EFFECTIVE METHODS OF LITHIUM EXTRACTION

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Abstract. *Lithium extraction is a very complex and multi-step process. The most effective methods are vacuum reduction and molten salt electrolysis. The most widely used method is electrolysis. Before electrolysis of lithium salts, it is necessary to bring it to a ready state.*

Keywords: *lithium, lithium salts, lightest metal, electrodes, energy.*

Introduction: Because lithium is the lightest metal, it is widely used in a variety of industrial applications, such as alloys for aircraft, electrodes for batteries, the pharmaceutical industry, and ceramics. With the increased focus on new energy sources, demand for lithium in energy storage is growing rapidly, making it the most popular metal of the twenty-first century, according to sources. Traditionally, lithium metal is mainly produced by two technologies: the vacuum reduction method and the molten salt electrolysis method. For the first method, silicon, aluminum and magnesium are mixed to reduce the oxidation of lithium, and its ore is heated at 1000°C.

For the second method, metal lithium is usually produced by electrolysis LiCl, and the raw material is formed from ore or salt water. The dissolved salt is LiCl-KCl. mass is adapted for electrolysis with a low eutectic point of 625.15 K. These events at each electrode work according to the following electrochemical reactions

$$\text{Cathode } Li^{+} + e^{-} = Li_{\text{ (liquid)}}$$

$$\text{Anode } 2Cl^{-} - 2e^{-} = Cl_{\text{ (gas)}}$$

$$\text{Overall } 2LiCl \rightarrow 2Li_{\text{(liquis)}} + Cl2_{\text{(gas)}}$$

Low-resistance graphite acts as the anode, and steel acts as the cathode. The electrolysis method operates at 693.15 K with a lithium purity of 99%. This method is more mature and stable, that is, it is widely used in industrial enterprises. And a lot of research has been done to improve the electrolysis process. However, the energy consumption for electrolysis is high and the electrolysis efficiency is low. It is important to optimize the lithium electrolysis process to reduce lithium production costs and meet the demand for lithium. The optimization of various parameters such as electrolyte depth, anode-cathode distance (ACD) and electrode height is important for the electrolysis efficiency and energy conservation in such an energy-intensive industrial process. However, conditions such as temperatures above 693.15 K and lack of space inside the electrolysis process make the study unobservable and dangerous. Events within the electrolysis process include mass transfer, momentum transfer, heat transfer, and reaction at the electrodes. The interaction of these phenomena and severe electrolysis conditions reduce the feasibility of experimental research and prevent the discovery of insights into the optimization of the electrolysis process. With the development of computing power, mathematical modeling became available and effective for investigating these mechanisms. electrolysis process. This simulation approach allows safe and cost-effective investigation of phenomena under various factors.

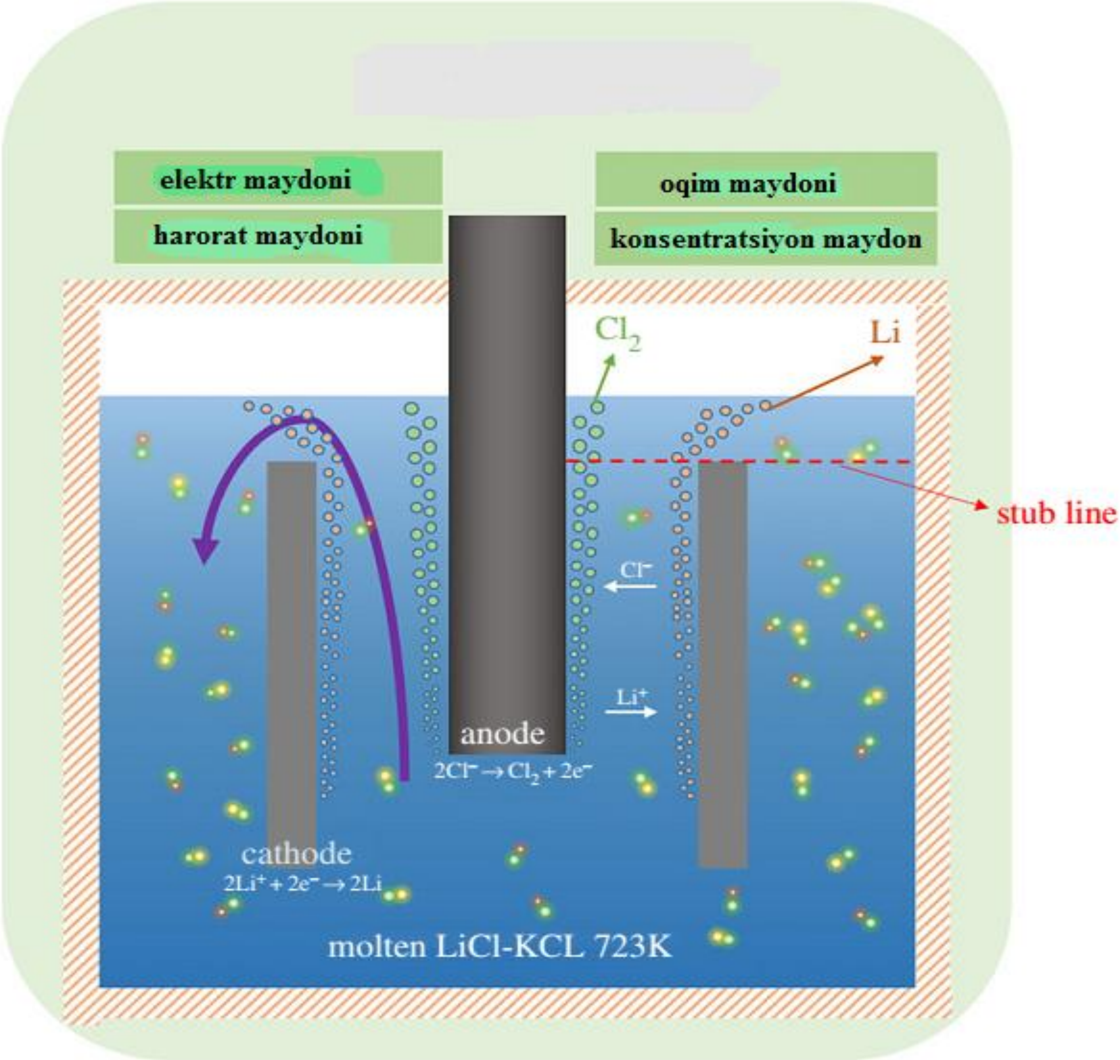
Several studies have been conducted to simulate electrolysis phenomena, such as electrolyte flow and bubble rise. Vogt studied the phenomenon of gas separation and found that it enhances mass transfer. For thermoelectric coupling, some studies have found that the intensity of the current and the height of the electrolyte are important for the thermal equilibrium of the process. It affects the efficiency and production of electrolysis. In the aluminum reduction chamber, developed a multi-block partial least squares modeling approach for multivariate analysis, and developed a micro-scale modeling approach for the monitoring of aluminum refineries and other electrochemical processes and the investigation of bubble dynamics during aluminum smelting. Used a three-dimensional computational fluid dynamic–population balance model to analyze the effects of different process designs and operating parameters on gas–liquid two-phase flows and bubble distribution characteristics under anode subregions. By connecting electric currents, the process of fluorine electrolysis was investigated, heat transfer, transport of diluted species and two-phase flow. However, few studies have focused on the electrolysis process in coupling the mass-electric-concentration fields and the reaction at the electrodes. Process simulation and optimization will be more accurate if the above fields and reactions are taken into account. Several researchers have optimized the lithium electrolysis cell based on the effect of structural and operational parameters on the electric field to increase the electrolysis efficiency and reduce energy consumption. However, no work has been done to optimize the electrolysis cell considering the process secondary reaction, which is one of the important factors affecting the electrolysis efficiency. There are few reports on the simulation of lithium electrolysis.

Based on the above discussion, this study focuses on optimization by adopting structural parameters

Consider the above fields and reaction to properly simulate and optimize the process. To study the influence of various parameters on electrolysis efficiency, a mathematical model with electric-concentration flow fields and reactions was created, which is characterized by lithium production in the cell and energy consumption per kilogram of lithium. By analyzing the concentration of the products in the process, this study considers the reduction of the secondary reaction as an important step to improve the efficiency of electrolysis. Finally, an energy-efficient and cost-effective lithium electrolysis process is developed by analyzing lithium production and the secondary reaction between the metallic lithium droplet and the chlorine bubble.

Lithium (Li) is an essential element in many industries; Li is a metalloid used in solar cells, optical fibers, metallurgy, chemotherapy, and polymerization catalysis. The main sources of Li are sulphide ores of Zn, Pb and Cu, coal mines, as well as by-products and residues from the processing of these ores and coal (eg, smelted flue dust and coal ash). In fact, more than 30% of Li consumed globally comes from recycling processes. Extraction of Li from sulphide ores is mainly based on hydrometallurgical processes, followed by a series of mass transfer techniques (e.g. solvent extraction) to concentrate the Li.

Lithium metal is obtained by electrolysis from a mixture of dissolved lithium and potassium chlorides at a temperature of 400-460°C (the weight ratio of the components is 1:1. Electrolysis baths are covered with magnesite, alum, mullite, talc, graphite and other materials resistant to liquid electrolyte; graphite sturgeons serve as anodes, and iron sturgeons serve as cathodes. Black lithium metal binds mechanical compounds and additives (K, Mg, Ca, Al, Si, Fe, but mainly Na) in its structure. Additions are made by remitting it is purified and lost in low pressure refining method.



1-Figure. Electrolysis process

Al-Li and its alloy containing Cd have found practical use in aviation. It is typically 3% lighter than aluminum alloys, has high ductility (8% higher than aluminum) and can withstand temperatures up to 204°C. Alloys of lithium with magnesium additives improve their performance, reduce the density of magnesium; in case of insufficient magnesium-lithium alloys, it is capable of rusting and decay. Its small amount (around 0.05%) eases the burning process of lead, mainly improves its viscosity, hardness and strength without losing it. In Germany, the bearing alloy Pb-Li-"ban metal" is widely used for the equipment of railway vehicles. This alloy contains 0.73% Ca, 0.58% Na and 0.04% Li, the remaining 98.65% is Pb.

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