POP-SCIENCE ABSTRACT

1. Research Objectives

Aims of the presented project are to develop an innovative method of separating lithium from aqueous solutions, which will allow for an effective increase in the efficiency of both mining processes as well as lithium recovery in lithium-ion battery recycling plants.

2. Scientific problem and current situation

The constantly evolving electronics industry and a clear growth and development of electric cars technologies are leading to the increase of global lithium mining every year moreover, in the coming years, this trend will certainly persist or even will be intensified. Therefore, the problems associated with the efficient and environmentally friendly extraction of this metal is a significant economic and scientific challenge. Despite the fact that the world's lithium resources are relatively large, the possibilities of their exploitation are significantly hindered by the problems of efficient and economically profitable lithium separation. One of the reasons for that situation is the fact, that a significant part of lithium is obtained from brines, not from mineral rocks, as it is in the case of most metals, also a significant part of the mentioned brines has a high content of other metals, primarily sodium, potassium and magnesium. A good example illustrating this problem is the Salar de Uyuni, which is a huge salar in Bolivia, and according to various estimates, it may contain up to 20% of the world's lithium resources. However, the magnesium content in its brines is so high that using current lithium extraction and stripping techniques for the extraction, the whole process is completely unprofitable. This is mainly due to the fact that in order to remove magnesium, it must be precipitated from the brine solution in the form of magnesium hydroxide, which is usually done alkalization of brine up to very high pH values. That is why, in the case of brines for which the magnesium/lithium ratio exceeds 20, it is considered that at current lithium prices, it is not profitable to exploit those reserves. The problem of selective lithium separation is also very important in the processes of recycling and utilization of used lithium-ion accumulators. Most of that recycling installations are located in highly developed countries and thus often with restrictive legal standards regarding the content of metals in wastewater and stored wastes. Therefore, it is one of the priority goals to develop a method of highly effective separation and removal of lithium from used batteries.

3. Planned research and their impact on the development of science and industry

Within the presented research project it is planned to develop a completely new generation of selective lithium adsorbents. One method to achieve this goal will be by using crown ethers, previously developed by the PI, to functionalize the existing adsorbents to maximize their selectivity for lithium ions. However, the main goal of the research will be to develop a method of synthesis of the functional chelating resins based on using an appropriate polymer base (*Cl-PS-DVB*) and the aforementioned crown ethers. This stage of the study will be conducted in cooperation with prof. Eksteen research group at Curtin University (*Perth, Australia*) as part of the internship planned during the presented project. Thanks to the implementation of the mentioned research objectives of the project, it will be possible to obtain novel adsorbents with a completely innovative character. In the future, they can be used for lithium mining from the salars, which exploitation at this moment is not profitable enough. It can be possible thanks to skipping one of the most expensive stages in the lithium extraction process, which is the chemical precipitation of magnesium compounds and significant changes of pH value, needed to carry out this stage. Thanks to that, the potential of global lithium mining would increase significantly, and many of the currently exploited deposits and reserves could bring great economic benefits by reducing the costs of lithium production. Moreover, mentioned functionalized adsorbents, presented in the project can also be used in lithium recovery processes in many kinds of installations for utilization and recycling of used lithium-ion batteries and accumulators.