pH and Electric Conductivity of Cement Solidification of Metal Hydroxide Waste

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1. Introduction

A lot of uranium soil waste from a uranium conversion facility has been stored in KAERI since 2010. The study of decontamination for uranium soil waste has been conducted [1-2]. Radioactive material (concentrated liquid waste, waste resin, waste sludge) generated from the decontamination process has to solidify and pass the integrity test of KORAD (Korea Radioactive Agency) for permanent disposal. For permanent disposal, a study on cement solidification of the radioactive waste is requested. Several studies on cement solidification of the radioactive waste have been carried out [3-7].

In this study, to study the characteristics of cement solidification on metal hydroxide waste for permanent disposal, the experiment for the solidified cement was performed. The pH and electric conductivity of cement solidification, which was immersed in demineralized water for a specified time, were measured and analyzed on sampling time.

2. Experiment and result

2.1 Experiment and measurement

2.1.1 Sample preparation. Table 1 shows test conditions of cement solidification. According to Table 1, water, Portland 1 species, and waste were homogeneously mixed using a Morter Mixer (HJ-1150). The mixing material is put into a polyethylene mold (ID 50 mm, H 120 mm) and solidified for 4 weeks. After solidifying the mixing material covered with vinyl for 4 weeks, cement solidification was fabricated.

Samples were prepared (diameter 50 mm, height 100 mm) by cutting the solidified cement with micro cutter. The samples were immersed in demineralized water for 90days.

Table 1. Test conditions

Specimen	Waste (g)	Cement (g)	Water (g)
C-2.0-60	2.0(106.95)	1(53.481)	1.80(96.253)
C-2.0-70	2.0(97.560)	1(48.786)	2.10(102.44)
C-2.0-80	2.0(89.687)	1(44.849)	2.40(107.62)
C-1.8-60	1.8(103.56)	1(57.541)	1.68(96.657)
C-1.8-70	1.8(94.435)	1(52.471)	1.96(102.83)
C-1.8-80	1.8(86.788)	1(48.221)	2.24(108.00)
C-1.6-45	1.6(116.60)	1(72.890)	1.17(85.270)
C-1.6-50	1.6(110.30)	1(68.970)	1.30(89.640)
C-1.6-60	1.6(99.620)	1(62.270)	1.56(97.130)

2.1.2 Measurement. The purpose of the immersion test for cement solidification is to evaluate durability of cement solidification at a permanent disposal site. The pH and electric conductivity of cement solidification, which was immersed in demineralized water for a specified time (1 day, 3 days, 7 days, 14 days, 47 days, 90 days), was measured.

2.2 Result and discussion

Fig. 1 shows the pH of cement solidification. The pH of deminerialized water was about 5. The pH of the solidified cement, which was immersed in demineralized water, had some fluctuation from day 1 of sampling until day 47 of sampling. It approached about 13 after 40 days of sampling. The immersion test on cement solidification indicates a strong alkali property.

Fig. 2 indicates the electric conductivity of cement solidification. The electric conductivity of deminerialized water was about 0.5 mS/m. The electric conductivity of cement solidification, which was immersed in demineralized water, shows a rapid increase from day 1 of sampling until day 7 of sampling. After 47 days of sampling, a saturation trend is shown. The solidified cement, which contains many cement components, shows a bigger electric conductivity, while the solidified cement that contains many waste components shows a smaller

electric conductivity. It was determined that the amount of cement has a strong influence on the electric conductivity compared with the waste amount.

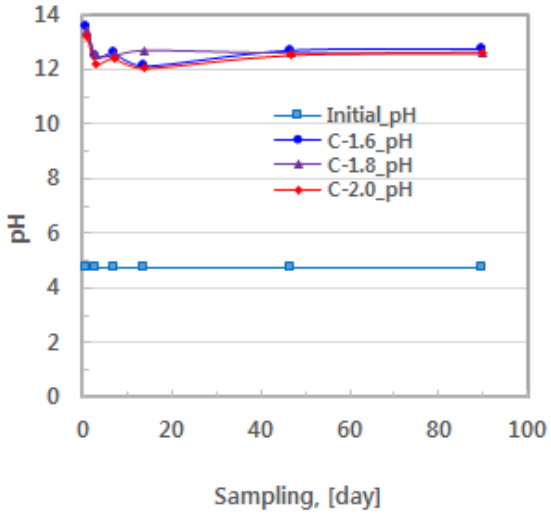

Fig. 1. pH of cement solidification.

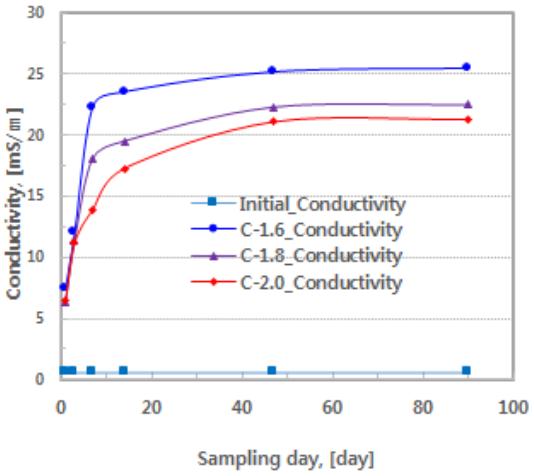

Fig. 2. Electric conductivity of cement solidification.

3. Conclusions

To study the characteristics of cement solidification on metal hydroxide waste for permanent disposal, the pH and electric conductivity of solidified cement was measured and analyzed. The pH of solidified cement immersed in demineralized water indicates some fluctuation from day 1 of sampling until about day 40. It approaches about 13 after 40 days of sampling. The immersion test on cement solidification indicates a strong alkali property. The electric conductivity of solidified cement immersed in demineralized water shows a rapid increase from day 1 of sampling until day 7. After 47 days of sampling, a saturation trend is shown. The solidified cement that contains a large cement component shows greater electric conductivity, while the solidified cement that contains many waste components shows smaller electric conductivity. It was determined that the amount of cement has a strong influence on the electric conductivity compare with the waste amount.

REFERENCES

[1] G.N. Kim, S.S. Kim, H.M. Park, W.S. Kim, J.K. Moon, J. H Hyeon, “Development of Complex Electrokinetic Decontamination Method for Soil Contaminated with Uranium”, Electrochimica Acta, 86, 49-56 (2012).

[2] G. Kim, H. Won, W. Oh and C. Jung, A Study on Aging Effect in Removal of Radionuclides from Soil by Electrokinetic Method, J. Korea Society of Waste Management, Vol. 21, No.3, pp. 243-252, (2004).

[3] G.N. Kim, H.J. Won, C.H. Jung, J.H. Yoo, W.Z Oh, “Effect of pH on Soil Remediation by Electrokinetic”, Journal Korean Solid Wastes Engineering Society, 17, 781-788 (2000).

[4] G.H. Jeong, K.J. Jung, S.T. Baik, U.S. Chung, K.W. Lee, S.K Park, D.G. Lee, H.R. Kim, Solidification of Slurry Waste with Ordinary Portland Cement, Report. KAERI/RR-2194/(2001).

[5] S.W. Shin, K.D. Kang, H.S. Kim, J.K Son. Y.J. Choi, Studies on Test and Assessment of Immobilization and Clearance Methodology for Soil and Uranium Wastes, Report. KAERI/CM-758/(2003).

[6] J. H Kim, B. G. Ahn, H. Y Kim, H. H Park, A Study on the Solidification of Borate Wastes using Cement, J. of Waste Management 6(2), 161-166, (1989).

[7] Y.J. Lee, K.W. Lee, B.Y. Min, D.S. Hwang, J.K. Moon, “The Characterization of Cement Waste Form for Final Disposal of Decommissioning Concrete Wastes”, Annals of Nuclear Energy, 77, 294-299 (2015).