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The Effect of Micro/Nano-metrics Size on the Interaction of Jordanian Aluminosilicate Raw Materials with High pH Solution

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Abstract

Environmental preservation has become a driving force behind the search for new sustainable and environmentally friendly composites to replace conventional concrete produced from ordinary Portland cement (OPC). Current researches concentrate on developing building products (geopolymers) through geopolymerization. The goal is to produce low cost construction materials for green housing. Geopolymerization is the process of polymerizing minerals with high silica and alumina at low temperature by the use of alkali solutions. Dissolution is the most important process for supplying the high initial Al and Si concentrations to produce the gel phase that is responsible for geopolymerization.

This study has been focused on the influence of different micrometric particle sizes of three Jordanian raw materials on their dissolution behavior in sodium hydroxide solution. The samples are kaolinite, volcanic tuff and silica sand. The dissolution properties of each material, alone and mixed with the other two materials were studied in different concentrations (5 and 10 M) using (NaOH) at 25ºC, and shaking time for 24 and 168 h. To better understand the dissolution process, the alkaline solution was renewed after the desired time in order to know if the Al-Si raw material is completely dissolved or not. Different analytical techniques were used to characterize raw materials physically, mineralogically, chemically and thermally. All processed samples either centrifuged solutions or solid residues were fully characterized. The leached concentrations of Al and Si were determined by inductively coupled plasma (ICP). X-ray Diffraction Technique (XRD), Scanning Electron Microscopy (SEM), and Thermo Gravimetric Analysis (TGA) were used to evaluate the solid residue characterization compared with the original ones.

The three aluminosilicate raw materials have indicated variable degrees of solubility under highly alkaline conditions. The method for the size reduction of the used raw materials achieved by using a ball mill increased the dissolution rate owing to the increased surface area of the material or particle exposed to the solvent. The used Jordanian raw materials are potential to be used for geopolymerization.

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