lower concentration that is found in the water due to consumption of chlorine in reactions with substances in the water is called “chlorine demand”. Typically adding 4 to 5 ppm chlorine to the water a residual chlorine content of less than 2 ppm is reached.

Advantages of this technology are efficient and reliable elimination of micro organisms, low treatment costs, easy adaptation to varying water quantities and low energy consumption.

Disadvantages are remaining residual chlorine in treated waters that is released into the receptive water body and continuous costs for chemicals.

For small water quantities chlorination tablets can be used. These are expensive and release too high concentrations of chlorine into the water. So dechlorination tablets have to be used to eliminate the remaining residual chlorine.

The scheme of a typical chlorination device is displayed in the following figure (Figure 10):

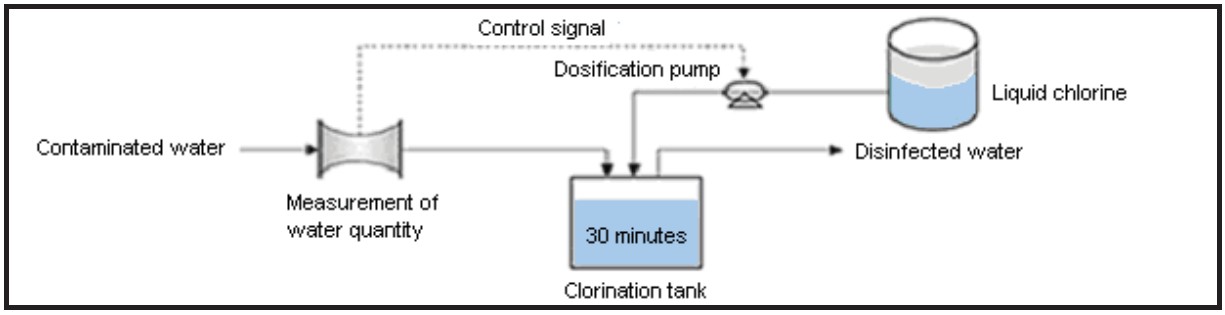

Figure 10: Scheme of a chlorination device

3.2.4.2 UV disinfection

UV disinfection devices can be used to treat drinking water, process water and municipal and industrial waste water. Surely, this technique is the most secure from the environmental point of view. No chemicals are released into the surroundings. This physical treatment does not modify the chemical composition of the treated water; taste and odour stay the same.

Small devices from a capacity of 7 litres per minute and higher are possible.

Major advantages are easy maintenance and cleaning.

Major disadvantages are the high energy consumption and an insecure disinfection effect in turbid waters.

The treated water passes a UV-radiation chamber. Here UV-C light (wave length approx. 254 nm) is emitted by UV lamps. The DNA of the micro organisms in the water is damaged by the UV-C so that their reproduction is stopped.

Contrary to ozone and chlorine disinfection the disinfection effect of this treatment system is unstable.

3.2.4.3 Disinfection based on Ozone

Ionization devices are available but not as common as chlorination devices.

Ozone is generated from air or pure oxygen. To improve the transfer of the gaseous ozone into the water it is released by diffusers in deep, closed tanks. 90-100% of the ozone is transferred to the water. The residual gases have to be treated to eliminate the ozone. The final product is oxygen that can be reused for the production of ozone.

The remaining substance in the water is oxygen, because excessive dissolved ozone changes to oxygen within 20-30minutes.

The ozone is produced by electric discharge.

By ionization the BOD is reduced, too.

3.2.5 Drinking water production

Special about the Chilean drinking water production is that in the last treatment stage 1 mg/l fluorine is added to the water. This is established in the Chilean Drinking Water Norm. About 70% of the population consume fluorized water. The aim of this treatment is to reduce tooth decay.

If the raw water is river or lake water, it usually contains impurities like solid organic matter and certain contaminants. Conventional treatment includes:

- Rakes of different sizes to remove big solid matter
- Removal of sand

- Coagulation
- Flocculation
- Sedimentation
- Filtration
- Disinfection

Ground water usually contains less organic matter and contaminants. Often the water can be used with mere addition of chlorine (due to the norm). If chemical contaminations like iron, manganese or to high contents of nitrates are contained, special treatments are applied.

Organic contaminants are usually removed by active carbon filters.

3.2.6 Landfill sites

Chilean landfill sites can be divided into “vertederos” – old landfills that fulfil only minimum or no environmental security criteria and “rellenos sanitarios” – sanitary landfills, more modern and secure landfills that comply with the law.

About half of the Chilean landfill sites do not have any waste water treatment facilities at all. In these cases the occurring waters are directly disposed of in rivers, the sea or percolate into the ground water.

Very often landfill leaches are treated by pumping a part of the water back to the landfill and by “fosas septicas”. “Fosas septicas” combine the processes of sedimentation and anaerobic treatment. Formed by usually 2 or more serial subterranean chambers, in these devices the first chamber serves for main sedimentation, anaerobic treatment and storage of the sludges. The further chambers serve for improving the treatment. Finally the effluent is disposed of in soakaways. This system is very common for the treatment of municipal waste water in rural areas, too.

The application of the electrochemical treatment technology in this area is very interesting. A huge variety of more or less biodegradable organic and inorganic substances and pathogens are contained in the water that can be eliminated, degraded or prepared for a posterior biological treatment.

For this application the combination with a following biological treatment is recommendable.

The array of organic chemicals in landfills is especially complex and influenced by the types of wastes deposited, the method of land filling used, ambient conditions, and the age of the landfill. So, especially in this sector experiments with a pilot plant are important to guarantee a highly efficient treatment of landfill leaches.

3.2.7 Cooling Water

The application of the electrochemical water treatment technology in cooling water treatment poses an interesting option as many enterprises have problems with effectively disinfecting their cooling water. The use of biocides causes problems in disposing of the sludge occurring in the cooling towers. The disinfection effect of UV lamps is not stable enough.

By the moment in Chile the necessary contacts to industrial partners do not exist, but in a later project stage this area of application may be interesting.

3.3 Standards and Legal Background

Under the ruling principles of the „Código de Aguas“(„Water Statute Book”) a great quantity of specific legal instructions of different origin and character are in force. Their objectives vary from funding of water connected activities to control of emissions and the delivery of environmental quality norms. The total of the norms related to contamination is formed by 61 dispersed juridical texts: international agreements, laws, decrees, resolutions, etc. These texts are primarily aimed at prohibiting contamination of maritime and continental water.

3.3.1 Ley 19.300 sobre Bases Generales del Medio Ambiente (Law 19.300 for General Fundamentals in Environmental Issues) [21]

This law established in 1994 is aimed at establishing a sound relationship between economy, nature and the human population. It sets the base for a modern and realistic environmental management at a national level.

3.3.2 Ley N° 3.133 sobre Neutralización de Residuos Industriales Líquidos (Law 3.133 for Neutralization of Liquid Industrial Wastes) [22]

This is the first legislative text of Chile that was aimed at the protection and conservation of the waters against the contamination by industries. It came into force in 1916. Since its creation in 1989 it is the responsibility of the SISS to implement it. This law establishes the obligation of all industries to neutralize or purify their liquid industrial wastes that are disposed in aqueducts, water courses, catchment areas of rivers, lakes or ponds.

It lays down that factories and metallurgical complexes that dispose their waste waters in sewage systems have to submit these waters to a special neutralizing treatment so that the piping of the sewage systems are not damaged. The empresa sanitaria that is the owner of the sewage system where the waste water is disposed has to control the compliance with the law. The SISS has to authorize the type of treatment and to supervise its correct function.

3.3.3 Ley del Agua Potable (Drinking water law) [18]

The Regulation of Services for Water destined for Human Consumption (Reglamento de los Servicios de Agua Destinados al Consumo Humano) that was established in 1969, lays down that water for human consumption may not contain elements, chemical substances, toxic or dangerous substances and pathogen organisms that possibly have not been eliminated by a common treatment in higher concentrations than the ones laid down. These waters also must be free of microscopic organisms and substances that can cause problems in the normal operation and efficiency of treatment processes. Furthermore obligations for the drinking water providing enterprises are established in this law.

3.3.4 Environmental Impact Assessment System SEIA

The Environmental Impact Assessment System SEIA was introduced to implement the Law 19.300. The purpose of the Environmental Impact Assessment, applied to projects and/or activities performed by the public and private sectors, is to assure the environmental sustainability of said undertakings.

The Law 19.300 provides that certain projects or activities prone to generating environmental impacts must be subjected to an Environmental Impact Assessment System. Their specific effects, characteristics or circumstances will determine whether an Environmental Impact Statement or an Environmental Impact Study should be filed.

The SEIA is to be conceptualized as a set of procedures designed to identify and evaluate positive and negative environmental impacts to be generated or presented by a given project or activity. The SEIA will assist in designing measures aimed at abating the negative impacts and enhancing any positive effects. An important part of these procedures depends on the involvement of State entities with environmental jurisdiction and/or in charge of issuing sectorial environmental permits associated with the project or activity.

The Law 19.300 has placed the burden of implementing and administrating the Environmental Impact Assessment System on the National Environmental Commission, CONAMA. Within this institutional framework, CONAMA and the Regional Environmental Commission (COREMAS) are in charge of coordinating the process whereby ratings are assigned to the Environmental Impact Study and Environmental Impact Statements, are reviewed. The various different State bodies with environmental competence participate actively in this process.

3.3.5 Norma Chilena de Agua Potable (Chilean Norm for Potable Water) [18], [23]

The Chilean Potable Water Norm defines the physical, chemical, radio-active and bacteriological requirements with that waters destined for human consumption have to comply. This norm is applicable at potable water from whatever source. The tables in this norm define the maximum acceptable limit for each type of contaminant (substance or element, chemical or radio-active matter) that the water may contain. E.g. the maximum allowed concentrations for pesticides in drinking water. In the case of bacteriological contaminations the norm requires that drinking water has to be totally free of micro organisms of faecal origin.

Furthermore the norm establishes that the drinking water that is distributed by drinking water networks has to be treated with a disinfection process that has a permanent effect, uses chlorine, chlorinated compounds or iodine and is authorized by the responsible Servicio de Salud (Health Service).

At the same time, the norm lays down that the minimum residual concentration of free chlorine has to be equal to or higher than 0,2 mg/l in every point of the net. No maximum concentration for free chlorine is set.

In spite of the existence of the law and the corresponding norm for potable water throughout Chile waters with to high contents of arsine, manganese, nitrogenated compounds, iron, dissolved solids, chlorides and magnesia are used as drinking water.

3.3.6 Norma Chilena 1.333 Decreto Nº 867 (Chilean Quality Norm 1.333 Decree Nº 867) [24]

This quality norm was elaborated by the MOP (Ministerio de Obras Publicas – Ministry of Public Building). It establishes the quality requirements for water for different types of applications, e.g. drinking water for human consumption, drinking water for animal consumption, irrigation, recreation, aquatic life.

3.3.7 Norma de Emisión para la Regulación de Contaminantes (alcantarillado) (Emission Norm for the Regulation of Contaminants (sewage system)) [25]

The norm „Norma de Emisión para la Regulación de Contaminantes Asociados a las Descargas de Residuos Industriales Líquidos a Sistema de Alcantarillado” (Emission norm

for the regulation of contaminants associated with the disposal of liquid industrial wastes in the sewage system) was elaborated and set into force in 1995 by the CONAMA (Comisíon Nacional del Medio Ambiente – National Commission for Environment) in the implementation process of the “Ley 19.300” together with further emission norms and norms for environmental quality.

This emission norm regulates the maximum quantity of contaminants the industries may feed into the public sewage systems. Its objective is protecting the sewage systems and networks of the enterprises that have to collect and dispose the waste waters, as well as protecting waste water treatment plants and reducing eventual risks for the population.

3.3.8 Norma de Emisión para la Regulación de Contaminantes (aguas marinas y continentales superficiales) (Emission Norm for the Regulation of Contaminants (marine and superficial continental waters)) [26]

On the 3rd of September 2001 the „Norma de Emisión para la Regulación de Contaminantes asociados a las Descargas de Residuos Líquidos a Aguas Marinas y Continentales Superficiales” (Emission norm for the regulation of contaminants associated with the disposal of liquid industrial wastes into marine and superficial continental waters) came into force. The aim of this norm is preventing the contamination of these waters. It is applicable to all emitting entities – industrial as well as sanitary – that dispose their waters into superficial water bodies (rivers, lakes, sea). For plants already existing when the norm came into force, the deadline for its implementation is the 3rd of September 2006.

3.3.9 Norma de Emisión de Residuos Industriales Líquidos a Cursos y Masas de Aguas Subterráneas” (Norm for emission of liquid industrial wastes to ground water courses and bodies) [19]

This norm was elaborated by CONAMA and came into force in March 2002. Its objective is the prevention of contamination of ground water bodies by control of deposition of liquid industrial wastes that percolate into the water carrying layers. It determines the maximum allowed concentrations of the mentioned contaminants in the emitted liquid industrial waste that is emitted via the ground to the water carrying layers by operations that are aimed at the infiltration of these waste waters. This norm does not touch infiltration due to irrigation.

3.3.10 Further Norms

The resolution 12.600 by DIRECTEMAR (Dirección General del Territorio Marítimo y de Marina Mercante – General Administration of the Marine Territory and Merchant Navy) regulates the disposal of waste waters into the juridical territory of this institution, namely seas and navigable continental water bodies.

According to a recent publication of the Programme “Chile Sustentable”:

> “…we can confirm that in general the compliance with the legislation and norms is scarce or inexistent. The capacity for control and fiscalization is minimal. E.g. according to information from 1998, 92,3% of the industries disposed their liquid industrial waste without any treatment. 7,9% have the necessary authorization, but just 1,9% have informed the SISS about the present treatment.” [18]

3.4 Possible Development Funds

3.4.1 Possible Development Funds in Chile

During the last decade the Chilean economy experienced an accelerated growth due to development of the export of raw materials. This cycle is closing and the need to grow by diversification, increasing productivity shortly by innovation is increasing. Therefore, the Chilean government has launched several initiatives that mainly independently from each other (contrary to the European centralized co-financing system FP 6) supports innovation and technology transfer by co-financing and assistance.

The most important of these initiatives are presented in the following.

3.4.1.1 CORFO

CORFO, the “Corporación de Fomento de la Producción” (“Corporation for the Funding of Production”) is the most important funding initiative of the Chilean government. Generally, funds are available for expanding enterprises and businesses, innovators that want access to new technologies, technical assistance and capital. Funded activities are improvement of management strategies, association, innovation, prospecting and creation of new businesses.

CORFO is organized in 6 lines. The two that are most important for the realization of the proposed project are the lines FONTEC and FDI.

3.4.1.1.1 FONTEC

FONTEC, the “Fondo Nacional de Desarrollo Tecnológico y Productivo” (“National fund for technological and productive development”) co-finances technological activities in productive private enterprises for projects relating to:

- Innovation
- Product
- Services

- Process technologies
- Technological infrastructure
- Technological transfer to groups of companies

This means that the participation of the Chilean partner SIGMA can be funded by means of FONTEC.

FONTEC is divided into 5 lines of funding:

- Technological innovation projects
- Technological infrastructure projects
- Technology transfer projects
- Technology transfer centres and management entities
- Pre-investment studies in innovation projects

Interesting for the project SAMSON are the lines 2 and 3 – Projects of technological innovation and projects of technology transfer.

3.4.1.1.1.1 FONTEC Line 2: Projects of technological innovation

This line is aimed at funding investments for the creation and implementation of service centres concerning technological assistance in production capacity and quality assurance of products and services of enterprises. Such centres can be laboratories for certification and quality assurance, laboratories for technological services and/or investigation and development that are connected to productive processes.

Funded are installations, equipment and technical training of the associated human resources.

The co-financing has the form of subsidies with the maximum amount of 25 % of the total project costs, not more than 250 million Chilean Pesos, corresponding to approximately 330.000 €.

3.4.1.1.1.2 FONTEC Line 3: Projects of technology transfer

This line is divided into 2 further lines:

- Line 3-A: Technology Transfer Projects: Technological Missions
- Line 3-B: Technology Transfer Projects: Specialized Consulting

3.4.1.1.1.2.1 Line 3-A: Technology Transfer Projects: Technological Missions

The objective of this line is to co-finance activities of associated partners that have the aim of finding, transfer and multiply new management strategies and production technologies to modernize the productive process.

Activities that are subsidized within this line are for instance travels of specialists to visit other enterprises, universities, R&D and technology transfer centres that are of interest for the participating Chilean enterprise and participation in courses and events of technical specialization.

Under certain conditions, air-passages, costs for hotels, food and courses are financed. Up to 100 % of the costs are taken by FONTEC. Participation in exhibitions and events is co-financed as well.

These possibilities are of importance for the participant SIGMA. By these means the costs that will eventually have to be taken by this participant itself can be mitigated.

3.4.1.1.1.2.2 Line 3-B: Technology Transfer Projects: Specialized Consulting

It is the objective of this FONTEC line to subsidize the contraction of international experts in highly specialized technology and productive processes to solve specific problems in technology and management and thus improve efficiency and competitiveness of the participating enterprises. FONTEC co-finances up to 50 % of the project costs.

Costs for the following activities can be co-financed: travel and royalties of the expert(s), hotel, food and translations.

This line, too, offers possibilities for the private Chilean participants to lower their project costs.

3.4.1.1.2 FDI

The FDI (“Fondo de Desarrollo e Innovación” – “Fund for Development and Innovation”) co-finances technological research, development and dissemination through private or public technological institutions along with public or private entities. Project results must significantly benefit the industries involved. Resources are allocated through bidding and project contests.

As the FDI is open to public and private actors, SIGMA as well as the UFRO can postulate co-financing by the FDI.

The FDI offers 5 lines that co-finance different phases and actors of innovation:

- Pre-competitive innovation projects
- Innovation-initiatives of public interest
- Innovation projects of high impact and risk
- Founding capital
- Business founding centres

The lines that are interesting for the implementation of the electrochemical water treatment technology of the IAE in Chile are the following:

3.4.1.1.2.1 Pre-competitive innovation projects

Eventually the Chilean participants of the 2 proposed projects could be funded in this line that is aimed at co-financing projects with high power in innovation and development that are executed by universities, private enterprises and public institutions. The funded projects are selected in annual competitions.

3.4.1.1.2.2 Innovation projects of high impact and risk

This line co-finances technological innovation and development projects of high risk, potential and economic impact that are executed by consortiums consisting of Chilean and foreign entities.

Funded are activities aimed at developing innovative products and processes and activities aimed at introducing innovative products and processes to the market. Proposals for this line can be submitted continuously.

3.4.1.1.2.3 Founding capital

Another interesting possibility for the implementation of the electrochemical water treatment technology of the IAE in Chile is creating an enterprise with the aim of commercializing this technique in Chile. The founding and starting of an enterprise like this can be co-financed in this line.

Formally, this line co-finances the founding of enterprises with innovative and promising business ideas. Funded are enterprises effectively existing less than one year and natural persons on the way to founding such an enterprise.

Proposals for this line can be submitted continuously as well as answering specific calls.

In every case the initiative has to be presented by a patron that is acknowledged by CORFO.

A list of these acknowledged patrons can be found at:

http://www.corfo.cl/index.asp?seccion=1&id=978

The patron acts as an intermediary between the founders and the FDI. Patrons are entities independent from CORFO that work in management of risk capitals. The founder can choose one of the proposed patrons (currently there are 26 patrons registered by the FDI)

The patron has to postulate the projects, evaluate the business plan and support the founder in the strategic management of the business.

As the idea of founding an enterprise to commercialize this technology in Chile complies with the knock-out criteria of this line, proposing in this line can be interesting.

The maximum contribution of the FDI is 35 million Chilean Pesos, corresponding to approximately 46500 €. The costs for patronage are included in this sum.

The following activities are funded by this line:

- Foundation and start of the enterprise
- Intellectual property, such as registration of brand marks and patents

- Commercial validation of prototypes and products
- Market analyses
- Development of strategies for commercialization
- Promotion and publicity
- Prospecting and commercial promotion
- Administration
- Human resources

Activities that are not funded in this line comprise the following:

- Purchase of furniture, shares, office equipment
- Experiments, pilot tests and industrial validation of a product or service
- Development of software

3.4.1.2 Agreement on Science and Technology between Chile and the European Union and the initiative *EuroChile*

In September 2002 an Agreement on Science and Technology was signed between Chile and the European Union. This agreement allows Chilean enterprises and technology centres to participate in the 6th Framework Programme of the EU.

The participation of Chilean enterprises is supported by the programme EuroChile (www.eurochile.cl).

Co operating with the EU in the programme A.R.I.E.L. (Active Research In Europe and Latin America – an instrument of the EU-programme AL-INVEST), EuroChile offers SMEs working in environmental technologies assistance in finding partners in Europe, subcontracting, commercialization, etc.

Unfortunately, EuroChile currently concentrates on mere assistance. The funding is based on the 6th Framework Programme.

EuroChile organizes business conferences and events on cleaner production to establish contacts and co-operations between Chilean and foreign enterprises. These events could be

a platform to disseminate the knowledge of the existence of the electrochemical water treatment technology of the IAE among Chilean enterprises and help finding interested partners and later on interested buyers for the treatment plant.

3.4.1.3 Fundación Chile

Fundación Chile («Foundation Chile») is a non-profit organization of private law. The objective of this institution is raising the competitiveness of the human resources, the productive and service sectors by enforcing the development of innovations and transfer and management of technologies that are of high impact for Chile.

Foundation Chile preferentially realizes the following activities:

- Participation in creation of demonstration enterprises, (independently or in co-operation with the private sector) to demonstrate the viability of innovative products, technologies, services, etc.
- Technical Assistance and lending of services (quality control, laboratories,…)
- Technology transfer: together with enterprises of the productive sector problems are studied and solutions implemented.
- Diffusion: Dissemination by publications, seminars, work shops, etc.

Support and co-operation in the creation of a business to implement the electrochemical water treatment technology can be available by this institution.

3.4.2 Possible Development Funds for Chile in the EU

3.4.2.1 6th Framework Programme

The European Union's funding initiatives are comprised in the 6th Framework Programme (FP 6). For the duration of the FP 6 (2002-2004) 17,5 billion Euros have been earmarked for funding.

The FP 6 is structured in 5 activity areas, among them:

- *Thematic areas:* e.g.: life sciences, biotechnology and genomics; information society technologies, nanotechnology; sustainable development, global change and ecosystems; etc.

- *Cross cutting research areas:* e.g.: international cooperation activities, SME activities, etc.

The FP 6 is a call-based funding system. This means that proposers have to submit their proposals answering certain calls for proposals. These calls are published on the homepage of the FP 6, www.cordis.lu. Each activity area publishes several calls with different funded areas and activities each year. In these calls important data like budget for this call, activity area, submission deadline, consortium composition, supported project types (e.g.: SSA, STREP, …) is included.

Calls can be highly specific or open for proposals covering a wide range of activities. Generally the intention of the FP 6 is that the research actors realize the projects and investigations the European Community wants. This means that a research actor offers the FP 6 to realize the investigations they want, and not that the research actor applies for financial support for his projects.

As for every call several hundred parties apply for co-financing it is of high importance that the proposed project fits the demands of the call to 100%. Otherwise the proposed project does not have any chance.

In the calls the European Commission establishes, which instruments can be used by the proposers. These instruments are:

- STREP (Specific Targeted Research and Innovation Projects)
- SSA (Specific Support Actions)
- IP (Integrated Projects)
- NoE (Networks of Excellence)
- CA (Coordination Actions)
- Specific research projects for SMEs
- Programmes implemented jointly by several Member States (“Article 169”)

For reasons of consortium size and suitability to the aims of this project STREP the most suitable instrument. Further details for STREPs and SSAs can found in the chapter 5.1.1 and 5.2.1.

The priority area “Sustainable development, global change and ecosystems” is divided into the sub priorities “Sustainable energy systems”, “Sustainable surface transport” and “Global change and ecosystems”. The total budget for this priority area is 2120 million Euros.

Research on water themes within this priority area is bund to the following areas:

- *Water cycle including soil-related aspects:* The objective is to understand the mechanisms and assess the impact of global change and in particular climate change on the water cycle, water quality and availability, as well as soil functions and quality to provide the bases for management and technological tools for water systems to mitigate the impacts. The research will focus on hydrology and climate processes, the ecological impacts of global change, soil functioning and water quality, integrated management strategies and mitigation technologies, and scenarios of water demand and availability.

- *Ecological impact of global change, soil functioning and water quality:* Global change can exert severe impacts on the ecology of aquatic and wetland ecosystems, on the filter and transport functions of soils and on water quality. Assessments of these changes requires a better understanding of the consequences of major hydrological changes, to identify and quantify the key biogeochemical processes and to predict the consequences of global change at different scales. The integrated management of soil-water systems requires a detailed understanding of the properties and the functional role of soils, and the behaviour and fate of pollutants, in order to allow the development of risk-based management approaches. The research will focus on impacts of global change on the ecology of surface water bodies, and on water-soil systems functioning and management.

- *Soil-groundwater protection and rehabilitation*

- *Integrated management strategies and mitigation technologies:* Research will focus on the development of integrated approaches and tools for water-soil resources management in the context of global change – with its different components of climate change, land use change, other anthropogenic drivers, etc. - and integrated vulnerability assessments, taking also into consideration socio-economic and technological aspects of water use. Research will focus on the catchment scale, on the specific aspects of integrated urban water management and mitigation technologies as well as on the management of scarce water resources and mitigation technologies. Emphasis has to be placed on developing flexible adaptation strategies to change, in order to decrease vulnerabilities. This will require specific technological development, particularly for matching with longer drought periods and with more intense rainfall events, especially in urban areas.

- *Methodologies of integrated water resource management and transboundary issues*

- *Wastewater treatment for re-use*
- *Scenarios of water demand and availability for Europe and neighbouring countries*

The most promising of these areas is wastewater treatment for re-use. Currently, no calls comprising this area are open or planned.

The calls in the area “Sustainable development, global change and ecosystems” currently concentrate on sustainable surface transport and sustainable energy systems. A technology transfer project of the electrochemical water treatment technology does not exactly fit in these calls, too. This is, why the INCO line of the FP 6 has been chosen as working line for this project. Details of INCO are discussed in chapter 5.1.1.

It is important to remark that in the first year of the FP 6 only 12000 of the 100000 proposed projects received funding by the EU.

3.4.2.2 Other European Funds

Apart from the FP 6 special funds are available for co-operations between Chile and Sweden.

3.4.3 Conclusions and Remarks

Given the current funding situation in the European Union, by the moment the most promising option seems to be founding a business in Chile with the business idea of commercializing the electrochemical water treatment technology in this country.

The foundation of this enterprise can be co-financed by the FDI. Further funds for projects of this enterprise can be gained by postulating co-financing by the Chilean initiative FONTEC or again the FDI.

The Austrian trade mission in Chile is active in presenting Austrian enterprises in Chilean events like the *Expo InduAmbiente*. A special emphasises of the presented products and businesses is laid on water technology. The trade mission is very interested in spreading the knowledge and implementation of Austrian water treatment technology in Chile. Contacting the trade mission for free publicity and promotion surely is an interesting option.

4 Presentations for Potential Chilean Partners

Water treatment with BDD-electrodes is hardly known in Chile. To contact potential industrial partners in Chile and eventually other South American countries, presentations of the electrochemical water treatment technology for several types of industry were created and sent to the most promising potential partners.

Different presentations were created for the following industries / types of application:

- Landfill sites: treatment of landfill leaches.
- Empresas sanitarias (sewage plants for municipal waste water): disinfection of treated municipal waste water.
- Paper industry: combination with biological treatment of off-water, elimination of hardly bio-degradable substances.
- Process water: disinfection of cooling water.

An important part of these presentations is a questionnaire that serves for raising the information necessary to estimate fundamental parameters of an electrochemical water treatment plant.

Two enterprises, the Constructora CAM Ltda. (operator and owner of a landfill site near Valparaíso, Chile) and the Empresa Sanitaria of Rinconada (a state-owned municipal waste-water treatment plant in the 5th Region of Chile) were chosen for their very good connections with SIGMA Consult Ltda., and the presentations and questionnaires were sent to them.

As they did not answer the questionnaire, the parameters of apt electrochemical treatment plants could not be estimated.

An example for these presentations and its translation can be found in the annex.

5 Proposals for EU-Funded Research Projects

In this chapter the proposals for EU-funded research projects that were created within this thesis will be explained and discussed. The proposals themselves can be found in the Annex.

5.1 STREP ISSAC

5.1.1 General information on STREP-Projects and Specific Measures in Support of International Cooperation (INCO)

STREPs (Specifically Targeted Research and Innovation Project) form the core of the FP 6. Specific Targeted Research Projects aim at improving European competitiveness and meeting the needs of society or Community policies. They should be sharply focused and take either of the following two forms, or a combination of the two:

a) a research and technological development project designed to gain new knowledge either to improve or develop new products, processes or services or to meet other needs of society and Community policies;

b) a demonstration project designed to prove the viability of new technologies offering potential economic advantage but which cannot be commercialised directly.

Within the Sixth Framework Programme (FP6) generally, specific targeted research projects are used in implementing the priority thematic areas, in other research areas supporting Community policies and anticipating scientific and technological needs, in specific international co-operation research activities, in activities promoting interaction between research and innovation, and in research activities aimed at developing harmonious relations between science and society.

Each STREP may represent a value of activities ranging up to several millions of euros and may involve up to several tens of researcher-years.

The duration of a project will be determined by the time necessary to obtain its research objectives. Typically, the duration might be expected to be 2-3 years. Only exceptionally and in duly justified cases will the duration exceed 3 years.

Officially, as an absolute minimum, the number of participants can not be less than three independent legal entities established in three different Member States or Associated States, of which at least two shall be Member States or Associated candidate countries.

According to information of the BIT, the Austrian Bureau for International Research and Technology Cooperation, and due to practical experiences the number of participants has to exceed the minimum number significantly.

STREPs with consortiums consisting of less than 10 to 15 participants practically do not have any chance for FP 6 co-financing. The participation of SMEs and a high number of partners from Member States or Associated States is important.

The costs for STREPs have to be split up into 3 categories:

a) Research and technological development

b) Demonstration activities

c) Management of the consortium

In FP 6 projects the participants may choose fro, three cost reporting models:

- **FC:** a full-cost model in which all eligible direct and indirect costs may be charged to the contract;
- **FCF:** a simplified variant of the full-cost model, in which all eligible direct costs may be charged to the contract, together with a flat-rate rate of 20% of all these direct costs, which will be deemed to cover all related indirect costs;
- **AC:** an additional-cost model, covering all eligible direct costs that are additional to the recurring costs of a participant (with the exception of consortium management for which recurring costs will also be eligible), together with a flat-rate of 20% of all these direct costs, excluding subcontracts, which will be deemed to cover all related non-recurring indirect costs.

Access to a cost model depends on the type of legal entity concerned:

- all legal entities can use the FC model with the exception of physical persons
- physical persons are obliged to use the AC model
- legal entities defined as SMEs have the choice between the FC and FCF model

As the IAE does not have a cost accounting system, the FCF model applies for this participant. For SIGMA, the FCF model is the most convenient, too. This is because the indirect project costs of SIGMA are significantly lower than 20%. By using the FCF cost model SIGMA can charge a higher amount to the Community than by using the FC cost model. This may apply for the UFRO as well.

It is important to note that any legal entity that is eligible to opt for the AC model in a first contract can change to the FCF or the FC model in a later contract. If it does so, it must then use the new cost reporting model in subsequent contracts. Any legal entity that is eligible to opt for the FCF model in a first contract can change to the FC model in a later contract. If it does so, it must then use the new cost reporting model in subsequent contracts.

Each contractor must use the same cost model for all proposals in the FP 6!

The maximum Community contribution for STREPs is shown in the following table (Table 5):

Table 5: Maximum Community contribution for STREPs

Activity	Maximum grant as percentage of costs: FC/FCF	Maximum grant as percentage of costs: AC
Demonstration activities	35%	100%
Research and techno-logical development or innovation activities	50%	100%
Management of the consortium activities	FC: 100% FCF: flat rate (up to 7% of the Community contribution)	Eligible direct costs

The Community financial contribution is based on the principles of non-profit, co-financing and additionality. Due to these principles financing a STREP on mere Community funds is impossible. Own capital and further funds have to be mobilized.

During the FP 6 that last from 2002 to 2006, 315 million Euros will fund **"Specific measures in support of international co-operation" (INCO)**. In support of the external relations, including the development policy, of the Community, these measures target the following groups of third countries: Developing countries, Mediterranean partner countries, Western Balkan countries, and Russia and the new independent states. Funding is available for

entities from countries with which co-operation agreements have been concluded. This is the case for Chile and most other South American countries.

5.1.2 STREP ISSAC

This proposal was the first one to be created. It was realized in a relatively early project phase and is based on the official information that can be found on the homepage of the 6th Framework Programme of the EU and on related internet pages.

The strategic objective of this project is transfer of the electrochemical water treatment technology of the IAE to different Third World countries in South America and adaptation to the specific needs in these countries and areas of application. To generate a high added-value on European level, additionally to Pro aqua and the IAE, 3 further European partners will participate in this project. All in all, 10 participants from 8 countries will form the project consortium.

According to the needs in South American developing countries, technological potential of the proposed technique and existing contacts the following areas of application were selected for this project:

- Disinfection of potable water
- Disinfection of municipal waste water treatment plants´ effluents
- Treatment of municipal waste water for re-use in irrigation
- Treatment of mining industry waste water
- Treatment of landfill leaches
- Combination of the electrochemical water treatment technology with a biological treatment

The following tasks and activities will be performed for each topic:

- Adaptation and validation of the electrochemical waste water treatment technique
- Technical feasibility analysis
- Financial feasibility analysis

- Comparative analysis of the current and the potential situation
- Comparison between the technological demands in Europe and South America
- Potential Impact Analysis of the technique's application.

5.2 SSA SAMSON

5.2.1 General information on SSA-Projects

Specific Support Actions (SSAs) are intended to support the implementation of the 6th Framework Programme, ensure dissemination and take-up of the results of former FP 6 projects and may also be used to help in preparations for future Community research policy activities. Within the priority themes of the FP 6, specific support actions will support, for example, conferences, seminars, studies and analyses, working groups and expert groups, operational support and dissemination, information and communication activities, or a combination of these as appropriate. Specific support actions will also be implemented to stimulate, encourage and facilitate the participation of SMEs, small research teams, newly developed and remote research centres, as well as organizations from the candidate countries in the activities of the priority thematic areas, in particular in the networks of excellence and the integrated projects. The implementation of such actions will rely on the information and assistance structures, including the network of national contact points, established by the Member States and the associated countries and will aim at ensuring a smooth transition from the Fifth to the Sixth Framework Programme. SSAs are smaller projects than STREPs. The generation of new knowledge is not the objective of SSAs.

The available cost models are the same as for STREPs.

The maximum Community contribution for SSAs is shown in the following table (Table 6):

Table 6: Maximum Community contribution for SSAs

Activity	Maximum grant as percentage of costs: FC/FCF	Maximum grant as percentage of costs: AC
Specific support activities	100%	100%
Management of the consortium activities	FC:100% FCF: flat rate (up to 7% of the Community contribution)	Eligible direct costs

5.2.2 SAMSON

By early November 2003 first drafts of the INCO work plan and the funded areas for the year 2004 were available. It showed that no funds for STREPs will be provided for 2004. The only projects that will be funded in 2004 were SSAs. So another proposal was created. This proposal will support the aim of a technology transfer to South America and fit into the SSA scheme. Furthermore, new unofficial information on success-criteria for SSAs was regarded, so that a high probability for funding by the FP 6 could be reached.

The objectives of the project SAMSON (Sustainable Water Management in South American Nations) are:

- Identification of management strategies for sustainable water management in arid and semi-arid South American ecosystems.
- Development of policy options.
- Identification of technological possibilities leading to a more reasonable use of natural resources, protection of the nature and population.
- Introduction of the partners, South American public and private actors and research institutes in new water treatment technologies that are up to date not available in South America, if it is found that these are the best solutions for the existing technological problems.

Within this project 5 South American partners from 4 different countries will study the actual situation in water management and water technology in South American arid and semi-arid ecosystems. Each partner will give an overview of the general situation in its country and concentrate on one of the following areas:

- Drinking water
- Municipal waste water treatment plants´ effluents
- Municipal waste water
- Cyanide-containing mining industry waste water
- Landfill leaches

Data will be collected on the following topics:

- Management strategies
- Available technologies, cost and efficiency of treatment.
- Quantity of water, types and concentrations of contaminants.

The co-ordinator of the project, the Department for Sustainable Waste Management and Technology of the University of Leoben, Austria (MUL), will analyze the state of technique and new technological developments in the EU.

The best technological and management solutions will be identified and policy options will be defined.

A conference will be held in Chile to focus and discuss the thoughts, ideas and approaches that have been developed independently from each other and this project, to collect opinions and points of view of a broad range of South American public and private environmental actors, scientists and those concerned.

Each of the 5 South American partners will realize a public seminar in its country, during which the results found for this specific country will be presented targeted to the responsible public and private actors.

If during the workshops it will be found, that technologies, that are not yet available in Latin America, are the best solutions for the existing problems, in a public workshop following the

conference, the South American partners and interested public and private environmental actors as well as research institutes and scientists will be introduced into these technologies.

As for 2004 no FP 6 funds for a STREP with the objective of transferring and implementing the electrochemical water treatment technology of the IAE to South America are available, the SSA-project SAMSON was created to pave the way for an implementation of this technique in Chile and South America.

Within the project, the South American participants will collect samples of different types of waters that will be transported to Europe and analyzed by the IAE laboratory. Thus important basic data on targeted waters can be gained.

Furthermore the objective “Introduction of the partners, South American public and private actors and research institutes in new water treatment technologies that are up to date not available in South America, if it is found that these are the best solutions for the existing technological problems” offers the possibility to introducing the electrochemical water treatment technology to these actors.

6 Results and Discussion

Research on the frame conditions in Chile was realized. Together with the Chilean partner SIGMA the most promising industrial sectors for the installation of 2 pilot plants were selected. These were the landfill site “El Molle” near Valparaíso, and the disinfection of the readily treated effluent of a municipal waste water treatment plant.

Presentations for these 2 potential partners and 2 further applications – paper and cellulose industry and treatment of process water – were created. These presentations contained questionnaires to collect data on the waters that allow the estimation of important parameters of electrochemical water treatment facilities like electrode surface and energy consumption. The presentations were sent to the owner of the landfill site and the *empresa sanitaria* that runs the municipal waste water treatment plant. No answers on these questionnaires were received, so that the estimation of the parameters was only possible in the case of the paper and cellulose producing industry (calculation: chapter 3.2.2).

Due to the requirements of the FP 6 in the prepared proposals research in 6 different areas, comprising the disinfection of treated municipal waste water and the treatment of landfill leaches, is planned.

2 different proposals for submission to the INCO funding line of the FP 6 were prepared. The first one of them, ISSAC, is aimed at realizing technology transfer to and implementation of the electrochemical water treatment technology of the Department for Sustainable Waste Management and Technology of the University of Leoben in Chile. It was realized on the assumption that in 2004 INCO calls for STREP projects would be available, like they were in 2003. First drafts of the planned INCO calls for the year 2004 that became unofficially available in early November 2003 showed that no funding of STREP projects would be available for the necessary area in 2004. In 2004 INCO will fund only SSAs in South America. This is why in November 2003 the proposal SAMSON was created. This proposal is aimed at developing management strategies for sustainable water management in arid and semi-arid South American ecosystems, collecting data that will be useful for a later implementation of the BDD electrode water treatment technology and eventually introducing Chilean environmental actors into this technology.

The costs for the realization of both projects were calculated.

The legal framework – a letter of intent, a consortium agreement and a cooperation agreement between the Chilean third parties and the consortium members of the FP 6 project - was created.

The electrochemical water treatment technology poses an interesting new possibility for an easily added on treatment technique. Due to the high treatment costs a total degradation of the organic water content is mainly a solution for special situations. The possibility to add this technology to existing treatment stages like a biological treatment may be of special

importance in the case of a stricter control of the compliance with the existing norms, when many Chilean enterprises will have to update and upgrade their off water treatment systems.

In the case of an application for drinking water disinfection it has to be considered that the Chilean Drinking Water Norm lays down that the minimum residual concentration of free chlorine in the drinking water has to be equal to or higher than 0,2 mg/l in every point of the drinking water net.

7 Conclusions and Future Developments

7.1 Frame Conditions in Chile

The legal framework in Chile can be considered as relatively good. Laws like the Drinking Water Law, quality norms like the Norm for Potable Water and emission norms like the Norm for the Regulation of Contaminants for Sewage Systems, Norm for the Regulation of Contaminants for Marine and Superficial Continental Waters, and the Norm for Emission of Liquid Industrial Wastes to Ground Water Courses and Bodies establish clear rules and requirements. The main problem in the legal sector is the lack of compliance with the legislation and norms that is caused by the only minimal capacity for control and fiscalization by the authorities. A sudden and strictly forced control of the compliance with the regulations would lead to severe problems of the Chilean industry. On a medium and long term base more strict control of the compliance with the waste and drinking water norms is absolutely necessary due to the increasing pressure on the water resources. This will increase the market for water treatment devices like the BDD systems that are easily added to already existing treatment facilities.

In the treatment of industrial waste waters and landfill leaches the electrochemical water treatment technology has a high potential in Chile mainly in combination with a posterior biological treatment. This is because of the significantly lower energy demand and the smaller plant size. The high treatment costs for total degradation make this application only interesting for special cases.

In the treatment of municipal waste water, the most promising option is the application as final treatment and disinfection device.

In the application for drinking water disinfection it has to be considered that the Chilean Drinking Water Norm lays down that the minimum residual concentration of free chlorine in the drinking water has to be equal to or higher than 0,2 mg/l in every point of the drinking water net. The disinfection effect of the anodic oxidation is stable, but is based on the generation of various differently effective disinfectants, not only on chlorine. Special attention has to be set on the issue, if the concentration of free chlorine in the treated water complies with the norm. This will depend on the composition of the raw water, too. A possible solution could be adding sodium chloride to the raw water.

7.2 Possibilities for Co-financing and Implementation of the Technology

The funding situation for this area in the European Union for the year 2004 is bad. No funding of activities for technology transfers is available. The only co-financed INCO projects for South America are Specific Support Actions (SSA), projects that are mainly aimed at guaranteeing the implementation of the results of previous FP 6-projects or preparing the ground for future FP 6 activities.

Given the current funding situation in the European Union, by the moment the most promising option seems to be founding a business in Chile with the business idea of commercializing the electrochemical water treatment technology in this country. The foundation of this enterprise can be co-financed by several Chilean institutions.

The Austrian trade mission in Chile is active in presenting Austrian enterprises and technology in Chilean events like industrial expositions on environmental issues. A special emphasise of the presented products and businesses is laid on water technology. The trade mission is very interested in spreading the knowledge and implementation of Austrian water treatment technology in Chile. Contacting the trade mission for free publicity and promotion surely is an interesting option.

7.3 Experiences with Proposals for FP 6 Projects

In the first year of the FP 6 only 12000 of the 100000 proposed projects received funding by the EU. Due to this low funding probability and the high effort necessary for their creation, it is not recommendable to invest too much energy into creating proposals for the FP 6.

During the realization of this thesis, several criteria for successful FP 6 proposals have crystallized:

- EU policies and therefore EU funding are designed to fill “gaps”. A gap of special importance for researchers is the difference in various economic sectors between the EU and the USA or Japan – the economic relevance of the proposed project. Helping the EU by the proposed project to reduce this gap or even becoming a leader in this sector, the funding probability increases significantly. In this case, the USA are realizing programmes to raise the importance of US enterprises in Chile. US enterprises already are important suppliers in Chilean water treatment. It can be said that the golden rule in FP 6

projects is, not to approach Brussels looking for money for one's R&D, but to help the EU in filling a gap the Commission itself has identified. This means concretely that a proposal has to address the specifications established in the specific call to 100%.

- The EU is interested in European Research on certain topics, not for instance in Austrian research in water technology. The composition of the consortium has to reflect that fact. Especially the participation of institutions from the new EU member states and candidate countries is important.

Further factors that are of importance in the assessment of FP 6 proposals are:

- Big consortium sizes (for STREPs at least 10 to 15 participants, generally significantly higher then demanded in the call – at least the double of the minimum requirement).
- High added value at European level and importance of the project results for other European regions.
- Intensifying the international co-operation. It should be demonstrated that the project is the base for further collaborations. E.g. by exchange of researchers.
- Involvement of participants from the industry, especially SMEs.

7.4 Future Developments

The pressure on the limited resource water in Chile is increasing. In the northern 8 Chilean regions the water resources are totally used. This fact combined with the growing water demand in the urban and productive areas will have to be faced by more strict control and fiscalization of the disposed waste waters to protect this ever more valuable resource. This will increase the market for water treatment devices like the BDD technology that can easily be added to already existing treatment facilities to improve their cleaning efficiency.

An interesting possibility could be based on the use of the BDD electrodes to generate chlorine as disinfectant for big scale drinking water disinfection.

As soon as the necessary contacts exist, the electrochemical treatment of process waters like cooling water by anodic oxidation poses an interesting option.

8 Index

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8.2 Index of Abbreviations

A	Ampere
AOX	Chlorinated organic compounds
ARI	Agricultural Research Institute of Cyprus
BIT	Bureau for International Research and Technology Cooperation
C	Carbon
COD	Chemical oxygen demand
D.S.	Decreto Supremo (Supreme Decree)
ECOIND	National Research and Development Institute for Industrial Ecology
e.g.	For example
etc.	Et cetera
€	Euro
FP 6	6th Framework Programme
g	Gram
h	Hour
H	Hydrogen
IAE	Department for Sustainable Waste Management and Technology of the University of Leoben
INCO	Specific Measures in Support of International Cooperation
IUNG	Institute of Soil Sciences and Plant Cultivation
kg	Kilogram
km	Kilometre
kWh	Kilo Watt hour
l	Litre
mg	Milligrams
mm	Millimetre
m^3	Cubic metre
µm	micrometer
Na	Sodium

nm	Nanometre
O	Oxygen
P 1	South American Partner 1
P 2	South American Partner 2
P 3	South American Partner 3
s	Second
SIGMA	SIGMA Consult Limitada
STREP	Specific targeted research project
SSA	Specific support action
TC	Total carbon
TOC	Total organic carbon
UFRO	Universidad de la Frontera
V	Volt

8.3 Index of Tables

8.4 Index of Figures

9 Annex 1: Presentations for Potential Chilean Partners

On the following pages an example for the created presentations for potential Chilean partners can be found – first the original document in Spanish, then its English translation.

9.1 Presentation for Potential Chilean Partners (Spanish Version)

Oxidación Anódica

Tratamiento Electro-Químico de Lixiviados

Tecnología – Posibilidades - Ventajas

Introducción

El tratamiento electro-químico de aguas es una tecnología innovadora, que abre nuevas posibilidades de tratar efectivamente agua potable, aguas de proceso, aguas servidas comunales, RILes y lixiviado.
La Universidad de la Frontera de Temuco en conjunto con la Universidad de Leoben, Austria, y SIGMA Consult Limitada cooperan con otras universidades y grandes empresas internacionales para desarrollar esta tecnología y transferirla a América Latina.

Principio de operación

La unidad más innovadora de las plantas de tratamiento electro-químico son los electrodos cubiertos con diamante modificado, BDD (boron doped diamond). Estos electrodos generan radicales de hidróxido a partir de H_2O en el agua tratada, que semejante a una combustión, oxidan todo tipo de compuestos orgánicos. El producto final de la descomposición es dióxido de carbono. El proceso no necesita químicos para la generación de radicales.

Combinación con tratamiento biológico

Al existir un tratamiento biológico posterior a la etapa electro-química, se reduce significativamente el tiempo de tratamiento y la superficie de los electrodos, ya que no se hace la descomposición completa de la materia orgánica en el tratamiento electro-químico.

La descomposición de sustancias difícilmente biodegradables por parte del tratamiento electro-químico genera compuestos fácilmente biodegradables, que son tratados eficientemente en la etapa biológica.
Este proceso corresponde a una transformación de la DQO (demanda química de oxígeno) a DBO (demanda biológica de oxígeno)

Ventajas del tratamiento electro-químico

Las ventajas principales del tratamiento electro-químico son:

- Fácil eliminación de COT (carbono orgánico total)
- Oxidación de todas clases de compuestos orgánicos a CO_2
- Oxidación directa de amonio a nitrógeno
- Reducción de nitrato, nitritos y N_2O a N_2
- Remoción de tóxicos (pe: eliminación de cianuro libre y complejo a través de oxidación directa)
- Mejoramiento de la degradabilidad biológica
- Remoción de metales pesados
- Desodorización a través de oxidación de compuestos de azufre a sulfato
- Desinfección a través de oxidación directa de microorganismos
- Baja producción de residuos
- Sin gastos adicionales de químicos agregados
- Alta eficiencia
- Fácil mantenimiento

Planta de experimentación

En el momento se realizan experiencias con aguas de lavado alcalinas de procesadores de acero, que contienen aceites minerales; y RILes provenientes de plantas de tratamiento de residuos peligrosos.
Los resultados de estos experimentos son positivos, ya que los contaminantes fueron degradados satisfactoriamente.

Datos técnicos de la unidad de experimentación:

Caudal: 100 litros por hora
Dimensiones: largo: 1200 mm
ancho: 300 mm
alto: 700 mm
Electrodos: 25 parejas del tamaño 100 mm x 100 mm;
material: BDD

Preguntas

Para evaluar la factibilidad de la implementación de un sistema electro-químico de tratamiento se solicita facilitar los siguientes antecedentes:

¿Caudal en metros cúbicos por hora?
¿Concentración de COT del agua antes del tratamiento?
¿Concentración de COT a la salida del tratamiento?
¿Qué contaminantes orgánicos e inorgánicos se encuentran en el agua, expresado en miligramos por litro?
¿Concentración de cloruro en el agua, expresado en miligramos por litro?
¿Conductividad y pH del agua?
¿Temperatura del agua antes del tratamiento?
¿Hay presencia de coliformes fecales, cuánto?
¿Existe o se proyecta actualmente un sistema de tratamiento?
¿Cuál es la remoción de COT y contaminantes específicos de este sistema?
¿Cuáles son sus costos de operación por metro cúbico?
¿Qué tipo de tarifa eléctrica usa?
¿Cuál es el consumo energético y costos de energía por metro cúbico de agua tratada?
¿Costos de inversión, capacidad, tiempo de tratamiento y vida útil de la planta proyectada?
¿Tiene algún problema especifico?

Si necesita más información, favor contactarnos a:

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9.2 Presentation for Potential Chilean Partners (English Version)

Anodic Oxidation

Electrochemical Treatment of Landfill Leaches

Technology – Possibilities - Advantages

Introduction

The electrochemical water treatment is an innovative technology that opens new possibilities in effectively treating drinking water, process waters, municipal and industrial waste waters and landfill leaches.
The University of la Frontera in Temuco, the University of Leoben, Austria, and the SIGMA Consult Ltda. cooperate with other universities and important international enterprises to develop and transfer this technology to Latin America.

Operational Principle

The most innovative part of these electrochemical treatment plants are the electrodes that are covered with modified diamond, BDD (boron doped diamond). These electrodes generate hydroxide-radicals beginning from H_2O in the treated water. These radicals oxidize, similar to combustion, all kinds of organic compounds. The final product of the decomposition is carbon dioxide. The process does not need any chemicals for the generation of the radicals.

Combination with a Biological Treatment

If a biological treatment stage exists after the electrochemical stage, the treatment-time and the surface of the electrodes can be reduced significantly. The reason for this is that in this case a complete elimination of the TOC in the electrochemical stage is not necessary.
The decomposition of difficultly biodegradable substances in the electrochemical treatment stage leads to easily biodegradable compounds that are effectively treated in the biological stage.
This process corresponds to a transformation of the COD (chemical oxygen demand) to BOD (biological oxygen demand).

Advantages of the Electrochemical Treatment Technology

The main advantages of the electrochemical water treatment technology are:

- Easy elimination of the TOC (total organic carbon).
- Oxidation of all types of organic compounds to CO_2.
- Direct oxidation of ammonia to nitrogen.
- Reduction of nitrates, nitrites and N_2O to N_2.
- Removal of toxic substances (e.g.: elimination of free and complex cyanide by direct oxidation).
- Improvement of the biodegradability.
- Removal of heavy metals.
- Deodorization by oxidation of sulphur compounds to sulphate.
- Disinfection by direct oxidation of the micro organisms.
- Very low production of residues.
- No additional costs for chemicals.
- High efficiency.
- Easy maintenance.

Experimental Plant

By the moment experiments with alkaline, mineral oil containing washing waters from the steel processing industry are being lead through. Furthermore, experiments with waste waters from treatment plants for dangerous wastes are realized.
The results of these experiments are positive, the contaminates were degraded satisfactorily.

Technical data of the experimental plant:

Capacity: 100 litres per hour
Size: Length: 1200 mm
Width: 300 mm
Height: 700 mm
Electrodes: 25 pairs of the size 100 mm x 100 mm;
Material: BDD

Questionnaire

To estimate the feasibility of the implementation of an electrochemical treatment plant we ask you to answer the following questions:

Quantity of water in cubic meters per hour?
Concentration of the TOC before the treatment?
Concentration of the TOC after the treatment?
Which organic and inorganic contaminants are in the water, expressed in milligrams per litre?
Concentration of chloride in the water, expressed in milligrams per litre?
Conductivity and pH of the water?
Temperature of the water before the treatment?
Are there coli-bacteria in the water, quantity?
Does a treatment system currently exist or is one planned?
What is the removal of TOC and specific contaminants of the system?
Operational costs of this system per cubic meter?
Which scale of charge do you use for electricity?
Energy consumption and energy costs per cubic meter treated water?
Investment costs, capacity, treatment time and life expectancy of the planned system?
Do any specific problems exist?

If you need more information, please contact us at:

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10 Annex 2: Proposal for Research Project “SAMSON”

10.1 General Remarks

Proposals for the FP 6 are obliged to comply with extremely strict formal criteria such as fixed numbers of pages for each chapter or fixed numbers of characters for certain chapters, partial anonymity and other knock-out criteria. Due to these obligations, the following chapters partially do not comply with the formal criteria set forth by the IAE for scientific documents.

These proposals have been prepared so that 3 additional participants from 3 further South American countries can be easily integrated into the proposal. These partners form an important part of the project consortium, but yet have not been fixed. So, these additional participants are called P 1, P 2 and P 3 throughout the proposals.

To successfully submit these proposals, P 1, P2 and P 3 will have to be replaced by real entities, and their data has to be filled into the proposals. The proposals have been designed so that this data can be filled in requiring minimal time.

10.2 Proposal SAMSON

SUSTAINABLE WATER MANAGEMENT IN SOUTH AMERICAN NATIONS

SAMSON

15th of December 2003

Specific Support Action

List of Participants (Coordinator first):

- University of Leoben, Austria - Department for Sustainable Waste Management and Technology (MUL)
- SIGMA Consult Limitada, Valparaíso, Chile (SIGMA)
- University of La Frontera, Temuco, Chile - Department for Chemical Engineering (UFRO)
- P 1
- P 2
- P 3

Coordinator:

Univ. Prof. Dr.-Ing. Karl E. Lorber

University of Leoben, Austria

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Proposal Summary

SUSTAINABLE WATER MANAGEMENT IN SOUTH AMERICAN NATIONS

SAMSON

Strategic objectives:

1. Identification of management strategies for sustainable water management in arid and semi-arid South American ecosystems.
2. Development of policy options.
3. Identification of technological possibilities leading to a more reasonable use of natural resources, protection of the nature and population.
4. Introduction of the partners and South American public and private actors and research institutes in new water treatment technologies, that are up to date not available in South America, if it is found that these are the best solutions for the existing technological problems.

Abstract:

Within this project 5 South American partners from 4 different countries will study the actual situation in water management and water technology in South American arid and semi-arid ecosystems. Each partner will give an overview of the general situation in its country and concentrate on one of the following areas:

- Drinking water
- Municipial waste water treatment plants´ effluents
- Municipial waste water
- Cyanide-containing mining industry waste water
- Landfill leaches

Data will be collected on the following topics:

- Management strategies
- Available technologies, cost and efficiency of treatment.
- Quantity of water, types and concentrations of contaminants.

The co-ordinator of the project, the Department of Sustainable Waste Management and Technology of the University of Leoben, Austria (MUL), will analyze the state of technique and new technological developments in the EU.

The best technological and management solutions will be identified and policy options will be defined.

A conference will be held in Chile to focus and discuss the thougths, ideas and approaches that have been developed independently from each other and this project, to collect opinions and points of view of a broad range of South American public and private environmental actors, scientifics and those concerned.

Each of the 5 South American partners will realize a public seminar in its country, during which the results found for this specific country will be presented targetedly to the responsible public and private actors.

If during the workshops it will be found, that technologies, that are not yet available in Latin America, are the best solutions for the existing problems, in a public workshop following the conference, the South American partners and interested public and private environmental actors as well as research institutes and scientists will be introduced into these technologies.

B.1 Objectives of the Proposed Project

The objectives of this project are the following:

Identification of management strategies for sustainable water management in South American arid and semi-arid ecosystems

The primary objective of SAMSON is to identify management strategies for sustainable water management at river basin scale in South American arid and semi-arid ecosystems. These management strategies aim at leading to more sustainable use of renewable natural resources in rural and peri-urban areas and harnessing judicious use of such resources.

These strategies will be identified and developed in cooperation between South American experts with a profound knowledge of the situation in their regions and European experts with access to state-of-the-art water treatment technologies.

Development of policy options

Within this project, policy options will be developed by both experienced experts of the actual situation in South America and European technology and management experts.

Identification of technological possibilities leading to a more reasonable use of natural resources and protection of nature and population

At the most detailled project level, the participants will realize studies on the available technologies and the state of the technique in South America and Europe. This is to identify the optimal existing technologies for the different regions and areas of application.

As in the recent years new technologies for both drinking water and waste water treatment have emerged and existing techniques have been improved, it is very likely that new, cheaper and more effective technological possibilities nowadays exist in Europe, that still are not common in South American developing countries.

The most suitable water treatment technologies will be identified for the following areas:

- Drinking water treatment
- Disinfection of municipial waste water treatment plants´ effluents
- Treatment of municipial waste water (in general and for re-use in irrigation)
- Treatment of cyanide-containing gold mining industry waste water
- Treatment of landfill leaches

Dissemination of new technologies

In the case that in the European Union water treatment technologies exist that still are not available in South America, and that these technologies possess significant advantages over the technologies currently available in South America, in a public workshop that will take place immediately after the conference, the South American partners and interested public and private actors as well as research institutes and scientifics will be introduced into these technologies. By this means a first step in the implementation of these technologies in South America will be taken.

B.2 Relevance to the Objectives of the INCO Specific Measures

To a growing extend, provision and quality of water represent a major problem not only in the so called “Third World” but worldwide. Even the industrialized countries face more and more quantitative and qualitative problems in this area.

Worldwide, 25 % of all people do not have access to potable water of sufficient quality and 35 % are not securely supplied. Only 40 % of the population has access to potable water in sufficient quantity and quality.

The main types of water consumption are

- Production of drinking water (10%)
- Industry and energy generation (25%)
- Agriculture and production of food (65%)

These figures make it clear, that actions concerning the natural resource “water” are strongly needed. Especially in regions where water is scarce, in arid and semi-arid climates, water is the crucial environmental factor.

The proposed project will concentrate on this key societal issue in the area A.2.3 “Managing arid and semi-arid ecosystems” of the INCO-workprogramme.

For the realization of the project an integrated approach, considering technological questions, management strategies and policy options has been chosen. By this approach, a maximum impact will be achieved.

The project will address the objectives of the INCO-specific measures in the following areas:

Identification of management strategies for sustainable water management in arid and semi-arid South American ecosystems

At this level of the project, water management strategies at river basin scale, that are apt for South American arid and semi-arid ecosystems and the societies living in these ecosystems will be developed in cooperation between the South American and European experts. Throughout South America, integrated management approaches to water management at river basin scale in arid and semi-arid ecosystems are needed to prevent the state of the

natural resources and surroundings, and thus the quality of life of the inhabitants who largely depend on these resources, from deteriorating.

These management strategies will be developed with a special focus on harnessing judicious use of the renewable natural resource “water” and concentrate on identifying management strategies for enhanced economic productivity without eroding the natural resource base in the long term, taking into account the specific socio-economic conditions.

Development of policy options

This is the most global project level. As the management strategies, these policy options will be developed with a special focus on harnessing judicious use of the renewable natural resource “water” and concentrate on identifying policy options for enhanced economic productivity without eroding the natural resource base in the long term, taking into account the specific socio- economic conditions.

Identification of technological possibilities leading to a more reasonable use of natural resources, protection of the nature and population

On the most detailled project level, the most suitable water treatment technologies for use in the respective regions and areas of application will be identified. Not only the technological solution of certain problems will be taken into account, but also local and social factors and properties of the specific technologies, that are of special importance in developing countries, like easy operation and maintainance.

The objective of this project-level is to provide the European Commission with information on which technologies to concentrate in future STREPs and technology transfer projects. The results gained within this part of the project will be applicable for other INCO-target-regions, like the Mediterranean Partner Countries, too.

The project will concentrate on five of the most important areas in water treatment in developing countries.

Dissemination of new technologies

This part of SAMSON is meant to make the initial step in filling the technological gap between Europe and South America in water treatment technologies. It will transfer

knowledge of new technologies to where it is needed most, spread awareness of the possibilities for third countries in participating in European research programmes and stimulate further initiatives to implement the presented technologies to South American countries.

Further INCO-objectives

Further INCO-objectives to which the proposed project contributes are:

- Water supply
- Water pollution
- Ground water management
- SMEs

B.3 Potential Impact

B.3.1 Exploitation and Dissemination of the Results

The proposal includes as a project activity the organization of a conference, five seminars, three workshops (one of them public), three project meetings and the conjunct work to prepare at least three publications in scientific magazines and presentations in congresses.

B.3.1.1 Workshops and Project Meetings

Three project meetings will be held together with the workshops in order to ensure the directions of the project.

The **first project meeting and the first workshop** will be held in Chile, in the first project month. Matters of detail will be cleared and specific working directions will be established.

The **second project meeting and the second workshop** will be held in YY, in the 5th project month, with the intention of analyzing the results of the studies and develop and identify management strategies and policy options. The 1st project report will be prepared at this meeting.

Finally, the **third project meeting and the third workshop** will be held in Chile, in the 10th project month, following the conference. Within this public workshop, the South American partners and interested public and private actors as well as research institutes and scientifics will be introduced into new technologies for water treatment that were found to be optimal for the application in South American arid and semi-arid ecosystems during the second workshop and that are not yet available in these countries. In the project meeting, the management strategies and policy options will be refined with the new input from the conference.

B.3.1.2 Dissemination of Results

The results obtained within the proposed project will be disseminated through the following channels:

B.3.1.2.1 Seminars

Each of the 5 South American participants will realize a public seminar in co-operation with the industries, public and private actors in its region. These seminars will spread the results of this project and support their implementation. The seminars will be held in 13th, 14th and 15th project month.

B.3.1.2.2 Conference

In the 9th project month, the conference “Sustainable water management in South American arid and semi-arid ecosystems” will be realized in Chile. This conference is primarily aimed to provide the possibility to focus and discuss the thougths, ideas and approaches that have been developed independently from each other and SAMSON, to collect opinions and points of view of a broad range of South American public and private environmental actors, scientists, researchers and those concerned.

As a secondary objective, this conference serves to disseminate the knowledge already created by the consortium and promote participation in EU-funded projects.

B.3.1.2.3 Further Dissemination Activities

Additionally, the obtained results will be disseminated by the following means:

- Publications in scientific journals of international reputation.
- Contributions (presentation of papers and posters) at national and international conferences on environmental subjects (e.g.: Depotech).
- Chapters in specialized books.
- Utilization of the obtained knowledge for the teaching programme at the universities.

B.3.2 Strategic Impact

The partners have well established relationships with the industries and public institutions of their countries. Therefore the results obtained by the proposed project will be made available to those enterprises and institutions who can implement them.

The potential impacts according to the different working areas of the project are the following:

- *Drinking water:* Lack of clean water is one of the main reasons for diseases transmitted by feces are so common in developing countries. In 1990 diarrhea led to 3 million deaths, 85 percent of them among children. New management strategies and new technologies will provide more people access to safe drinking water

- *Municipial waste water treatment plants´ effluents:* Contrary to Europe, river water is used for irrigation in agriculture in South America. So, these effluents have to be disinfected before being disposed of in rivers. New management strategies and technologies will lower the risks for river water applications (e.g.: irrigation and drinking water) and provide more effective and cheaper treatment.
- *Municipial waste water:* Apt effective and cheap concepts for management and treatment of municipial waste waters will be elaborated. Especially in arid and semi-arid ecosystems, these waters may be used for agricultural irrigation and save natural resources.
- *Landfill leaches:* Landfill leaches represent a major threat to soil, rivers and ground water. This project will help to protect these ever more valuable natural resources. Furthermore, activities in this area will rise public consciousness in South America that treatment of landfill leaches is of vital importance.
- *Mining industry waste water:* Cyanide-containing gold mining industry waste waters have caused several heavy accidents recently. New strategies and technologies will lead to a more sustainable mining industry, protecting humans, and nature and water resources.

B.3.3 Contributions to other EU-Policies

EU Water Initiative

The most prominent goal of this initiative is to half, by 2015, the number of people without access to save water and basic sanitation – estimated at over one and two billion people respectively.

External Relations and Development Cooperation:

A full range of co-operation agreements have been concluded between the European Union and South America based on the three pillars of economic co-operation, institutionalised political dialogue and the strengthening of trade relations.

An exampel is the Association Agreement EU – Chile, an economic and political cooperation agreement that has recently been signed. The following intervention priorities have been identified for 2000-2006:

I. Economic co-operation and technological innovation.

II. Environment and natural resources

III. Support to the reform of the state

This project will contribute to the creation of a joint scientific basis and enable the South American countries to open up its research system to make it part of the global effort. Furthermore, it will prepare the way for new European water treatment technologies in Latin American, a market that is historically dominated by providers from the US and strengthen the position of the EU in this area.

Article 164

Article 164 of the Amsterdam treaty states that the EU-member states will undertake R&D to support EU policies and to support competitiveness of EU industry.

This project will help the European water treatment industry to break the US-American dominance in supplying Latin America with water treatment plants.

South America represents an enormous growing market for water treatment facilities. Becoming a leader in this market at this stage will secure many jobs in water treatment supply during the next decade.

It will contribute to European excellence in water science and technology, helping to make the EU the world´s number one research area by 2010.

World Summit on Sustainable Development (WSSD) agreements

SAMSON will help to achieve the Millennium Development Goals in the following areas:

Goal 7: Ensure environmental sustainability:

- **Target 9 -** Integrate the principles of sustainable development into country policies and programmes and reverse the losses of environmental resources.
- **Target 10 -** Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation

Goal 8: Build a global partnership for development:

- **Target 18** - In cooperation with the private sector, make available the benefits of new technologies

B.4 Consortium and Project Resources

B.4.1 Consortium

MUL - Department of Sustainable Waste Management and Technology

Personal resources:

Total number of employees: 25 (40% female employees)

Personnel number in R/D: 20

Thematic priorities of the Institution

The thematic priorities of this department are waste and waste water management. Beside research projects in electrochemical treatment of oilwater emulsions this department is also working in the field of drinking water treatment. Especially in the treatment of liquid dangerous wastes exists experience.

Further areas of activities include thermal and material utilization of residues, landfill technology and mechanical biological treatment of residual waste.

Role of the participant:

The Department for Sustainable Waste Management and Technology of the MUL is the project co-ordinator. The head of this department, ***o. Univ. Prof. Karl E. Lorber,*** has good practice in co-ordinating INCO-projects. He is specialized in waste and project management, eco-auditing, environmental impact assessement and manpower development. The MUL will analyze the state of technique and new technological developments in the EU.

UFRO - Department for Chemical Engineering

Personal resources:

Total number of employees: 20 (40% female employees)

Personnel number in R/D: 17

Thematic priorities of the Institution

Current research of this institute concentrates on management, treatment and revaluation of waste and waste waters, new waste and water treatment technologies, bio-processes, food engineering and agro-industrial development.

Role of the participant:

UFRO is an important environmental research actor in Chile It will lead through studies. Additionally it will act as promotor and multiplier. The conference, a seminar and 2 of the workshops will be organized by this partner.

SIGMA Consult Limitada

Personal resources:

Personnel number: 6 (33% female employees)

Thematic priorities of the Institution

The SME SIGMA is a consulting and engineering enterprise specialized in sustainable use of natural resources, water treatment and provision of drinking water and renewable energy. SIGMA has good experience in working with European partners (colaborations with the Ministry of Environment, Territorial Development and Agriculture of North Rhine Westphalia).

Role of the participant:

SIGMA has well established contacts to public and private actors in Chile. It will lead through studies and promote the take-up of the results. SIGMA will emphasize the implementation of

new technologies in South America after the official end of the project and hold a seminar to targetedly disseminate the results found for Chile.

P 1

Personal resources:

Thematic priorities of the Institution

Role of the participant:

It will lead through studies. This participant will hold a seminar to disseminate the results found for its country in its country.

P 2

Personal resources:

Thematic priorities of the Institution

Role of the participant:

It will lead through studies and will organize the 2nd workshop. This participant will hold a seminar to disseminate the results found for its country in this country.

P 3

Personal resources:

Thematic priorities of the Institution

Role of the participant:

It will lead through studies. This participant will hold a seminar to disseminate the results found for its country in this country.

All partners have the necessary human and technological infrastructure to successfully realize this project. A detailed description would go beyond the scope set by the formal length of this section.

The partners of this consortium complement one another as is shown in the following:

The selected South American partners have profound knowledge of the current situation in their countries and regions and have remarkable experience in implementing environmental innovation. They are experts in the management strategies and technologies used in their areas.

The co-ordinator of the project, the Department for Sustainable Waste Management and Technology has shown its capability for co-ordinating INCO-projects in South America in the INCO-DC-project “EILT – Reduction of Environmental Impact of Leather Tanneries”. This institute is an expert in environmental management and water treatment technologies. It will introduce the South American partners into the current European management strategies and water treatment technologies. It is the source for the transferred know-how.

This combination of South American knowledge of the current situation and the European expertise in management strategies and technologies will create a high critical mass to achieve the project´s objectives.

B.4.2 Financial Plan:

The participants follow their own cost accounting principles. To lower the costs, all workshops and project meetings will be realized in South America. If it is necessary to realize laboratory tests to determine the best technological solutions, the Department for Sustainable Waste Management and Technology of the MUL will take over all costs for these activities. No community grant will be requested for these activities.

B.5 Project Management

B.5.1 General Structure

The organisation structure of the consortium will comprise the following:

- **Project Co-ordination Committee** as the supervisory body for the project execution and decision making body in all relevant project matters.
- **Panels** can be established by the Project Co-ordination Committee to deal with specific issues or problems.
- **Project Co-ordinator** as the intermediary to the European Commission is authorised to execute the project management, will report and be accountable to the Project Co-ordination Committee (which will in turn report and be accountable to the General Assembly. The conditions will be set forth in the consortium agreement). The project co-ordinator will be the single point of contact between the members of the consortium and the European Commission. Assigned as the co-ordinator of this project is Prof. Karl E. Lorber of the MUL.
- **Project Office:** A project office will be established by the Project Co-ordinator. It will use the existing facilities of the MUL.

B.5.2 Representatives

Each partner has nominated a representative to the Project Co-ordination Committee with due authorisation to discuss, negotiate and agree decisions or provide recommendations made by the organs within the frame of its responsibilities.

These representatives are:

Partner	*Representative*
MUL	Karl E. Lorber
SIGMA	Patricio Siggelkow
UFRO	Valerio Bifani
P 1	
P 2	
P 3	

B.5.3 Consortium Agreement

The partners will sign a consortium agreement, in which all questions of intellectual property and protection of knowledge will be laid down exactly. A short abstract of the most important questions is shown below.

B.5.4 Intellectual Property and Management of Knowledge

The participants agree to respect their individual intellectual property rights.

B.5.4.1 Access Rights

Access-rights to knowledge and pre-existing know-how shall be granted upon bilateral agreement between the participants concerned. Access rights to knowledge shall be granted on a royalty-free basis, access rights to pre-existing know-how shall be granted on fair and non-discriminatory conditions. The granting of access-rights shall be made conditional on to the principles laid down in the consortium agreement.

After conclusion of an agreement in accordance with the contract, the requesting party is entitled to use the pre-existing know-how, knowledge or software for performing the project work.

If a party applies pre-existing know-how of another party without the grant of access, a penalty up to € 50,000 will be charged for the illegal utilisations. The IPR Council will decide on the amount of the penalty.

B.5.4.2 Publications

General

Each party shall have the right to publish or allow the publishing of data which constitutes such party’s knowledge, pre-existing know-how or confidential information it owns in accordance with the contract.

Any publication or communication, whether written or oral, is required to have obtained the consent of the parties concerned. To this end, a brief description and the subject of the

proposed publication or communication shall be submitted to the Project Coordination Committee, with a copy being provided to all parties.

If none of the parties objects to the publication within one calendar month from the date of referral, consent shall be deemed to be given.

Publication to qualify for a degree

Where a person carrying out work on the project on behalf of a party needs to include pre-existing know-how or knowledge of another party in a publication to qualify for a degree, approval for use shall be obtained from the appropriate party owning such rights or affected by the use.

These and all other topics concerning intellectual property will be laid down clearly and more precisely in the consortium agreement.

B.6 Workplan

Management Activities:

Workplan introduction

The management activities are to coordinate and prepare the support activities. They are an integrated part of the project as a whole and form the back bone of the support activities.

Work planning

The management activities comprise:

- Project coordination
- Coordination of cost and payment
- Mobility coordination
- Reports coordination

The MUL will be responsible for all management activities on consortium level that arise during the project. These activities follow the logical course of the project. Their timing is displayed in the Gantt-chart at the end of this section.

Support Activities

Workplan introduction

An integrated approach working on three differently detailled levels have been chosen. On the most global level, policy option will be identified.

On the next level, current management strategies will be analyzed and management strategies leading to a more sustainable use of water as a renewable natural resource in South American arid and semi-arid ecosystems will be developed.

The objective of the most detailled project-level is to analyze the water treatment technologies that are currently used in South American developing countries and to study the

state of the technology and new developments in the European Union to identify more suitable water treatment technologies that are not yet available in South America. If such technologies are found, the partners and interested South American public and private actors, research institutions and scientists will be introduced into these technologies by experts of the Department for Sustainable Waste Management and Technology of the MUL in a workshop following the conference.

Work planning

In project month 0, the kick-off workshop will be held in Chile. In this **first workshop**, that will be realized together with the **first project meeting**, the South American partners will be introduced into water treatment technologies and management strategies that are common in the European Union. First specific problems will be discussed and specific working directions will be laid down.

After this workshop, the South American partners will realize the **studies** on the actual situation in water management and technologies in South American arid and semi-arid ecosystems. They will **collect samples**, for the case that it is necessary to realize laboratory tests to determine the most suitable water treatment technologies.

The MUL will study the state of technique and new developments in water treatment in Europe. These studies will last till month 4, and take 3 person months per participant.

The following table specifies the task on which each participant will concentrate during the studies:

Partner	*Task*
MUL	Analysis of available technologies in Europe and current European management strategies
SIGMA	
UFRO	
P 1	
P 2	
P 3	

In the **second workshop** and **second project meeting** in the 5th project month, the results of the studies will be assessed. It will be analyzed, if in Europe more suitable technologies are available. For every type of water studied, the in the given situations **best treatment technology** will be identified. **Management strategies** and **policy options** will be developed and identified in cooperation between the South American and European specialists. This workshop is the **first milestone**.

If it is necessary to realize laboratory tests, to determine, which water treatment technologies are the most suitable; these tests will be realized by the MUL. These tests will be carried out following the second workshop. ***It is important to point out that the Department for Sustainable Waste Management and Technology of the MUL will take over all costs for these laboratory tests.*** No additional costs for the EU will arise.

During the next 3 months, the workshop results will be assessed and the results of the studies and the workshops will be prepared for the conference.

In the 9th project month, the **conference** “Sustainable water management in South American arid and semi-arid ecosystems” will be realized in Chile. This conference is primarily aimed to provide the possibility to focus and discuss the thougths, ideas and approaches that have been developed independently from each other and SAMSON, to collect opinions and points of view of a broad range of South American public and private environmental actors, scientists, researchers and those concerned and integrate their input into the management strategies and policy options that have been developed by the consortium.

As a secondary objective, this conference serves to disseminate the knowledge already created by the consortium and promote participation in EU-funded projects.

Following the conference, the **third workshop** will be held. This workshop consists of two parts:

In the first, public part, interested South American participants, public and private environmental actors, researchers and scientists will be introduced into new water treatment technologies that are not yet available in South America. These technologies will only be presented if it is found that these are the most suitable for the situations in South America.

In the second part of the workshop, the results of the conference will be integrated into the management strategies and policy options. The consortium will discuss the further directions of the project and develop further actions for the implementation of the project-results.

Together with the third workshop, the partners will meet for the **third project meeting**. The conference and the third workshop represent the **2nd milestone**.

Each South American partner will prepare a seminar that will be held in the last 3 project months in the respective regions. During these **seminars**, the results found for each region

and type of water will be presented targetedly to the specific actors of the concerned regions to achieve a maximum impact of the project. The realization of the last seminar in project month 14 represents the **third and final milestone**.

The partners will prepare **publications and presentations** to present the achieved results in various national and international scientific magazines and events.

The following Gantt-chart displays the timing of the project activities.

Work planning: Gantt-Chart

Activity	Partner	Month																													
		0		1		2		3		4		5		6		7		8		9		10		11		12		13		14	
1. Management Activities																															
Project coordination	MUL																														
Mobility coordination	MUL																														
Coordination of costs and payment	MUL																														
Report coordination	MUL																														
2. Support Activities																															
1st workshop	MUL																														
1st project meeting	UFRO																														
Study on the state of technique and new developments in water treatment in Europe	MUL																														
Study on the actual situation in water management and technologies in South American arid and semi-arid ecosystems and collection of samples (Cases A-E)	South American partners																														
2nd workshop	Teamwork																														
2nd project meeting	P 2																														
1st Milestone										1																					

Activity	Partner	Month																													
		0		1		2		3		4		5		6		7		8		9		10		11		12		13		14	
If necessary, laboratory tests to determine the most suitable water treatment technologies (costs will be taken by the MUL)	MUL																														
Assessment of workshop-results and preparation for the conference	MUL																														
Preparation and organisation of the conference	UFRO																														
Preparation for the conference	Teamwork																														
Conference	Teamwork																														
3rd workshop	Teamwork																														
3rd project meeting	UFRO																														
2nd Milestone																				2											
Preparation of seminars	South American partners																														
Seminars	South American partners																														
Reports	Teamwork																														
Publication preparation	Teamwork																														
3rd Milestone																															3

Please refer to the previous pages for the definition of the milestones.

Summary of Workplan description (full duration of project)

Workplan	SAMSON	**Start date or starting event:**			1st workshop		
Participant id		MUL	UFRO	SIGMA	P 1	P 2	P 3
Person-months per participant:		13	11	7	7	8	7

Objectives:

1. Identification of management strategies for sustainable water management in arid and semi-arid South American ecosystems.
2. Development of policy options.
3. Identification of technological possibilities leading to a more reasonable use of natural resources, protection of the nature and population.
4. Introduction of the partners and South American public and private actors and research institutes in new water treatment technologies, that are up to date not available in South America, if it is found that these are the best solutions for the existing technological problems.

Description of work

Within this project 5 South American partners from 4 different countries will study the actual situation in water management and technology in South American arid and semi-arid ecosystems. Each partner will give an overview of the general situation in its country and concentrate on one specific type of water.

The coordinator will analyze the state of technique and new technological developments in the EU.

The best technological and management solutions will be identified and policy options will be defined.

A conference will be held in Chile to focus and discuss the thougths, ideas and approaches that have been developed. 5 public seminars will be realized, to present the results to the responsible actors. If during the workshops it will be found, that technologies, that are not yet available in Latin America, are the best solutions for the existing problems, in a public workshop following the conference, interested public and private environmental actors will be introduced into these technologies.

Deliverables

- Report “*Actual situation of water management in South South American arid and semi-arid ecosystems*”
- Report “*State of the technique and new developments in water treatment in Europe*”
- Report “*Management strategies and policy options in South American arid and semi-arid ecosystems*”
- Final report

Milestones and expected result

1st Milestone: The 2nd workshop has been held; for every type of water studied, the best treatment technology has been identified; drafts of management strategies and policy options have been developed.

2nd Milestone: The conference and the 3rd workshop have been held; final management strategies and policy options have been identified; the introduction of interested actors into technologies that are new in South America has been realized.

3rd Milestone: The publications have been prepared, all seminars have been held.

Workplan list (full duration of project)

Work-Planning	Workplan List	Lead contractor No[1]	Person-months[2]	Start month[3]	End month[4]	Deliv-erable No[5]
M	Project co-ordination	MUL	1,5	0	14	D5
M	Co-ordination of mobility, costs, payment and reports	MUL	0,5	4	14	D5
S	Report preparation	All	3,5	5	14	D5
S	Participation in project meetings, workshops and conference	All	6	0	9	
S	Organisation of 1st and 3rd project meeting and workshop	UFRO	2	0	9	
S	Preparation for conference, 1st and 3rd workshop	MUL	3	0	9	
S	Organisation of 2nd project meeting and workshop	P 2	1	4	4	
S	Study South America	SIGMA	3	0	4	D1
S	Study South America	UFRO	3	0	4	D1
S	Study South America	P 1	3	0	4	D1
S	Study South America	P 2	3	0	4	D1
S	Study South America	P 3	3	0	4	D1

[1] Number of the contractor leading the work in this work-plan.

[2] The total number of person-months allocated to each work-plan.

[3] Relative start date for the work in the specific work-plan, month 0 marking the start of the project, and all other start dates being relative to this start date.

[4] Relative end date, month 0 marking the start of the project, and all ends dates being relative to this start date.

[5] Deliverable number: Number for the deliverable(s)/result(s) mentioned in the work-plan: D1 - Dn.

S	Study Europe	MUL	3	0	4	D2
S	Assessment of 2nd workshop´s results and preparation for conference	MUL	2,5	5	8	
S	Preparation and organisation of the conference	UFRO	2	0	8	
S	Preparation for the conference	SIGMA, UFRO, P 1, P 2, P 3	2,5	8	8	
S	Preparation and realization of seminars	SIGMA	1,5	9	14	D4
S	Preparation and realization of seminars	UFRO	1,5	9	14	D4
S	Preparation and realization of seminars	P 1	1,5	9	14	D4
S	Preparation and realization of seminars	P 2	1,5	9	14	D4
S	Preparation and realization of seminars	P 3	1,5	9	14	D4
S	Publication preparation	All	3	11	14	D5
	TOTAL		53			

M...Management activities

S.... Support activities

Deliverables list (full duration of project)

Deliverable No[1]	Deliverable title	Delivery date [2]	Nature [3]	Dissemination level [4]
D1	Actual situation of water management in South South American arid and semi-arid ecosystems	5	R	PU
D2	State of the technique and new developments in water treatment in Europe	5	R	PU
D3	Management strategies and policy options in South American arid and semi-arid ecosystems	9	R	PU
D4	Report on the seminars in South America	14	R	PU
D5	Final Report	14	R	PU

[1] Deliverable numbers in order of delivery dates: D1 – Dn

[2] Month in which the deliverables will be available. Month 0 marking the start of the project, and all delivery dates being relative to this start date.

[3] Please indicate the nature of the deliverable using one of the following codes:

R = Report

P = Prototype

D = Demonstrator

O = Other

[4] Please indicate the dissemination level using one of the following codes:

PU = Public

PP = Restricted to other programme participants (including the Commission Services).

RE = Restricted to a group specified by the consortium (including the Commission Services).

CO = Confidential, only for members of the consortium (including the Commission Services).

B.7 Other Issues

B.7.1 Ethical Issues

No ethical issues arise within the project. No experiments on human subjects, genomics or cell tissue are realized. Therefore the Helsinki Declaration, the Convention of the Council of Europe on Human Rights and Biomedicine, the UN Convention on the Rights of the Child and the Universal Declaration on the human genome and human rights are not applicable.

No experiments on animals are realized.

In every case, all participants respect the mentioned conventions and declarations and confirm that the proposed project does not involve:

- Research activities aimed at human cloning for reproductive purposes;
- Research activities intended to modify the genetic heritage of human beings which could make such changes heritable;
- Research activities intended to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer;
- Research involving the use of human embryos or embryonic stem cells with the exception of banked or isolated human embryonic stem cells in culture.

B.7.2 Gender Issues and Young Scientists

No gender issues arise within the project. The participation of young and/or female scientists is encouraged by all partners. A high number of female and/or young scientists will contribute to the project.

B.7.3 SMEs

As far as possible, SMEs have been integrated into the project. So, a remarkable percentage of the consortium is constituted by SMEs.

B.7.4 Dissemination of Awareness and Knowledge

Publication and dissemination activities are being discussed in section B.3.1. This project will contribute to spread the awareness on environmental issues concerning water in South America. Addittionally it will increase the awareness of South American environmental actors that the European Union is an excellent open to the world research center that gives parties from third countries the possiblity to participate in its programmes.

B.7.5 Wider Societal Implications

Water is one of the crucial resources of the 21st century. Especially societies of developing countries and mostly the societies in arid and semi-arid regions will face severe problems in this area. By realizing this project, an important step in investigating the possibilities to provide these societies with save water during the coming decades will be made.

This project will have a lasting impact on these societies by preparing the way for important changes in water management and treatment technologies.

10.3 Official Forms

FP 6 proposals consist of two parts: in the first, the consortium presents its project due to the set formal rules. This part has been presented in the previous chapter. The second part consists of several forms that have to contain certain data from each participant. These forms are filled out on-line using the EPSS, the Electronic Proposal Submission System. The finished forms can be downloaded. As they are an important part of the proposal, these forms can be found in the following.

The forms become available with the opening of a call. This is why for ISSAC these forms are not included in this document.

Proposal Submission Form

EUROPEAN COMMISSION
6th Framework Programme on
Research, Technological
Development and Demonstration

Specific Support Action **A1**

Proposal Number	000000	Proposal Acronym	SAMSON

General Information on the Proposal

Proposal Title	Sustainable Water Management in South American Nations
Duration in months	15
Call identifier	FP6-2002-INCO-DEV/SSA-1

Activity code(s) most relevant to your topic

Activity code 1	INCO-A.2
Activity code 2	
Activity code 3	
Keyword 1	Water policy
Keyword 2	Integrated management of water
Keyword 3	Wastewater treatment
Free Keywords	Managing arid and semi-arid ecosystems, drinking water, mining industry waste water, landfill leaches, municipial waste water, South America, cyanide, water treatment

Abstract (up to 2000 characters)

Within this project, 5 South American partners from 4 different countries will study the actual situation in water management and technology in South American arid and semi-arid ecosystems. Each partner will give an overview of the general situation in its country and concentrate on one of the following areas : Drinking water, Municipial waste water treatment plants´ effluents, Municipial waste water, Cyanide-containing mining industry waste water, Landfill leaches.

Data will be collected on the following topics: Management strategies, Available technologies, cost and efficiency of treatment, Quantity of water, types and concentrations of contaminants.
The co-ordinator of the project, the Department of Sustainable Waste Management and Technology of the University of Leoben, Austria (MUL), will analyze the state of technique and new technological developments in the EU.
The best technological and management solutions will be identified and policy options will be defined.

A conference will be held in Chile to focus and discuss the thougths, ideas and approaches that have been developed independently from each other and this project, to collect opinions and points of view of a broad range of South American public and private environmental actors, scientifics and those concerned.
Each of the 5 South American partners will hold a public seminar in its country, during which the results found for this specific country will be presented targetedly to the responsible public and private actors.

If during the workshops it will be found, that technologies, that are not yet available in Latin America, are the best solutions for the existing problems, in a public workshop following the conference, the South American partners and interested public and private environmental actors as well as research institutes and scientists will be introduced into these technologies.

Proposal Submission Form

EUROPEAN COMMISSION
6th Framework Programme on
Research, Technological
Development and Demonstration

Specific Support Action **A2**

Proposal Nr	000000	Proposal Acronym	SAMSON	Participant Nr	3

Information on Participants

Participant organisation

Org. legal name	University of La Frontera
Org. short name	UFRO

Legal address

PO Box	54-D	Postal Code		Cedex	
Street Name and Nr	Av. Francisco Salazar 01145				
Town	Temuco	Country	Chile		
Internet Homepage	www.ufro.cl				
Activity Type	Higher Education	Legal Status	GOV		
If "PRC" please specify					
Is the organisation a Small or Medium-Sized Enterprise (SME)?	No				
Any dependencies between the organisation and (an)other participant(s)?	No				
If yes, part.nr		short name		Character of dependence	
If yes, part.nr		short name		Character of dependence	
If yes, part.nr		short name		Character of dependence	
Person in charge	Title	Mr.		Sex	Male
Name	Navia				
First name(s)	Rodrigo				

Department/Faculty/Institute/Laboratory name

Department for Chemical Engineering

Address (if different from above)

PO Box		Postal Code	8700	Cedex	
Street Name and Nr	Peter-Tunner-Str. 15				
Town	Leoben	Country	Austria		
Phone1	++43 3842 402-5106	Phone2		Fax	++43 3842 402-5102
e-mail	rnavia@ufro.cl rodrigo.navia@stud.unileoben.ac.at				
Previously submitted similar proposals or signed contracts?	No				
if yes, programme names&year					
If yes, proposal or contract number(s)					

Proposal Submission Form

EUROPEAN COMMISSION
6th Framework Programme on
Research, Technological
Development and Demonstration

Specific Support Action **A2**

Proposal Nr	000000	Proposal Acronym	SAMSON	Participant Nr	1

Information on Participants

Participant organisation

Org. legal name	University of Leoben
Org. short name	MUL

Legal address

PO Box		Postal Code	8700	Cedex	
Street Name and Nr	Franz-Josef-Str. 18				
Town	Leoben	Country	Austria		
Internet Homepage	http://www.unileoben.ac.at				
Activity Type	Higher Education	Legal Status	GOV		
If "PRC" please specify					
Is the organisation a Small or Medium-Sized Enterprise (SME)?					No
Any dependencies between the organisation and (an)other participant(s)?					No
If yes, part.nr		short name		Character of dependence	
If yes, part.nr		short name		Character of dependence	
If yes, part.nr		short name		Character of dependence	
Person in charge	Title	Mr.		Sex	Male
Name	Kotschan				
First name(s)	Michael				

Department/Faculty/Institute/Laboratory name

Department for Sustainable Waste Management and Technology (IAE)

Address (if different from above)

PO Box		Postal Code	8700	Cedex	
Street Name and Nr	Peter-Tunner-Str. 15				
Town	Leoben	Country	Austria		
Phone1	++43 3842 402 5103	Phone2	++43 676 845386 300	Fax	++43 3842 4025102
e-mail	michael.kotschan@notes.unileoben.ac.at				
Previously submitted similar proposals or signed contracts?					No
if yes, programme names&year					
If yes, proposal or contract number(s)					

Proposal Submission Form

EUROPEAN COMMISSION
6th Framework Programme on Research, Technological Development and Demonstration

Specific Support Action **A2**

Proposal Nr	000000	Proposal Acronym	SAMSON	Participant Nr	2

Information on Participants

Participant organisation

Org. legal name	SIGMA Consult Limitada
Org. short name	SIGMA

Legal address

PO Box		Postal Code		Cedex	
Street Name and Nr	Juan Elkins 144E, Depto. A40, Cerro Placeres				
Town	Valparaíso	Country	Chile		
Internet Homepage					
Activity Type	Others	Legal Status	PRC		
If "PRC" please specify	LTD				
Is the organisation a Small or Medium-Sized Enterprise (SME)?				Yes	
Any dependencies between the organisation and (an)other participant(s)?				No	
If yes, part.nr		short name		Character of dependence	
If yes, part.nr		short name		Character of dependence	
If yes, part.nr		short name		Character of dependence	
Person in charge	Title	Ms.		Sex	Female
Name	Velasquez				
First name(s)	Carolina				

Department/Faculty/Institute/Laboratory name

same adress as above

Address (if different from above)

PO Box		Postal Code		Cedex	
Street Name and Nr					
Town		Country			
Phone1	++56 32 493340	Phone2	++56 32 797734	Fax	++56 32 493339
e-mail	cvelasquez@vtr.net				
Previously submitted similar proposals or signed contracts?				No	
if yes, programme names&year					
If yes, proposal or contract number(s)					

10.4 Estimation of Costs SAMSON

In SSAs a flat rate of 20 % of all direct project costs has to be added for the participants that use the FCF cost model to cover their indirect costs. As SSAs are not aimed at producing new knowledge, the IAE has to take over all costs for eventually necessary laboratory tests.

Max. 7% of the total community grant can be used for management activities.

Table 7 displays the calculation of costs. Table 8 shows which participants use which cost model. In the estimation of costs the FCF-model has been used for the participants P 1, P 2 and P 3.

Table 7: Estimation of costs for the project SAMSON

Participant	Support Activities			Management -Activities			Person Months	Costs per Person Month [€]	Type of Employment or Name of Specialist
	Activity	Costs Support Activities [€]	Requested Grant [€]	Activity	Costs Management Activities [€]	Requested Grant [€]			
MUL				Project Coordination	4200	4200	0,5	8400	Prof. Lorber
MUL				Project Coordination	2680	2680	1	2680	Dipl-Ing/Dr
MUL				Coordination of mobility, reports, costs and payment	1340	1340	0,5	2680	Dipl-Ing/Dr
MUL	Report preparation	2680	2680				1	2680	Dipl-Ing/Dr
MUL	Travel costs 1st workshop: AT-CL-AT	1200	1200						
MUL	Staying costs in CL (4 days)	400	400						
MUL	Travel costs 2nd workshop: AT-YY-AT	1200	1200						
MUL	Staying costs in YY (4 days)	400	400						
MUL	Travel costs 3rd workshop: AT-CL-AT	1200	1200						
MUL	Staying costs in CL (1 week)	700	700						
MUL	Health insurance	200	200						

MUL	Preparation 1st Workshop	2680	2680					1	2680	Dipl-Ing/Dr
MUL	Preparation for conference and 3rd workshop	5360	5360					2	2680	Dipl-Ing/Dr
MUL	Study on state of the technique and new developments in water treatment in Europe	8040	8040					3	2680	Dipl-Ing/Dr
MUL	Assessment of the results of the second workshop and preparation for the conference	6700	6700					2,5	2680	Dipl-Ing/Dr
MUL	Laboratory tests if it is necessary to determine the optimal technology [4)]	2500	0							
MUL	Travel costs expert for European water treatment technologies: AT-CL-AT	1200	1200							
MUL	Staying costs in CL (1 week)	700	700							
MUL	Participation in project meetings, workshops and conference	2680	2680					1	2680	Dipl-Ing/Dr
MUL	Publication preparation	1340	1340					0,5	2680	Dipl-Ing/Dr
Total participant MUL per category:		39180	36680			8220	8220	13		
Total participant MUL:[1)]		47400								
Flatrate for indirect costs (20 % of direct cost, only FCF):[2)]		7836	7336			1644	1644			
Total per category with flatrate:		**47016**	**44016**			**9864**	**9864**			
Grant to the budget participant MUL:[3)]		**53880**								
UFRO	Organisation 1st Workshop and 1st project meeting (personal costs)	900	900					1	900	Administrative
UFRO	1st Workshop and 1st project meeting (location, etc.)	800	800							
UFRO	Travel costs 2nd workshop: CL-YY-CL	600	600							
UFRO	Staying costs in YY (4 days)	400	400							
UFRO	Organisation 3rd Workshop and 3rd project meeting (personal costs)	1450	1450					1	1450	Dipl-Ing/Dr
UFRO	Organisation 3rd Workshop and 3rd project meeting (location, etc.)	1000	1000							
UFRO	Health insurance	100	100							
UFRO	Report preparation	725	725					0,5	1450	Dipl-Ing/Dr
UFRO	Study in South America (+samples collection)	4350	4350					3	1450	Dipl-Ing/Dr

UFRO	Preparation and organisation of the conference (person months)	1800	1800					2	900	Administrative
UFRO	Preparation and organisation of the conference (location, etc.)	8000	8000							
UFRO	Preparation for the conference	725	725					0,5	1450	Dipl-Ing/Dr
UFRO	Preparation and realization of seminar (person months)	2175	2175					1,5	1450	Dipl-Ing/Dr
UFRO	Preparation and realization of seminar (location)	700	700							
UFRO	Participation in project meetings, workshops and conference	1450	1450					1	1450	Dipl-Ing/Dr
UFRO	Publication preparation	725	725					0,5	1450	Dipl-Ing/Dr
Total participant UFRO per category:		25900	25900			0		11		
Total participant UFRO:[1)]		25900								
Flatrate for indirect costs (20 % of direct cost, only FCF):[2)]		5180	5180					0		
Total per category with flatrate:		**31080**	**31080**					**0**		
Grant to the budget participant UFRO:[3)]		**31080**								
SIGMA	Travel costs 1st workshop: within CL	100	100							
SIGMA	Staying costs in CL (4 days)	400	400							
SIGMA	Travel costs 2nd workshop: CL-YY-CL	600	600							
SIGMA	Staying costs in YY (4 days)	400	400							
SIGMA	Travel costs 3rd workshop: within CL	100	100							
SIGMA	Staying costs in CL (1 week)	700	700							
SIGMA	Health insurance	100	100							
SIGMA	Report preparation	725	725					0,5	1450	Dipl-Ing/Dr
SIGMA	Study in South America (+samples collection)	4350	4350					3	1450	Dipl-Ing/Dr
SIGMA	Preparation for the conference	725	725					0,5	1450	Dipl-Ing/Dr
SIGMA	Preparation and realization of seminar (person months)	2175	2175					1,5	1450	Dipl-Ing/Dr
SIGMA	Preparation and realization of seminar	700	700							

	(location)								
SIGMA	Participation in project meetings, workshops and conference	1450	1450				1	1450	Dipl-Ing/Dr
SIGMA	Publication preparation	725	725				0,5	1450	Dipl-Ing/Dr
Total participant SIGMA per category:		13250	13250		0	0	7		
Total participant SIGMA:[1)]		13250							
Flatrate for indirect costs (20 % of direct cost, only FCF):[2)]		2650	2650		0	0			
Total per category with flatrate:		**15900**	**15900**		**0**	**0**			
Grant to the budget participant SIGMA:[3)]		**15900**							
P 1	Travel costs 1st workshop: XX-CL-XX	100	100						
P 1	Staying costs in CL (4 days)	400	400						
P 1	Travel costs 2nd workshop: XX-YY-XX	600	600						
P 1	Staying costs in YY (4 days)	400	400						
P 1	Travel costs 3rd workshop: XX-CL-XX	600	600						
P 1	Staying costs in CL (1 week)	700	700						
P 1	Health insurance	100	100						
P 1	Report preparation	500	500				0,5	1000	Dipl-Ing/Dr
P 1	Study in South America (+samples collection)	3000	3000				3	1000	Dipl-Ing/Dr
P 1	Preparation for the conference	500	500				0,5	1000	Dipl-Ing/Dr
P 1	Preparation and realization of seminar (person months)	1500	1500				1,5	1000	Dipl-Ing/Dr
P 1	Preparation and realization of seminar (location)	700	700						
P 1	Participation in project meetings, workshops and conference	1000	1000				1	1000	Dipl-Ing/Dr
P 1	Publication preparation	500	500				0,5	1000	Dipl-Ing/Dr
Total participant P 1 per category:		10600	10600		0	0	7		
Total participant P 1:[1)]		10600							

Flatrate for indirect costs (20 % of direct cost, only FCF):[2)]		2120	2120			0	0			
Total per category with flatrate:		**12720**	**12720**			**0**	**0**			
Grant to the budget participant P 1:[3)]		**12720**								
P 2	Travel costs 1st workshop: YY-CL-YY	600	600							
P 2	Staying costs in CL (4 days)	400	400							
P 2	Organisation 2nd Workshop and 2nd project meeting (personal costs)	700	700					1	700	Administrative
P 2	Organisation 2nd Workshop and 2nd project meeting (location, etc.)	800	800							
P 2	Travel costs 3rd workshop: YY-CL-YY	600	600							
P 2	Staying costs in CL (1 week)	700	700							
P 2	Health insurance	100	100							
P 2	Report preparation	500	500					0,5	1000	Dipl-Ing/Dr
P 2	Study in South America (+samples collection)	3000	3000					3	1000	Dipl-Ing/Dr
P 2	Preparation for the conference	500	500					0,5	1000	Dipl-Ing/Dr
P 2	Preparation and realization of seminar (person months)	1500	1500					1,5	1000	Dipl-Ing/Dr
P 2	Preparation and realization of seminar (location)	700	700							
P 2	Participation in project meetings, workshops and conference	1000	1000					1	1000	Dipl-Ing/Dr
P 2	Publication preparation	500	500					0,5	1000	Dipl-Ing/Dr
Total participant P 2 per category:		11600	11600			0	0	8		
Total participant P 2:[1)]		11600								
Flatrate for indirect costs (20 % of direct cost, only FCF):[2)]		2320	2320			0	0			
Total per category with flatrate:		**13920**	**13920**			**0**	**0**			
Grant to the budget participant P 2:[3)]		**13920**								
P 3	Travel costs 1st workshop: ZZ-CL-ZZ	600	600				0			

P 3	Staying costs in CL (4 days)	400	400							
P 3	Travel costs 2nd workshop: ZZ-YY-ZZ	600	600							
P 3	Staying costs in ZZ (4 days)	400	400							
P 3	Travel costs 3rd workshop: ZZ-CL-ZZ	600	600							
P 3	Staying costs in CL (1 week)	700	700							
P 3	Health insurance	100	100							
P 3	Report preparation	500	500					0,5	1000	Dipl-Ing/Dr
P 3	Study in South America (+samples collection)	3000	3000					3	1000	Dipl-Ing/Dr
P 3	Preparation for the conference	500	500					0,5	1000	Dipl-Ing/Dr
P 3	Preparation and realization of seminar (person months)	1500	1500					1,5	1000	Dipl-Ing/Dr
P 3	Preparation and realization of seminar (location)	700	700							
P 3	Participation in project meetings, workshops and conference	1000	1000					1	1000	Dipl-Ing/Dr
P 3	Publication preparation	500	500					0,5	1000	Dipl-Ing/Dr
Total participant P 3 per category:		11100	11100			0	0	7		
Total participant P 3:[1)]		11100								
Flatrate for indirect costs (20 % of direct cost, only FCF):[2)]		2220	2220				0	0		
Total per category with flatrate:		**13320**	**13320**				**0**	**0**		
Grant to the budget participant P 3:[3)]		**13320**								
Total project costs per category		**111630**				**8220**		**53**		
Requested grant to budget per category (without flatrate)			**109130**				**8220**			
Requested grant to budget per category (with flatrate)			**130956**				**9864**			
Total grant to the budget (including flatrate)		***140820***								

1) The total costs per participant are calculated by adding the costs for support activities and the costs for management activities.

2) The flatrate for indirect costs (20 % of direct cost, only FCF) is calculated by multiplying the direct costs (total participant per category) by 0,2.

3) The grant to the budget per participant is calculated by adding the flatrate of 20 % of the direct costs to the total per participant of the categories Support Activities and Management Activities.

4) Laboratory costs MUL: 15 samples (3 of each type of water); it is possible to test 3 samples simultaneously each day = 5 laboratory days at 500 € each.

Table 8: Cost models used by the participants

Participant	Cost Model
MUL	FCF
UFRO	FCF
SIGMA	FCF
P 1	
P 2	
P 3	

11 Annex 3: Proposal for Research Project “ISSAC”

11.1 Proposal ISSAC

Introduction of a New Electrochemical System for Drinking Water, Process Water and Waste Water Treatment in South America Countries

ISSAC

1st of March, 2004

Specific Targeted Research Project

Proposal Summary

Introduction of a New Electrochemical System for Drinking Water, Process Water and Waste Water Treatment in South America Countries

ISSAC

Strategic objectives

1. Transfer and adaptation of a new electrochemical water treatment technology to Third World countries in South America.
2. Comparison between the specific technological needs for electrochemical water treatment in Europe and South America.

Abstract

To increasing extent water quality and supply are a major problem worldwide, but especially in Third World countries. Thus, new cheap and effective water treatment technologies are needed. Diamond-coated electrodes are a relatively young development opening new possibilities in water treatment.

The general objective of the present project is to transfer and adapt this emerging technology to the needs of South America’s developing countries, to improve the supply of the population with high-quality potable water and water for irrigation as well as providing an inexpensive, effective method for the cleaning of process waters, industrial and mining waste waters and landfill leaches thus protecting valuable natural resources.

To reach these targets, a consortium consisting of 10 partners from 8 countries has been united in a compact and dense working plan dealing with the following topics:

- Disinfection of potable water
- Disinfection of municipal waste water treatment plants´ effluents
- Treatment of municipal waste water for re-use in irrigation
- Treatment of mining industry waste water
- Treatment of landfill leaches

- Combination of the electrochemical water treatment technology with a biological treatment

The following tasks and activities will be performed for each topic:

- Adaptation and validation of the electrochemical waste water treatment technique
- Technical feasibility analysis
- Financial feasibility analysis
- Comparative analysis of the current and the potential situation
- Comparison between the technological demands in Europe and South America
- Potential Impact Analysis of the technique’s application.

The activities will not only focus on the treatment itself, but also on the surrounding environments of the effluents. Thus, precise knowledge of the environmental impact of this technique will be obtained.

The gained results will be of high use in the Mediterranean, Baltic and European Community countries, too, achieving a high added value at European level.

This project is considered to be a start point of a long-term co-operation between the participating institutions.

B.1.1 Scientific and technological objectives of the project and state of the art

B.1.1.1 Scientific state-of-the-art

The anodic oxidation is an electrochemical process that directly uses the liquid to be cleaned as electrolyte. In this case electrodes are applied that possess the ability of direct anodic oxidation of organic substances into carbon dioxide and thus can be used for the degradation of organic contamination in waste waters, for example.

Contrary to conventional electrodes the electrodes used in this project consist of a basic material which is coated with doped industrial diamonds. Due to the special surface the anodic generation of oxygen is repressed and only occurs at a potential of more than 2 volt. This facilitates the generation of extremely reactive hydroxyl radicals that degrade organic substances and also the oxidative in situ degradation of organic substances.

Other materials such as dimensionally stable anodes made of mixed titanium oxides or lead electrodes do not possess any comparable effectiveness. The oxidation is incomplete and at the same time the danger exists that the water which has to be cleaned is contaminated by the dissolving electrodes.

This technique of water treatment by means of anodic oxidation is relatively new. The possibilities were only recognized and described after the invention of diamond electrodes. The following possibilities and advantages are especially worth mentioning:

Oxidative degradation of organic contamination:

The degradation of organic substances such as solvent residues or detergents is of special interest for waste water disposal. By the use of these electrodes any organic contamination can be almost completely degraded without the use of chemicals.

Disinfection:

In addition to the degradation of organic substances an excellent disinfection effect is the basis of the application, a replacement of chemical disinfection systems (such as chlorine) is possible. The concurrent generation of biologically stable water – contrary to the UV disinfection – guaranties the sustainability of disinfection in the further pipe system.

B.1.1.2 Description of the project areas and the specific objectives

This project will focus on 6 crucial topics of water treatment. In each case, the following activities will be performed:

- Adaptation and validation of the electrochemical wastewater treatment technique
- Comparison between the technological demands in Europe and South America
- Technical feasibility analysis (Scale-up)
- Financial feasibility analysis (Cost analysis comparing the current water treatment facilities and the new electrochemical process)
- Comparative analysis to evaluate the new technique considering advantages and disadvantages in comparison with the current situation
- Potential Impact Analysis of the technique’s application (Study of the environmental surroundings and analysis of the potential impact of the treated effluent over the environment)

Disinfection of potable water

Current potable water plants in South America use chlorination-devices to perform disinfection, causing negative effects on the populations´ health due to imprecise dosage of chlorine.

The objective in this area is to adapt the technology to the needs in South America, leading to an effective, reliable and cheap disinfection device for communities of all sizes.

The possibility of portable plants based on this technology will be studied.

Municipal waste water treatment plants´ effluents

Contrary to Europe, in many regions of South America it is common to use river water for agricultural irrigation. Thus, municipal waste water treatment plants´ effluents must be cleaned of pathogenic microorganisms before being disposed of in river bodies. The common system currently used is based on disinfection by UV-radiation. A major disadvantage of this technique is that eventual solid matter in the water inhibits complete disinfection.

The electrochemical water disinfection process is highly effective even in very turbid water and provides lower operation costs due to a significantly lower energy-consumption.

The objective in this area is to adapt the technology to the demands of common South American municipal waste water treatment plants.

Treatment of municipal waste waters for use in irrigation

Municipal effluents represent an unused source of water for agricultural purposes. Since municipal waste waters are derived from both domestic and industrial sources, they contain a wide variety of constituents. These are generally described within categories such as solids, substances that exert a biological/chemical oxygen demand (BOD/COD), nutrients, pathogens, organic chemicals, metals, oils and greases, and plastics and floatables.

Unlike common municipal waste water treatment systems, electrochemical water treatment targets metals and chemicals, too.

The aim of the project in this area is to develop a plant for the treatment of municipal waste water for further use in agricultural irrigation.

Landfill leaches

Landfill leaches pose a unique environmental challenge because they are complex, vary from site to site, and contain potentially hazardous chemicals. The array of organic chemicals in landfills is especially complex and influenced by the types of wastes deposited, the method of land filling used, ambient conditions, and the age of the landfill. Treatment may be required to reduce the Biological Oxygen Demand (BOD) or Chemical Oxygen Demand (COD) brought about by the passage of the water through the oxygen-starved heart of the landfill. Treatment is often needed to reduce the ammonia level or the level of nitrates in the leaches. It may be necessary to eliminate other contaminants such as oil, cyanide, phosphorus or any chemical which may interfere with operations of sewage works or the environment downstream of the landfill. Nowadays, most South American landfill sites lack effective leaches treatment, contaminating ground and surface water. In combination with the rising amount of waste deposed in landfill sites an effective and uncomplicated technology is needed.

The objective is to adapt the technology to the demands of developing countries to facilitate sustainable landfill sites. The possibility of combination with a biological treatment will be studied.

Mining industry waste waters

In the mining industry, chemicals such as cyanide are used in the refining process to leach and to separate valuable minerals from other unwanted minerals. Cyanide and other toxic chemicals such as oil, petroleum products, solvents, acids, and reagents used for processing can be released into the environment and can subsequently affect water, soil, aquatic organisms, wildlife, waterfowl, and humans. The cyanide-contaminated solution left after valuable minerals have been removed is placed in a tailing pond or solution retention basin. These ponds and basins have proven to attract unsuspecting waterfowl and wildlife that suffers both acute and chronic poisoning as a result of direct contact with and ingestion of cyanide-contaminated solution. Leakage from the piles of waste that are leached with cyanide can allow release of cyanide and other toxic constituents directly into the environment via surface and ground water flow.

The aim is to adapt the electrochemical water treatment technique to the needs in the mining industry in South America.

Combination with biological treatment

The possibility of a combination with a biological treatment will be studied. In the electrochemical treatment plants, not or only difficultly bio-degradable substances like chlorophenols are cracked to easily biologically degradable substances like formic acid. For the degradation in the electrochemical cell does not have to be complete, up to 80 % of energy can be saved. On the other hand, the biological treatment can be realized faster and more efficiently, leading to smaller biological water treatment plants.

B.1.2 Relevance to the objectives of the INCO specific measures

To a growing extend, provision and quality of water represent a major problem not only in the so called “Third World” but worldwide. Even the industrialized countries face more and more quantitative and qualitative problems in this area.

Worldwide, 25 % of all people do not have access to potable water of sufficient quality and 35 % are not securely supplied. Only 40 % of the population has access to potable water in sufficient quantity and quality.

The main types of water consumption are

- Production of drinking water (10%)
- Industry and energy generation (25%)
- Agriculture and production of food (65%)

Given these facts, it is clear that new approaches are needed to satisfy the growing demands.

The proposed project will concentrate on this key societal issue. By implementing an innovative water treatment technology in South American development countries, it will contribute to the area A.2 (rational use of natural resources).

The project will address the objectives of the INCO-specific measures in the following areas:

Sustainable irrigation / Increasing recycling and re-use / Increasing use efficiency

In the regions where water is scarce the electrochemical treatment of municipal waste water for re-use in irrigation will provide a valuable water source, helping to minimize importation of water and supporting sustainable irrigation.

The results gained in this area will be of high value in other INCO-target-regions, for instance in the Mediterranean Partner Countries, too.

Water supply

Contrary to Europe, ground water is not the main drinking water resource in South America. Many people depend on river water as source for potable water. The introduction of the electrochemical water treatment technique will address the INCO specific goals by providing a cheaper, easy to use and more effective technique for treatment of municipal waste water treatment plants´ effluents. This means that a growing number of municipal waste water treatment facilities will produce cleaner effluents that have a lower potential for inducing diseases to the population. The lower energy consumption will contribute to a judicious use of not renewable natural resources.

Furthermore this technique will provide a new, effective and easy maintainable possibility for drinking water production that is independent from potentially noxious chemicals like chlorine, and therefore free of negative effects caused by over dosage.

Ground water management

Landfill leaches pose a unique challenge in order to their great variety of constituents and are a major threat to ground water reservoirs. Nowadays, South American landfills generally totally lack or are equipped with merely insufficient treatment facilities for the occurring leaches. A part of these leaches percolate into the ground water reservoirs and contaminate them. This contamination is harmful for populations that use ground water as drinking water and water for irrigation in agriculture.

Mining industry waste waters are among the most noxious industrial waste waters. Especially in developing countries, that depend to a high extend on the export of their natural resources, and are therefore intensively exploiting these resources, out-of-date waste water treatment technologies are still in use. The transfer of this treatment technique will contribute to a more sustainable mining industry that shows consideration for the needs of present and future generations.

Water pollution

Electrochemical treatment of landfill leaches and mining industry waste waters not only prevents pollution of ground water, but also of surface water. In combination with the treatment of municipal waste water treatment plants´ effluents and municipal waste water itself (for re-use in irrigation) this technique represents an integrative approach to easily implement able end-of-pipe water treatment.

SME

As far as possible, SMEs have been involved (20% of the consortium are SMEs). Further future co-operations between these SMEs (an European electrode-supplier and a well-established Chilean environmental actor) are being planned.

It is an objective of this project to develop strong scientific partnerships between the actors – especially between the European and South American participants in order to contribute to the sustainable development of the Latin American developing countries.

In order to create new contacts and transfer practices and knowledge, an intense exchange of researchers will be realized, not only between the European and South American partners, but between the European partners, too.

The planned comparative analysis between the technological demands in South America and Europe is aimed to create knowledge that can be used to implement this technique in Europe and the other INCO-target-regions (especially in the Mediterranean partner countries).

B.1.3 Potential impact

B.1.3.1 Exploitation and Dissemination of the results

The proposal includes as a project activity (see Work Package 2) the organization of two workshops, three project meetings and the conjunct work to prepare at least 4 publications in scientific magazines and presentations in congresses (e.g. DepoTech 2006).

B.1.3.1.1 Project meetings

Three project meetings will be held in order to ensure the financial, technical and research directions of the project.

The **first project meeting** will be held in Austria, in order to establish a coherent distribution of the planned activities and to discuss the possibilities of publication and/or presentation of the project results in scientific congresses and magazines.

The **second project meeting** will be held in Chile, with the intention of revising the proper achievement of the project goals. The preparation of the 1st project report is also intended at this meeting.

Finally, the **third project meeting** is planned to be held in the EU, following the second project workshop. In this meeting the preparation of the final report is intended.

B.1.3.1.2 Dissemination of results

The results obtained within the proposed project will be disseminated through the following channels:

- Public seminars in co-operation with the industries and the public health services of the respective regions, to be conducted during the three foreseen meetings.
- Publications in scientific journals of international reputation.
- Chapters in specialized scientific books.
- Contributions (presentation of papers and posters) at national and international conferences on environmental subjects (p. e.: DepoTech).
- Applying for patents in the case of technical developments leading to new processes or process modifications.
- Utilization of the obtained knowledge for the teaching programme at the universities.

B.1.3.1.3 Workshops

Two workshops are intended to be held within the project:

The **first workshop** will be entitled “Practical use of ELWA-TRETECH”. This workshop will refer to the results gained during the experimental phase.

The **second workshop** will be entitled „Technical and economical aspects of ELWA-TRETECH“. This workshop will refer to the results obtained by the technical and economical feasibility analysis of the adapted technology.

B.1.3.2 Potential Impact

The partners have well established relationships with the industries and public institutions of their respective regions, therefore the results obtained by the proposed project will be made available to these enterprises which can use the elaborated know how.

Moreover, it is the intention of this project to involve the industrial partners in the technical development of the laboratory electrochemical cells for wastewater treatment to an industrial pilot scale.

The potential impacts according to the different working areas of the project are the following:

- ***Disinfection of potable water:*** The provision of a cheap, reliable, easy-to-use and easily maintainable technique will help providing high quality potable water to larger parts of the South American population, increasing public health.
- ***Disinfection of municipal waste water treatment plants´ effluents:*** The development and adaptation of the electrochemical water treatment technique in this area will provide municipal waste water treatment plants a more reliable alternative to UV-disinfection. The electrochemical process operates at lower costs and energy consumption. The lower energy consumption saves natural resources, the more reliable disinfection leads to lower risks for river water applications (p. e.: irrigation and drinking water).
- ***Treatment of municipal waste water for re-use in irrigation:*** The application in this area will save natural resources, especially in regions with difficult access to water for irrigation.
- ***Treatment of mining industry waste water:*** The electrochemical waste water treatment technique will inhibit the further accumulation of cyanide and metals in the biosphere, protecting humans, wild life, soil and groundwater, and will lead to a more sustainable mining industry.

- ***Treatment of landfill leaches:*** Landfill leaches represent a major threat to soil, rivers and ground water. The implementation of this technique will help protect these ever more valuable natural resources. Furthermore, activities in this area will rise public consciousness that treatment of landfill leaches is vital.
- ***Combination with biological treatment:*** The combination of the electrochemical water treatment technology with a biological stage offers the possibility to save a significant quantity of energy without loss of efficiency. Possible fields of application are all biological treatment plants that have to cope with not or only difficultly degradable substances. So, the emission of highly persistent chemicals to the biosphere can be reduced, having positive effects on the flora, fauna and the population’s health.

B.1.3.3 Innovation related activities

The objective of the present project is to transfer, adapt and validate the proposed technique in the mentioned areas and perform the scale-up from laboratory electrochemical cells to industrial scale plants. For each field of application, a technical and financial feasibility study as well as a comparison to the needs in Europe, a comparative analysis of the current and the potential situation and a potential impact analysis will be performed.

6 pilot plants in South America will perform experiments in each area of investigation and will be adapted to the specific needs of each region and effluent/water during the experimental phase. One of the plants will carry out tests on synthetic samples in Temuco. A laboratory plant in Europe at the IAE laboratory will serve for the comparison of the technological needs in South America and Europe.

B.1.3.4 Contributions to other EU policies

Science and technology cooperation agreements have been signed between the European Union and South American countries like Chile and Argentina. This project will help realizing these agreements.

This project will raise the consciousness of South American research performers that the EU is a research area open to the world, leading to a higher quantity and more intense co-operations and participation in EU-funded research.

Furthermore it will contribute to the EU water initiative, and support the External Relations and Development Cooperation policies.

Article 164 of the Treaty which covers the co-operation with third countries and international organizations will be supported by this project, too.

B.1.3.5 Added-value at European level

It is the declared aim of the European Union to be the world’s leading research area by 2010. This project will help secure the leadership in water research and technology. The South American continent represents a huge future market for water treatment facilities. Becoming a leader in this market at an early stage will secure that the European Union is the number one supplier for water treatment plants in this region during the next decade.

Furthermore this cooperation will strengthen the EU’s reputation as highly innovative and open-to-the-world research center.

In addition to this, the proposed project is considered to be the starting point for upcoming research and technological co-operations by all partners, reinforcing research on a European level (ERA) as well as collaboration between Europe and South America.

The production of industry diamond coated electrodes will become an important area for European enterprises in the next years. A technological advantage in this field will secure several hundred jobs in the EU.

An important task in this project is the comparison of the technological needs in Europe and South America, with the aim to exploit the obtained results in the Mediterranean and Western Balkan countries as well as within the European Union.

B.1.3.6 Contributions to standards

It is not the objective of this project to contribute to national or international standards.

B.1.4 Work plan

B.1.4.1 Implementation plan introduction

All research institutions involved in this project have long experience on scientific research and development projects. Moreover, each participant has a number of contacts in their own areas of studies, which allows them to provide a practical scope on the experiences to be developed within the framework of this project.

The conception of the consortium has been conceived in such a way that all partners are obligated to participate with partners from the industry, so that the performed investigations can have an immediate evaluation for future applications in real-scale experiences.

Furthermore, the proposed organization scheme (refer to section B.2.2.1) and the project methodology allow a permanent dialogue between all partners in order to achieve faster and more comprehensive results through the project period.

An integrated approach to the subject has been chosen. The implementation plan consists of the following-phases:

1. Initial phase: Transport of the plants to their sites in South America, installation of the plants and training of the users.
2. Experimental phase: Treatment of the specific waters in South America and in Europe, analysis and characterization of the waters and the treated effluents; adaptation of the technology to the needs in South America.
3. Comparison of the technological demands in Europe and South America.
4. Technical feasibility analysis: Scale up of the technique in the different fields of application.
5. Financial feasibility analysis: Cost analysis comparing the current water treatment facilities and the proposed alternative.
6. Comparison between the current and the potential situation: Comparative analysis to evaluate the new technique considering advantages and disadvantages in comparison with the current situation.
7. Potential impact analysis: Study of the environmental surroundings where the disposal of the effluent takes place and analysis of the potential impact of the treated effluent over the environment.
8. Closing activities: Protection and dissemination of the gained knowledge, final scientific and cost report.

An intense cooperation between the actors in Europe and South America is foreseen. Most Latin American partners will collaborate with one European partner that is a specialist in its area.

The comparison between the technological demands in Europe and South America is meant to gain new information necessary to effectively lay out water treatment plants in both continents, highlighting specific differences in the characteristics of the effluents and waters. This information will contribute to a higher added value at an European level by extending the field of application of the electrochemical water treatment technique to new areas in Europe.

Responsible Partner(s)	Location	Task	European Partner
IAE	University of Leoben, Austria	Treatment of the European samples for comparative purposes	-
SIGMA, UFRO	Landfill site “El Molle”, Valparaíso, Chile	Treatment of landfill leaches	IUNG
SIGMA, UFRO	Municipal waste water treatment plant in Rinconada, Chile	Treatment of effluents of a municipal waste water treatment plant	-
UFRO	Universidad de La Frontera, Temuco, Chile	Experiments using artificial samples, possibility of the combination of the electrochemical treatment with a biological treatment	-
Partner 1	South America	Treatment of mining industry waste water	ECOIND
Partner 2	South America	Treatment of municipal waste waters for re-use in irrigation	ARI
Partner 3	South America	Disinfection of drinking water	-

B.1.4.2 Work planning

To save project time, pro aqua will produce the electrochemical water treatment plants during the contract negotiations between the European Commission and the project coordinator.

IAE will act as the project coordinator. It will be responsible for the general project coordination, the coordination of scientific mobility, coordination of costs and payment, the coordination of the meetings and the organization of the kick-off meeting. Furthermore, it will realize the scientific and cost reports to be delivered to the Commission.

During the shipment of the plants to South America (month 0 and 1 of the project) and their transport to their sites, IAE will develop the standard laboratory procedures to be used by all participants throughout the project.

The plants will be installed by a specialist of the IAE. He will train the local users in operation and maintenance of the electrochemical treatment plants, too.

The first milestone will be achieved, when all plants have been successfully installed, and are ready to begin the treatment of the specific waters and effluents.

Meanwhile, the European partners ARI, ECOIND and IUNG will collect samples of European mining industry waste water, landfill leaches and municipal waste water. These samples will be analyzed, characterized and treated in the electrochemical treatment plant in Austria.

The treated samples will be analyzed and characterized. To realize this, scientists of the above mentioned 3 organizations will visit the IAE.

The South American partners will collect samples of their specific waste waters and waters to analyze and characterize them in their laboratories.

Having achieved the first milestone by the end of month 3, the South American partners will begin the experimental phase. This phase is to last from month 4 to month 17. During this part of the project, the specified effluents and waters will be treated, and the treated samples will be analyzed and characterized. The technique will be adapted to the specific needs of each region and type of water (Location, responsible partners and task of each plant are shown in the table in section B.2.1.2).

All plants will begin the experimentation phase with batch-tests to create time-degradation-curves for the contaminants on which investigations will concentrate. In the next step, flow-tests will be performed.

The final step of this stage is the comparison between the specific technological demands of the electrochemical treatment of municipal waste waters for re-use in irrigation, waste waters

from the mining industry and landfill leaches in South America and Europe and adaptation of the technique for the use in Europe.

In addition to its other tasks, Partner 3 (working on the disinfection of potable water) will study the possibility of portable plants and lead through experiments on disinfection based on production of chlorine starting from common salt. UFRO will realize experiments on artificial samples and on the combination of the electrochemical process with a biological treatment (aerobic and anaerobic conditions).

The second milestone will be achieved by the end of month 17, when the treatment, characterization and analysis of the effluents as well as the adaptation of the technology and the comparison between South America and Europe have been performed.

This milestone will be immediately followed by the second project meeting in Chile and the first workshop, both to be held in month 17. The second project meeting will be organized by UFRO. The first workshop will be organized by UFRO and prepared in teamwork.

The next project phases are the technical and financial feasibility analysis for all applications including the scale up of the pilot plants to industrial scale treatment facilities and a cost analysis for the current treatment plants and the alternative electrochemical process. These tasks will be lead through by each participant for its effluent.

By completing these tasks, the third milestone will be achieved.

In the next stage a comparative analysis between the current and the potential situation considering advantages and disadvantages of the electrochemical water treatment technique will be performed for each area of application by the responsible partners.

The potential impact analysis is the last of the technological development and innovation related phases. Within this stage, the environmental surroundings where the disposal of the effluent takes place will be studied and the potential impact of the treated effluent over the environment will be analyzed. These tasks will be performed by specialists of the IAE.

The last project-stage are the closing activities, including further dissemination activities, preparation of the final scientific and cost report.

The forth and final milestone is achieved by the second workshop that will be held in Austria in the 26th month of the project.

For a clear separation between research, technological development and innovation related activities and project management activities refer to the Gantt-chart.

For an overview of the project, refer to the Pert-chart.

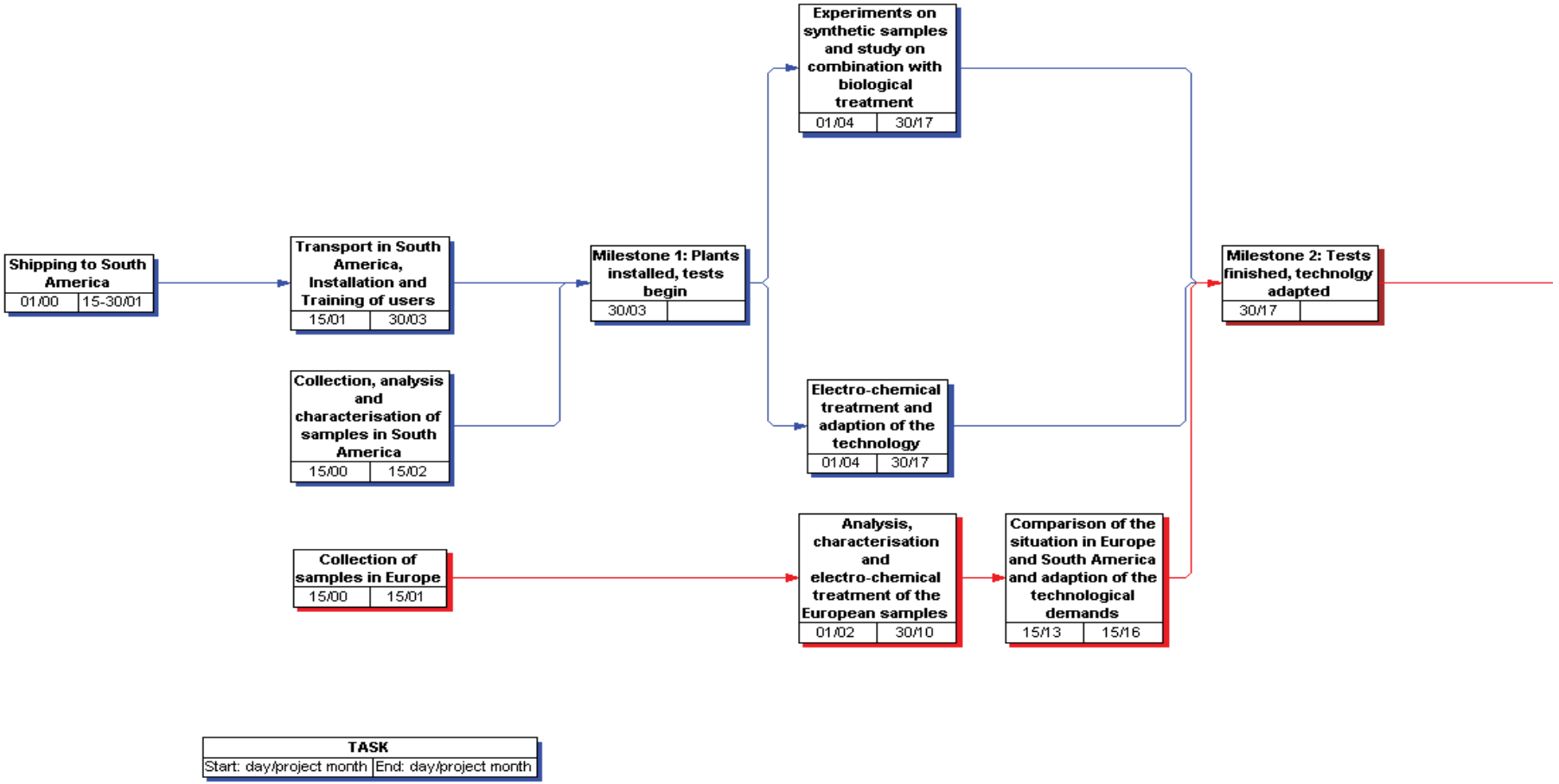
Significant Risks

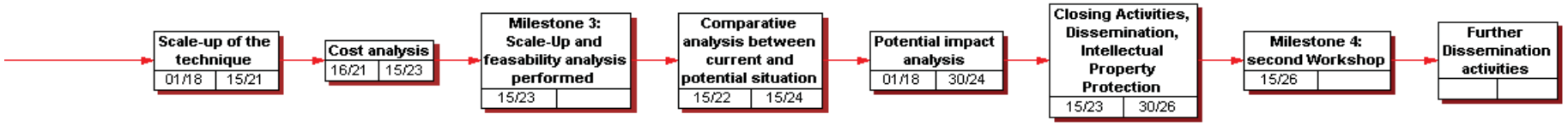
This is a dense and intense working plan. There are little technological risks, for the proposed technique is appropriate for all areas of application, as a literature survey has shown.

Delays in the first year of the project may be compensated by a more superficial and shorter experimental phase in certain areas of application. In this case, the Project Co-ordination committee will decide the appropriate measure.

Delays in the second project year may lead to longer project duration. As far as possible, the Project Co-ordination Committee will elaborate countermeasures and decide case-sensitively.

Pert-Chart


Experiments on synthetic samples and study on combination with biological treatment
01/04
30/17
Shipping to South America
01/00
15-30/01
Transport in South America, Installation and Training of users
15/01
30/03
Milestone 1: Plants installed, tests begin
30/03
Milestone 2: Tests finished, technolgy adapted
30/17
Collection, analysis and characterisation of samples in South America
15/00
15/02
Electro-chemical treatment and adaption of the technology
01/04
30/17
Collection of samples in Europe
15/00
15/01
Analysis, characterisation and electro-chemical treatment of the European samples
01/02
30/10
Comparison of the situation in Europe and South America and adaption of the technological demands
15/13
15/16
TASK
Start: day/project month
End: day/project month


Scale-up of the technique
01/18
15/21
Cost analysis
16/21
15/23
Milestone 3: Scale-Up and feasability analysis performed
15/23
Comparative analysis between current and potential situation
15/22
15/24
Potential impact analysis
01/18
30/24
Closing Activities, Dissemination, Intellectual Property Protection
15/23
30/26
Milestone 4: second Workshop
15/26
Further Dissemination activities

Gantt-Chart

WP	Activity	Partner	Month																										
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1. Management Activities																													
1	Project Coordination	IAE																											
1	Scientific Mobility Coordination	IAE																											
1	Coordination of costs and payment	IAE																											
1	1st project meeting	IAE																											
1	Scientific Report Coordination	IAE																											
2	1st workshop	Teamwork																											
1	2nd project meeting	UFRO																											
2	2nd workshop	Teamwork																											
1	3rd project meeting																												
	4th Milestone																												4
1	Last scientific and cost report	IAE																											
2. Research Activities																													
13	Laboratory procedures development	IAE																											

3. Technological development and innovation related activities			
3.1 Experimental Phase			
4	Shipping of treatment plants to South America	pro aqua	
4	Transport of plants in South America	SA partners	
4	Installation of plants in South America and training of users	IAE	
	1st Milestone		1
5	Collection, analysis and characterization of samples of the effluent of the municipal waste water treatment facility in Chile (A)	SIGMA/ UFRO	
6	Collection, analysis and characterization of samples of mining industry waste water in SA (B1)	P 1	
6	Collection of samples of mining industry waste water in Romania (B2)	ECO-IND	
7	Collection, analysis and characterization of landfill leaches samples in Chile (C1)	SIGMA/ UFRO	
7	Collection of samples of landfill leaches samples in Poland (C2)	IUNG	

8	Collection, analysis and characterization of raw water for drinking water production in SA (D)	P 3	
9	Collection, analysis and characterization of samples of municipal waste water for irrigation in SA (E1)	P 2	
9	Collection of samples of municipal waste water for irrigation in Cyprus (E2)	ARI	
5	Electrochemical treatment and adaptation of the technology - Case A	SIGMA, UFRO	
6	Electrochemical treatment and adaptation of the technology - Case B1	P 1	
7	Electrochemical treatment and adaptation of the technology - Case C1	SIGMA, UFRO	
8	Electrochemical treatment and adaptation of the technology - Case D	P 3	
9	Electrochemical treatment and adaptation of the technology - Case E1	P 2	
11	Electrochemical treatment of synthetic samples and study of possibility of combination with biological treatment- Case F	UFRO	

5	Analysis and characterization of treated samples - Case A	UFRO	
6	Analysis and characterization of treated samples - Case B1	P 1	
7	Analysis and characterization of treated samples - Case C1	UFRO	
8	Analysis and characterization of treated samples - Case D	P 3	
9	Analysis and characterization of treated samples - Case E1	P 2	
11	Analysis and characterization of treated samples - Case F	UFRO	
	2nd Milestone		2
3	Analysis and characterization of the sample, electrochemical treatment, analysis and characterization of the treated sample - Case B2	ECO-IND	
3	Analysis and characterization of the sample, electrochemical treatment, analysis and characterization of the treated sample - Case C2	IUNG	

3	Analysis and characterization of the sample, electrochemical treatment, analysis and characterization of the treated sample - Case E2	ARI																	■	■	■	■	■	■																																
6	Comparison of the situation in Europe and South America and adaptation of the technological demands (B)	ECOIN D/P 1																											■	■	■	■	■	■																					
7	Comparison of the situation in Europe and South America and adaptation of the technological demands (C)	SIGMA, UFRO, IUNG																											■	■	■	■	■	■																					
9	Comparison of the situation in Europe and South America and adaptation of the technological demands (E)	ARI/P 2																											■	■	■	■	■	■																					
3.2 Technical feasibility analysis																																																									
5	Scale-up of the technique for the treatment of effluents of municipal waste water treatment facilities (A)	SIGMA/ UFRO																																			■	■	■	■	■	■	■											
6	Scale-up of the technique for the application at the mining industry field (B)	ECO-IND/P 1																																			■	■	■	■	■	■	■											
7	Scale-up of the technique for the application with landfill leaches (C)	IUNG/ SIGMA/ UFRO																																			■	■	■	■	■	■	■											

8	Scale-up of the technique for the application in drinking water production (D)	P 3
9	Scale-up of the technique for the application in treatment of municipal waste water for irrigation (E)	ARI/P 2
11	Scale-up of the technique for the application in combination with a biological treatment (F)	UFRO
3.3 Financial feasibility analysis		
5	Cost analysis comparing the current water treatment facilities and the proposed alternative (A)	SIGMA/ UFRO
6	Cost analysis comparing the current water treatment facilities and the proposed alternative (B)	ECO-IND/P 1
7	Cost analysis comparing the current water treatment facilities and the proposed alternative (C)	IUNG/ SIGMA/ UFRO
8	Cost analysis comparing the current water treatment facilities and the proposed alternative (D)	P 3

9	Cost analysis comparing the current water treatment facilities and the proposed alternative (E)	ARI/P 2																																																						
11	Cost analysis comparing the current water treatment facilities and the proposed alternative (F)	UFRO																																																						
	3rd Milestone																																																3							
3.4 Comparison between current and potential situation																																																								
5	Comparative analysis (A) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation	SIGMA/ UFRO																																																						
6	Comparative analysis (B) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation	ECO-IND/P 1																																																						
7	Comparative analysis (C) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation	IUNG/ SIGMA/ UFRO																																																						

8	Comparative analysis (D) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation	P 3
9	Comparative analysis (E) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation	ARI/P 2
11	Comparative analysis (F) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation	UFRO
3.5 Potential impact analysis		
12	Study of the environmental surroundings, where the disposal of the effluent takes place (A)	IAE
12	Analysis of the potential impact of the treated effluent over the environment (A)	IAE
12	Study of the environmental surroundings, where the disposal of the effluent takes place (B)	IAE

12	Analysis of the potential impact of the treated effluent over the environment (B)	IAE
12	Study of the environmental surroundings, where the disposal of the effluent takes place (C)	IAE
12	Analysis of the potential impact of the treated effluent over the environment (C)	IAE
12	Study of the environmental surroundings, where the disposal of the effluent takes place (D)	IAE
12	Analysis of the potential impact of the treated effluent over the environment (D)	IAE
12	Study of the environmental surroundings, where the disposal of the effluent takes place (E)	IAE
12	Analysis of the potential impact of the treated effluent over the environment (E)	IAE
12	Analysis of the potential impact of the treated effluent over the environment (F)	IAE

4. Closing Activities			
2	Publication Preparation	Team-work	
Milestones			
1st Milestone: All plants have been installed and are ready for the treatment of effluents			
2nd Milestone: The partners have performed the treatment of the effluents. The treated effluents have been analyzed and characterized. The technology has been adapted to the specific effluents.			
3rd Milestone: The scale-up and the financial feasibility analysis have been carried out for all applications			
4th Milestone: Concerning the dissemination activities, the 2nd project workshop has been held			

SA Partners…all South American partners
P 1…Partner 1
P 2…Partner 2
P 3…Partner 3

Work packages:

WP	Responsible partners	Activities
WP 1	IAE	**Management Activities:** *Objectives:* Coordination of the project, preparation of reports for the Commission *Milestones and expected result:* 1st project meeting, last scientific and cost report *Description of work:* 1.1. Scientific mobility coordination 1.2. Coordination of costs and payment 1.3. Meetings coordination 1.4. Scientific report coordination 1.5. Cost report coordination *Leading contractor:* IAE *Start date or starting event:* Project start (month 0) *Person months per participant:* *Deliverable:* Final report (Deliverable number D1)
WP 2	Teamwork	**Joint Activities:** *Objectives:* Dissemination of knowledge *Milestones and expected result:* Project workshops; dissemination of the obtained results *Description of work:* 2.1. Workshop organization and preparation 2.2. Publication preparation *Leading contractor*: IAE *Start date or starting event:* month 17 *Person months per participant:* *Deliverable:* Milestone 4, 2nd workshop (Deliverable number D2)
WP 3	IAE, IUNG, ARI, ECOIND	**Treatment and analysis of European waste waters** *Objectives:* Analysis and treatment of 3 crucial European waste waters for comparison with the demands in South America *Milestones and expected result:* Analysis and characterization of the treated European samples Description of work: 3.1. Analysis and characterization of samples of European municipal and mining industry waste waters and landfill leaches 3.2. Electrochemical treatment 3.3. Analysis and characterization of the treated samples *Leading contractor:* IAE *Start date or starting event:* month 2 *Person months per participant:*

		Deliverable: Report "Electrochemical treatment in Europe" (Deliverable number D3)
WP 13	IAE	**Laboratory Procedures development** *Objectives:* development of standard laboratory procedures for all participants *Milestones and expected result:* standard laboratory procedures for all participants *Description of work:* 3.1. Laboratory procedures development *Leading contractor:* IAE *Start date or starting event:* month 0 *Person months per participant:* *Deliverable:* Report "Laboratory procedures" (Deliverable number D13)
WP 4	IAE, Pro aqua, South American Partners	**Installation of the electrochemical treatment plants in South America** *Objectives:* Shipment and installation of the plants, training of users *Milestones and expected result:* 1st Milestone, all plants are ready to begin the treatment of the specific effluents *Description of work:* 4.1. Shipment of the plants to South America. 4.2. Shipment of the plants in South America to their locations 4.3. Installation of the plants and training of users by a specialist of the IAE. *Leading contractor:* IAE *Start date or starting event:* month 0 *Person months per participant:* *Deliverable:* Milestone 1 – all plants ready for treatment of samples (Deliverable number D4)
WP 5	SIGMA, UFRO	**Adaptation and validation of the technique for treatment of municipal waste water treatment plants´ effluents in Chile** *Objectives:* Treatment of the specific effluent, adaptation and validation of the technique, scale up, cost-analysis *Milestones and expected result:* 2nd Milestone: the treatment has been performed, the treated effluents have been analyzed and characterized, the technique has been adapted to the specific needs of this effluent. *Description of work:* 5.1. Characterization of the effluents of a municipal waste water treatment facility in Chile (A). 5.2. Application and validation of the new water treatment technique. 5.3. Adaptation of technology. 5.4. Scale up of the technique. 5.5. Cost analysis, comparing the current treatment facility with the electrochemical water treatment plant. 5.6. Comparative analysis (A) to evaluate the new technique

		considering advantages and disadvantages in comparison with the current situation *Leading contractor:* UFRO *Start date or starting event:* month 0 *Person months per participant:* *Deliverable 1:* Report "Electrochemical treatment in Chile" (Deliverable number D5) *Deliverable 2*: Report "Validation of the electrochemical treatment of landfill-leaches and municipal waste water treatment plants´ effluents in Chile" (Deliverable number D14)
WP 6	ECOIND, P 1	**Adaptation and validation of the technique for treatment of mining industry waste water in ... and comparison with the needs in Europe** *Objectives:* Treatment of the specific effluent, adaptation and validation of the technique, scale up, cost-analysis and comparison with the technological needs in Europe. *Milestones and expected result:* 2nd Milestone: the treatment has been performed, the treated effluents have been analyzed and characterized, the technique has been adapted to the specific needs of this effluent. 3rd Milestone: The scale up and the financial feasibility studies have been performed. *Description of work:* 6.1. Characterization of mining industry waste water in Romania and ... (B). 6.2. Application and validation of the new water treatment technique in South America. 6.3. Application and validation of the new water treatment technique in Europe (at the IAE-laboratory in Austria). 6.4. Comparison of the specific demands in South America and Europe. 6.5. Adaptation of technology. 6.6. Scale up of the technique. 6.7. Cost analysis, comparing the current treatment facility with the electrochemical water treatment plant. 6.8. Comparative analysis (B) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation *Leading contractor:* ECOIND *Start date or starting event:* month 0 *Person months per participant:* *Deliverable 1:* Report "Electrochemical treatment of mining industry waste water in ..." (Deliverable number D6) *Deliverable 2:* Report "Validation of the electrochemical treatment of mining industry waste water in Romania and ..." (Deliverable number D15)
P 7	SIGMA, UFRO, IUNG	**Adaptation and validation of the technique for treatment of landfill leaches in Chile and comparison with the needs in Europe**

		Objectives: Treatment of the specific effluent, adaptation and validation of the technique, scale up, cost-analysis and comparison with the technological needs in Europe. *Milestones and expected result:* 2nd Milestone: the treatment has been performed, the treated effluents have been analyzed and characterized, the technique has been adapted to the specific needs of this effluent. 3rd Milestone: The scale up and the financial feasibility studies have been performed. *Description of work:* 7.1. Characterization of landfill leaches in Chile and Poland (C). 7.2. Application and validation of the new water treatment technique in South America. 7.3. Application and validation of the new water treatment technique in Europe (at the IAE-laboratory in Austria). 7.4. Adaptation of technology. 7.5. Comparison of situation in South America and Europe and adaptation of the technological demands. 7.6. Scale up of the technique. 7.7. Cost analysis, comparing the current treatment facility with the electrochemical water treatment plant. 7.8. Comparative analysis (C) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation *Leading contractor:* UFRO *Start date or starting event:* month 0 *Person months per participant:* *Deliverable 1:* Report "Electrochemical treatment of landfill leaches in Chile" (Deliverable number D7) *Deliverable 2:* Report "Validation of the electrochemical treatment of landfill leaches in Poland and Chile" (Deliverable number D16)
WP 8	P 3	**Adaptation and validation of the technique for drinking water production in ...** *Objectives:* Treatment of the specific effluent, adaptation and validation of the technique, scale up, cost-analysis. *Milestones and expected result:* 2nd Milestone: the treatment has been performed, the treated effluents have been analyzed and characterized, the technique has been adapted to the specific needs of this effluent. 3rd Milestone: The scale up and the financial feasibility studies have been performed. *Description of work:* 8.1. Characterization of raw water for drinking water production in South America (D). 8.2. Application and validation of the new water treatment technique. 8.3 Study of the possibility of portable plants and experimentation on disinfection merely based on production of chlorine 8.4 Adaptation of technology.

		8.5 Scale up of the technique. 8.6 Cost analysis, comparing the current treatment facility with the electrochemical water treatment plant. 8.7 Comparative analysis (D) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation *Leading contractor:* *Start date or starting event:* month 0 *Person months per participant:* *Deliverable 1:* Report “Electrochemical treatment for drinking water production in ...” (Deliverable number D8) *Deliverable 2:* Report “Validation of the electrochemical treatment for drinking water production in ...” (Deliverable number D17)
WP 9	ARI, P 2	**Adaptation and validation of the technique for treatment of municipal waste water for irrigation in ... and comparison with the needs in Europe** *Objectives:* Treatment of the specific effluent, adaptation and validation of the technique, scale up, cost-analysis and comparison with the technological needs in Europe. *Milestones and expected result:* 2nd Milestone: the treatment has been performed, the treated effluents have been analyzed and characterized, the technique has been adapted to the specific needs of this effluent. 3rd Milestone: The scale up and the financial feasibility studies have been performed. *Description of work:* 9.1. Characterization of municipal waste water in ... and Europe (E). 9.2. Application and validation of the new water treatment technique for treatment of municipal waste water for irrigation in South America. 9.3. Application and validation of the new water treatment technique in Europe (at the IAE-laboratory in Austria). 9.4. Adaptation of technology. 9.5. Comparison of situation in South America and Europe and adaptation of the technological demands. 9.6. Scale up of the technique. 9.7. Cost analysis, comparing the current treatment facility with the electrochemical water treatment plant. 9.8. Comparative analysis (E) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation *Leading contractor:* ARI *Start date or starting event:* month 0 *Person months per participant:* *Deliverable 1:* Report “Electrochemical treatment of municipal waste water for irrigation in ...” (Deliverable number D9) *Deliverable 2:* Report “Validation of the electrochemical treatment of municipal waste water for irrigation in Cyprus and ...” (Deliverable number D18)
WP 11	UFRO	**Experiments on synthetic samples and study of the**

		possibilities of the combination with a biological treatment *Objectives:* Treatment of synthetic effluents, validation of the technique, study of the possibility of a combination with a biological treatment. *Milestones and expected result:* 2nd Milestone: the treatment has been performed, the treated effluents have been analyzed and characterized, the possibility of a combination with a biological treatment has been performed. 3rd Milestone: The scale up and the financial feasibility studies have been performed. *Description of work:* 11.1. Electrochemical treatment of synthetic samples (F) (containing organic, inorganic, mixed organic/inorganic and micro-organisms) 11.2. Study on the combination of the electrochemical treatment with a biological stage 11.3. Scale up of the technique. 11.4. Cost analysis, comparing the current treatment facilities with the electrochemical water treatment plant in combination with a biological treatment. 11.5. Comparative analysis (F) to evaluate the new technique considering advantages and disadvantages in comparison with the current situation *Leading contractor:* UFRO *Start date or starting event:* month 4 *Person months per participant:* *Deliverable 1:* Report: "Electrochemical treatment of synthetic samples and combination of this technique with a biological treatment" (Deliverable number D11) *Deliverable 2:* Report: "Feasibility of a combination of the electrochemical water treatment technique with a biological treatment" (Deliverable number D19)
WP 12	IAE	**Potential Impact Analysis:** *Objectives:* In-situ-studies of the environmental impact of the treated effluent on its surroundings, analysis of the improvement compared to the current situation *Milestones and expected result:* Environmental validation of the electrochemical water treatment technique. *Description of work:* 12.1. In-situ study of the environmental surroundings where the effluent is disposed and potential impact analysis (A). 12.2. In-situ study of the environmental surroundings where the effluent is disposed and potential impact analysis (B). 12.3. In-situ study of the environmental surroundings where the effluent is disposed and potential impact analysis (C). 12.4. In-situ study of the environmental surroundings where the effluent is disposed and potential impact analysis (D). 12.5. In-situ study of the environmental surroundings where the effluent is disposed and potential impact analysis (E). 12.6. Study of the potential environmental impact of the effluent and potential impact analysis (F).

		Leading contractor: IAE *Start date or starting event:* month 18 *Person months per participant:* *Deliverable:* Report “Potential Impact of the electrochemical treatment-technique in specified environmental surroundings” (Deliverable number D12)
Remarks		*Dissemination level for all deliverables is “Confidential (CO)”.* *The title of each work package appears in this column in bold letters.* *For official use in EU-proposals this data has to anonymous.*

Scientific Mobility

Partner	Number of persons	To	Period	Project-month	Activities
ARI	1	IAE	4 days	0	1st project meeting
ECOIND	1	IAE	4 days	0	1st project meeting
IUNG	1	IAE	4 days	0	1st project meeting
SIGMA	1	IAE	4 days	0	1st project meeting
UFRO	1	IAE	4 days	0	1st project meeting
P 1	1	IAE	4 days	0	1st project meeting
P 2	1	IAE	4 days	0	1st project meeting
P 3	1	IAE	4 days	0	1st project meeting
ECOIND	1	IAE	3 months	5-7	WP 3
IUNG	1	IAE	3 months	8-10	WP 3
ARI	1	IAE	3 months	11-13	WP 3
ARI	1	P 2	3 weeks	17	WP 9
ECOIND	1	P 1	3 weeks	17	WP 6
IUNG	1	UFRO, SIGMA	3 weeks	17	WP 7
ARI	1	UFRO	1 week	17	1st workshop, 2nd project meeting
ECOIND	1	UFRO	1 week	17	1st workshop, 2nd project meeting
IAE	1	UFRO	1 week	17	1st workshop, 2nd project meeting
IUNG	1	UFRO	1 week	17	1st workshop, 2nd project meeting
SIGMA	1	UFRO	1 week	17	1st workshop, 2nd project meeting
P 1	1	UFRO	1 week	17	1st workshop, 2nd project meeting
P 2	1	UFRO	1 week	17	1st workshop, 2nd project meeting

P 3	1	UFRO	1 week	17	1st workshop, 2nd project meeting
IAE	1	UFRO, SIGMA	4 months	18-21	WP 12, Cases A and C
IAE	1	P 2	2 months	22-23	WP 12, Case E
IAE	1	P 1	2 months	19-20	WP 12, Case B
IAE	1	P 3	2 months	21-22	WP 12, Case D
IAE	1	UFRO	2 months	23-24	WP 12, Case F
ARI	1	P 1	1 week	26	2nd workshop, 3rd project meeting
ECOIND	1	P 1	1 week	26	2nd workshop, 3rd project meeting
IAE	1	P 1	1 week	26	2nd workshop, 3rd project meeting
IUNG	1	P 1	1 week	26	2nd workshop, 3rd project meeting
SIGMA	1	P 1	1 week	26	2nd workshop, 3rd project meeting
UFRO	1	P 1	1 week	26	2nd workshop, 3rd project meeting
P 1	1	P 1	1 week	26	2nd workshop, 3rd project meeting
P 2	1	P 1	1 week	26	2nd workshop, 3rd project meeting
P 3	1	P 1	1 week	26	2nd workshop, 3rd project meeting

B. 1.5 Other issues

No ethical or gender issues arise within the project. The participation of young and/or female scientists is encouraged by all partners. A high number of female and/or young scientists will contribute to the project.

20 per cent of the consortium is constituted by SMEs.

Publication and dissemination activities are being discussed in chapter B.1.3.1.2. During the workshops, the gained results will be spread targeted among the specific industries, introducing the industrial actors into the possibilities of the electrochemical water treatment facilities and opening the way for the first industry scale electrochemical treatment plants in South America. To spread awareness of the new technology and the possibility for actors from third countries to participate in EU-funded projects, 5 South American enterprises – one for each area of research – will participate as third parties and will use this participation for publicity purposes.

This water treatment technology will gain importance in the Mediterranean region where high quality water is rare. So, a partner from Cyprus has been chosen to work on the subject of the electrochemical treatment of municipal waste water for re-use in irrigation.

Furthermore, 60 per cent of the European members of the consortium are institutes of associated candidate countries in order to integrate more actors from these countries into research on European scale.

PART B / SECTION B2

Implementation of a New Electrochemical Technique for Drinking Water, Process Water and Waste Water Treatment in South America

ISSAC

1st of March, 2004

Specific Targeted Research Project

List of Participants (Coordinator first):

- Department for Sustainable Waste Management and Technology (IAE) of the University of Leoben, Austria
- ARI, Cyprus
- ECOIND, Romania
- IUNG, Poland
- Pro aqua, Austria
- SIGMA Consult Limitada, Chile
- Universidad de La Frontera, Temuco, Chile
- Partner 1
- Partner 2
- Partner 3

Coordinator:

Univ. Prof. Dr.-Ing. Karl E. Lorber
Department for Sustainable Waste Management and Technology (IAE) of the University of Leoben, Austria
Email: iae@unileoben.ac.at
Fax: ++43 3842 / 402-5102

B.2.1 The consortium and project resources

B.2.1.1 Participants

IAE (Department of Sustainable Waste Management and Technology)

Address: Peter-Tunner-Str.15
8700 Leoben, Austria
Homepage: http://www.unileoben.ac.at/iae/1_seite_engl/index_eng.htm
Head: Univ. Prof. Dr.-Ing. Karl E. Lorber

Personal Resources:
Total number of employees: 25
Personal in R/D: 20

Infrastructure and thematic priorities of the Institution:

Waste and Waste Water Management:

Water Treatment: Beside research projects to the electrochemical treatment of oil-water emulsions the department of Waste Management and Landfill Technologies is also working in the field of drinking water treatment. Especially in the treatment of liquid dangerous wastes e.g. Cyanide contaminated liquids exists experience.

Thermal Utilization of Waste/Residues: Beside research projects with full-scale incineration-experiments (fluidized bed, cement kiln) the Department of Sustainable Waste Management and Technology also is in charge of full scale research projects in the field of the processing of waste. Furthermore, the Department contributes quality standards for secondary fuels by managing the Austrian Quality Association for Secondary Fuel.

Material Utilization of Waste: In material utilization waste is being used as a secondary source of raw material. It has to be differentiated between Recycling (= utilization on an equivalent level), the production of products of the same quality (example of use: waste glass, scrap iron, aluminum) and downcycling (= utilization cascade), transformation to products of less quality. Therefore Business to Business Recycling-Networks are established.

Landfill Technology: The Department of Waste Management and Landfill Technologies therefore conducts a long-term research project to investigate both leaches and the landfill gas problem as well as the waste composition over long periods of time.

Mechanical Biological Treatment of Residual Waste: Within the framework of numerous research projects in the present and past the Department of Waste Management and Landfill Technologies obtained profound know-how in the field of Mechanical Biological Treatment of Residual Waste.

Lab, Measurement Bus:

Years of experience in the field of waste management and analysis, recycling and process management prove our competence. Since 1999 we have been certified accordance to ISO 9001 and since 2001 we have been accredited to EN 17025. We use statistical process control to achieve continuous reliability of analytical results.

Contaminated Sites:

For the acceptance of concepts for the reuse of contaminated sites as well as the application of decision models their practical applicability is substantial. At present no general evaluation models as decision basis for the selection of remediation technologies, promotion instruments and organizational structures are available. Such decision models are to be developed, checked and adapted for the practical application by the Department of Waste Management and Landfill Technologies.

Management Systems and Life Cycle Assessment:

Management Systems: Implementation of quality management systems (ISO 9001, VDA 6.1, QS 9000, TGS 17614) and environmental management systems (EMAS, ISO 14001) as well as risk and safety management systems (OHSAS 18001, SCC). *Life Cycle Assessment*: The Department for Waste Management and Landfill Technologies assess environmental impacts of products, processes and companies with different quality (ABC-Analysis, Checklist etc.) and quantity (ECO-Indicator, CML, ECO-Points, LCA etc.).

Percentage of female employees: 40 %

ARI (Agricultural Research Institute of Cyprus)

Address: P. O. Box 26792,
1647, Nicosia, Cyprus
Homepage: http://www.ari.gov.cy/
Head: Dr. Ioannis Papadopoulos

Personal Resources:
Total number of employees: 175
Personal in R/D: 105

Infrastructure and thematic priorities of the Institution

ARI has been selected by the EU as a ‘**Centre of Excellence in Agriculture and Environment’**.

Experience:

The institute was involved in two EU projects (AVICENNE and INCO-DC) on wastewater use for irrigation. In respect to research concerning wastewater re-use the institute is particularly strong with more than 50 publications on this aspect.

Regional training courses on wastewater treatment and use are a regular activity of the institute.

Moreover, the experimental fields for wastewater use for irrigation are attractive demonstration sites for EU, FAO, UNDP, WHO and other organizations.

Facilities:

The ARI has all the equipment needed and three experimental farms where most of the experimental work is taking place. Experiments in progress with treated wastewater were initiated 1982.

Key activities:

The main research activities of ARI are within the following aspects:

- Soils, Water Use and Environment
- Animal Production
- Plant Breeding and Genetics
- Entomology and Pesticide Toxicology
- Agricultural Production Systems
- Plant Pathology and Biotechnology
- Vegetables and Ornamental
- Agricultural Economics
- Tree Crops and Viticulture
- Biometrics and Information Technology

Involvement in other EU projects:

1. INCO DC: Sustainability and optimization of treatment and use of wastewater in agriculture.
2. INCO-MED: Partial Root Drying: A sustainable irrigation system for efficient water use without reducing fruit yield.
3. INCO-MED: Sustainable water in protected Mediterranean horticulture.
4. LEONARDO DA VINCI: Dissemination and transfer of training and certification of methodologies in the European livestock industries.
5. EU Third Financial Protocol: Sustaining Applied Agriculture. Research for planting material in Cyprus.
6. INCO-2: “Centers of Excellence” Agricultural Research Institute of Cyprus; Center of Excellence in Agriculture and Environment.
7. STRATA: Exchange of Foresight Relevant Experiences for Small European and Enlargement Countries
8. RESGEN 97: Conservation, characterization, collection and utilization of genetic resources in Olive.
9. EU: Exchange of Foresight Relevant Experiences for Small European and Enlargement Countries.
10. CRAFT: Development of greenhouse foils and additives to optimize plant growth and disease inhibition through the control of photo morphogenesis.

Percentage of female employees: 25%

IUNG (Institute of Soil Sciences and Plant Cultivation)

Address: Czartoryskich 8
24-100 Pulawy, Poland

Homepage : http://www.iung.pulawy.pl/
Head: Prof. Dr. hab. Seweryn Kukula

Personal Resources:

Personal in R/D: 110 (including 23 professors and 82 researchers with Ph.D. degree)
Ph.D. Students: 20
Personal in engineering and administration: 125

Infrastructure and thematic priorities of the Institution:

The Institute of Soil Science and Plant Cultivation (IUNG) in Pulawy is working under the supervision of the Polish Ministry of Agriculture and Rural Development. Its primary tasks are scientific development, implementation and dissemination of knowledge related to plants growth and quality of plant products, soil fertility, protection of agricultural area against various forms of degradation, soil remediation, collection of georeferenced soil data and implementation of agro-environmental schemes for rural development and sustainable land use. In the recent years the Institute has significantly succeeded in the area of international co-operation being involved in the realization of a number of different research projects and exchange of scientists.

Equipment

The Institute complex includes main building (the historical Palace), the Central Laboratory, the Congress-Training Centre with the hotel and the restaurant as well as an agro meteorological station, greenhouses, the field experimental station. The Central Laboratory (accredited) has at his disposal: GC-MS, HPLC systems, LECO C, N, S analyzer, analyzer of mercury, different kinds of spectrophotometers, analyzers CONTIFLO, IPC, atomic absorption spectrometers AAS, and others. IUNG owns also three Experimental Farms (total about 160ha), located in different parts of Poland.

Quality

Within the 52 years of its activity IUNG has greatly contributed to agricultural and agro-environmental science progress in Poland. The latest specific achievements are:

- development of georeferenced databases for soils such as a database characterizing soil contamination with heavy metals, sulfur and PAHs,
- development of agro climatic databases,
- assessment of potential water and wind erosion for agricultural land in Poland,
- assessment of chemical and physical degradation of soils in Poland,
- establishment of ground water monitoring for nitrates and pesticides,
- development and implementation of remediation technologies for metal polluted sites,
- implementation of good agricultural practices,
- establishment of continuous monitoring of farm performance including economic and environmental perspective.

In the last 10 years scientists from IUNG published over 15 books, 52 monographs and 1850 scientific papers (308 in international reviewed journals), received 43 patents, were awarded with grants for 69 research projects of KBN and with 49 international scholarships for young researchers, organized 12 international conferences and workshops and received 10 international (e.g. US EPA) an national (e. g. Ministry of Agriculture, Ministry of the Environment Protection, Polish Academy of Sciences) awards. IUNG scientists are active members of 26 international scientific organizations and participate in 11 editorial boards of international scientific journals. They participate in standardization activities on the international level (experts in ISO TC 190 "Soil quality"), and on the national level (member or leaders of Polish Standardization Committee Commissions). Two scientific journals are edited by IUNG: Pamitnik Pulawski and Zalecenia Agrotechniczne. The IUNG is classified by KBN to the first class research institutes in Poland.

IUNG researchers participated in preparation of 4 projects in FP4, 21 projects submitted to FP5 and 14 other international programs and actions. In the last 5 years 34 governmental agreements with 15 countries and 20 bilateral co-operation agreements with scientific institutions from 12 countries were realized by IUNG (e.g. with Belarus, Czech Republic, Denmark, Germany, Greece, UK, France, Italy, Russia, Spain, Sweden, Ukraine). 712 foreign scientists visited IUNG over the last decade.

Co-operation with industrial partners

IUNG is very active in working on contracts for industry, administration and local communities (the list of collaborators comprises 35 positions and 43% of the Institute budget comes from the sources other than statutory). The examples include: the development and implementation of remediation and revegetation of metal polluted sites, elaboration and implementation of models for nutrient balancing and in implementation of strategies for distribution and use of liquid fertilizers in agriculture, implementation of a modified Danish system for dairy production in the north region of Poland, use of IUNG databases for planning and assessment the country, elaboration of the strategies of erosion control and remediation of degraded areas.

Percentage of female employees: >50%

ECOIND (National Research & Development Institute for Industrial Ecology)

Address: Sos. Panduri no. 90-92, sector 5
Bucharest, Romania
Homepage: http://www.rnc.ro/ICPEAR/
Head: General Manager - chem. Margareta NICOLAU

Personal Resources:
Total number of employees: 131
Personal in R/D: 116
Graduated employees: 65
Scientific certified employees: 42

Our personnel consist of highly qualified specialists; most of them are scientific researchers in: chemistry, chemical engineering, biology, biochemistry, ecology, hydro technology, pedology, physics, geography a. s. o.

The personnel is highly specialized for different specific fields (environmental technologies, analytical control, pollution assessment, environmental and quality management) during master studies, Ph.D. courses, postgraduate courses, other thematic training courses, participation-organization of scientific events in Romania and abroad, a. s. o.

Infrastructure and thematic priorities of the Institution

The institute disposes of the following facilities:

- logistic endowment
- specific equipment/apparatus for sampling analysis, technological researches.

Thematic priorities of the institution:

- According to UNESCO classification:
  - 3308 - Surrounding environment engineering and technology
  - 2301 - Chemistry
- According to EU classification:
  - 3 - Pollution and Environment Protection
  - 3.2. - Surrounding Air
  - 3.4. - Water
  - 3.5. - Soil and groundwater
- Assessment of pollution degree for environmental factors in industrial areas in order to elaborate measures for its prevention and reduction.
- Development of modern and specifically techniques / methodologies for control and monitoring of industrial pollutants discharged by economical agents.
- Advanced and precompetitive technologies for preventing and abatement of environmental pollution with dangerous products: coming from industrial activities.
- •Environmental and quality management.

Percentage of female employees: 72%

UFRO (Department for Chemical Engineering of the University of La Frontera)

Address: P.O. Box 54-D
Temuco, Chile
Homepage: http://dungun.ufro.cl/%7Ediquim/
Head: Valerio Bifani C.

Personal Resources:

Total number of employees:

Personal in R/D: 17 (70% Ph.D., 30% Mag.)

Infrastructure and thematic priorities of the Institution

Infrastructure

The department for chemical engineering of the University of La Frontera disposes of various modern equipped laboratories. 2 of these laboratories are specialized in the treatment and analysis of waste waters. They are accredited to certificate the potability of drinking water according to the Chilean normative.

A specialized laboratory for bio-processes has great experience in the aerobic and anaerobic treatment of waste waters.

Thematic priorities

Current research in this institute concentrates on:

- Management, treatment and revaluation of waste and waste waters
- Food engineering and agro-industrial development
- Bio-processes

Within this areas, special emphasizes are given to:

- Design and optimization of processes
- Environmental analysis of production processes
- New waste and water treatment technologies

Percentage of female employees: 40 %

SIGMA Consult Limitada

Address: Juan Elkins 144 E, A-40
Cerro Placeres, Valparaíso, Chile

Homepage : -

Head: Ing. Patricio Siggelkow

Personal Resources:

Personal number: 6

Infrastructure and thematic priorities of the Institution

The SME SIGMA is a consulting and engineering enterprise specialized in sustainable use of natural resources, waste water treatment and provision of drinking water and renewable energy.

Recent projects comprise:

- Alternative systems for irrigation
- Design, construction and start-up of municipal and industrial waste water treatment plants (including 2 pre-projects on municipal waste water treatment in Tierra del Fuego with the Ministry of Environment, Territorial Development and Agriculture of North Rhine Westphalia)
- Design of drinking water production plants and systems for the distribution of drinking water.
- Process-optimization to minimize quantity and pollutant load of waste water
- Design of sewage systems

SIGMA has well established contacts to public and private actors in Chile.

Percentage of female employees: 33%

pro aqua Diamantelektroden Produktions-GmbH & Co KEG

Address: Leobnerstraße 94
A-8712 Niklasdorf, Austria

Homepage: -

Head: Dipl. Ing. Michael Schelch

Personal Resources:

Personal number: 1

Infrastructure and thematic priorities of the Institution

The SME Pro aqua is a supplier for electrodes and electrochemical cells.

It is very experienced in the production of BDD-coated electrodes and construction and production of electrochemical cells.

Percentage of female employees: 0%

Partner 1

Address:

Homepage:

Head:

Personal Resources:

Infrastructure and thematic priorities of the Institution

Percentage of female employees:

Partner 2

Address:
Homepage:
Head:

Personal Resources:

Infrastructure and thematic priorities of the Institution

Percentage of female employees:

Partner 3

Address:
Homepage:
Head:

Personal Resources:

Infrastructure and thematic priorities of the Institution

Percentage of female employees:

B.2.1.2 Third Parties

The following table shows the cooperation with third parties. These parties will permit the consortium the installation of the electrochemical treatment plants on their sites.

All costs of the co-operations will be taken by the third parties. They will provide space, technical support, electric energy and (waste) waters necessary to perform the experiments.

The day to day operation and maintenance of the plants will be part of the third parties obligations.

Obligations of the third parties:

The third parties will provide the following free of charge to the project:

a) Technical colaboration and material for the installation of the pilot plants.
b) Permit the access of technicians and professionals in charge of the project to the installations of the pilot plants with the objective to carry out experiments and take samples as well as for purposes of publicity.
c) Technical staff to be trained by the Consortium with the objective that these operate the pilot plants.
d) Electric energy to operate the pilot plants.
e) Historical information that is relevant to the project and that the third parties have at their disposal.

In return, the consortium will:

a) Train staff of the third parties in the operation of electrochemical pilot-plants, to be installed in the third parties´ areas with the aim to take the samples necessary for the project.
b) Provide the third parties the possibility to participate in an EU-funded project and publicize the obtained results and positive effects of the electrochemical technique for treatment of waste water from sanitary landfills together with the consortium. Furthermore, the third parties will have the possibility to use the innovative frame in which they will get involved by means of this research project for publicity-activities.

The cooperation with the third parties is subject to legally binding agreements between the consortium and the third parties.

The following table shows which partner will be responsible for which third party.

Responsible Partner(s)	Third Party	Task	Location Plant
SIGMA, UFRO	Constructora CAM	Landfill leaches	El Molle, Valparaíso, Chile
SIGMA, UFRO	Municipalidad de Rinconada	Municipal waste water treatment plants´ effluents	Rinconada, Chile
Partner 1	South America	Mining industry waste water	South America
Partner 2	South America	Municipal waste water for re-use in irrigation	South America
Partner 3	South America	Drinking water	South America

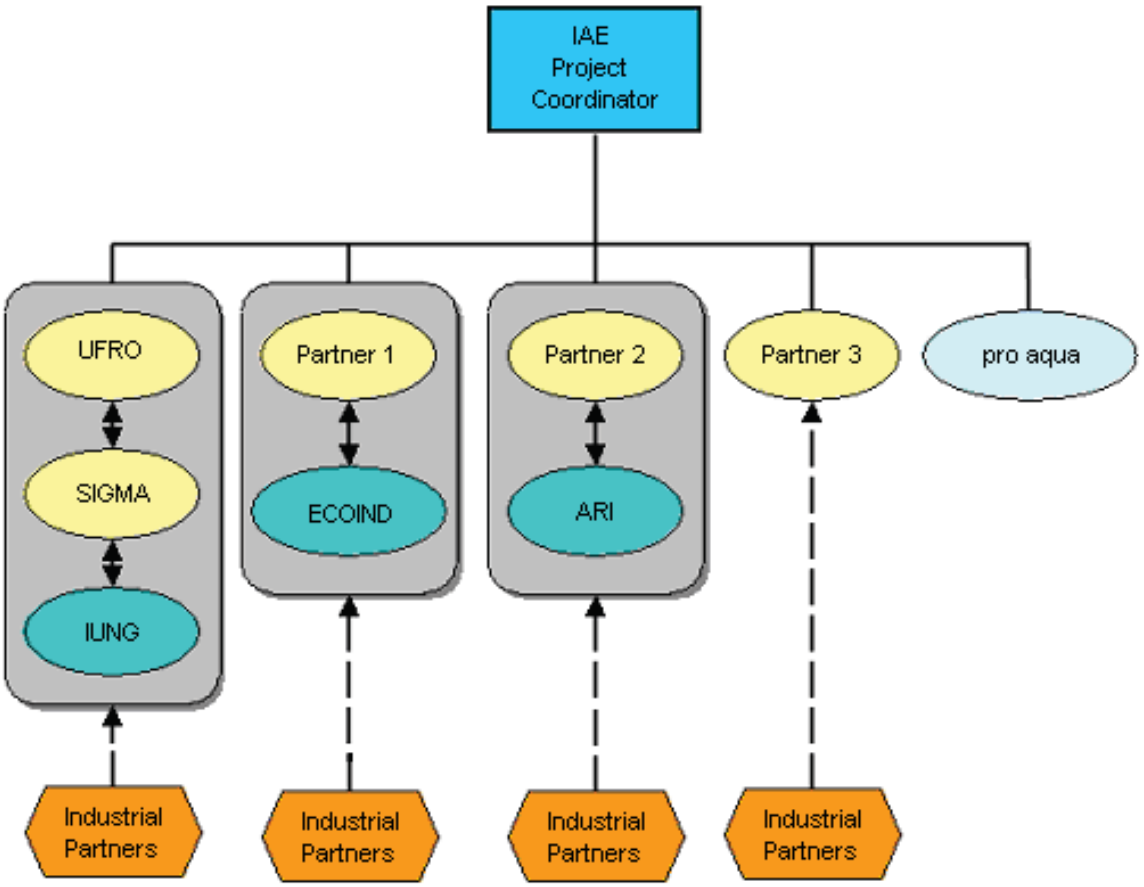
B.2.2. Project management

B.2.2.1 General Structure

The initial organization structure of the consortium will comprise the following:

- **Project Co-ordination Committee** as the supervisory body for the project execution and decision making body in all relevant project matters.
- **Panels** can be established by the Project Co-ordination Committee to deal with specific issues or problems. An Intellectual Property Rights panel will be set up.
- **Project Coordinator** as the intermediary to the European Commission is authorized to execute the project management, will report and be accountable to the project co-ordination committee (which will in turn report and be accountable to the general assembly) under the conditions set forth in Section 5.4 of the consortium agreement. The project coordinator will be the single point of contact between the members of the consortium and the European Commission. Assigned as the coordinator of this project is Prof. Karl E. Lorber, head of the IAE, who already has remarkable experience in coordinating INCO-projects with South American participation.
- **Project Office:** It will be established by the project coordinator to provide the necessary support for day-by-day project management for the project coordination committee as well as reporting activities to the European Commission. It will use the existing resources and the infrastructure of the IAE.
- **Third Parties:** Several industrial partners that are not members of the consortium but provide certain resources to the consortium (see B.2.1.2) will participate in the project.

Organization-Chart



B.2.2.2 Representatives

Each partner has nominated a representative to the project co-ordination committee with due authorization to discuss, negotiate and agree decisions or provide recommendations made by the organs within the frame of its responsibilities.

These representatives are:

Partner	Representative
ARI	
ECOIND	
IAE	Karl E. Lorber
IUNG	
Pro aqua	Michael Schelch
SIGMA	Patricio Siggelkow
UFRO	
Partner 1	
Partner 2	
Partner 3	

B.2.2.3 Intellectual property, protection of knowledge

The participants agree to respect their individual intellectual property rights.

B.2.2.3.1 Joint Inventions

If, in the course of carrying out work on the project, a joint invention, design or work is made - and more than one participant is contributor to it - and if the features of such joint invention design or work are such that it is not possible to separate them for the purpose of applying for, obtaining and/or maintaining the relevant patent protection or any other intellectual property right, the participants concerned agree that they may jointly apply to obtain and/or maintain the relevant right together with any other participants.

The participants concerned shall seek to agree amongst themselves arrangements for applying for, obtaining and/or maintaining such right on a case-by-case basis. So long as any such right is in force, each participant concerned shall be entitled to use and to license such right without the consent of the other participants, provided that the participants concerned shall be informed in advance of any licensing to third parties. In case of licensing to third parties, appropriate financial compensation shall be given to the other participants concerned.

B.2.2.3.2 Application for a Patent

In respect of a country either specified by the Commission or agreed upon by the participants, a participant shall notify the other participants (via the coordinator, if this is practical) if it does not intend to seek adequate and effective protection (as required by the contract) of certain of its knowledge from the project or if that participant intends to waive such protection.

If another participant (or participants) informs the notifying participant in writing within one calendar month of such notice that it wishes to obtain or maintain such protection, the notifying participants shall assign to such other participant(s) all necessary rights which it owns. Such assignment shall ensure that the access rights of all participants will be unaffected.

For the avoidance of doubt, the participant which assigned its rights shall have at least the same access rights as the non-involved participants.

In case of any disputes, the participants may appeal the IPR Council according to Section 16.2. of the consortium agreement.

B.2.2.3.3 Access rights

Access-rights to knowledge and pre-existing know-how both needed for use shall be granted upon bilateral agreement between the participants concerned. Access rights to knowledge shall be granted on a royalty-free basis, access rights to pre-existing know-how shall be granted on fair and non-discriminatory conditions. The granting of access-rights shall be made conditional on to the principles laid down in the consortium agreement.

Concerning access rights, the following topics are being dealt with in the consortium agreement:

- *Access rights*
  - Restrictions of Access-rights
  - General Principles relating to Access-rights
  - Access-rights for carrying out the Project
  - Conditions for Access
  - Entitlement for Use for the Project
  - Illegal Utilization
- *Access-rights for Use*

Conditions

Reimbursements

Royalties due to Substantial Commercial Benefits

Access rights for using Knowledge in subsequent Research Activities

Access-rights for Affiliates

Access-rights for Parties joining or leaving the Project

Access-rights for Third Parties

- *Specific Provisions for Access-rights to Software*

11.2 Estimation of Costs ISSAC

This estimation of costs is based on the assumption, that all participants use the FCF cost model. Therefore the flatrate of 20% of all direct project costs has been added to the project costs.

Table 9 displays the calculation of costs.

Table 9: Estimation of costs ISSAC

Participant	Work Package	RTD or Innovation Related Activities		Management activities		Person Months	Costs per Person Month	Name of Person	Type of Employment
		Activity	Costs RTD (€)	Activity	Costs Management (€)				
IAE	1			Project Coordination, Management activities	16800	2	8400	Lorber	Prof-Dr
IAE	1			1.1-1.5	10720	4	2680		Dipl-Ing/Dr
IAE	1			1.1-1.5	3600	3	1200		Ph-D student
IAE	2	Publication preparation	1200			1	1200		Ph-D student
IAE	2			Meetings Organization (1st meeting)	1000				
IAE	2			Travel costs 2nd Meeting: AT-CL-AT	1200				
IAE	2			Staying costs in Chile (1 week)	700				
IAE	2			Travel costs 3rd Meeting	1200				
IAE	2			Staying costs (1 week)	800				
IAE	13	Laboratory procedures development	5360			2	2680		Dipl-Ing/Dr
IAE	13	Laboratory costs	15000						

IAE	4	Shipping costs + insurance	5000						
IAE	4	Installation of plants (Material)	5000						
IAE	4	Installation of plants, training of users	5360			2	2680		Dipl-Ing/Dr
IAE	4	Travel cost AT-South America-AT	1200						
IAE	4	Health insurance	500						
IAE	4	Staying costs in South America (2 months)	2000						
IAE	4	Travel cost within South America	1400						
IAE	12	12.1 to 12.7: in-situ studies & impact studies	14280			12	1190	Sepulveda	Ph-D student
IAE	12	Travel cost AT-South America-AT	1200	(2 persons working parallel in SA)					
IAE	12	Health insurance	500						
IAE	12	Staying costs in South America (6 months)	4500						
IAE	12	Travel cost within South America	1400						
IAE	12	Travel cost AT-South America-AT	1200						
IAE	12	Health insurance	500						
IAE	12	Staying costs in South America (6 months)	4500						
IAE	12	Travel cost within South America	1400						
Total participant IAE per category			71500		36020	26			
Total costs participant IAE			107520						
Flatrate for indirect costs (20 % of direct cost, only FCF):			21504						
Grant to the budget participant IAE:[3)]			**129024**						
Pro aqua	4			Management shipping of plants	1340	0,5	2680	Schelch	Dipl-Ing/Dr
Total participant Pro aqua per category			0		1340	0,5			
Total costs participant Pro aqua			1340						
Flatrate for indirect costs (20 % of direct cost, only FCF):			268						
Grant to the budget participant Pro aqua:[3)]			**1608**						
ECOIND	2	Publication preparation	600			1	600		Phd-student
ECOIND	2			Travel costs 1st Meeting: RO-AT-RO	450				
ECOIND	2			Staying costs in Austria (4 days)	500				
ECOIND	2			Travel costs 2nd Meeting: RO-CL-RO	1200				

ECOIND	2			Staying costs in Chile (1 week)	700				
ECOIND	2			Travel costs 3rd Meeting	1200				
ECOIND	2			Staying costs (1 week)	800				
ECOIND	3	European samples: characterization, treatment and analysis at IAE-Lab	3200			4	800	Doaga	Dipl-Ing/Dr
ECOIND	3	Samples transportation	300						
ECOIND	3	Rent of Labour IAE - Validation of Technique	2000						
ECOIND	3	Rent of Labour IAE - Application on samples	4000						
ECOIND	3	Laboratory Analysis	2500						
ECOIND	3	Travel costs RO-AT-RO	450						
ECOIND	3	Staying costs in Austria (3 months)	3600						
ECOIND	3	Health insurance	300						
ECOIND	6	6.4, 6.6, 6.7	3600			6	600	Patroescu	Phd-student
ECOIND	6	6	3296			8	412	Cosma	Dipl-Ing/Dr
ECOIND	6	Travel costs RO-South America-RO	1200						
ECOIND	6	Health insurance	500						
ECOIND	6	Staying costs in South America (3 weeks)	1000						
Total participant ECOIND per category			26546		4850	19			
Total costs participant ECOIND			31396						
Flatrate for indirect costs (20 % of direct cost, only FCF):			6279						
Grant to the budget participant ECOIND:[3)]			**37675**						
ARI	2	Publication preparation	4000			1	4000	Padopoulos	Director
ARI	2			Travel costs 1st Meeting: CY-AT-CY	450				
ARI	2			Staying costs in Austria (4 days)	500				
ARI	2			Travel costs 2nd Meeting: CY-CL-CY	1200				
ARI	2			Staying costs in Chile (1 week)	700				
ARI	2			Travel costs 3rd Meeting	1200				
ARI	2			Staying costs (1 week)	800				
ARI	3	European samples: characterization, treatment and analysis at IAE-Lab	4000			4	1000	Anayiotou	Dipl-Ing/Dr
ARI	3	Samples transportation	300						

ARI	3	Rent of Labour IAE - Validation of Technique	2000						
ARI	3	Rent of Labour IAE - Application on samples	4000						
ARI	3	Laboratory Analysis	2500						
ARI	3	Travel costs CY-AT-CY	550						
ARI	3	Staying costs in Austria (3 months)	3600						
ARI	3	Health insurance	300						
ARI	9	9.5, 9.6, 9.7	6000				6	1000	Dipl-Ing/Dr
ARI	9	9	8000				8	1000	Dipl-Ing/Dr
ARI	9	Travel costs CY-South America-CY	1200						
ARI	9	Health insurance	500						
ARI	9	Staying costs in South America (3 weeks)	1000						
Total participant ARI per category			37950			4850	19		
Total costs participant ARI			42800						
Flatrate for indirect costs (20 % of direct cost, only FCF):			8560						
Grant to the budget participant ARI:[3)]			**51360**						
IUNG	2	Publication preparation	940				1	940	Dipl-Ing/Dr
IUNG	2				Travel costs 1st Meeting: PL-AT-PL	450			
IUNG	2				Staying costs in Austria (4 days)	500			
IUNG	2				Travel costs 2nd Meeting: PL-CL-PL	1200			
IUNG	2				Staying costs in Chile (1 week)	700			
IUNG	2				Travel costs 3rd Meeting	1200			
IUNG	2				Staying costs (1 week)	800			
IUNG	3	European samples: characterization, treatment and analysis at IAE-Lab	3760				4	940	Dipl-Ing/Dr
IUNG	3	Samples transportation	300						
IUNG	3	Rent of Labour IAE - Validation of Technique	2000						
IUNG	3	Rent of Labour IAE - Application on samples	4000						
IUNG	3	Laboratory Analysis	2500						
IUNG	3	Travel costs PL-AT-PL	550						
IUNG	3	Staying costs in Austria (3 months)	3600						
IUNG	3	Health insurance	300						

IUNG	7	7.5, 7.6, 7.7	5640			6	940		Dipl-Ing/Dr
IUNG	7	7	7520			8	940		Dipl-Ing/Dr
IUNG	7	Travel costs PL-Chile-PL	1200						
IUNG	7	Health insurance	500						
IUNG	7	Staying costs in Chile (3 weeks)	1500						
Total participant IUNG per category			34310		4850	19			
Total costs participant IUNG			39160						
Flatrate for indirect costs (20 % of direct cost, only FCF):			7832						
Grant to the budget participant IUNG:[3)]			**46992**						
UFRO	2			Organisation 1st Workshop (personal costs)	1450	1	1450		Dipl-Ing/Dr
UFRO	2			Organisation 1st Workshop	2000				
UFRO	2			Meetings Organization (2nd meeting)	1000				
UFRO	2	Publication preparation	1450			1	1450		Dipl-Ing/Dr
UFRO	2			Travel costs 1st Meeting: CL-AT-CL	450				
UFRO	2			Staying costs in Austria (4 days)	500				
UFRO	2			Travel costs 3rd Meeting	600				
UFRO	2			Staying costs in (1 week)	800				
UFRO	5	Equipment costs (1 electrochemical water treatment plant)	9000						
UFRO	5	Laboratory costs	10000						
UFRO	5	5.1 to 5.5	8700			6	1450		Dipl-Ing/Dr
UFRO	5	Transport of samples to laboratory	500						
UFRO	5	Travel expenses to plant site	1980	*(Remark 1)*					
UFRO	7	Laboratory costs	10000						
UFRO	7	7.1 to 7.7	3600			6	600		PhD-student
UFRO	7	Transport of samples to laboratory	500						
UFRO	7	Travel expenses to plant site	1980	*(Remark 1)*					
UFRO	11	Laboratory costs	10000						
UFRO	11	11.1 to 11.4	6000			10	600		PhD-student
Total participant UFRO per category			63750		6800	24			

Total costs participant UFRO			70550						
Flatrate for indirect costs (20 % of direct cost, only FCF):			14110						
Grant to the budget participant UFRO:[3)]			**84660**						
SIGMA	2	Publication preparation	1450			1	1450		Dipl-Ing/Dr
SIGMA	2				Travel costs 1st Meeting: CL-AT-CL	450				
SIGMA	2				Staying costs in Austria (4 days)	500				
SIGMA	2				Travel costs 2nd Meeting: within CL	100				
SIGMA	2				Staying costs in CL (1 week)	700				
SIGMA	2				Travel costs 3rd Meeting	600				
SIGMA	2				Staying costs (1 week)	800				
SIGMA	5	5.1 to 5.5	8700				6	1450		Dipl-Ing/Dr
SIGMA	5	Equipment costs (1 electrochemical water treatment plant)	9000							
SIGMA	5	Transport of samples to UFRO	500							
SIGMA	5	Travel expenses to plant site	792		*(Remark 2)*					
SIGMA	7	7.1 to 7.7	8700				6	1450		Dipl-Ing/Dr
SIGMA	7	Equipment costs (1 electrochemical water treatment plant)	9000							
SIGMA	7	Transport of samples to UFRO	500							
SIGMA	7	Travel expenses to plant site	576		*(Remark 2)*					
Total participant SIGMA per category			39218			3150	13			
Total costs participant SIGMA			42368							
Flatrate for indirect costs (20 % of direct cost, only FCF):			8473							
Grant to the budget participant SIGMA:[3)]			**50841**							
P 1	2				Organisation 2nd Workshop (personal costs)	1000	1	1000		Dipl-Ing/Dr
P 1	2				Organisation 2nd Workshop	2000				
P 1	2				Meetings Organization (3rd meeting)	1000				
P 1	2	Publication preparation	1000				1	1000		Dipl-Ing/Dr
P 1	2				Travel costs 1st Meeting	450				

P 1	2			Staying costs in Austria (4 days)	500				
P 1	2			Travel costs 2nd Meeting	1200				
P 1	2			Staying costs (1 week)	700				
P 1	6	Equipment costs (1 electrochemical water treatment plant)	9000						
P 1	6	Laboratory costs	8000						
P 1	6	6.1 to 6.7	14000			14	1000		
P 1	6	Transport of samples to laboratory	500						
P 1	6	Travel expenses to plant site	800						
Total participant P 1 per category			33300		5850	16			
Total costs participant P 1			40150						
Flatrate for indirect costs (20 % of direct cost, only FCF):			8030						
Grant to the budget participant P 1:[3)]			**48180**						
P 2	2	Publication preparation	1000			1	1000		
P 2	2			Travel costs 1st Meeting	450				
P 2	2			Staying costs in Austria (4 days)	500				
P 2	2			Travel costs 2nd Meeting	1200				
P 2	2			Staying costs in Chile (1 week)	700				
P 2	2			Travel costs 3rd Meeting	600				
P 2	2			Staying costs (1 week)	800				
P 2	9	Equipment costs (1 electrochemical water treatment plant)	9000						
P 2	9	Laboratory costs	8000						
P 2	9	9.1 to 9.7	14000			14	1000		
P 2	9	Transport of samples to laboratory	500						
P 2	9	Travel expenses to plant site	800						
Total participant P 2 per category			33300		4250	15			
Total costs participant P 2			37550						
Flatrate for indirect costs (20 % of direct cost, only FCF):			7510						
Grant to the budget participant P 2:[3)]			**45060**						

P 3	2	Publication preparation	1000			1	1000		
P 3	2			Travel costs 1st Meeting	450				
P 3	2			Staying costs in Austria (4 days)	500				
P 3	2			Travel costs 2nd Meeting	1200				
P 3	2			Staying costs in Chile (1 week)	700				
P 3	2			Travel costs 3rd Meeting	600				
P 3	2			Staying costs in (1 week)	800				
P 3	8	Equipment costs (1 electrochemical water treatment plant)	9000						
P 3	8	Laboratory costs	8000						
P 3	8	8.1 to 8.5	14000			14	1000		
P 3	8	Transport of samples to laboratory	500						
P 3	8	Travel expenses to plant site	800						
Total participant P 3 per category			33300		4250	15			
Total costs participant P 3			37550						
Flatrate for indirect costs (20 % of direct cost, only FCF):			7510						
Grant to the budget participant P 3:[3)]			**45060**						
Total project costs per category [€]			**373.174**		**77.210**	**166,5**			
Total project costs excluding flatrate [€]			**450.384**						
Total project costs including flatrate [€]			**540.461**						

Footnotes to the table:

1) If in an activity appear costs for material *and* working time, this activity is divided into 2 lines, one for the material costs and one for the working time costs.
2) If as an activity appear only numbers, these numbers refer to the number of the activity in the proposal.
3) Including all direct costs and flatrate

Calculation of travel costs:

(Remark 1):Travel Costs: Every 2 weeks 1 person for 3 days to the plants:		
Travel costs:	20000	Pesos
Accommodation (2 nights):	20000	Pesos
Meals (3 days):	15000	Pesos
Expenses per travel:	55000	Pesos
Expenses per travel:	73,3	Euro
Total 12 project months:	**1980,0**	**Euro**
(Remark 2):Travel Costs: Every week 1 person for 1 day to the plants:		
El Molle:		
Travel costs:	3000	Pesos
Meals:	5000	Pesos
Expenses per travel:	8000	Pesos
Expenses per travel:	10,7	Euro
Total 12 project months:	**576,0**	**Euro**
Rinconada:		
Travel costs:	6000	Pesos
Meals:	5000	Pesos
Expenses per travel:	11000	Pesos
Expenses per travel:	14,7	Euro
Total 12 project months:	**792,0**	**Euro**

1) 1 Euro = 750 Chilean Pesos

12 Annex 4: Letter of Intent

Letter of Intent

Between

Department of Sustainable Waste Management and Technology of the University of Leoben, Austria

Peter Tunner Str. 15
A-8700 Leoben, Austria
Tel ++43 3842 / 402-5101
Fax ++43 3842 / 402-5102
E-Mail: michael.kotschan@notes.unileoben.ac.at

And

Department of Chemical Engineering of the University de La Frontera, Temuco, Chile

P.O. Box 54-D
Temuco, Chile
Tel ++56 45 / 325472
Fax ++56 45 / 325053
E-Mail: rnavia@ufro.cl

And

SIGMA Consult Limitada, Valparaíso, Chile

Juan Elkins 144 E, A 40
Valparaíso, Chile
Tel ++56 32 / 797734
Fax ++56 32 / 493339
E-Mail: infosigma@vtr.net

And

P 1

Street
City
Country
Tel ++
Fax ++
E-Mail:

And

P 2

Street
City
Country
Tel ++
Fax ++
E-Mail:

And

P 3

Street
City
Country
Tel ++
Fax ++
E-Mail:

Preamble

The Parties intend to submit a proposal for an indirect RTD action of the specific programme for research, technological development and demonstration activities for „Integrating and Strengthening the European Research Area (2002 – 2006)“ in the area “Specific measures in support of international cooperation (INCO)” and to implement the project in case of an acceptance by the European Commission.

§ 1 State of negotiations

The Parties will set up a consortium agreement, which shall define the legal issues for the internal relationship between the Parties.
All arrangements that are reached within this letter of intent shall be replaced by the provisions of the consortium agreement. If the negotiations will fail to lead to a consortium agreement the hereinafter under *§ 3* reached provisions shall continue until 2008/12/31.

§ 2 Schedule / Time-limitation

The Parties intend to conclude the negotiations for the consortium agreement until 2004/11/30. As far as required, a prolongation shall be possible after mutual agreement.

§ 3 Confidentiality

The Parties commit themselves to treat all information, documents, evaluations, drafts, outlines or technical specifications etc., they have received indirectly or directly in the context of the negotiations about the project as well those of technical, financial or other business nature (in the following called ,,information“), strictly confidential and will not in any form forward it to third Parties.
Henceforth it is strictly forbidden to the Parties, to use the gained information for another purpose as the preparation of the intended consortium agreement. The confidentiality clause included in this paragraph is not applicable to such information, the Parties have obtained in

legally permitted ways from other sources, which has been known in advance or which is evident.

The Parties undertake to make sure that their own employees, representatives or other people, who have the possibility of access to the information, will be bound by the same complete confidentiality clause, as mentioned above.

SIGNATURES:

Authorized to sign on behalf of Department of Sustainable Waste Management and Technology of the University of Leoben

Karl E. Lorber, Univ. Prof. Dr.-Ing. Date:

Authorized to sign on behalf of the Department of Chemical Engineering of the University of La Frontera

Valerio Alfredo Bifani Cosentini, Mag. Date:

Authorized to sign on behalf of SIGMA Consult Limitada

Patricio Siggelkow Sanhueza, Ing. Date:

Authorized to sign on behalf of P 1

Name, Title Date:

Authorized to sign on behalf of P 2

Name, Title Date:

Authorized to sign on behalf of P 3

Name, Title Date:

13 Annex 5: Consortium Agreement

Consortium Agreement

This AGREEMENT is made BETWEEN

(1) University of Leoben, Austria - Department for Sustainable Waste Management and Technology of the

(2) University of La Frontera, Temuco, Chile - Department for Chemical Engineering of the

(3) SIGMA Consult Limitada

(4) P 1

(5) P 2

(6) P 3

relating to the *Project* entitled "**Sustainable Water Management in South American Nations**"

WHEREAS:

(A) The *Parties*, having considerable experience in the field concerned, have submitted a *Proposal* for a *Project* entitled **"Sustainable Water Management in South American Nations**" to the *Commission* in **the INCO-Dev/SSA-1** part of the Sixth Research and Technological Development Framework Programme.

(B) The *Parties* wish to specify or supplement, between themselves, the provisions of the *Contract*

NOW THEREFORE IT IS HEREBY AGREED AS FOLLOWS:

Section 1: Definitions

1.1 Contract Definitions

Words defined in the *Contract* or in the *Contract,* Annex II, Article 1 have the same meaning in this *Consortium Agreement* and appear in italics.

1.2 Additional Definitions

"Affiliate" of a *Party* means:

(a) any legal entity – which deals with issues, provides services or products that constitute the goal(s), content, or part of the objectives of the *Project* – directly or indirectly controlling, controlled by, or under common control of a *Party*, for so long as such control lasts and provided that the said Affiliate or the ultimate controlling entity is incorporated and resident in, and subject to the law of, a Member State of the Community, or an *Associated State*.

Control of an entity shall exist through the direct or indirect:

- control of fifty (50) percent or more of the nominal value of the issued equity share capital of the entity or of fifty (50) percent or more of the equity's shares entitling the holders to vote for the election of directors or persons performing similar functions, or
- right by any other means to elect or appoint directors of the entity (or persons performing similar functions).

(b) any other organisation specified in the agreed schedule to this *Consortium Agreement* to be an *Affiliate* of the *Party*, subject to consent of the other Parties, only to be withheld on the basis of legitimate interest.

"Allocated Work" shall mean the research work and the related activities and services allocated to any of the *Parties* in accordance with *Contract* Annex I and the subsequent *Implementation Plan.*

“Application Programming Interface” means an interface or other means provided for by a Software *applicatio*n, component or library for the purpose of interfacing or interaction of other Software with such application, component or library including, but not limited to, data types and structures, constant and macro definitions, function and procedure definitions including their name, parameters, parameter count and parameter data type(s) and any data type of function results thereof, as set forth in header files, specifications and related documentation.

“Common Liability Reserve” shall mean the fund contributed by the Parties and established by in accordance with Article 13 Chapter 2 “Rules of Participation” due to joint and several liability.

“Compensating Party*”* means a *Part*y, other than the “Defaulting Party”, from whom the *Commission* claims reimbursement due to financial collective responsibility in accordance with *Contract* Annex II, Article 18.

***"Contract*"** means the Contract No. <insert project number> (including its Annexes) for the undertaking by the *Parties* of the *Projec*t. *Contract* also means, as applicable, any Contract amendment.

"Defaulting Party" means a *Party* breaching its obligations or this *Consortium Agreement.*

“IPR Council” is the court of arbitration with power to decide in disputes between the *Parties* concerning Intellectual Property Rights.

“Limited Source Code Access*”* means

(a) access to *Object Code*; and,

(b) where normal *Use* of such *Object Code* requires an *API,* access to *Object Code* and such *API;* and,

(c) if neither (a) nor (b) is available, access to Source Code

"Object Code" means Software in machine-readable, compiled and/or executable form including, but not limited to, byte code form and in form of machine-readable libraries used for linking procedures and functions to other Software.

"Party" or ***"Parties"*** means a party or the parties to this *Consortium Agreement.*

"Project Co-ordination Committee" means the project management decision-making body established in accordance with Section 5.3.

"Project Deliverables" mean reports, including progress reports and certified audit reports, as well as hardware and Software referred to in the Contract and in this *Consortium Agreement* that have to be delivered to the *Co-ordinator*, if any, and/or the Commission).

"Project Share" means for each *Party* that *Party's* share of the total cost of the *Project* as shown in the *Contract* and defined in Annex B (Joint Budget) of this *Consortium Agreement*.

"Proposal" means the proposal for the *Project* submitted by the *Parties* to the *European Commission*, including any amendments.

"Software" means software programmes being sequences of instructions to carry out a process in, or convertible into, a form executable by a computer and fixed in any tangible medium of expression.

For the avoidance of doubt, Software may be *Knowledge* or *Pre-existing Know-how*.

“Software Documentation” means software information, being technical information used or, useful in, or relating to the design, development, *Use* or maintenance of any version of a software programme.

“Source Code” means Software in human readable form normally used to make modifications to it including, but not limited to, comments and procedural code such as job control language and scripts to control compilation and installation.

“Source Code Access” does not include any right to receive Source Code ported to a certain hardware platform, but only as available from the *Party* granting the Source Code Access.

1.3 Further Understandings

In order to clarify certain ambiguities appearing in the provisions of the *Contrac*t, the *Parties* have agreed on the following interpretations:

(a) **"Indirect utilisation of *Knowledge*"** in the *Contract's* definition of *Use* includes, for and on behalf of the *Party* concerned, *Use* by having products and/or services developed, made and/or provided;

(b) **"Fair and Non-discriminatory Conditions"** means fair market conditions.

(c) ***“Pre-existing Know-how”*** means only such *Pre-existing Know-how* which has been accumulated within and/or developed by the specific research group, research department, or research institute directly involved in carrying out the *Project.*

Section 2: Purpose, Nature and Duration of the Agreement

2.1 Purpose

The purpose of this *Consortium Agreement* is to facilitate the fulfilment of the research work and related services and activities allocated to the *Parties* under the *Contract* (and as described in more detail in *Contract* Annex I) by setting forth the terms and conditions pursuant to which the *Parties* agreed to function and cooperate in the performance of their respective tasks under the *Contrac*t.

2.2 Nature of the Agreement

Nothing contained in this *Consortium Agreement* shall constitute or be deemed to constitute either a partnership or any formal business organisation or legal entity between the *Parties.* Each *Party* shall act as an independent contractor and not as the agent of any of the other *Parties.* Nothing contained in this *Consortium Agreement* shall be construed as constituting or organizing the sharing of profits or losses arising out of the efforts of any other *Party* hereunder. Any participation as a *Party* in this *Project* requires the signature of the *Contract* and of this *Consortium Agreement.*

In case of conflict between this *Consortium Agreement* or parts of it and the *Contrac*t, the latter will have precedence.

2.3 Duration

This *Consortium Agreement* shall come into force as of the date of its signature by the *Parties,* but shall have retroactive effect from the date of the *Contract Signature* by the *Co-ordinator* and shall continue in full force and effect until terminated in accordance with Section 15 or until complete discharge of all obligations for carrying out of the *Project* undertaken by the *Parties* under the *Contract* and under this *Consortium Agreemen*t, whichever is earlier.

Section 3: Project Organisation and Management Structure

3.1 General Structure

The initial organisation structure of the *Consortium* shall comprise the following:

(a) ***Project Co-ordination Committee*** as the supervisory body for the project execution and decision making body in all relevant project matters.

(b) ***Panels*** can be established by the *Project Co-ordination Committee* to deal with specific issues or problems, e.g. Technical, Technology or Scientific Panel, Financial Panel, and Exploitation or Dissemination Panel.

(c) ***Project Co-ordinator*** as the intermediary to the *European Commission* is authorised to execute the project management, shall report and be accountable to the *Project Co-ordination Committee* (which shall in turn report and be accountable to the General Assembly) under the conditions set forth in Section 5.4.

(d) Project Office, if necessary, established by the *Project Co-ordinator* shall provide the necessary support for day-by-day project management for the *Project Co-ordination Committee* as well as reporting activities to the *European Commissio*n.

3.2 The Party's Representatives

Each Party agrees to nominate a representative to the *Project Co-ordination Committee* with due authorisation to discuss, negotiate and agree decisions or provide recommendations made by the organs within the frame of its responsibilities.

3.3 European Commission Representative

The *European Commission* may participate as an observer at the meetings of the *Project Coordination Committee.*

Section 4: Responsibilities of each Party

4.1 General Responsibilities

Each *Party* hereby undertakes with respect to other *Parties* all reasonable endeavours to perform and fulfil, promptly, actively and on time, all of its obligations under the *Contract* and this *Consortium Agreement,* including in particular the submission to the *Commission* of the deliverables pursuant to the *Contract* Articles 5.3 and 5.4 and Annex II, Article 7.

4.2 Responsibilities towards the Co-ordinator and the Project Co-ordination Committee

Each *Party* undertakes reasonable endeavours to supply promptly to the *Co-ordinator* all such information or documents as the *Co-ordinator* and the *Project Coordination Committee* need to fulfil obligations pursuant to this *Consortium Agreement,* the *Contract* and upon request of the European Commission.

In particular, information and documents required by the *Contract* Annex II, Article 3 shall be submitted via the *Co-ordinato*r.

4.3 Obligations of the Parties towards each other

(a) Each Party undertakes reasonable endeavours:

- to notify the *Co-ordinator* and each of the Parties promptly of any significant problem and delay in performance; and

- to inform other *Parties* of relevant communications it receives from third parties in relation to the *Project.*

(b) Each *Party* shall use reasonable endeavours to ensure the accuracy of any information or materials it supplies hereunder or under the *Contract* and promptly to correct any error therein of which it is notified. The recipient *Party* shall be entirely responsible for the *Use* to which it puts such information and materials.

(c) In addition to the obligations specified in the *Contract* Annex II, Article 36, each *Party* agrees not to use knowingly, as part of a deliverable or in the design of such deliverable or in any information supplied hereunder or under the *Contrac*t, any proprietary rights of a third party for which such *Party* has not acquired the right to grant licences and user rights to the other *Parties* in accordance with the *Contrac*t, unless all of the other *Parties* have accepted such *Use* in writing, such acceptance not to be unreasonably withheld.

Section 5: Authority and Obligations

5.1 Project Co-ordination Committee

5.1.1 Kick-off

The first meeting of the *Project Co-ordination Committee* (Kick-off Meeting of the Project) will take place at the latest seven (7) days after the start of the Project. The structure of the *Project* must be confirmed by the *Project Co-ordination Committe*e. Each representative shall have a named deputy.

5.1.2 Responsibility

The *Project Co-ordination Committee* shall co-ordinate the *Project.* The *Project Co-ordination Committee* assumes overall responsibility for liaison between the *Parties* in relation to the *Projec*t, for analysing and approving the results, for proper administration of the *Project* and for implementation of the provisions contained in the *Consortium Agreement.*

In particular, the *Project Coordination Committee* shall be responsible for:

a. supporting the *Co-ordinator* by fulfilling the obligations towards the European Commission,

b. ensuring that all work of the Project meets functional requirements;

c. provision of project management in relation to the activities of Panels on technical, financial and/or exploitation / dissemination issues, as applicable.

d. making proposals to the *Parties* (other than the *Defaulting Party*) to service of notices on a *Defaulting Party* in accordance with Section 8.6 and to assign the *Defaulting Party*'s tasks to specific entity(ies) (preferably chosen from the remaining *Parties*).

e. agreeing press releases and (without prejudice to Section 12) joint publications by the *Parties* with regard to the *Project*

f. agreeing (without prejudice to Section 12) on procedures and policies in accordance with the *Contract,* Annex II, Article 34 for Dissemination of *Knowledge* from the *Project* which is not to be used by the *Parties*;

g. checking the progress of the works,

h. co-ordinating the research teams,

i. advising and directing the Partners on the developments necessary for the Project,

j. permit formal exchanges of information between the Partners.

5.1.3 Decisions

The *Project Coordination Committee* decides in cases of

- co-ordination, preparation and final approval of reports (technical, financial, etc.) prior to the submission to the *European Commission,*
- all budget-related matters,
- definition, allocation of tasks and changes in worksharing,
- the exclusion of project-partners,
- the structure and restructuring of the Project,
- the alteration of the *Consortium Agreement*, and
- the premature completion/ termination of the *Project*.

upon the designation of the Trustees in accordance with Section 6.2 of this *Consortium Agreement.*

5.1.4 Panels

The *Project Co-ordination Committee* shall have the right to set up Panels to advise and support it in the proper management and co-ordination of the *Project.* These Panels have an advisory role only.

5.1.5 Meetings

The *Project Co-ordination Committee* shall convene with the representatives of the project partners and the *Co-ordinator's* representative as Chairperson.

The *Project Co-ordination Committee* shall meet 3 times according to the working plan specified in the proposal or at any other time when necessary at the request of 25 % of the *Project Partners.* Meetings shall be convened by the chairman with at least fifteen (15) calendar days prior notice with an agenda.

Ordinary and extraordinary meetings of the *Project Co-ordination Committee* shall constitute a quorum if more than fifty (50) percent of the Parties are present or duly represented by proxy.

The *Project Co-ordination Committee* as the principal body of the *Consortium* decides legally binding for all *Parties* the *Project* related cases described in Article 5.1.3.

5.1.6 Rules of Voting

A double majority is required for all matters (decisions) mentioned above. The majority of the project shares and the majority of the votes of the project partners. Each Partner gets one vote for 15.000 € project share. Decisions mentioned in Chapter 5.1.3 need a majority of seventy-five percent (75%) of the project share votes as well as two third (2/3) of all *Parties*.

All decisions will be taken by the majority vote of the *Parties* present or duly represented by proxy.

Each representative shall have a named deputy.

Any decision requiring a vote at a *Project Co-ordination Committee* meeting must be identified as such on the pre-meeting agenda, unless there is unanimous agreement to vote on a decision at that meeting and ¾ *of* the *Project Partners representatives* are present or represented.

A *Party* may issue its veto only in the case of a decision to accept a new party in the *Consortium* if a substantial threat to its commercial or strategic interests is likely to exist which cannot be resolved by any other measure.

5.1.7 Minutes of Meetings

Minutes of the meetings of the *Project Co- ordination Committee* shall be transmitted to the representatives of the project partners without delay. The minutes shall be considered as accepted by the representatives if, within fifteen (15) calendar days from receipt, no *Party* has objected in a traceable form to the *Co-ordinator.*

However, any decision required or permitted to be taken by the *Project Co- ordination Committee* may be taken in accordance with the above

(i) in meetings via teleconference and/or via email;

(ii) without a meeting without prior notice and/or without a vote, if, in any such case, a consent in writing, setting forth the decision so taken, is signed by the representatives of the *Parties* having not less than the minimum number of votes that would be necessary to take such decision at a meeting at which all *Parties* entitled to vote on such decision were represented and voted, and provided the consent has been delivered for signature to all *Parties'* representatives.

5.2 Co-ordinator

5.2.1 Rights and Obligations

The *Co-ordinator* is the single point of contact between the *European Commission* and the *Consortiu*m. In this function the *Co-ordinator* shall:

(a) sign the *Contract* with the *European Commission* after authorisation by the *Parties* representing at least eighty percent (80%) of the Project Shares and who have signed the Contract form and *Consortium Agreement,*

(b) collect from all Parties the cost and other statements for submission to the European Commission,

(c) prepare, with the support of the members of the *Project Co-ordination Committee*, the reports and project documents required by the European Commission, and

(d) ensure prompt delivery of all hardware, Software and data identified as deliverable items in the Contract or requested by the *European Commission* for reviews and audits, including the results of the financial audits prepared by independent auditors.

5.2.2 Responsibilities of the *Co-ordinator*

Pursuant to the *Contract,* the *Co-ordinator* is responsible for the following tasks and functions

(a) overall management of the *Project* with the support of a Project Team, if necessary, and

(b) chairing the Project Co-ordination Committee

(c) preparation of the meetings and decisions of the *Project Co-ordination Committe*e, and

(d) preparation of the agendas for the meetings of the *Project Coordination Committee.*

5.2.3 No power of representation

The *Co-ordinator* shall not be entitled to act or to make legally binding declarations on behalf of any other *Party*.

5.2.4 Submitting Deliverables

If one or more of the Parties is late in submitting of *Project* deliverables, the *Co-ordinator* may submit the other *Parties' Project* deliverables to the *European Commission.*

5.2.5 Specific Authorisation of the *Co-ordinator*

(a) To the extent that serious concerns regarding the financial soundness of one or several *Parties* exist, the *Co-ordinator* has the authority to require the appropriate letter of comfort to prove that the corresponding *Party* is able to fulfil their financial obligations with regard to the *Contract* and this Agreement.

Until this is provided, the *Co-ordinator* is entitled to refuse the disbursement of the financial contributions of the *European Commission* to this *Party*.

(b) Furthermore, the *Co-ordinator* has the right to retain any payment if a *Party* is late in submitting or refuses to provide deliverables as defined in Section 4.3 of the *Consortium Agreement* and Contract Annex II, Article 7.

(c) If one or more of the Parties is late in submitting of *Project* deliverables, the *Co-ordinator* may submit the other *Parties' Project* deliverables to the *European Commission.*

Section 6: Costs - Payment

6.1 General Principle

Each *Party* shall bear its own costs incurred in connection with the performance of the *Contract* and this *Consortium Agreemen*t, carrying out of the *Project* work and implementation of the *Projec*t.

The costs for each audit certificate shall be reimbursed up to an amount of € 2.000,00 of the *Co-ordinator's* budget. Any management costs exeeding such amount shall be born by the respective *Part*y.

6.2 Payments

The *Co-ordinator* shall receive all payments made by the *European Commission*. Except for the part of the advance payments withheld for the Common Liability Reserve (if any), the *Co-ordinator* will transfer, in accordance with the *Contract* and the budget allocation decided by the *Project Co-ordination Committe*e, the appropriate sums to the respective *Parties* with minimum delay, but not later than thirty (30) calendar days from the receipt thereof from the *European Commission*. The *Co-ordinator* shall notify each *Party* promptly of the date and amount transferred to its respective bank account, as listed in Annex C, and shall give the relevant references.

The *Co-ordinator* undertakes to keep advance payments allocated by the *Contrac*t, this *Consortium Agreement* or by budget allocation in accordance with a decision of the *Project Co- ordination Committee* in a trust account separated from its normal business accounts and his own assets and property. Such separation shall be made by means of, but not limited to, a notary public deposit or similar deposit provided for in the national laws and regulations of the country where the money is deposited in a trust account which means have been decided upon by the *Project Co- ordination Committe*e.

The *Project Co-ordination Committee* shall designate two Parties, which shall act together with the *Co-ordinator* as the trustees (hereinafter including the *Co-ordinator* referred as "Trustees") for the Joint Funds. Any disposition regarding the Joint Budget shall be made by the *Co-ordinator* with one of the other two Trustees in accordance with this *Consortium Agreement* and /or any directions given by decision of the General Assembly.

Any costs incurred by the deposit of the Joint Budget shall, if not reimbursed as management costs by the Commission, be borne by the Parties in accordance with their Project Share. *The Co-ordinator* may withhold the deposit costs to be borne by a *Party* from the advance payment.

6.3 Common Liability Reserve (optional)

The *Co-ordinator* shall withhold five percent (5 %) of all advance payments made by the Commission as a Common Liability Reserve to cover the financial liabilities in accordance with *Contract* Annex II, Article 18. The reserve shall be released in part or as a whole to the Parties in accordance with Section 6.2 of the *Consortium Agreement* when the General Assembly has unanimously decided that there is no further need for precaution with regard to financial risks, or when the *European Commission* has accepted all deliverables and costs whichever is earlier.

Parties with the status of an international organisation, a public body or a legal entity whose participation in the indirect action is guaranteed by a Member State or an associated State are free from the obligation to contribute to the Liability Reserve.

Section 7: Confidentiality

7.1 Principles

With respect to all information of whatever nature or form as is

(a) disclosed to a *Party* in connection with the submission to the *Commission* of a proposal for a project under the Sixth Framework Programme pending the signing of the *Contrac*t;

(b) disclosed to a *Party* in connection with the *Project* after the signing of the *Contrac*t, but which

(i) is clearly marked "confidential";

(ii) if disclosed orally, was at the time of disclosure indicated to be "confidential" and within thirty (30) calendar days reduced to physical form and marked "confidential" by the discloser; or

(iii) is obviously of a confidential nature,

the terms of this Section 7 shall apply.

7.2 Obligations

Each *Party* agrees that such information is communicated on a confidential basis and its disclosure may be prejudicial to the owner of the information, and undertakes that:

(a) it will not during a period of five (5) years from the date of disclosure to the *Party Use* any such information for any purpose other than in accordance with the terms of the *Contract* and of this *Consortium Agreemen*t; and

(b) it will during the period of five (5) years treat the same as (and use reasonable endeavours to procure that the same be kept) confidential and not disclose the same to any other third party without the prior written consent of such owner in each case; provided always that:

(i) such agreement and undertaking shall not extend to any information which the receiving *Party* can show:

(1) was at the time of disclosure to the *Party* published or otherwise generally available to the public, or

(2) has after disclosure to the *Party* been published or become generally available to the public otherwise than through any act or omission on the part of the receiving *Part*y, or

(3) was already in the possession of the receiving *Part*y, without any restrictions on disclosure, at the time of disclosure to the *Part*y, or

(4) was rightfully acquired from others without any undertaking of confidentiality, or

(5) was developed independently of the work under the *Contract* by the

receiving *Party*.

7.3 Communication of Information

Each *Party* agrees that nothing shall prevent the communication of information

(a) as is needed to be communicated to comply with applicable laws or regulations or with a court of administrative order provided that insofar as reasonably possible the complying *Party* shall have informed the owner of the information of such need and shall have complied with such owner's reasonable instructions designed to protect the confidentiality of such information;

(b) subject to Section 7.2, to any *Affiliate* or to any other third party (including the Commission) insofar as needed for the proper carrying out of the *Contract* and/or this *Consortium Agreemen*t;

(c) subject to Section 7.2, to any third party (including to the public) as strictly needed for technical reasons and insofar as needed for proper *Use* of *Knowledge* from the *Project.*

7.4 Confidentiality towards third parties

With respect to any permitted communication of any of the information referred to in Section 7.1 by the recipient *Party* to a third party (including but not limited to its *Affiliate*s) such *Party* will use reasonable endeavours to procure due observance and performance by such third party of the undertakings referred to in Section 7.2, (a) and (b) and all relevant undertakings in the *Contract*.

Section 8: Liabilities

8.1 Liability of the Parties towards each other

In respect of information or materials provided by one *Party* to another hereunder or under the *Contrac*t, the supplier *Party* shall be under no obligation or liability other than as stated in Section 4.3 (b) and no warranty condition or representation of any kind is made, given or to be implied as to the sufficiency, accuracy or appropriateness for purpose of such information or materials, or, subject to Section 4.3 (c), the absence of any infringement of any proprietary rights of third parties by the *Use* of such information and materials and the recipient *Party* shall in any case be entirely responsible for the *Use* to which it puts such information and materials.

8.2 Indemnification in the event of claims between the Parties, without Commission claims

Each Party shall indemnify each of the other Parties in respect of acts or omissions of itself and of its employees, agents and subcontractors provided always that such indemnity shall not extend to claims for indirect or consequential loss or damages such as, but not limited to, loss of profit, revenue, contract or the like and provided that the total limit of liability of that Party to all of the other Parties collectively in respect of any and all such claims shall not exceed that *Party's Project* Share - any excess shall be apportioned between all the Parties pro rata to their Project Shares.

8.3 Indemnification in the event of claims from the Commission

8.3.1 Indemnification by the Defaulting Party

In any case where the Commission claims reimbursement in accordance with the *Contract* Annex II, Article 18, from *Parties* other than the Defaulting *Partie*s, the Compensating *Parties* shall be entitled to seek full indemnification by the Defaulting *Part*y.

8.3.2 Indemnification from the Common Liability Reserve

If and to the extent the Defaulting Party is obviously not be able or willing to fulfill its obligations under Art. 8.3.1 the Compensating Party shall be indemnified with money from the Liability Reserve.

If and to the extent that such indemnification or the indemnification from the total amount of the Common Liability Reserves does not cover full indemnification, the Compensating *Party* shall be entitled to seek the remaining indemnification from the other Parties in accordance with their share of the Project budget, limited however to the amount received by such Party from the Commission, including the amount withheld for the Common Liability Reserve.

The Compensating Party benefiting from the Common Liability Reserve in accordance with this Section shall assign its claim against the Defaulting Party to the other *Parties*.

As far as it is legally and economically reasonable, the *Consortium* represented by the *Co-ordinator* shall be entitled to seek indemnification from the Defaulting *Party*.

8.4 Liability towards Third Parties

Subject always to such other undertakings and warranties as are provided for in this *Consortium Agreement* and the *Contract*, each *Party* shall be solely liable for any loss, damage or injury to third parties resulting from the execution of its assigned tasks in the project and from its *Use* of *Knowledge* and/or *Pre-existing Know-how.*

8.5 Third Parties

(a) each *Party* shall be fully responsible for the performance of any part of its share of the *Project*, or other *Contract* obligation, in respect of which it enters into any contract with a third party (e.g. a *Subcontractor*) and shall ensure

(i) such contracts enable fulfilment of the *Contract*;

(ii) the other *Parties*' *Access rights* are the same as would have been the case had the contracting *Party* performed its share of the *Project* and/or those obligations itself; and

(iii) the third party shall not have access to any other *Party's Knowledge* or *Pre-Existing Know-How* without that *Party's* prior written consent.

(b) each Party shall inform the *Co-ordinator* in writing, as applicable, asking for a decision of the *Project Co-ordination Committe*e, as applicable, if it intends to enter into a contract with a third party (giving the rationale therefore) if such an event has not been detailed in the *Contract* Annex I and the contract is other than for less than ten (10) percent of its share of the Project.

(c) each *Party* shall ensure that it can grant *Access rights* and fulfil the obligations under the *Contract* notwithstanding any rights of its employees, or persons it engages to perform part of its share of the *Projec*t, in the *Knowledge* or *Pre-existing Know-how* they create after the Project Commencement Date.

8.6 Defaults and Remedies

8.6.1 Principles

A *Party* in default of its obligations under the *Contract* and which default causes lawful withholding of payments by the *Commission* to other *Partie*s, shall pay to the other *Parties* interest on the amount withheld at an annual rate equal to one (1) percentage point above the prime rate of interest on overdrafts charged according to the Euro Interbank Rate (EURIBOR) on the last working day before the *Commission* informed the other *Parties* of such withholding or on the last working day before which the *Parties or the Co-ordinator* became aware of such withholding (whichever was earlier).

Such interest shall accrue on a daily basis until the *Commission* has effectively transferred the withheld amount to the *Co-ordinator.*

8.6.2 Procedure and Consequences

In the event of a breach by a Party (Defaulting Party) of its obligations under this *Consortium Agreement* or the *Contract* which is irremediable or which is not remedied within thirty (30) calendar days of a written notice from the *Co-ordinato*r, then the other *Parties* in the *Project Co-ordination Committee* may jointly decide to terminate this *Consortium Agreement* with respect to the Defaulting Party following a minimum of 30 calendar days prior to written notice by the *Co-ordinato*r.

Such termination shall take place with respect to the Defaulting Party and the latter shall be deemed to have agreed to the termination of the *Contract* in respect of its participation therein under the general provisions of *Contract* Annex II, Article 15, as the other Parties and/or the *European Commission* shall decide provided always that

(a) any and all *Access rights* granted to the Defaulting Party and its *Affiliates* by the other Parties as well as under the Contract, shall cease immediately; but any and all *Access rights* granted by the *Defaulting Party* to the other Parties and their Affiliates shall remain in full force and effect;

(b) the Work Package of the Defaulting Party, shall be assigned to one or several companies and/or entities which are chosen by the other Parties, are acceptable to European Commission and who agreed to be bound by the terms of this *Consortium Agreement.* The preference shall be granted to one or more of the remaining Parties.

(c) the Defaulting Party shall:

(i) assume all reasonable direct costs increase (if any), resulting from the assignment referred to in (b) above in comparison with the costs of the Work Package of the Defaulting Party as specified in the *Contract* Annex I and Annex B of this *Consortium Agreement,* and

(ii) be liable for any so resulting additional direct cost caused to the other Parties, up to a total amount which, together with any liability to the *European Commission* under the *Contract* Annex II, Article 18, will not exceed the total Project Share.

Section 9: Force Majeure

Each *Party* will notify the other *Parties* in writing of any *Force Majeure* as soon as possible. The *Parties* shall discuss in good faith the possibilities of a transfer of tasks affected by the event. Such discussions shall commence as soon as reasonably possible. If such *Force Majeure* event is not overcome within 6 weeks after such notification, the transfer of tasks shall be carried out.

Section 10: Intellectual Property Rights

10.1 General Provisions

The *Parties* agree to respect their individual *Intellectual Property Rights*.

10.2 Protection of *Knowledge*

10.2.1 Joint Invention

If, in the course of carrying out work on the *Projec*t, a joint invention, design or work is made - and more than one *Party* is contributor to it - and if the features of such joint invention design or work are such that it is not possible to separate them for the purpose of applying for, obtaining and/or maintaining the relevant patent protection or any other *Intellectual Property Right*, the *Parties* concerned agree that they may jointly apply to obtain and/or maintain the relevant right together with any other parties.

The *Parties* concerned shall seek to agree amongst themselves arrangements for applying for, obtaining and/or maintaining such right on a case-by-case basis. So long as any such right is in force, each *Party* concerned shall be entitled to use and to license such right without the consent of the other *Parties,* provided that the Party concerned shall be informed in advance of any licensing to third parties. In case of licensing to third parties, appropriate financial compensation shall be given to the other *Parties* concerned.

10.2.2 Application for a Patent

In respect of a country either specified by the *Commission* or agreed upon by the *Parties,* a *Party* shall notify the other *Parties* (via the *Co-ordinator,* if this is practical) if it does not intend to seek adequate and effective protection (as required by the *Contract)* of certain of its *Knowledge* from the *Project* or if that *Party* intends to waive such protection.

If another *Party* (or *Partie*s) informs the notifying *Party* in writing within one calendar month of such notice that it wishes to obtain or maintain such protection, the notifying *Party* shall assign to such other *Party(ies)* all necessary rights which it owns. Such assignment shall ensure that the *Access rights* of all *Parties* will be unaffected.

For the avoidance of doubt, the *Party* which assigned its rights shall have at least the same *Access rights* as the non-involved *Partie*s.

In case of any disputes, the *Parties* may appeal the IPR Council according to Section16.2.

10.3 Access-rights

10.3.1 Restrictions of *Access-rights*

In accordance with *Contract* Annex II, Article 35.1.d, each *Party* has the right to exclude specific *Pre-existing Know-how* from the other *Parties'* access, as far as the restrictions are announced as described hereinafter before the signature of the *Contract* or before the effective joining of a new party.

The procedure comprises the following steps:

- The *Co-ordinator* shall first be informed by the owning *Party* in writing about the type and scope of *Pre-existing Know-how* for which exclusion from access is requested or announced,

- The *Co-ordinator* will inform the other *Parties* about such requests or announcements.

- The exclusion from access to *Pre-existing Know-how* will become effective in accordance with Annex II, Article 35, subject to the written contradiction of the other *Parties* to be substantiated in accordance with Annex II, Article 35,

- In case a *Party* objects to exclusion from access to *Pre-existing Know-ho*w, the *Party* seeking to exclude access must petition the IPR-Council to decide whether the exclusion can take effect. Until a decision of the IPR Council is taken, access to *Pre-existing Know-how* is regarded as denied.

- In the event that a new *Party* is admitted to the *Project,* any other *Party* may exclude access to *Pre Existing Know-how* only to the newly admitted *Party.*

- the *Pre-existing Know-how* originally excluded from access or excluded at any later moment or any modification thereof will be listed in Annex D and become part of this *Consortium Agreemen*t.

10.3.2 General Principles relating to *Access-rights*

All *Access rights* granted in accordance with this Section are granted on a non-exclusive basis, expressly exclude any rights to sub-license and shall be made free of any transfer costs.

Access rights shall be granted in accordance with and subject to the *Contract Annex,* Article 35. *Knowledge* and *Pre-existing Know-how* shall be used only for the purposes for which *Access rights* to it have been granted and only for so long as is necessary for those purposes.

In relation to the granting of *Access rights* "needed" or "need" shall mean that, without the grant of such *Access right*s:

- in the case of *Access rights* granted for the execution of the *Project,* carrying out the tasks assigned to the recipient *Party* under the Execution Plan (as amended from time to time) would be impossible, significantly delayed, or require significant additional financial or human resources.

- in the case of *Access rights* granted for *Use,* the *Use* of a defined and material element of the recipient *Party´*s own *Knowledge* would be technically or legally impossible.

- The burden of proof in relation to a claimed need for *Access-rights* shall be on the receiving *Part*y. Where *Access rights* are deemed to have been granted, the receiving Party shall provide such proof to the granting Party within 30 days of receipt of a written request. Subject to the receiving Party acting in good faith, *Access rights* for execution of the Project shall remain in force pending the resolution of any dispute between the Parties over the need for *Access rights*.

- Any grant of *Access rights* not covered by this Section shall be at the absolute discretion of the owning Party and subject to such terms and conditions as may be agreed between the owning and receiving *Parties*.

- The *Parties* shall endeavour to reconcile any dispute concerning the *need* for *Access-rights* through the *Project Co-ordination Committee.*

- If no agreement can be reached, the matter shall be referred to the IPR-Council, whose membership shall comprise persons not involved in the project, and whose decision shall be final and binding on all *Parties*.

Should the *Project Co-ordination Committee* and/or the *IPR Council* have been already dissolved, the *Parties* concerned shall have recourse to the Settlement of Disputes procedures as provided for in Section 16 of this *Consortium Agreement.*

10.3.3 *Access-rights* for carrying out the Project

10.3.3.1 Conditions for Access

Access rights to *Knowledge* and *Pre-existing Know-How needed* for the execution of the *Project* shall be granted on a royalty-free basis only upon written request specifying the scope and duration of their application particularly with respect to *Pre-existing Know-how.*

10.3.3.2 Entitlement for *Use* for the Project

After conclusion of an agreement in accordance with *Contract* Annex II, Article 35, the requesting party is entitled to use the *Pre-existing Know-ho*w, *Knowledge* or Software for performing the project work.

10.3.3.3 Illegal Utilisation (optional)

If a *Party* applies *Pre-existing Know-how* of another *Party* without the grant of access, a penalty up to € 50,000 will be charged for the illegal utilisations. The IPR Council will decide on the amount of the penalty.

10.3.4 Access-rights for Use

10.3.4.1 Conditions

Subject to Section 10.3.2, *Access-rights* to *Knowledge* and *Pre-existing Know-how* both needed for *Use* shall be granted upon bilateral agreement between the *Parties* concerned. *Access rights* to *Knowledge* shall be granted on a royalty-free basis, *Access rights* to *Pre-existing Know-how* shall be granted on *Fair and Non-discriminatory Conditions*. The granting of *Access-rights* shall be made conditional on to the following principles:

(i) The access to *Pre-existing Know-how* is limited to the field of application being identified as pertaining to the objectives, content and goals of the project and necessary for the *Use* of own *Knowledge* of the recipient *Party*.

(ii) The royalty-free access to *Knowledge* is limited to the field of application being identified as the objectives and goals of the project. Outside this identified area, access to *Knowledge* may be granted on market conditions only.

(iii) Subject to (i) and (ii) access has to be granted within 6 months after written request by the potential user to the owning *Party*. In case access is not being granted within the above-mentioned period, the IPR Council will decide this issue.

The IPR Council also decides on the appropriateness of possible license fees as well as on the conditions for granting access.

(iv) In accordance with *Contract* Annex II, Article 35.3.b, *Access-rights* exist in full scope until 2 years after project completion or in case of prior termination of a certain *Party* after the time of leaving of such *Party*. For a further three years period, *Access-rights* are limited to *Knowledge* only, however to be granted between not prematurely leaving *Parties* and on *Fair and Non-discriminatory Conditions* only.

10.3.4.2 Reimbursements

Any obligation regarding to claims or rights of a third party, including especially rights of employees of the providing *Party*, resulting from the royalty-free *Access rights* granted by the providing *Party* must be reimbursed by the receiving *Party*.

10.3.4.3 Royalties due to Substantial Commercial Benefits

A *Party* which, having received royalty-free *Access rights* for *Use* of the *Knowledge* of another *Party*, and which over the period up to ten years after the end of the *Contract* has derived substantial commercial benefit from the exploitation of such *Access rights* shall, without prejudice to the rights and obligations of the *Parties* concerned, make a payment or payments to the granting *Party* reflecting the royalties that would have been payable had the grant of *Access rights* been on *Fair and Non-discriminatory Conditions*.

In order to determine the commercial benefit achieved with the Knowledge, the owning *Party* is entitled to request from the receiving *Party* any information concerning this commercial benefit.

10.3.4.4 *Access rights* for using *Knowledge* in subsequent Research Activities

Recognising the *Parties'* obligations to act in good faith and in accordance with Section 7.2.b, the *Parties* agree that the *Access rights* for using *Knowledge* in subsequent research activities are to be as follows:

As of the date set out in the *Contract,* Article 4, *Parties* are deemed to be granted, a right to use free of charge *Knowledge* from the *Project* for:

(a) internal research;

(b) third-party research, provided the third party does not have direct access to confidential *Knowledge* from the *Project* generated by other *Parties* (as examples - producing research results which are available to the third party but which contain hermetically sealed *Knowledge* from the *Projec*t; using *Knowledge* from the *Project* for in-house testing or diagnosis purposes in doing research) joint publications.

10.3.4.5 *Access-rights* for Affiliates

Each *Party* hereby grants *Access rights* to all *Affiliates* of any other *Party* as if such *Affiliates* were *Parties* provided all such *Affiliates* grant *Access rights* to all *Parties* (and their *Affiliate*s) and (without prejudice to the *Partie*s' obligations to carry out the *Project* and to provide *Project Deliverable*s) fulfill all confidentiality and other obligations accepted by the *Parties* under the *Contract* or this *Consortium Agreement* as if such *Affiliates* were *Partie*s.

Upon cessation of the control of an *Affiliate,* any *Access rights* granted to such *Affiliate* in respect of *Knowledge* or *Pre-existing Know-how* shall lapse, provided however that information that is *Knowledge* which has been incorporated into the products, processes, software or services of such *Affiliate* or which has been amalgamated with such *Affiliate's* own information may continue to be used (in the manner it was then being used) by such *Affiliate*, if it is not practical to do otherwise. In such an event, at the request of such *Affiliate*, each requested *Party* shall grant to such *Affiliate* non-exclusive licences under that *Party's* intellectual property rights which are *Knowledge* against terms and conditions to be agreed, provided that no *Legitimate Interests* of such *Party* oppose the grant of such licences. Upon such cessation of control, *Access rights* granted by such *Affiliate* shall continue in full force and effect.

10.3.4.6 *Access-rights* for Parties joining or leaving the Project

Parties joining the Project after the date of the *Contract* will be granted the *Access rights* as from the date of their signature of the Declaration of Accession.

For Parties leaving the Project in accordance with the provisions of Section 8.6.2 hereof, the following will apply:

With the exception of the cases where the participation of a Defaulting Party is terminated, the *Access rights* granted and the obligations to grant *Access rights* pursuant to the Contract and this *Consortium Agreement* shall continue to be in full force and effect.

Defaulting Parties are obliged to continue to grant *Access rights* pursuant to the Contract and this *Consortium Agreemen*t, but the *Access rights* granted to the Defaulting Party pursuant to this *Consortium Agreement* shall cease immediately upon termination of the participation of the Defaulting Party in the Contract.

Termination of this *Consortium Agreement* and/or cessation of licenses granted to the Defaulting Party in accordance with Section 8.6.2 shall not terminate any sublicenses granted or agreed upon to be granted or offered by the Defaulting Party in accordance with Section 10.3.3 prior to the date on which such termination of this *Consortium Agreement* and/or cessation of licenses becomes effective, provided that the Party or Parties which generated the *Knowledge* or *Pre-existing Know-how* so sublicensed shall have the right to have an assignment of the Defaulting Party's rights under such sublicenses.

Any Party leaving voluntarily from the *Project* has access to *Knowledge* as this exists at the date of the membership expiration of the *Consortium*.

Any party eliminated by decision of the *General Assembly* does not have any access to *Knowledge.*

10.3.4.7 *Access-rights* for Third Parties

Notwithstanding the provisions of Section 10.3 of this *Consortium Agreement* and the provisions as set out in *Contract* Annex II. 35., each *Party* may enter into a technical co-operation or licensing arrangement with a third party in respect of its own *Knowledge*, including, but not limited to, the carrying out of research on behalf of a third party, even if there are minor amounts of *Pre-existing Know-how* and *Knowledge* owned by another *Party*, unavoidably incorporated into or amalgamated with such own *Knowledge*. In such circumstances and upon request of the Party entering into the co-operation or arrangement, the other *Party* shall grant non-exclusive rights to permit such co-operation

or arrangement against terms and conditions to be agreed upon, provided that no *Legitimate Interest* of the other *Party* opposes the grant of such rights.

10.4 Specific Provisions for *Access-rights* to Software

10.4.1 General principles relating to *Access-rights* to Software

For the avoidance of doubt, the general provisions for *Access rights* provided for in Sections 10.3.2 herein are applicable also to Software.

Access-rights to Software do not comprise access to Source Code but only *Limited* Source Code *Access* as defined below. Access to Source Code will be granted subject to separate agreements only, to be concluded between the *Parties* concerned.

Access-rights to Software do not include any right to receive Source Code or *Object Code* ported to a certain hardware platform or any right to receive respective Software *Documentation* in any particular form or detail, but only as available from the *Party* granting the *Access-rights.*

10.4.2 *Access-rights* to Software for the execution of the *Project*

Access-rights to Software which is *Knowledge* or *Pre-existing Know-how, needed* for the execution of the *Project* shall be granted on the basis of royalty free *Limited* Source Code *Access* upon written request, specifying the scope and duration of their application particularly with respect to Software which is *Pre-existing Know-ho*w.

10.4.3 *Access-rights* to Software for *Use*

Software*,* which is *Knowledge* or *Pre-existing Know-how* needed for *Use* shall be granted on the basis of *Limited* Source Code *Access* upon a bilateral agreement between the *Parties* concerned.

Access to Software which is *Knowledge* shall be granted on a royalty free basis.

Access to Software which is *Pre-existing Know-how* shall be granted on *Fair and Non-Discriminatory Condition*s. The granting of *Access-right*s shall be made conditional on the same principles as stated in Sections 10.3.4.1 and Article 10.3.4.3 through 10.3.4.7 and shall be applied accordingly.

10.4.4 Software license and sub-licensing rights

(a) Access-rights to *Object Code* and/or Limited Source Code Access all granted in accordance with Section 10.3.2 and 10.4.1 shall comprise the right:

(i) to use *Object Code* and Limited Source Code Access in research, or to create and market a product or process, or to create and provide a service; and

(ii) to make and have made an unlimited number of copies of *Object Code* and Limited Source Code Access; and

(iii) to distribute, make available, market, sell and offer for sale; even by using services of a third party, such *Object Code* and Limited Source Code Access in connection with products or services of the *Party* having the *Access-rights.* provided however that,

(1) any product, process or service has been developed by the *Party* having the *Access-rights* in accordance with its rights to use *Object Code* and Limited Source Code Access for its own *Knowledg*e; and (2) *Object Code* and Limited Source Code Access represent only a minor part of the overall product, process or service; and

(3) *Object Code* and Limited Source Code Access cannot be separated from and/or have been amalgamated with such product, process or service. In addition, *Access-rights* to *Object Code* shall comprise the worldwide right to grant in the normal course of the relevant trade to end-user customers buying/using the product/services a perpetual, irrevocable, worldwide license

- to use *Object Code* in connection with or integrated into, products and services of the *Party* having the *Access-rights* and, as technically essential,

- to maintain such product/service, and

- to create for its own end-use interacting interoperable Software in accordance with the Council Directive of 14 May 1991 on the legal protection of computer programs (91/250/EEC*).*

(b) Where a *Party* has been granted access to Source Code to *Knowledge* according to Section 10.4.1 herein, the Parties concerned may further agree that the *Access-rights* to such Source Code can comprise a worldwide license to use, to make and have made copies, to modify and have modified, develop and have developed, to adapt and have adapted Source Code for research, or to create and market a product or process, or to create and provide a service. In addition, *Access-rights* can comprise the worldwide right to sub-license such Source Cod*e,* but solely for purpose of adaptation, error correction, maintenance and/or support of the Softwar*e.*

(c) Each sublicense granted according to the provisions of this Section 10.4.2 shall when reasonably possible be made by a traceable agreement specifying and protecting the proprietary rights of the *Party* or *Parties* concerned unless otherwise agreed upon in a separate agreement.

10.4.5 Modifications of Software

Unless otherwise agreed, any change or modification on the Software made by the receiving *Party* must be reported with a detailed description immediately to the owning *Party*. In the event a *Party* will not comply with this obligation, which is valid for *Pre-existing Know-how* as well as for *Knowledge*, Section 10.3.3.2 will be applied.

Section 11: Standards

If one of the main explicit objectives of the *Project* is to contribute to the establishment of a particular European standard, the *Parties* hereby agree to make available to third parties, needed licences relating to *Knowledge* and *Pre-existing Know-how* in conformance with the rules of the standards body setting such standard, provided such third party similarly makes needed licences available under its intellectual property rights.

The *Parties* agree that the *Contract* Annex II, Article 10.2 only refers to actions required by a *Party* in respect of its own information or information which is not subject to any obligation of confidence

Section 12: Publications, Press Releases and Reports to the Commission

12.1 Publications of own Knowledge

For the avoidance of doubt, each *Party* shall have the right to publish or allow the publishing of data which constitutes such *Party's Knowledge*, *Pre-existing Know-how* or confidential information it owns in accordance with the *Contract* Annex II.33.3.

12.2 Other Publications

Any publication or communication, whether written or oral, is required to have obtained the consent of the *Parties* concerned. To this end, a brief description and the subject of the proposed publication or communication shall be submitted to the *Project Coordination Committe*e, with a copy being provided to all *Partie*s.

If none of the *Parties* objects to the publication within one (1) calendar month from the date of referral, consent shall be deemed to be given.

Any objection shall include:

a) a request for modifications, specifically if information contained in the proposed publication or communication is likely to impair the industrial and commercial *Use* of *Knowledg*e; or

b) a request that the publication or communication shall be postponed if information

contained in the proposed publication or communication is the subject matter of intellectual property protection.

If no consent on the publication can be achieved within two (2) calendar months from the request, the *Project Coordination Committee* shall decide the issue. However, none of the Parties concerned may withhold their consent to publication or communication upon the expiry of a period of six (6) calendar months following the first submission of the proposed publication or communication.

It is understood that any publication or communication made pursuant to this Article is required to indicate the contribution made by each of the *Parties.*

12.3 Disclaimer and marking of confidential information provided to the Commission

In addition to the *Contract,* Annex II, Article 9:

(a) All information provided to the *Commissio*n, publications and press releases shall have a disclaimer saying "The information in this document is provided as is and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at its sole risk and liability."

(b) Confidential information provided to the *Commission* will be marked stating the information is confidential and may be used only for information purposes by Community Institutions to whom the *Commission* has supplied it.

12.4 Publication to qualify for a degree

Where a person carrying out work on the *Project* on behalf of a *Party* (the "Relevant *Party*") needs to include *Pre-existing Know-how* or *Knowledge* of another *Party* in a publication to qualify for a degree, approval for *Use* shall be obtained from the appropriate *Party* owning such rights or affected by the *Use*. To ensure that the planned date of publication can be met the approval of the relevant parties shall be sought at least three months before the latest date on which (pursuant to the qualification procedures) the contents of the planned publication can be altered.

However, except as stated below, no such publication will be made under the above procedure –

(i) without a majority agreement of the *Parties* and

(ii) provided no *Party* who would be adversely affected by the publication has vetoed such publication.

Notwithstanding the foregoing, such a publication can be made if the *Relevant Party* has as soon as reasonably possible (preferably before submission of the *Project* proposal to the *Commission*, but in any case prior to entering the *Contract* or the *Consortium Agreement* (whichever is the later)) notified in writing the other *Parties* of the intention to make such a publication.

Section 13: No Partnership or Agency

Nothing in this *Consortium Agreement* shall create a partnership or agency between the *Parties* or any of them.

Section 14: Assignment

No *Party* shall, without the prior written consent of the other *Parties*, partially or totally assign or otherwise transfer any of its rights and obligations under this *Consortium Agreement*. Such consent shall not be unreasonably withheld.

Section 15: Termination

15.1 Rules for Termination

No *Party* shall be entitled to withdraw from this *Consortium Agreement* and/or participation in the *Project* unless:

(a) that *Party* has obtained the prior written consent of the other *Parties* (such consent not to be unreasonably withheld), and also of the *Commission*, to the withdrawal from, or termination of, the *Contract*; or

(b) that *Party's* participation in the *Contract* is terminated by the *Commission* pursuant to the provisions of the *Contract,* Annex II, Article 15; or

(c) the *Contract* is terminated by the *Commission* for any reason whatsoever, provided always that a *Party* shall not by withdrawal or termination be relieved from

(i) its responsibilities under this *Consortium Agreement* or the *Contract* in respect of that part of that *Party's* work on the *Project* which has been carried out (or which should have been carried out) up to the date of withdrawal or termination; or

(ii) any of its obligations or liabilities arising out of such withdrawal or termination.

15.2 Termination by the European Commission

If any *Party's* participation in the *Contract* is terminated by the *European Commission* pursuant to the provisions of the *Contract,* Annex II, Article 15, or a *Party* withdraws from the *Project*, then, without prejudice to any other rights of the other *Parties,* the provisions of Sections 4.3(c), 8.6.1, 8.6.2 (a) and (b) shall apply correspondingly.

15.3 Termination due to Bankruptcy or Liquidation

If any *Party* enters into bankruptcy or liquidation or any other arrangement for the benefit of its creditors, the other *Parties* shall, subject to approval by the *Commissio*n, be entitled to take over the fulfilment of such *Party's* obligations and to receive subsequent payments under the *Contract* in respect thereof. In such event all rights and obligations under the *Contract* and this *Consortium Agreement* shall in good faith be redistributed among the remaining *Parties* and the affected *Party* on the basis of the work performed by the affected *Party* prior to the occurrence of the above circumstance.

15.4 Continuance of Regulations

The provisions of Sections 1, 4.3.(c), 7, 8, 10, 11, 15 and 16 shall survive the expiration or termination of this *Consortium Agreement* to the extent needed to enable the *Parties* to pursue the remedies and benefits provided for in those Sections.

15.5 Continuance of Sublicenses

Termination of the *Consortium Agreement* and/or cessation of licences granted to the *Defaulting Party* in accordance with Section 8.6.2 shall not terminate any sublicenses granted or agreed to be granted or offered by the *Defaulting Party* in accordance with Section 10 prior to the date on which such termination of the *Consortium Agreement* and/or cessation of licences becomes effective, provided that the *Party* or *Parties* which generated the *Knowledge* or *Pre-existing Know-how* so sublicensed shall have the right to have an assignment of the *Defaulting Party*'s rights under such sublicenses.

Section 16: Settlement of Disputes

16.1 Arbitration

All disputes or differences arising in connection with this *Consortium Agreement* which cannot be settled amicably shall be finally settled by arbitration in Brussels under the rules of arbitration of the International Chamber of Commerce by one or more arbitrators to be appointed under the terms of those rules. In any arbitration in which there are three arbitrators, the chairman shall be of juridical education.

The award of the arbitration will be final and binding upon the *parties* concerned.

The *Parties* may instead elect to resolve by mediation a dispute or difference arising in connection with this *Consortium Agreement* which cannot be settled amicably.

16.2 IPR Council

In accordance to Section 10, the IPR Council can be appealed to by each Party for clarification of controversies or disputes. The decisions of the IPR Council are binding for all parties.

The IPR Council shall comprise three representatives who are not involved in the project and who are neither interconnected nor economically related in any manner with any of the *Parties*. As members are suggested, one representative of each of the European Patent Office, UNICE and/ as well as the IPR-Helpdesk. The decisions of the IPR Council need the simple majority.

Section 17: Language

This *Consortium Agreement* is drawn up in English, which language shall govern all documents, notices and meetings for its application and/or extension or in any other way relative thereto.

Section 18: Notices

Any notice to be given under this *Consortium Agreement* shall be in writing to the addresses and recipients as listed in Annex A in the form or to such other address and recipient as a *Party* may designate in respect of that *Party* by written notice to the others.

Section 19: Applicable Law

This *Consortium Agreement* shall be construed according to and governed by the law provided in the *Contract,* Article 5.

Section 20: Entire Agreement – Amendments / Severability

Should any provision of this *Consortium* Agreement prove to be invalid or incapable of fulfilment, or subsequently become invalid or incapable of fulfilment, whether in whole or in part, this shall not affect the validity of the remaining provisions of this *Consortium Agreement*. In such a case, the Contractors shall be entitled to demand that a valid and practicable provision be negotiated which mostly fulfils the purpose of the invalid or impracticable provision.

This *Consortium Agreemen*t, the *Contract* and - when such exist(s) – *Complementary Contract(s*), constitute the entire agreement between the *Parties* in respect of the *Projec*t, and supersede all previous negotiations, commitments and writings concerning the *Project* including any memorandum of understanding between the *Parties* (whether or not with others) which relate to the *Project* or its proposal to the *Commissio*n.

Amendments or changes to this *Consortium Agreement* shall be valid only if made in writing and signed by an authorised signatory of each of the *Partie*s.

Section 21: Accession to the Contract

All Parties declare that they have taken notice of all provisions of the *Contract* and its Annexes, which they have approved and have taken notice of all Sections of this *Consortium Agreement.*

Therefore, through signature of this *Consortium Agreement,* the parties are obliged to accede to the *Contract* by submission their Forms A to the *Co-ordinato*r.

Section 22: Counterparts

This *Consortium Agreement* may be executed in any number of counterparts, each which shall be deemed an original, but all of which shall constitute one and the same instrument.

SIGNATURES

AS WITNESS the *Parties* have caused this *Consortium Agreement* to be duly signed by the undersigned authorised representatives the day and year first above written.

Authorized to sign on behalf of

Department for Sustainable Waste Management and Technology of the University of Leoben, Austria

Karl E. Lorber, Univ. Prof. Dr.-Ing. Date:

Authorized to sign on behalf of

Department for Chemical Engineering of the University of La Frontera, Temucao, Chile

Valerio Alfredo Bifani Cosentini, Mag. Date:

Authorized to sign on behalf of

SIGMA Consult Limitada

Patricio Siggelkow Sanhueza, Ing. Date:

Authorized to sign on behalf of

P 1

Name, Title Date:

Authorised to sign on behalf of

P 2

Name, Title Date:

Authorised to sign on behalf of

P 3

Name, Title Date:

Consortium Agreement: ANNEX A: Recipients for Notices

Recipients for Notices in Accordance with Section 17 of this *Consortium Agreement:*

Department for Sustainable Waste Management and Technology of the University of Leoben

8700 Leoben, Austria,

Mr. Michael Kotschan

Tel. ++43 3842 402-5103

Fax ++43 3842 402-5102

E-mail: michael.kotschan@notes.unileoben.ac.at

Department for Chemical Engineering of the University of La Frontera

Temuco, Chile,

Mr. Rodrigo Navia Diez

Tel. ++43 3842 402-5103 or ++56 45 325472

Fax ++43 3842 402-5102 or ++56 45 325053

E-mail: rnavia@ufro.cl, rodrigo.navia@stud.unileoben.ac.at

SIGMA Consult Limitada

Valparaíso, Chile,

Ms. Carolina Velasquez

Tel. ++56 32 493340

Fax ++56 32 493339

E-mail: cvelasquez@vtr.net

P 1

City, Country,

Person in charge

Tel. ++

Fax ++

E-mail:

P 2

City, Country,

Person in charge

Tel. ++

Fax ++

E-mail:

SA 3

City, Country,

Person in charge

Tel. ++

Fax ++

E-mail:

Consortium Agreement: ANNEX B: Budget and Project Shares

Rules for Voting: see section 5.1.6

Department for Sustainable Waste Management and Technology of the University of Leoben

Total costs: 53.800 €

Percentage of total project costs: 38,2 %

Votes: 3

Department for Chemical Engineering of the University of La Frontera

Total costs: 31.080 €

Percentage of total project costs: 22,1 %

Votes: 2

SIGMA Consult Limitada

Total costs: 15.900 €

Percentage of total project costs: 11,2 %

Votes: 1

P 1

Total costs: 12.720 €

Percentage of total project costs: 9 %

Votes: 1

P 2

Total costs: 13.920 €

Percentage of total project costs: 9,8 %

Votes: 1

P 3

Total costs: 13.320 €

Percentage of total project costs: 9,4 %

Votes: 1

Consortium Agreement: ANNEX C: Bank Accounts

Department for Sustainable Waste Management and Technology of the University of Leoben,
Leoben, Austria,
Bank: Bank Austria, Creditanstalt Leoben
Address: Franz-Joseph-Str. 2, 8700 Leoben
Bank Code Number: 11910
Number: 0991-40261/00

Department for Chemical Engineering of the University of La Frontera,
Temuco, Chile,
Bank:
Address:
Bank Code Number or BIC:
IBAN or Number:

SIGMA Consult Limitada,
Valparaíso, Chile,
Bank: Banco Estado
Address: Sucursal Quilpué
Bank Code Number or BIC:
IBAN or Number: 25300059417

SA 1,
00000 City, Country,
Bank:
Address:
Bank Code Number or BIC:
IBAN or Number:

SA 2,
00000 City, Country,
Bank:
Address:
Bank Code Number or BIC:
IBAN or Number:

SA 3,
00000 City, Country,
Bank:
Address:
Bank Code Number or BIC:
IBAN or Number:

Consortium Agreement: ANNEX D: Exclusion of Pre-existing Know-how from Right to Access

Department for Sustainable Waste Management and Technology of the University of Leoben,

Protected Know-how:

Patent No. or File No.:

Filed:

Department for Chemical Engineering of the University of La Frontera,

Protected Know-how:

Patent No. or File No.:

Filed:

SIGMA Consult Limitada,

Protected Know-how:

Patent No. or File No.:

Filed:

SA 1,

Protected Know-how:

Patent No. or File No.:

Filed:

SA 2,

Protected Know-how:

Patent No. or File No.:

Filed:

SA 3,

Protected Know-how:

Patent No. or File No.:

Filed:

14 Annex 6: Cooperation Agreement for Chilean Third-Parties

AGREEMENT OF COOPERATION
CONVENIO DE COOPERACIÓN

In the city of Valparaíso, Chile, on August ... 2003 this agreement of cooperation is made between the consortium for the realization of the project SAMSON (participants see annex 1), from now on "Consortium", represented in the 5th Region of Chile by **SIGMA Consult Limitada**, and **Constructora CAM Limitada,** from now on CAM, relating to the project entitled "SAMSON".

NOW THEREFORE IT IS HEREBY AGREED AS FOLLOWS:

En la ciudad de Valparaíso, Chile, a ... de agosto del 2003, entre el consorcio para la realización del proyecto "SAMSON" (partecipantes del consorcio vea anexo 1), desde ahora en adelante **"Consorcio"**, representado en la V. Región de Chile por **SIGMA Consult Limitada**, domiciliado en ..., cédula de identidad número ... por una parte, y **Constructora CAM Limitada**, RUT ... representada por ... , chileno, domiciliado en ..., cédula de identidad número ... , de ahora en adelante **"CAM"**, por la otra parte, establecen celebrar un convenio de cooperación, el que se regirá por las siguientes claúsulas:

1) Purpose of the Agreement

The purpose of this *Consortium Agreement* is the mutual collaboration between the parties to realize the project entitled "..." of the European Union's 6th Framework Programme.

The aim of the project is to develop, implement and test a new electrochemical technique for disinfection of effluents from municipal waste water treatment plants and treatment of industrial waste water as well as waste waters from sanitary landfill, and to adapt this technology to the technical and normative requirements in Chile.

1) Objeto del presente convenio

El objeto del presente convenio es la mutua colaboración entre las partes en el desarrollo de un proyecto del Programa Marco (FP 6) de la Union Europea, titulado "SAMSON".

El objetivo de este proyecto es el desarrollo, implementación y prueba, de una tecnología basada en un proceso electro-químico, para la Desinfección de Aguas Servidas comunales tratadas, así como para el Tratamiento de Residuos Industriales Líquidos y lixiviados provenientes de vertederos, la adaptación de esta tecnología a las exigencias normativas chilenas, así como a las características, flujos y contenidos de las aguas y residuos líquidos ya mencionados.

2) Costs

The project "SAMSON" will be lead through by the consortium, which will bear all costs.

2) Costos

El proyecto titulado "SAMSON" será elaborado por el consorcio, asumiendo éste los costos involucrados para dicho efecto.

3) Representation of the Consortium

The consortium will be represented in the 5th region of Chile by SIGMA Consult Ltda, which is the member of the consortium with legal responsibility over the pilot plant in El Molle.

3) Representante del consorcio

El consorcio será representado en la V. Región de Chile por SIGMA Consult Ltda, como miembro del consorcio con responsabilidad legal sobre la planta piloto en El Molle.

4) Obligations of the Consortium

In the case that the European Union decides to finance the project "...", the consortium will:

c) Train staff of CAM in the operation of an electrochemical pilot plant , to be installed in the landfill site "El Molle" in the city of Valparaíso, with the aim to carry out the experiments necessary for the project.

d) Provide CAM the possibility to participate in an EU-funded project and publicize the obtained results and positive effects of the electrochemical technique for treatment of waste water from sanitary landfills together with the consortium. Furthermore, CAM will have the possibility to use the innovative frame of research in environmental protection-technologies in which it will get involved by this project for publicity-activities.

e) Provide CAM the possibility to purchase a plant for electrochemical treatment of waste water from sanitary landfill at cost.

4) Obligaciones del consorcio

En el caso de que la Unión Europea apruebe el financiamiento del proyecto individualizado en el punto segundo del presente convenio, el consorcio se compromete a:

a-) Entrenar personal de CAM para la operación de una planta electro-química piloto a instalar en el vertedero El Molle de la comuna de Valparaíso, esto con el fin de realizar las pruebas requeridas para el desarrollo del proyecto.

b-) Participar en el proyecto financiado por la Unión Europea y publicar en conjunto con el consorcio resultados y efectos positivos que el sistema electro-químico genere en el proceso de tratamiento de lixiviados. Así como publicitar el marco innovativo en que CAM se involucra al participar en proyectos de investigación en materias de desarrollo de tecnología de protección ambiental.

c-) La posibilidad de adquirir, por parte de CAM, una planta de tratamiento electro-químico de lixiviados al valor de costo.

5) Obligations of CAM

In the frame of the project “SAMSON” CAM will:

a) Provide technical cooperation and material for the installation of the pilot plant in the landfill site “El Molle”.

b) Permit access for technicians and professionals in charge of the project to the pilot plant in “El Molle” to take samples, realize experiments and for purposes of publicity related to the project.

c) Technical staff that will be trained by the consortium with the objective that this staff operates the pilot plant .

d) Electric energy to operate the pilot plant .

e) Historical information on the landfill site that is relevant to the project and that CAM has at its disposal.

5) Obligaciones de CAM

En relación a lo anterior, CAM pondrá a disposición del proyecto:

a-) Colaboración técnica y material para la instalación de la planta piloto en el vertedero El Molle.

b-) Permitir el acceso de técnicos y profesionales a cargo del proyecto a las instalaciones de la planta piloto con el fin de desarrollar pruebas y experimentación, así como para fines de publicidad del proyecto.

c-) Personal técnico para entrenar, con el fin de que éstos operen la planta piloto.

d-) Energía eléctrica para la operación de la planta piloto.

e-) Información histórica del vertedero que pueda ser relevante para el éxito de la investigación y que CAM tenga disponible.

6) Property of Equipment and Results

Concerning the property of the equipment and the results of the experiments the following shall be established:

a) The pilot plant that will be installed in the landfill site “El Molle” remains property of the consortium, which will withdraw the plant having finished experiments and data acquisition.

b) The intellectual property of the technology and the property of all results obtained within experimentation belongs to the consortium.

c) The parties shall treat confidentially all information within this project. Information may only be spread or passed on with authorization by the consortium.

6) Propiedad de equipamiento y resultados

Respecto del equipamiento y resultados de la experimentación, en el marco del Programa Marco (FP 6) de la Unión Europea, se establece:

a-) La planta piloto a instalar en el vertedero El Molle, será de propiedad del consorcio, quien se compromete a retirarla una vez terminado el período de experimentación y adquisición de resultados.

b-) La propiedad intelectual de la tecnología, así como los resultados de la experimentación es de propiedad del consorcio.

c-) En el marco del presente convenio, los participantes se compromenten a mantener la información en forma confidencial, la que sólo podrá ser divulgada con autorización del consorcio.

7) Modification of the Pilot Plant

The pilot plant shall be modificated exclusively by technicians and professionals of the consortium or with the explicit aprobation of the legal representative of the consortium.

7) Modificación de la planta piloto

La planta piloto podrá ser modificada solamente por técnicos y profesionales del consorcio o con explicita aprobación por el representante legal del consorcio.

8) Case of Litigation

In the case of litigation caused by this agreement the parties agree to find a solution of common interest.

If this is not possible, all cases of litigation caused by this agreement will be presented to the jurisdiction of the competent law court in ….

The parties have the possibility to solve this cases by arbitration or mediation.

8) Litigio:

En caso de presentarse litigio originado por el presente convenio las partes se comprometen a buscar una solución de común acuerdo.

De no ser posible, todos los litigios originados por el presente convenio serán sometidos a la jurisdicción del tribunal competente en....

Las partes tienen la posibilidad de someter los litigios a arbitraje o mediator.

9) Responsibility

Each party will be responsible for damages that it causes the other by incorrect use of property of the other party, like non-compliance of the instructions for installation, maintainance and operation.

Guarantees for the success of the project do not exist.

Each party shall be responsible for claims of third parties toward this party.

9) Responsabilidad

Cada parte será responsable por daños, que cause a la otra por uso incorrecto de los bienes del otro, así como por incumplimiento de instrucciones para montaje, mantención y operación.

No existen garantías del éxito del proyecto.

Cada parte es responsable de demandas de terceros a su parte.

10) Confidentiality

The parties shall treat confidentially all information related to this project, even after the termination of the project, as far as this information is not public knowledge or has been previously published.

Furthermore, the parties shall use this information exclusively in the frame set by this agreement.

10) Confidencialidad

Las partes se comprometen a mantener todas las informaciones y antecedentes relacionadas con este proyecto en forma confidencial, incluso después del fin del proyecto, siempre que no sea demostrable su conocimiento publico o publicación previa.

Además, las partes se comprometen a usar estas informaciones exclusivamente en el marco establecido en el presente convenio.

11) Termination of the Cooperation

a) To prematurely end the cooperation based on this agreement, the applying party has to inform the other party of its intention in writing with 2 months of anticipation (date as per postmark).In the case that CAM solicitates the premature termination of the cooperation wtihout coming to a consent between the parties, it will permit the access to the landfill El Molle for taking samples of off-water for the duration of the project “SAMSON” as far as it is necessary to fulfill the objectives of this project.

b) The reasons for a premature termination of the project have to be dully justified. Reasons for a premature termination of the project may be declaration of insolvency, opening of bankruptcy proceedings, stoppage of important parts of the enterprise or paralysation of activities that are vital for the common project.

c) The term of this agreement ends with the declaration of the official end of the project “SAMSON” by the project-coordinator.

d) In the case that the consortium stops the project, realized works will not be reimbursed.

11) Término de la cooperación

a) Para dar término anticipado al presente convenio la parte solicitante deberá informar su voluntad en forma escrita con 2 meses de anticipación. (fecha del timbre de correos). En caso de que CAM solicite el término anticipado sin llegar a acuerdo entre las partes, se compromete a permitir el acceso al vertedero El Molle para la toma de muestras de lixiviado por el período del proyecto “SAMSON” en cuanto es necesario para desarrollar este proyecto.

b) Las causas del término anticipado deberán ser justificadas. Se entenderán como causales el inicio de un proceso de quiebra, el término de giro, embargo de partes importantes de la empresa o paralización de actividades vitales para el desarrollo del proyecto de cooperación.

c) La vigencia del presente convenio terminará con el anuncio del fin oficial del proyecto „SAMSON“ por el coordinador del proyecto.

d) En el caso de que el consorcio cese el proyecto, no se reembolsarán trabajos realizados

12) Bankruptcy

In the case that one of the parties opens insolvency, the following shall come into force:

a) In the case that the legal representative of the consortium opens insolvency, the consortium shall designate an other legal representative.

b) In the case that CAM opens insolvency, CAM shall permit the consortium to take off-water samples in El Molle as far as this is necessary for reaching the objectives of the project “SAMSON”.

12) Quiebra

En el caso de que una de las partes se someta a quiebra, se establece lo siguiente:

a) En el caso de quiebra del ripresentante legal del consorcio, el consorcio se compromete de designar un otro representante legal.

b) En el caso de quiebra de CAM, CAM se compromete a facilitar al consorcio tomar muestras de lixiviados en El Molle en cuanto será necesario para el desarrollo del proyecto „SAMSON“.

13) Non-fulfillment

In the case that a party does not fulfill the obligations established in this agreement, the other party shall have the right to terminate the cooperation after written anouncement. This shall correspond to a termination in desagree by the party that does not comply with its obligations.

13) No-cumplimiento

En el caso de que una parte no cumple con las obligaciones establecidas en el presente convenio, la otra parte tiene el derecho de terminar la cooperación después de aviso escrito. Eso corresponde a un termino en desacuerdo por la parte que no cumple con sus obligaciones.

14) Cession of Rights and Obligations

The partial or total cession of rights and obligations originating in this agreement, needs the written aprobation of the other party.

14) Cesión de derechos y obligaciones

La parcial o total cesión de derechos y obligaciones proveniente del presente convenio demanda la aprobación por escrito de la otra parte.

15) Modifications and Extensions:

Amendments or changes to this agreement shall be valid only if made in writing and signed by an authorised signatory of each of the parties.

15) Modificaciones y extensiones:

Las modificaciones o extensiones del presente convenio serán legítimas solamente al estar por escrito y firmadas por los representantes legales de ambas partes.

16) Modification of the Consortium-Composition

This agreement stays in force if the composition of the consortium is changed, if these changes do not affect the economic or strategic interests of CAM.

16) Modificación del consorcio

El presente convenio mantiene vigencia, si se modifica la composición del consorcio, a menos que esa modificación esté en oposición con los intereses economicos o estratégicos de CAM.

17) Force Majeur

Each party shall inform the other of cases of force majeur as fast as possible.

17) Fuerza mayor

Cada parte informará la otra por escrito de casos de fuerza mayor lo antes posible.

18) Duration

This agreement shall come into force as of the date of the approbation of the project by the European Union and shall continue in full force and effect for the period necessary to lead through the project, approximately 1 year.

18) Duración

El presente convenio tendrá vigencia a partir de la fecha de aprobación del proyecto por parte de la Unión Europea y su vigencia corresponderá al tiempo de desarrollo del proyecto, el que se estima en un año.

19) Settlement

In any case, the parties are settled in the city of Valparaíso, Chile.

19) Domicilio

A todos los efectos, las partes fijan domicilio en la ciudad de Valparaíso, Chile.

20) Language

This agreement will be signed in Spanish and English.

20) Idioma

El presente convenio será firmado en Español e Ingles.

SIGNATURES / FIRMAS

AS WITNESS the parties have caused this agreement to be duly signed by the undersigned authorized representatives the day and year first above written.

En comprobante y previa lectura, en Valparaíso a XX de XX de 2003, firman

Authorized to sign on behalf of CAM

Representante legal de CAM

Signature / Firma

Name / Nombre Title / Titulo

Authorised to sign on behalf of the consortium in the 5th Region of Chile

Representante legal del consorcio en la V. Región de Chile

Signature / Firma

Patricio Siggelkow Title / Titulo

Annex – Parties, Composition of the Consortium, Project-Coordinator

1) Constructora CAM Limitada, ("CAM")

RUT ... represented in this agreement by ... , Chile, resident in ..., number of identity card ...

2) Consortium for the realization of the project SAMSON, ("Consortium")

2.a) Institut für Nachhaltige Abfallwirtschaft und Entsorgungstechnik of the University of Leoben, Austria ("IAE-MUL")

Represented in this agreement by... , Austria, resident in ..., passport number ...

2.b) SIGMA Consult Limitada ("SIGMA Consult")

RUT 77.054.000-3 represented in this agreement by Patricio Eduardo Siggelkow Sanhueza, Chile, Engineer, resident in Prat # 865 office 63, number of identity card 10.348.940-7.

Tel: ++56-(0)32-797734

Fax:++56-(0)32-493339

Email: infosigma@vtr.net

2.c) Universidad de la Frontera ("UFRO")

RUT ... represented in this agreement by... , Chile, resident in ..., number of identity card ...

3) Project Coordinator

Prof. Lorber of the University of Leoben, Austria.

Passport number ...

Appéndice – Partes, Participantes del Consorcio, Coordinador del Proyecto

1) Constructora CAM Limitada, ("CAM")

RUT ... representada en este convenio por ... , Chile, domiciliado en ..., cédula de identidad número ...

2) Consorcio "..." ("Consorcio")

2.a) Institut für Nachhaltige Abfallwirtschaft und Entsorgungstechnik de la Universidad Montanistica de Leoben, Austria ("IAE-MUL")

Representado en este convenio por ... , Austria, domiciliado en ..., cédula de identidad número ...

2.b) SIGMA Consult Limitada ("SIGMA Consult")

RUT 77.054.000-3 representada en este convenio por Patricio Eduardo Siggelkow Sanhueza, Chile, Ingeniero, domiciliado en Prat número 865 oficina 63, cedula de identidad número 10.348.940-7

Tel: ++56-(0)32-797734

Fax:++56-(0)32-493339

Email: infosigma@vtr.net

2.c) Universidad de la Frontera ("UFRO")

RUT ... representada en este convenio por ... , chileno/a, domiciliado en ..., cédula de identidad número ...

3) Coordinador del Proyecto

Prof. Lorber de la Universidad Montanistica de Leoben, Austria.

Cédula de identidad número ...