Preparation of Regulatory Clearance for Organic Liquid Radwaste at KAERI

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1. Introduction

The nuclear facilities at Korea Atomic Energy Research Institute (KAERI) have generated a variety of organic liquid radwaste and most of the organic liquid have low-level radioactivity or lower levels.

At KAERI, the organic liquid rad-wastes have been stored at Radioactive Waste Treatment Facility (RWTF) temporarily due to the absence of the recognized treatment technique while inorganic liquid radwaste can be treated by evaporation, bituminization and solar evaporation process. Therefore, it should be treated by regulatory clearance to secure the storage safety.

In this study, a treatment procedure such as generation, management, sampling and characterization of the organic liquid radwaste for regulatory clearance are described.

2. Generation and Management

2.1 Generation of Organic Liquid Radwaste

The organic liquid radioactive waste such as spent oil, cutting oil, acetone, ethanol, etc. was generated from the nuclear facilities at KAERI. The total amount of the organic liquid radioactive waste was about 7,000 L from 2008 to 2018. Among the organic liquid radioactive wastes, spent oil is particularly significant (Fig 1).

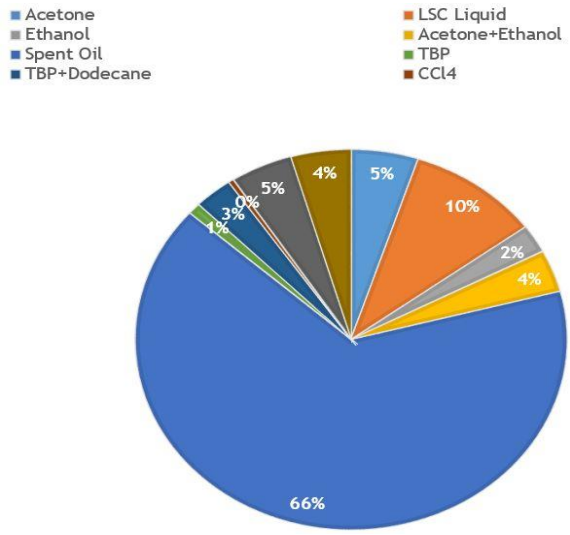

Fig. 1. Proportion of the organic liquid radwaste generated from 2008 to 2018.

2.2 Management of Organic Liquid Radwaste

Since the recognized technique or method for treating the organic liquid radwaste has not yet been developed, those are stored and managed in the designated area in RWTF as shown in Fig. 2.

Fig. 2. The organic liquid radwaste has been stored at designated area in RWTF.

3. Sampling and Characterization

This chapter describes the working procedure for the sampling and analysis of the organic liquid radwaste.

3.1 Sampling of Organic Liquid Radwaste

Above all, radionuclides and activity concentrations should be analyzed for the regulatory clearance, and the results must meet the standards of Nuclear Safety Act of Korea. To analyze radionuclides and activity concentrations of radwaste for regulatory clearance, representative samples of the organic liquid radwaste were collected by 50 ml beaker at a ratio of 1 L to 200 L.

Fig. 3. Sampling of the organic liquid radioactive waste.

Fig. 4. Collected representative samples of organic liquid radioactive waste.

3.2 Characterization of Organic Liquid Radwaste

The radionuclides identification and radioactivity concentration of collected samples was analyzed by a High-Purity Germanium (HPGe) detector. As a result of the measurements, Co-60 and Cs-137 are the major radionuclides in most of the organic liquid radwaste.

The Certified Reference Material (CRM) of a 50 ml beaker was used for calibration. The maximum radioactivity concentration of the organic liquid radwaste was showed at Table I.

Fig. 5. High-Purity Germanium (HPGe) detector.

Table I: Activity concentration of radwastes

Nuclide	Activity Concentration [Bq/g]	Mixed two nuclides
Co-60	0.04	0.74
Cs-137	0.03	

Where, $C_{Co\text{-}60}$: Activity concentration of Co-60,
$C_{Cs\text{-}137}$: Activity concentration of Cs-137

According to the International Atomic Energy Agency (IAEA) and Nuclear Safety Act of Korea, it is recommended that activity concentration for regulatory clearance should be less than 0.1 Bq/g for Co-60 and Cs-137 (Table II). And, in the case of mixed more than two radionuclides, the activity concentrations should be adjusted by following equation.

$$\sum_i \frac{C_i}{C_{L,i}} < 1 \quad (1)$$

Where, C_i : Activity concentration of nuclide (i) [Bq/g],
$C_{L,i}$: Activity concentration allowed for regulatory clearance of nuclide (i) [Bq/g]

Table II: Recommendations of the IAEA

Nuclide	Activity Concentration [Bq/g]	Mixed two nuclides
Co-60	< 0.1	$(C_{Co\text{-}60}/0.1) +$
Cs-137	< 0.1	$(C_{Cs\text{-}137}/0.1) < 1$

Where, $C_{Co\text{-}60}$: Activity concentration of Co-60,
$C_{Cs\text{-}137}$: Activity concentration of Cs-137

The analysis results show that radioactivity concentrations of the radwaste are satisfied to the regulatory clearance and mixed two radionuclides (Co-60 and Cs-137) values are less than 1 by the equation. So, the results have indicated that the recommendations of the IAEA and the Nuclear Safety Act of Korea were met (Tables I and II). [1, 2]

3. Conclusions

According to the procedure described in this study, about 10% of all organic liquid radwaste such as spent oil, cutting oil e.t.c. being stored in RWTF were analyzed and it was confirmed that some satisfied the clearance allowance criteria.

In addition, when the organic liquid radwaste that meets the clearance allowance criteria is cleared, it can be expected to save more than 50% of the total amount.

For regulatory clearance, the radiological doses should be assessed. And the result of the assessment must meet the criteria set by Nuclear Safety Act of Korea (individual dose < 10 μSv/year, collective dose < 1 man×Sv/year) to get the permission from regulatory body.

In the future study, the radiological dose will be assessed based on a clearance scenario. A scenario will set up using MCNP Code (for incineration) and RESRAD Code (for landfill).

Finally, the organic liquid radioactive waste generated from KAERI will be cleared by committed disposal after permission from the regulatory body.

REFERENCES

[1] Nuclear Safety and Security Commission Notification No. 2017-65.
[2] IAEA Safety standards Series RS-G-1.7, “Application of the Concepts of Exclusion, Exemption and Clearance”, 2004