Large-scale Valorization of Bauxite Residue for Inorganic Polymers

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Abstract

A process is suggested in this paper to valorize bauxite residue (BR) on a large-scale. The resulting material is a binder that can be used, depending on its properties, in the production of bricks and tiles, or as an aggregate which can be safely stored in landfills or used in concrete or asphalt. The strategy is to develop a precursor that upon mixing with alkalis will lead to an inorganic polymer. To achieve the above, thermodynamic calculations were carried out. It was found that reducing conditions and additional silica promote the formation of an Fe^{2+}-rich liquid phase during heating, which is expected to result in an amorphous phase upon solidification. In practice, this implies minor additions of silica and carbon to the bauxite residue, and firing at temperatures of about 1200 °C to produce a semi-glassy precursor. Experimental work verified the above hypothesis and indeed a highly reactive alkali activated binder was formed. Mixing this binder with “fresh” filter-pressed BR at a ratio 3:7 led to a hard, water-insoluble, reddish composite that can find different applications. An industrial implementation seems to be straightforward since existing installations can be adapted and only minor additions have to be carried out.

Keywords: Bauxite Residue; valorization; inorganic polymer; aggregate; firing.