Leaching of potassium and metakaolin based geopolymer and mechanical properties under electron irradiation

*Yaru Yang[1], Thi-Chau-Duyen Le[4], Thi-Mai-Dung Do[1,2], Koichi Niihara[1], Tadachika Nakayama[1], Gordon Thorogood[1,4] and Hisayuki Suematsu[1]
[1]Extreme Energy-Density Research Institute, Nagaoka University of Technology, 1603-1 Kamotomioka-cho, Nagaoka, Niigata 940-2188, Japan
[2]Department of Nuclear System Safety Engineering, Nagaoka University of Technology, 1603-1 Kamotomioka-cho, Nagaoka, Niigata 940-2188, Japan
[3]ANSTO, New Illawarra Rd, Lucas Heights, NSW, 2234, Australia
[4]Dandang University of Science and Technology,
[5]Nguyen Luong Bang, Lien Chieu, Danang City, Vietnam

Abstract

Geopolymers are inorganic polymers composed of AlO_4 and SiO_4 tetrahedral structural units and a three-dimensional network structure. The stability of geopolymer under irradiation is important. After the decommissioning of JMTR, the geopolymer treatment method for difficult waste ion exchange. Leaching experiments will be used to detect the compaction of geopolymers for radioactive aluminum ions.

Keywords: Geopolymer, irradiation, ion- exchange, hardness, leaching

Introduction

With the development of the nuclear industry, there are inevitable problems of nuclear power plant decommission and nuclear waste disposal. The disposal of some radioactive metal ions, in particular aluminum alloys from the JMTR reactor core, has not yet been well solved. Geopolymers are inorganic polymers with a three-dimensional network structure [1]. This structure can adsorb metal ions in the framework [2]. Utilizing this property, we have proposed geopolymers being used to compact radioactive aluminum ions by replacing a part of the raw materials in this research.

Experiment

Geopolymer samples were made of EFACO silica, metakaolin powder, potassium hydroxide and potassium silicate solution with molar ratios of Al: Si: K: H_2O =1: 2.1: 0.8: (7, 8, 9,10). 6 Samples were synthesized and divided in to 3 groups, then cured at RT, 40℃ and 60 ℃ for 1 day with lid respectively in curing 1. In curing 2, all the samples were moved to RT. For one of the samples in each group, the lid was opened while for the others, the lid was kept sealed until the 7 days.. The potassium and metakaolin-based geopolymer was irradiated by ETIGO-III at a peak voltage 2MeV, current 5kA and a pulse with of 100 ns from one to four shots. A Vickers indenter was loaded at 1 kgf to analyze Vickers hardness.

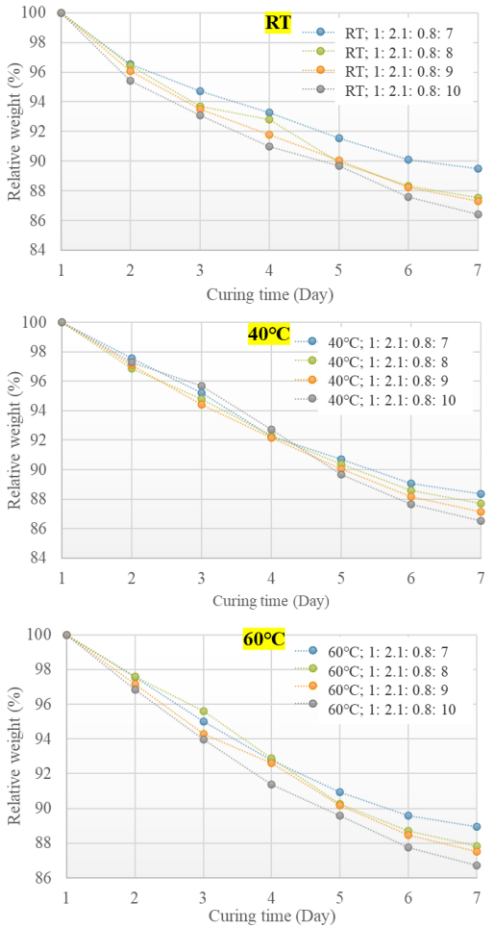

Fig. 1 Vickers hardness of geopolymer before and after irradiation

Results and Discussion

In this research, the potassium and metakaolin-based geopolymer with different water content have been synthesized. The Vickers hardness will be measure before and after irradiated by ETIGO-III at a peak voltage 2MeV, current 5kA and a pulse with of 100 ns at room temperature from one to four shots. The relative weight change was measured during curing as shown in Fig.1, the result showed that higher water content relative weight decreases more, however not so much different (the range of relative weight decrease was from 10% to 14%).

References

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