

Characteristics Testing of Solidified Radioactive Waste From Nuclear Fuel Manufacturing

Sungjong Kim^{a*}, Changhwan Cho^a, Seunghoon Han^b, Youngjong Ju^b, Hyunkyu Kang^b, and Jungwoo Lee^b

^aMIRAEEN Co. Ltd., 72, Techno Jungang-ro, Yuseong-gu, Daejeon, Republic of Korea

^bKEPCO NF, Daedeok-daero 989beon-gil, Yuseong-gu, Daejeon, Republic of Korea

*sungjong.kim@mirae-en.co.kr

1. Introduction

The sludge-type of radioactive wastes generated from the nuclear fuel manufacturing cycle should be solidified using solidification agent for physically and chemically safe deliverable to disposal site. This is accomplished through the solidification methods and its process.

To deliver these kind of treated radioactive waste, waste generator should show that this solidified radioactive wastes should have physical integrity by ensuring the results of consecutive tests such as compressive strength, leaching and immersion, thermal cycling and free standing liquid, which should be implemented based on the test plan and procedure-

2. Test criteria and methods

To test the treated solidified radioactive wastes, instead of deliverable drum, the multi number of test specimens are prepared for their own unique test during the process of solidification.

This specimen has a size of 1:2 for diameter and height, and this should be cured more than 28 days after preparation. The details of specimen preparation is left out.

3. Physical integrity test

3.1 Compressive strength test

The primary objective of compressive strength test is for making sure of physical and mechanical robustness of solidified radioactive waste in the event of incident. .

Compressive strength in KS F 2405[1] of test method and criteria for concrete compressive

strength', requires more than 3.44 MPa. In the lab., the specimen meets the this criteria.



Fig. 1. Compressive strength test of specimen (before/after).

3.2 Immersion and leaching

When radioactive waste is exposed to rain or groundwater, there is a possibility of dispersion of radionuclide and/or corrosion of an internal of container. To protect this at best, the immersion and leaching test has been done to show that this symptom is not assumable.

Leaching test has been done based on the ANS 16.1[5], and immersion test has been done by verifying the status of specimen such as weight and the change of volume through visual inspection. After this immersion and leaching, additionally compressive strength test is conducted again to show mechanical integrity.

Container and holders used for test should use the material of HDPE (High Density Polyethylene), which eliminate the chemical reaction with leachant and specimen.

In order to calculate the leaching index, initial radioactivity and the leachate radioactivity of each leaching interval are measured through HPGe.



Fig. 2. Immersion and leaching test.

3.3 Thermal cycling test

The solidified radioactive wastes maintained in temporary and permanent storage for long time can experience the environmental change especially temperature and humidity. Thermal cycling test has been done to evaluate and show that this solidified radioactive waste can endure the environmental changes [4]

3.4 Free standing liquid

Standard requires test of free standing water because free standing liquid inside the drum can increase the liquidity of radionuclides, which can cause adverse impact to safety.

Free standing liquid test is done by lifting the drum and rotate 180 degree, and watching 24 hours to see if free standing liquid is less than 0.5% from the deliverable drum.

4. Conclusions

The series of test requirements of standards is established a couple of decade ago primarily guidance for cement based solidified radioactive waste. However today there are various solidification agent and immobilization technologies like paraffin and vitrification and etc. is being developed and available in laboratory level. Thus it is recommended that all the testing required for solidified radioactive waste be discussed for confirmation.

Also a serious of independent test such as compressive strength, immersion and leaching, thermal cycling, voidage, irradiation and other chemical characteristics testing should be reviewed and upgraded for solidified radioactive waste, and its relationship and interoperability among tests should be discussed. For example, the merge of leaching and immersion could be acceptable in some kind of aspect.

REFERENCES

- [1] KS F2405: 2010 (Standard test method for compressive strength of concrete)
- [2] 10CFR61 (Waste Classification and Waste Form Requirements)
- [3] NRC Technical Position on Waste Form, Rev.1
- [4] ASTM B553-79(Standard Test Method for Thermal Cycling of Electroplated Plastics, Withdrawn 1991)
- [5] ANSI/ANS 16.1-2003(Measurement of the Leachability of Solidified Low-level Radioactive Wastes by a Short-term Test Procedure)

Fig. 2. Free standing water test.