



# BrineMine – Extracting minerals and drinking water from geothermal sources in Chile

## Client II – International partnerships for sustainable innovations

Chile has some of the most extensive geothermal resources in the world, meaning it has the potential to use geothermal sources to generate electricity or heat. At the same time, it is one of the driest countries on Earth. In addition to being used by geothermal power plants to produce energy, the brine mines found in geothermal springs often also contain a very wide range of exploitable minerals such as lithium, magnesium or potassium. The German-Chilean project “BrineMine” aims to make these geothermal brines usable by means of an innovative process for recovering reusable materials and drinking water.

### Minerals and fresh water extraction

The use of the very limited freshwater resources in northern Chile presents a very great potential for conflict between the indigenous population and, above all, the mining industry. In addition to their use as energy sources, the brines produced in Chile’s extensive geothermal systems could also be used to produce fresh water. This could help defuse the growing conflicts over the use of water resources. In addition to this, these brines often contain reusable materials. The extraction of minerals such as lithium, magnesium, potassium, boron or gold from geothermal brines is not easy from a technological point of view, but it is possible. Under the right conditions, this is likely to become economically viable in future.



Geothermal power plant in Souz.

The “BrineMine”’s project therefore aims to develop and test a multi-stage process that will allow geothermal brines to be concentrated in order to selectively separate minerals and extract fresh water. Up until now, most geothermal sources in Chile have only been characterized in terms of their key elements. Further exploration will therefore provide detailed information on the mineral content of various sources and their value, enabling an economic analysis of the new process.

### Process development and initial implementation

The aim of the project is to develop a multi-stage process for the recovery of minerals from geothermal brines. This process consists of three stages: pre-treatment, reverse osmosis and membrane distillation. The innovativeness of this approach is primarily in the use of membrane distillation as a thermal separation process, which is particularly well suited for use in very high salt concentrations. The thermal energy requirement can be covered directly from geothermal energy.

First of all, heat is extracted from the geothermal brine. The relatively weakly concentrated fluid is thus cooled and then fed into a reverse osmosis process, where pre-concentration takes place. This simultaneously results in a significant portion of the fresh water being recovered at this stage. The concentrate from the reverse osmosis process is then fed into the membrane distillation process for further concentration up to saturation. The project will also investigate methods for the selective separation of solids.

The project is divided into three phases. In the first phase, preliminary examinations are carried out in the field and in the laboratory. These include the sampling and analysis of various geothermal brines as well as experiments in the laboratory with artificial and real brines to investigate thermal and concentration-induced scaling. In the second phase, a demonstration plant will be developed and built. For this purpose, potential demonstration sites will be explored and plans will be made for the technical integration of the demonstration system. The technical processes of the demonstration system will be also designed and, finally, the demonstration plant will be built. In the third phase, the demonstration plant will first be commissioned in a technical centre in Santiago and then transferred to

the demonstration site and operated there. The operating results will be analysed and evaluated.

Throughout all three phases of the project, models for commercialization will be developed on the basis of brine analyses, current and prospective raw material prices as well as the planned investment and operating costs of the extraction plants.



Preliminary investigations into the concentration of geothermal brines with a membrane distillation test cell.

### Testing of feasibility and profitability analysis

The “BrineMine” project aims to deliver two essential insights. Firstly, it will test, demonstrate and evaluate the technical feasibility of the newly developed process. Secondly, it will clarify whether and under what technical and economic conditions the extraction of minerals from geothermal sources can be useful and to what extent it could supplement conventional mining in the future. The extraction of fresh water can play an important role here. Furthermore, the project will not only initiate interdisciplinary and international cooperation between German and Chilean geohydrologists, process engineers, geothermal companies and plant constructors, but also form a basis for long-term cooperation. After 18 months, the initial results will be presented at an industrial workshop in Santiago, thereby stimulating industry interest in the “BrineMine” technology.

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