

Adaptation of Eco-Friendly Approach in the Production of Soluble Pozzolanic Material

Andri Kusbiantoro¹, Rahimah Embong¹, Nasir Shafiq²

¹*Faculty of Engineering Technology, Universiti Malaysia Pahang*

²*Department of Civil and Environmental Engineering, Universiti Teknologi PETRONAS*

Abstract

Silica gel made of natural waste materials of sugarcane bagasse has initiated a new trend in pozzolanic area. The employment of eco-friendly approach by using low concentration acids and natural drying via solar heat based equipment in the pre-treatment process were projected to minimize the energy consumption in producing silica ash. Conversion of ultrafine silica ash from sugarcane bagasse into silica gel was conducted by-using a modified hydrothermal method. NaOH and HCl solution were employed in the dissolution and gelification of soluble silica. Analysis on the effect of silica gel in cementitious system was evaluated by including it in mortar specimen as a pozzolan to replace certain portion of Portland cement. Inclusion of additional siliceous gel showed enhancement in the cement hydration process, which resulted in early hardening and consolidated formation of cement matrix to further contribute in the strength development. Measurement of pozzolanic reactivity of silica gel via Chapelle method verified the active consumption of $\text{Ca}(\text{OH})_2$ by the soluble silica, which illustrates the possible formation of secondary calcium silicate hydrate (C-S-H) from the pozzolanic reaction. Densification of pore structure via large voids were observed via porosity test at age of 7 and 28 days. Based on the experimental result in this study, silica gel has presented an encouraging prospect to be used as a cement replacement material. Its rapid reaction during the early age would be beneficial in providing early strength properties to the cement based product.

Keywords: sugarcane bagasse, silica, eco-friendly, pozzolanic materials