Fluidity of Cement Solidification of Residual Radioactive Waste

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1. Introduction

About ten-thousand drums of uranium soil waste from the demolition of a uranium conversion facility have been stored from 2010 until now at KAERI. The cost of their permanent disposal is very expensive. To solve this pending problem, a study on electrokinetic decontamination of uranium soil waste has been conducted. The technology of electrokinetic decontamination eliminates contaminated material in soil using a direct current. It enables various contaminated materials such as heavy metals, radioactive elements, and organic materials in soil to be removed with low permeability. Residual radioactive waste is generated from the process of electrokinetic decontamination of uranium soil waste [1-2]. To perform permanent disposal of residual radioactive waste, a study on its cement solidification has been conducted [3-5].

In this study, a fluidity experiment of cement solidification has been conducted to analyse the characteristics of cement solidification on residual radioactive waste. The compressive strength of the specimens of moulding cement solidifications has also been measured and analyzed.

2. Main title

2.1 Experiment and measurement

2.1.1 Specimen preparation. To prepare the specimens, cement (Portland cement type I) and water were mixed, and waste was also mixed together using a mortar mixer (HJ-1150) according to Table 1. The mixed materials were solidified for 4 weeks by covering vinyl on them. The cylindrical moulding cement solidifications were cut into 50mm diameter and 100 mm height using a micro cutter. The equipment (HCT-DC50) shown in Fig. 1 was used to measure the compressive strength of cement solidification. The receiving criterion on the compressive strength of KORAD (Korea Radioactive Waste Agency) is 34 kg·f/㎠.

Table 1. Condition of Flow Test for Cement Solidification

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)

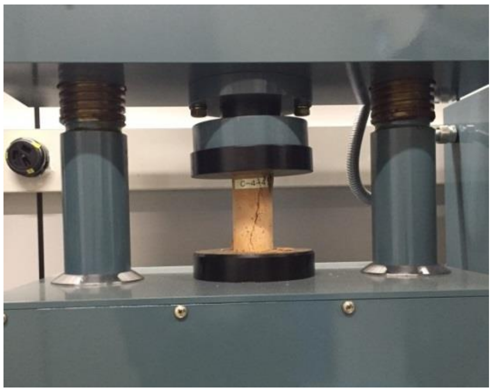

Fig. 1. Measurement of compressive strength.

2.1.2 Fluidity analysis of cement solidification. Tables 2~4 show the fluidity results of cement solidification (C-1.6, C-1.8, C-2.0) for residual metal hydroxide waste. The fluidity of cement solidifications is different from the ratio of cement to waste. As the quantity of water increases, the fluidity of cement solidifications showed an increasing trend. The workability of cement solidifications based on the receiving criterion of the compressive strength of KORAD was about 175~190%. Table 5 shows the compressive strength of cement solidification (C-1.6, C-1.8, C-2.0). The compressive strength of the cement solidifications (C-1.6-45, C-1.8-60, C-2.0-60), which have relatively small ratios of waste and cement to water, showed an increasing trend. The compressive strength of all cement solidifications (C-1.6, C-1.8, C-2.0) was acceptable for the receiving criterion of the compressive strength of KORAD. As the amount of water of each cement solidification increases, the compressive strength of its cement solidification showed a decreasing trend.

Table 2. Condition Result of Flow Test for Cement Solidification(C-1.6)

Round	C-1.6-45	C-1.6-50	C-1.6-60
1	166%	182%	240%
2	168%	184%	217%
3	164%	185%	216%
4	162%	181%	219%
Average	165.0%	183.0%	223.0%

Table 3. Condition Result of Flow Test for Cement Solidification(C-1.8)

Round	C-1.8-60	C-1.8-70	C-1.8-80
1	183%	209%	220%
2	185%	212%	219%
3	190%	207%	225%
4	188%	200%	226%
Average	186.5%	207.0%	222.5%

Table 4. Condition Result of Flow Test for Cement Solidification(C-2.0)

Round	C-2.0-60	C-2.0-70	C-2.0-80
1	170%	200%	210%
2	175%	200%	225%
3	180%	210%	220%
4	174%	204%	213%
Average	174.8%	203.5%	217.0%

Table 5. Compressive Strength of Cement Solidification

Specimen	Compressive Strength (kg·f/㎠)		
C-2.0-60/70/80	124.49	86.225	64.898
C-1.8-60/70/80	127.55	99.490	82.857
C-1.6-45/50/60	174.90	169.18	131.94

3. Conclusion

An experiment for the fluidity of cement solidification was conducted to analyse the characteristics of cement solidification for residual radioactive waste. As the quantity of water increases, the fluidity of cement solidification shows an increasing trend. The fluidity of cement solidification is different from the ratio of cement to waste. As the quantity of water increases, the fluidity of cement solidification for residual radioactive waste shows an increasing trend. The workability of cement solidification shows about 175~190%. The compressive strength of all cement solidifications (C-1.6, C-1.8, C-2.0) was acceptable for the receiving criterion of compressive strength of KORAD. As the quantity of water for each cement solidification increases, the compressive strength of its cement solidification showed a decreasing trend.

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