Interaction of Organic Liquid with Metakaolin-based Geopolymer

***Fang[1] C, Elakneswaran[2] Y, Niu[1] X, and Hiroyosi[2] N**

[1]Graduate School of Engineering, Hokkaido University, Japan
[2]Faculty of Engineering, Hokkaido University, Japan

*Corresponding author – chuweifang97@gmail.com

Abstract

In recent years, there has been growing interest in geopolymer cement as a more sustainable alternative to traditional concrete. Metakaolin-based geopolymers have a high capacity to immobilise radioactive cations such as Cs^{+} and Sr^{2+} via an ion exchange mechanism. In the meantime, the geopolymer has a high potential to solidify organic liquid waste and has been considered for developing porosity-controlled materials. However, the interaction mechanism between organic liquid and metakaolin-based geopolymer has not been fully understood. In this study, the appropriate control of organic liquid in the geopolymer has been studied. Firstly, alkali-activated solution (K_2O:SiO_2:H_2O molar ratio of 1:1:13) was mixed with the lubricant (FBK Turbine 32) and cationic surfactant (CTAB) to form an emulsion. Then metakaolin-based (Sobueclay) geopolymers were synthesised in the emulsion (Al: Si molar ratio of 1:1). The interaction mechanism between the oil with emulsion and geopolymer (with or without surfactant) was evaluated using the zeta potential, paste slump flow, SEM, and compressive strength. The metakaolin-based geopolymer could not solidify the oil. However, the geopolymer can successfully solidify oil content with the help of a surfactant that changes the surface of the oil from negative to positive, allowing it to interact with the opposing surface of the geopolymer. However, the compressive strength of the resulting composite decreased as the oil content increased due to an increase in porosity, and as the hydration products filled the pores over time, the strength increased. These findings suggest that geopolymer could be a promising solution for solidifying oil. However, careful consideration must be given to the porosity induced by the presence of oil to ensure that the resulting composite has sufficient strength for its intended application.

Keywords: Geopolymer-oil, Surfactant, Solidification, Interaction, Porosity