A Study on the Optimal Characterization for the Disposal of Low and Intermediate Level Wastes (LILWs) in Korea

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Ⅰ. Introduction

In Korea, the major LLW generator, called KHNP (Korea Hydro and Nuclear Power Co.) has generated about 67,000 drums (200L) of low and intermediate level radioactive waste (LILW) stored in the temporary storage facilities at each reactor sites since 1977. Especially, the amount of DAW (dry active waste) has been accumulated around 36,600 drums and this number represents about 56% of total LILW generated by all NPP in Korea. The amount of evaporated bottoms, concentrated wastes, spent ion exchange resins and spent filters have been accumulated around 19,000 drums, 9,700 drums, and 1,600 drums and these numbers represent about 28%, 14%, and 2% in respectively.

Ⅱ. Methodology for the characterization of LILW in Korea

Ⅱ-1. Radioactive characterization

In this study, the four mandatory items for the radioactive characterization of LILW are proposed such as the total activity, surface dose, individual activity, and surface contamination[1]. The surface dose and contamination can be measured by the detection. The total activity can be calculated by the summation of all radionuclide concentration. In case of γ-nuclides, the individual activity can be detected by the TGS (Tomographic Gamma Scanning), SGS (Segment Gamma Scanning), DTC method (Dose to Curie), and ISOCS (In-situ Object Counting System), and then α,β-nuclides can be also estimated by the scaling factor.

TGS has some advantages for detecting the γ-nuclide compared to other methods. In other words, TGS can accurately analyze γ-nuclide and easily apply to non-homogeneous drum, but this system needs too long time for detection of γ-nuclide and restricts the size of drum to 200L and 320L only. In case of DTC method, although γ-nuclide can be readily evaluated in a short time through each surface dose, there is some disadvantage that the error range is so high. Therefore, this system may be applied to the drum which has low radioactivity, simple geometry, or homogeneous material. And then ISOCS is one of the methodologies for the analysis of large volume drum. After considering the advantages and disadvantages of all methodologies for detecting γ-nuclide, the optimal characterization was proposed for analyzing γ-nuclides. In order to applying DTC methodology, however, it is necessary to increase the reliability of DTC method through the cross-check between the result of DTC calculation and the detection value of TGS or ISOCS.

Ⅱ-2. Physical characterization

For disposal of LILW in Korea, the four mandatory items for the physical characterization are suggested such as the weight (density), voidage, free liquid, and homogeneity[1]. The weight of drums can be known by direct measurement irrespective of kinds of drums. The voidage and free liquid can be inspected by the NDA (i.e. X-ray, neutron, microwave) and sampling analysis. In order to using the NDA methodology, first of all, the sampling analysis must be conducted to reduce the uncertainties that the NDA methodology has. In case of the concrete drum, however, the NDA can not be applied due to the large volume size. Therefore, in exceptional case, the methodology of sampling analysis can be

used in regard of the concrete drum. Furthermore, the homogeneity of LILW may be identified through the document inspection.

Ⅱ-3. Chemical characterization

For disposal of LILW in Korea, the four mandatory items for the chemical characterization are suggested such as the leachability, corrosiveness, explosiveness, and chelate[1]. The leachability would be only required with regard to the drum solidified by the cement and paraffin. In order to estimate the leachability, ANS 16.1 was recommended by proper sampling analysis in this study[2]. However, it is clear that the disposal of the paraffin solidification must be reserved because the leachability test methodology for the paraffin solidification has not existed yet. The existence and nonexistence of corrosive and explosive materials in drum can be generally known by the document inspection. The DAW, representative non-homogeneous material, may require the NDA using x-ray and neutron as well as the document inspection. However, the corrosive and explosive materials in the homogeneous drum such as the spent ion exchange resin and concentrated waste are sufficiently examined by using the document inspection alone. The chelate such as EDTA, which could accelerate the migration of the radioactive materials, may be inspected by the NDA. The chelate agent will be more in DAW than in homogeneous material such as concentrated waste and spent ion exchange resin because the chelate is generally wiped by the contamination paper, which is typical DAW.

Ⅱ-4. Mechanical characterization

For disposal of LILW in Korea, the two mandatory items for the mechanical characterization are proposed such as the compressive strength and integrity of drum[1]. The compressive strength of all evaporated bottom and some spent ion exchange resin solidified by the cement and paraffin can be readily estimated by the methodology named KS F 2405 with adding sampling analysis to be more accurate[3]. However, the disposal of the paraffin solidification must be held because the test methodology has not developed yet like the case of the leachability. The integrity of drum can be easily inspected by the visual inspection in regard of all kinds of drums.

Ⅲ. Conclusion

In this study, the optimal characterization for the disposal of LILW in Korea was derived. The methodology inspecting total activity, surface dose, individual activity, and surface contamination were proposed for the radioactive characterization. And then, the methodology examining the weight (density), voidage, free liquid, and homogeneity were also suggested for the physical characterization. Furthermore, the methodology inspecting the leachability, corrosiveness, explosiveness, and chelate were mentioned for chemical characterization. Finally, the methodology examining the compressive strength and integrity of drum were dealt for the mechanical characterization.

Acknowledgement

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References

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