Extraction of Raw Materials from Geothermal Fluids - A Review of the BrineMine Project

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The German-Chilean BrineMine project analyzed the potential of geothermal fluids as a raw material and freshwater resource. Within the German geothermal sector, the focus was set on investigating the potential in terms of a local, independent raw material resource. In terms of the Chilean sector, the scope was set on using geothermal fluids as a new approach within the large mining sector and on evaluating the possibility of freshwater production in remote areas. The study summarizes the major project outcomes and the challenges for implementing geothermal raw material extraction in the future.

The conditions in geothermal reservoirs can lead to an enrichment of several elements in the fluids. At the current state, the already existing geothermal sites in Germany could cover 2–12% of the annual demand for the planned battery cell production. In Chile, 2nd biggest lithium-producing country, the capacity of the only geothermal power plant could enhance the country's production by up to 3 %.

Bearing a great raw material potential, the dissolved elements also pose challenges for manufacturing. Different extraction technologies with a focus on direct lithium extraction were thus evaluated on their integrability in geothermal cycles. Being partly established in lithium production from shallow salar brines, there appeared distinctive challenges for the integration into geothermal settings. The high temperatures, gas concentrations, retention times, lower raw material concentrations (in volcanic systems), and scaling potential were defined as key challenges to the implementation of the approaches in the geothermal sector.

To overcome one key challenge, a silica handling strategy was developed as a typical challenge in high-temperature fields. Based on a site-specific design simulation a field demonstrator was developed for testing silica removal in a flow-through system. The demonstrator was implemented over several weeks in a geothermal powerplant in Germany and achieved 98 % silica reduction during continuous operation. Furthermore, access to the running geothermal fluids enabled studying the reaction and precipitation kinetics of typical scaling mineral groups under different operation conditions.

The field demonstrator was also implemented in a geothermal setting in Chile. Here, beyond the chemical pre-treatment, the concentration for a more effective downstream raw material extraction was investigated. This enabled further the production of freshwater using a geothermal-powered membrane distillation process. In Chile a 50% silica reduction was achieved and at the same time a mineral concentration up to a factor of 20.

The results show the raw material potential in different geothermal settings worldwide. The developed physical, chemical, and numerical approaches demonstrated the processibility of geothermal brines and further showed the neuralgic points to overcome for this promising field for the geothermal and raw material sector.