

ABSTRACT

The Development of a Building Material from Jamaican Bayer Process Waste (Red Mud)

Junior N. Gordon.

Red Mud is produced in large volumes in Jamaica and its environmentally safe storage is a very important consideration for the alumina processing companies especially when, over time, new storage areas must be found to replace exhausted ones. The possibility of using up large volumes of this waste in some industrial activity, has for a long time been mooted as a possible way to slow down the rate of exhaustion of existing storage areas and thereby reduce the demand for new ones to be found. The use of red mud as a major component in building materials provides a possible way to achieve this objective, given that the inclusion of red mud does not prejudice the economic, engineering, and safety considerations associated with its use.

This thesis examines the possibility of producing a building material from red mud using a structured approach in which,

- (a) the inherent strength and weather resistance properties of dried red mud are identified and quantified,
- (b) the chemical basis of these properties is explored and identified, and
- (c) the improvement of these properties is attempted through the use of simple, easily available additives.

The results indicate that building bricks produced with red mud only, meet a minimum strength standard for building bricks of 7 MPa and a minimum weather resistance standard. A mixture of hydrated lime and condensed silica fume in a 2:1 ratio by mass, when added to the mud under conditions which promote a chemical reaction between the components, produces strengths of over 18 MPa in red mud composites. The rate of strength development with time is observed to follow a trend similar to that of portland cement concrete.

The chemical analysis of the composites using X-Ray Diffraction, Scanning Electron Micrography and Thermal Gravimetry techniques indicate the possible formation of stratlingite ($\text{Ca}_2\text{Al}_2\text{SiO}_7 \cdot 8\text{H}_2\text{O}$) as the basis of the improved strengths of the composites containing red mud, lime and silica.