

Lead-free X-ray Shielding System fabricated from Red Mud: A Waste to Wealth Approach

Shivani

CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal, India
Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, India

Alka Mishra

CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal, India
Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, India

Neeraj Dwivedi

CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal, India
Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, India

Abstract:

Red Mud (RM), a highly alkaline (pH 10-13) and oxide-rich by-product of the alumina industry, produced in massive quantities, about 1-1.5 tons per 1 ton of alumina production. Its accumulation in especially designed clay-lined ponds pose serious environmental and economic challenges due to costly disposal requirements. Owing to its rich composition of metallic oxides, RM presents a sustainable opportunity for value-added applications. In this study, X-ray shielding composites were successfully fabricated via economically viable solution casting route using RM (up to 90 wt%) in a polyvinyl alcohol (PVA) matrix. The resulting composites exhibited a significant rise (upto 1.76 cm^{-1}) in linear attenuation coefficient (LAC) values with increasing RM content, confirming enhanced shielding efficiency. Structural and morphological analyses were performed to understand shielding behavior. The work highlights the RM's potential as a low-cost, eco-friendly material for high-performance X-ray radiation shielding applications.

Keywords:

Waste to wealth, sustainability, radiation shielding, economically viable.