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COMPARATIVE LIFE CYCLE INVENTORY ANALYSIS OF TECHNOLOGIES FOR OBTAINING ALUMINUM

Voronina E.N. (ITMO University)
Scientific supervisor – PhD, associate professor Sergienko O.I.
(ITMO University)

Introduction. Aluminum is a vital material in various industries due to its unique properties and versatility; it is used in transportation, construction, packaging and electrical engineering. Aluminum production is carried out through two main technologies: primary aluminum production, which involves extracting aluminum from bauxite ore, and secondary aluminum production, which focuses on recycling existing aluminum products. Secondary aluminum production is much cheaper and more environmentally friendly, as the recycling process requires only about 5% of the energy required to produce primary aluminum from ore [1]. As global demand for aluminum continues to grow, understanding the environmental impacts and efficiencies of these production technologies is becoming increasingly important. The work aims to perform a comparative assessment of the environmental impact of the production of primary and secondary aluminum.

Main part. Primary aluminum production involves several key steps: bauxite mining, alumina production, electrolytic reduction (Hall-Héroult process), refining and casting. Secondary aluminum is produced from recycled scrap, which is classified into new and old based on whether it is generated during production or collected post-consumption. New scrap typically requires minimal sorting and can be directly used in smelting or sent to refiners, while old scrap, sourced from various waste materials, undergoes collection, sorting, pre-treatment, and melting.

The life cycle inventory (LCI) phase involves collecting and organizing data essential for comparing environmental impacts and identifying potential improvements in the aluminum production process. Accurate inventory analysis is critical for understanding resource use, emissions, and sustainability, as it assesses inputs, outputs, and environmental impacts throughout the production stages, from bauxite mining to the final aluminum ingots. Studies from the Aluminum Association highlights the energy-intensive nature of primary aluminum production, detailing the significant energy requirements at each stage and emphasizing the importance of renewable energy sources for reducing carbon footprints [2]. Data from Best Available Techniques Reference Document illustrate the differences in energy demand and emissions between processes using 100% scrap versus those incorporating primary aluminum [3]. Overall, the findings emphasize that secondary aluminum production is more efficient and more environmentally friendly than primary aluminum production.

Conclusions. A review of 2 technologies for obtaining aluminum - primary and secondary - was conducted. An inventory analysis conducted within the framework of the life cycle assessment shows that secondary aluminum production has a significantly lower environmental impact compared to primary production: reducing energy consumption by 15 times, water consumption by 13 times, carbon dioxide emissions by 16 times. A more precise comparative assessment will be carried out at the impact assessment stage.

List of references:

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