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論 文 内 容 の 要 旨
Abstract of Dissertation

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Geopolymers are inorganic, typically ceramic, alumino-silicate forming long-range, covalently bonded, amorphous networks. Due to its special porous structure, geopolymer itself has many excellent physical and chemical properties, such as high porosity, thermal stability, and chemical inertness. Therefore, geopolymers are often used as alternatives to concrete for insulation and radioactive waste solidification. In this study geopolymers were attempted to apply for catalyst support in PAR and for radioactive aluminum compaction in JMTR by controlling the pore distribution of geopolymers.

The geopolymer samples in this research were made of AFACO silica, metakaolin powder, potassium hydroxide and potassium silicate solution. Samples were synthesized with same molar ratios of Al: Si: K: H_2O =1: 2.1: 0.8: 8, but different post curing conditions after 4 days initial cured at 60℃. The result showed that average pore sizes were almost the same for the demolded (fast dehydration) and the open cap (slow dehydration) samples. This implies that the pores may form in the first 4 days at a certain viscosity. A single chemical reaction (dehydration) was likely to be the origin of the pore formation and to take place at the same viscosity and irrelevant to the curing condition.

In the next research geopolymer samples were synthesized with the same molar ratios and cured sample at 60℃ from 1 to 4 days but different post curing conditions (open lid and with lid) for studying the air tightness on pore forming process. The results showed that the pores were with similar average sizes, and might have been formed within a day. The average pore sizes of the samples with lid were smaller than or the same as the one without lid. In the sample with lid, the water was kept in the mold, it might increase the pressure inside the mold, the pressure on the internal pores increased and the formation of larger pores was hindered. This may result in the formation of smaller pores in the samples with lid.

In this thesis geopolymers were used to compact radioactive aluminum material. The geopolymer was synthesized with different water content and cured at different initial temperatures. After electron irradiation up to 992 kGy, the Vickers hardness at 110 MPa did not change significantly with water content. The geopolymers in this study are stable enough to be used as catalyst support materials and compaction materials for radioactive aluminum ions.