A Fundamental Study for Development of Radioactive Waste Content and Solidifying During the Dissolution of Concrete in Decommissioning Nuclear Power Plant

Youngbum Mun*, Hyunkook Choi, Jaeyoung Kim, and Donghee An

Sungshin Cement Co., LTD, 48-37 Bugang oecheon-ro, Bugang-myeon, Sejong, Republic of Korea

*heromyb@sscem.com

1. Introduction

It is a concrete waste that occupies the largest amount of waste produced in the process of decommissioning a nuclear plant. In the concrete of the radioactive elements of the paste (the curing of the cement and water) is present in most cases, selectively separating the parts of the radioactive concrete waste volume can be greatly reduced.

The purpose of this study is to obtain the basic data necessary for the development of the solidification technology for radioactive waste disposal by restoration of hydration ability by through firing the paste part contaminated with radioactivity among radioactive concrete wastes.

2. Experiments

2.1 Materials

The paste was made W/B = 40% and cured for 28 days. For making the paste as the sample powder of solidification agent, crashed to a size of several millimeters using jaw-crasher. And they were dried at 100 °C to remove un-acted water. Also it was ground as same particle size to cement using ball mill.

2.2 Experiment methods and items

In order to sift the waste portion of the concrete and the sand, the fluorescence X-ray analysis method by the analysis of the XRF(x-Ray-Fluorescence, Rigaku, Japan, ZSX primus Ⅱ) analysis device was used, In order to analyze the correlation between chemical composition of paste and sand, each 10% was mixed at a constant ratio.

In order to be used as a solidifying, the hydration of the cementitious materials is required. Therefore, the calcination temperature of the previous 500 to 900℃ calcination temperature test results based on the thermal decomposion mechanism, the method for recovering the reactive hydration was carried out by 600℃.

Mortar compressive strength was measured according to KS L ISO 679 for evaluation of strength development.

2.3 Result of Paste Content calculation

The results of the XRF analysis for chemical composition according to the volume of paste and sand are expressed in table 1. Cao ingredients can be seen that the paste contains a large amount of SiO_2 in the sand, and the presence of 10% content at a certain rate.

Table 1. XRF analysis of Samples

No	Mixture ratio(%)		Chemical composition(%)		
	Paste	Sand	CaO	SiO_2	Al_2O_3
0	100	0	70.3	18.3	2.8
1	90	10	69.0	20.0	2.8
2	80	20	67.2	21.8	2.8
3	70	30	63.0	26.4	2.7
4	60	40	58.2	31.7	2.6
5	50	50	52.1	38.6	2.4
6	40	60	43.6	48.0	2.2
7	30	70	34.1	59.0	2.0
8	20	80	24.5	70.1	1.6
9	10	90	11.6	85.2	1.0
10	0	100	0.1	98.8	0.4

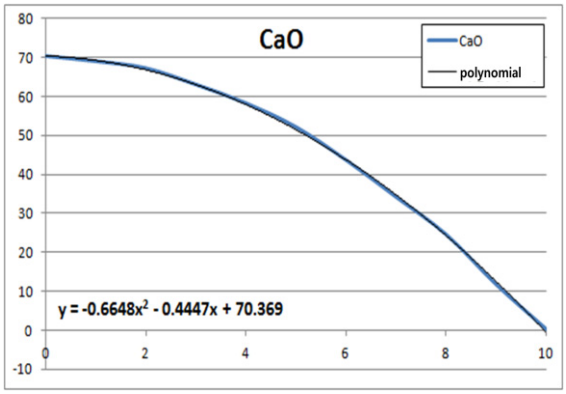

Fig. 1. Calculation of paste content.

The result according to an estimated formula based on the CaO ingredient that contains a large amount of waste is shown in Fig. 1. If you apply it by analyzing the CaO content of the recycled concrete, it is judged to be able to easily predict the content of the waste paste.

2.4 Result of compressive strength and Heat

Based on Table 1, the compressive strength of 28 days is shown in Fig. 2. 0, 1, 9, and 10 were analyzed and excluded from the results of this experiment to a very low value. If only a paste or sand exists, the strength was very low. In this experiment, the strength of the high-intensity standard is over 3.44MPa, and the formulation satisfying the strength criteria appeared in 2 ~ 6. The contents of the adequate paste should be more than 40%, and the paste content increases, the higher the compressive strength can be confirmed.

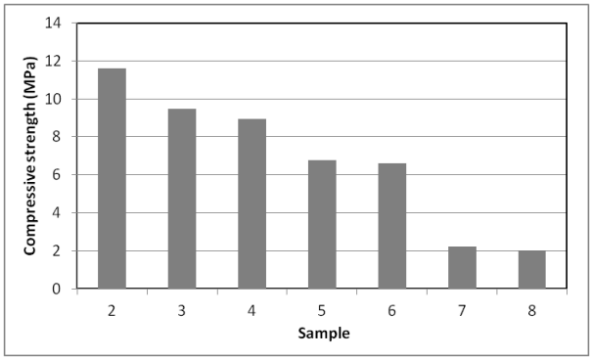

Fig. 2. Compressive strength of Solidifying.

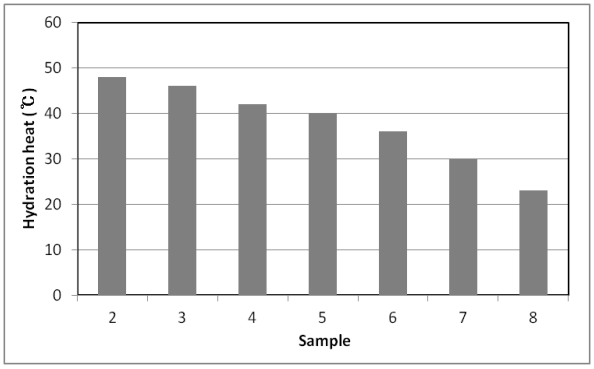

Fig. 3. Hydration heat of Solidifying.

3. Conclusion

Fig. 3 is a graph showing the temperature of the hydration heat of the compressive strength experiment. The higher the paste content was analyzed to increase the hydration heat, and in the second batch of experiments, a very high heat generated at 48℃, and the future of the paste Recycling study also considered necessary for the occurrence of hydration heat.

Acknowledgement

This work was supported by the Energy Technology Program of the Korea Institute of Energy Technology Evaluation and Planning(KETEP) granted financial resource from the Ministry of Trade, Industry & Energy, Republic of Korea (No. 20161510300420)

REFERENCES

[1] Jang Jong-Ho, “A Study on the Fundamental Properties and Application as Cementious Admixture by heating Temperature of Recycled Powder”, Proceeding of Korea Concrete Institute, May 12, 635-40, (2001).

[2] Ahn JC, Lee JH, Kang BH, “Properties of Recycle Cement made of Cementitious Powder from Concrete Waste by Conditions of Burning”, Journal of Architectural Institute of Korea, Nov,19(11):109-12, (2013).