

# Development of Low Carbon Composite Cement Using Performance Improved Thermo-mechanical Activated Pozzolanic Red Mud for Sustainable Development

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**Abstract:** Red mud (RM), now more frequently termed bauxite residue (BR), is an industrial waste generated during bauxite processing into alumina using the Bayer process. It is composed of various oxides including iron oxides which give its red colour. The Bayer process accounts for more than 95% of global alumina production, generating approximately 1 to 1.5 tons of red mud for every tons of alumina produced. In 2020, the annual alumina production exceeded 133 MT, resulting in the generation of over 175 million tons of red mud all over the world. Red mud has a high alkaline pH and contains various chemical compounds. When it comes into contact with water in a landfill, it can leach out alkaline substances and other potentially harmful components. This leachate can contaminate the surrounding soil and groundwater, leading to environmental pollution. Therefore, red mud should be used in building construction material specifically red mud as a pozzolanic material in OPC. As, the reactivity of RM is slightly higher than that of inert fillers, but this can be slightly increased by co-calcination at higher temperatures. Also, Co-calcination reduced the mobility of heavy metals significantly. The reactivity of the calcined BRs can be assessed via the heat release in the R3 test (ASTM C1897-20) etc. The sodium-containing phases interacted with the kaolinite during co-calcination, producing a supplemental cementitious material with high reactivity and low free-sodium concentration.

## Objectives:

- Characterization of raw materials such as red mud, fly ash, additives etc.
- Investigation of the effect of calcination at different temperatures
- Assessment and optimisation of appropriate clinker replacement ratio
- Evaluation of the imparted pozzolanic properties of red mud -induced cement clinker
- Examination of the concrete properties (such as fresh, hardened, microstructural and durability attributes) with composite cement derived from red mud
- Life - Cycle Assessment of thermo - chemically activated red mud - based concrete

