Comparison on the physicochemical properties of alumina extracted from various aluminum wastes

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ABSTRACT
Aluminum production, which is primarily derived from bauxite mines, increased dramatically worldwide throughout the year. This phenomena results in an increase in aluminum waste in landfills, which creates an environmental hazard. Furthermore, it reduces the groundwater quality due to the toxicity of metal ions and flammable gases released from the process. Therefore, a recycling strategy is needed to reduce the negative environmental impacts of aluminum waste. Aluminum oxide (Al_2O_3), or commercially known as alumina, can be extracted with a low-cost method. From literature, it was found that the extraction of Al_2O_3 from aluminum waste only requires 5% of the total energy needed, making it a cost-effective recycling method. Al_2O_3 is commonly extracted from Bayer process, but the technology used to produce Al_2O_3 leads to high electricity and fuel consumption. Alternative extraction methods for Al_2O_3 have been extensively investigated, including sol–gel, hydrothermal, and leaching-precipitation procedures. Although the extraction of Al_2O_3 has been widely studied, the comparison on physicochemical properties of Al_2O_3 from various aluminum waste (i.e. aluminum dross (AD), aluminum foil (AF) and aluminum can (AC)) has not been explored. Therefore, this paper evaluates the physicochemical properties of Al_2O_3 extracted from AD, AF and AC. All the extracted Al_2O_3 was prepared using acid leaching technique and from the analyses conducted, Al_2O_3 extracted from AD having the highest percentage of Al_2O_3 than AC and AF. The experiment was then extended by investigating the effect of calcination temperature source (i.e. 700, 800, 900, 1000 and 1100 °C), utilizing the best alumina source. The results showed that the phase of Al_2O_3 transformed from $\gamma \rightarrow \theta \rightarrow \kappa \rightarrow \alpha$ with the increased in calcination temperature. This indicates that the extraction technique and calcination temperature play important role in the extraction and transformation of Al_2O_3 phases.

KEYWORDS
Effect of calcination; Aluminum dross; Aluminum foil; Aluminum can; Leaching; Alumina

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