Effect of Dehydration on Mechanical Properties of Metakaolin-base Geopolymer

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Key words: geopolymer; metakaolin; dehydration; temperatures

Introduction

As catalyst supports in the nuclear waste containers in Fukushima Daiichi Nuclear Power Station, geopolymer is required to show high strength, low porosity, and durability. Geopolymer with a high-water content [1] may form larger pores and larger pore volumes, which degrade the mechanical strength. Thus, geopolymer with a lower water content results in a dense product with smaller pores and a better mechanical strength [2]. In the present work, dehydration of geopolymer was carried out.

Experimental

Geopolymer samples were made of AFACO silica, potassium hydroxide, potassium silicate solution, and two types of metakaolin powders, with molar ratios of Al: Si: K: H_2O =1:2:1:8. After mixing the raw materials, the mixture was poured in molds with caps. The samples were initially cured at 60ºC for 4 days and then kept at RT. Then, one sample was completely demolded, while the other sample was left in the mold without the cap to change the water release rate. Then, the same experiments were carried at the latter curing temperature of 60ºC and 80ºC. From comparing the mechanical properties and result of dehydration of geopolymer at different latter curing temperatures to analysis the effect of dehydration on geopolymer.

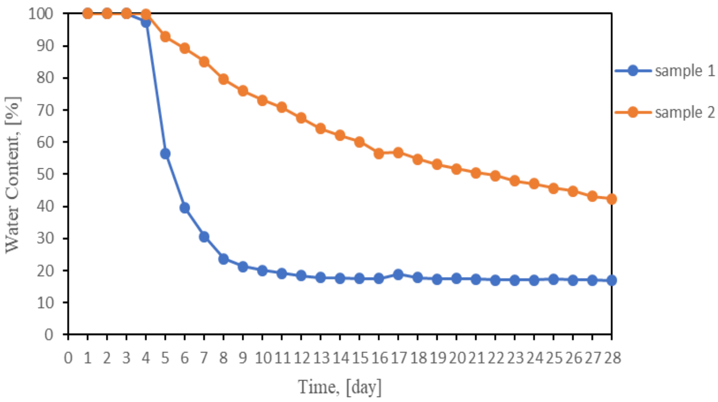

Figure.1 Water content change during curing

Results

Water content in the samples change during curing is shown in Fig.1. In the demolded samples, the water content quickly decreased to less than 30% within 7 days, while, in the open cap sample, more than 50% of water remained after 28 days. Pore size distributions for the samples are shown in Fig 2. The average pore size was 1.53x10^2 μm and 1.51 x10^2 μm for the molded and the open cap sample, respectively.

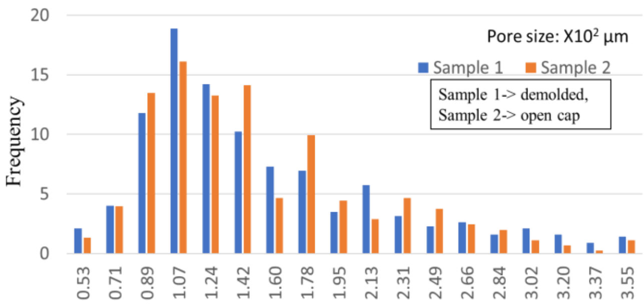

Figure.2 Pore size distribution from SEM images

Discussion

In liquid, pressure in a pore is inversely proportional to the radius and proportional to the surface tension which may relate to the viscosity. In the present sample it is expected the dehydration can increase the viscosity [1]. From Fig 2, the average pore sizes are almost the same for the demolded (fast dehydration) and the open cap (slow dehydration) sample. This implies that the pores were formed at a certain viscosity and a single chemical reaction (dehydration) was the origin of the pore formation.

Reference

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