Red Mud Recovery: A Zero Waste Solution?

Cory Brolliar  
*Worcester Polytechnic Institute*

Emily Molsstad  
*Worcester Polytechnic Institute*

Connor Murphy  
*Worcester Polytechnic Institute*

William Schwartz  
*Worcester Polytechnic Institute*

Kyle Tyler  
*Worcester Polytechnic Institute*

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Red Mud Recovery
A Zero Waste Solution

Team Members: Cory Broliar (Robotics Engineering), Emily Molstad (Environmental Engineering), Connor Murphy (Aerospace Engineering), William Schwartz (ECE and CS), Kyle Tyler (Environmental Engineering),

Advisors: Prof. Brajendra Mishra

Abstract
The aluminum industry is booming but with its mass production comes large amounts of waste known as red mud. This hazardous waste is not only an economical loss, but has serious environmental impacts such as leaching into the water table. Many attempts have been made to utilize it from forming bricks or mixing it in with cement but these solutions fall short. The struggle to dispose of this waste product may be at an end as we turn to the potential of red mud as a source for commercial materials. Red mud is composed of fair amounts of iron oxide, additional alumina, titanium dioxide, calcium silicate, and trace amounts of rare earth elements. The objective of this project is to establish a system that efficiently extracts these materials individually and sells them to their respective industries. After careful analysis of the processes required for extraction and the profit made from these metals, it has become evident that red mud should no longer be considered a mere waste product.

Conclusion/Recommendation
- Iron Extraction by Fluidized bed reaction with metallurgical coke
- Aluminum Extraction by solid Na₂CO₃ reacting with the Al₂O₃ at 950°C, yielding a water soluble NaAlO₂. Once cooled with water to 25°C, up to 95% of the Al₂O₃ can be extracted in pure form and sold for profit.
- Titanium Extraction by sulfuric acid leaching
- Rare Earths Extraction by autoclaving at 300 °C in presence of 300-500 g of NaOH.
- Calcium Silicate can be used for construction materials
  - Bricks
  - Insulation
  - Portland Cement

 Breakdown of Revenue
- Titanium, 28.44
- Alumina, 407.67
- Scandium, 907.1636
- Calcium Silicate, 1.352

Total Revenue: $1.4 Trillion

Composition of Red Mud by Percent Weight
- Iron Oxide 30%
- Calcium Silicate 17%
- Scandium 0.2%
- Titanium Dioxide 8%
- Other 18%
- Other 18%

Red Mud Accident in Karba, Serbia
Statistical Modeling of Sulfuric Acid Leaching of TiO₂ from Red Mud.
Titanium Alloy Production Technology, Market Prospects and Industry Development
- Cool Solution 950°C
- Sodium Aluminate Dissociates in Water
- Slag Leached with Sodium Hydroxide
- Filter
- 90°C
- Slag + Sodium Hydroxide
- Autoclaving 300°C
- Scandium
- Calcium Silicate
- Titanium