Re-evaluation of the Activity Concentration for a Volume Reduction of the Combustible Wastes in KAERI

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1. Introduction

According to the active operation of the nuclear facilities, a great amount of radioactive wastes has been generated, and also, the storage volume of the radioactive waste is considerably on the increase at the Korea Atomic Energy Research Institute (KAERI). At the moment, to secure a space in a waste storage facility approaching saturation, the radioactive waste treatment facility (RWTF) is now carrying out a project on a volume reduction of the wastes in storage. As a part of that project, a study on the treatment of a combustible solid waste is being conducted in the RWTF.

All combustible wastes in interim storage at KAERI were collected into 200 liter steel drums in accordance with the original form without any treatment of them. Thus, in order to send them to the final disposal site, a repacking through a compaction treatment is a solution for a volume reduction of the combustible wastes. To do that, it is first necessary to conduct a radionuclide assessment of the combustible waste drums before a compaction treatment of them.

2. Methods and Results

Among the current wastes stored in the interim storage facility, the combustible wastes account for about 30 %. And then, the weight of the contents in each 200 liter drum filled with the combustible waste is about 40 kg, because they were not compacted, so that all combustible waste drums are in the light state when compared with the volume of those waste packages.

2.1 Classification of the combustible solid wastes

The combustible solid wastes about 3,900 drums (200ℓ/drum) have been stored in the waste storage facility of the KAERI since its operation [1]. These combustible solid wastes have generally consisted of them generated in the HANARO research reactor, the radioisotope production facility (RIPF) and the nuclear fuel cycle facilities which mean the nuclear fuel processing facility (NFPF), the irradiated material examination facility (IMEF) and the post irradiation examination facility (PIEF) and the RWTF.

As shown in Fig. 1, it was possible to divide the main generation facilities into 7 categories. Here, for the research laboratories, it was divided into 2 categories which mean laboratories using uranium, type A, and not using uranium, type B. Therefore, the volume of the combustible wastes generated at the facility using uranium accounted for about 28 % of them in storage. And then, a large amount of combustible wastes were generated in the nuclear fuel cycle facility.

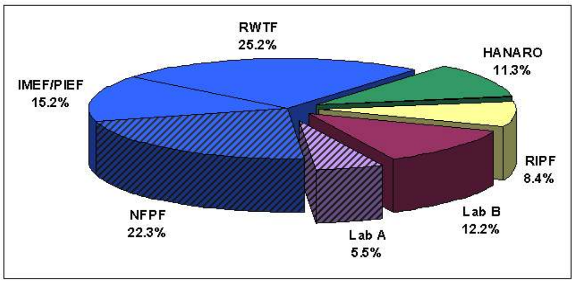

Fig. 1. Distribution of the combustible solid wastes by the generation facilities at KAERI

The combustible wastes were also classified by their activity level by investigating their inventory about the surface dose rate at the time of their generation as a combustible solid waste. As a result, all the combustible wastes were included in the low level radioactive waste (LLW) that corresponds to below 2 mSv/h. And also, the combustible wastes of about 85 % belonged to a very low level radioactive waste (VLLW) that corresponds to below 0.02 mSv/h. That means not only a compaction treatment of them but also a regulatory clearance is possible to reduce the volume of the stored combustible solid waste. At present, the volume for VLLW will increase because of their radioactive decay.

2.2 Contents of the combustible solid waste

The combustible solid wastes generated at KAERI were comprised of a vinyl class, a cotton class, a paper class, a plastic class, a rubber class, a shoe class, and a wood class. Among them, a vinyl, a cotton and a paper class account for about 90 %. In the case of a vinyl and a cotton class, the packing vinyl and the used protective clothing are main contents and are expected to be seldom contaminated by the radioactive matter. On the other hand, the decontamination paper that is main content of a paper class is expected to have a higher radioactivity level than any others.

Therefore, in view of the waste treatment, it is desirable to group all of the combustible solid waste by the generation facility as well as by the same contents.

And then, it is necessary to reclassify as either a regulatory clearance waste or a radioactive waste through a radionuclide assessment of them.

2.3 Re-evaluation method of the activity concentration

After a classification by the same contents in a combustible waste drum, a nuclide analysis is conducted by taking a representative sample according to the content. From the results of nuclide analyses, the content having a high activity concentration could designate as the radiologically dominant content in the corresponding facility. Therefore, it is necessary to know what percentage of the activity concentration for the dominant content accounts for in the total activity of the corresponding combustible solid waste drum.

Besides the facility using uranium, the major nuclides at every facility were Co-60, Cs-137 through the investigation for nuclides that could be generated during the operation of the facilities. So, from the result for the measured surface dose rate of the combustible waste drum, the total activity concentration in that drum was calculated by using a MCNP code, as shown in Table 1. The calculation was conducted by the ideal situation which means the homogeneous distribution of Co-60, Cs-137 with the same ratio in a combustible solid waste drum.

Table 1. The total activity in a combustible solid waste drum by the surface dose rate

Surface dose rate	0.002 mSv/h	0.2 mSv/h	2 mSv/h
Total activity	0.048 mCi	4.84 mCi	48.35 mCi

In the case of a different concentration ratio between Co-60 and Cs-137 that are homogeneously distributed in a combustible waste drum, the variation of the total activity also calculated by using a MCNP code. From those results, it was possible to obtain a conversion factor (F) for the total activity according to the change of the concentration ratio (Fig. 2). As shown in Fig. 2, in the case only Cs-137 exists, the value of F is 1. On the contrary, in the case only Co-60 exists, the value of F is about 4.1. And also, in the case of the same ratio like an above Table 1, the value of F is about 2.6.

From a nuclide analysis for the radiologically dominant content by the combustible waste drum, the concentration ratio between Co-60 and Cs-137 is first calculated. And then, the conversion factor is obtained from a Fig. 2. The total activity corresponding to the determined concentration ratio between Co-60 and Cs-137 is calculated from the measured surface dose rate with the same method of the Table 1. And finally, it is possible to know what percentage of the activity concentration for the dominant content accounts for in the total activity of the corresponding combustible solid waste drum.

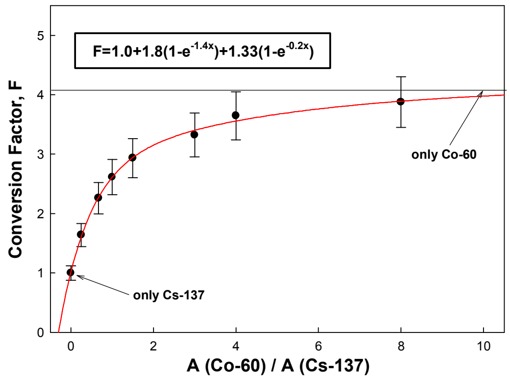

Fig. 2. The conversion factor (F) for the total activity according to the change of the concentration ratio between Co-60 and Cs-137

3. Conclusions

From the results of a classification, it was possible to obtain the following characteristics of the combustible wastes at KAERI. First, the majority of the combustible wastes were included in the very low level radioactive waste category. Also, besides the facility using uranium, the major nuclides at every facility were Co-60, Cs-137. And then, the total activity in a combustible solid waste drum was calculated from the measured surface dose rate by using a MCNP code.

REFERENCES

[1] Operation of Nuclear Fuel Cycle Examination Facilities, KAERI/MR-471/2007(2007)