Summary

"USE OF MICROALGAE FOR TREATMENT OF CONTAMINATED WATER CONTAINING MINERALS AND HEAVY METALS"

This research aims to develop a bioremediation system based on the use of microalgae and its usefulness as an alternative to the current treatment process in Loa River basin, located in the region of Antofagasta, Northern Chile. This river is of great importance in the area because it is the only source of surface water in the Atacama Desert. The use of this water has important limitations due to the presence of minerals (such as boron and arsenic) and heavy metals (mainly copper, zinc and manganese) at concentrations classified as hazardous contamination by the World Health Organization (WHO).

The source of this pollution is associated both to natural causes (the volcanic and geological characteristics of the terrain make water bodies solubilize metals from various minerals present in the subsoil composition), as well as a product of human activity, mainly associated with the development of industrial mining processes. They involve the generation of solid and liquid wastes, which may diffuse to the underground drainage and from there, to the surface drainage in the region, causing serious environmental issues.

In addition to this problem, the small amount of natural water sources present in this desert region (no rivers, no rainfall) makes water a critical resource and a very scarce commodity that must be shared by the community, agriculture and industrial activity in the region. Also, the tightening of environmental laws regarding industrial standards, and the growing social interest concerning pollution makes today the treatment and management of these wastes an area of great interest and importance, and searching for new and better alternatives to conventional treatment methods with higher efficiencies, lower costs and a more environmentally friendly become necessary.

In response, bioremediation technique has gained attention in recent years and emerged as an alternative to compete with conventional treatment processes. The use of microalgae has focused a special attention because of their wide availability and the fact that numerous species of microalgae have been reported to be able of eliminate pollutants found in their environment through several mechanisms. These elimination processes can be carried out in two ways: biosorption, where the pollutant is just retained on the outer surface of the cell wall thanks to its physicochemical properties, and bioaccumulation, an active process in which microalgal cells capture free ions of contaminants, holding them inside the cell.

In order to know the potential of microalgae and the viability of the process on a commercial scale, it is necessary to study the fundamental aspects of these mechanisms and the main factors affecting these processes (See diagram 1). To do this, and based on an analysis of the pollution in the Loa River basin, a relevant study area will be selected in order to analyze the degree of contamination. Also, a selection of the contaminants to be studied and an isolation of the microorganisms located in this area will be made.

Next step will be the acquirement of experimental evidence concerning growth and viability of the selected microalgae species in a synthetic solution of water with a composition similar to that of Loa River but containing different concentrations of heavy metals. In addition, the biosorption mechanism will be studied for each microalgae strain as a function of pH and ion concentration, in

order to obtain the kinetics of this process. The adsorption capacity of bioaccumulation and biosorption methods will be compared to know if there are differences between both processes by using both living microalgae and dead biomass.

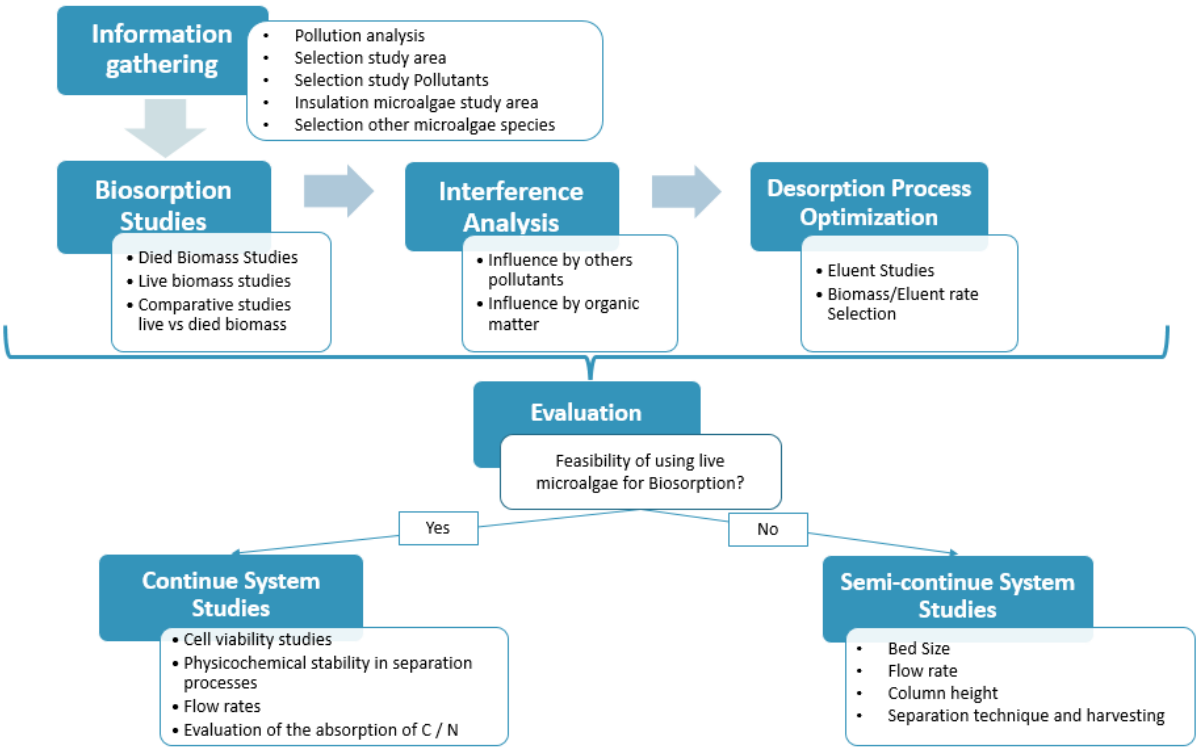

Diagram 1. Process scheme of the project based in microalgae bioremediation for heavy metals contamination in water sources.

Subsequently, the presence of organic matter and/or other compounds in the biosorption ability of selected elements will be discussed. Once this information is determined, studies on the biomass regeneration capacity in the process of biosorption/desorption will be performed, in order to optimize the recovery of the biomass loaded with heavy metals, comparing different types of eluents and different eluent and algal biomass ratios.

Finally, it will be decided which process is more convenient to develop the main purpose of this research project, which is developing a biological remediation system for water contaminated with heavy metals. It will be defined whether to use a continuous or a semi-continuous process, and whether to use live or dead microalgae (using the abilities of the first for bioaccumulation, or by simple biosorption process using the second) if the use of live microalgae in the process results feasible. Once the process selected, the most important factors for obtaining the optimal process conditions will be studied, in order to initiate the development of the full-scale application.