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Statistical Method for Reducing Error in Surface Contaminated CLW Radioactivity Analysis

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1. Introduction

As a part of a radioactive waste, clearance level radioactive waste treatments is getting more important not only as for budget reduction but for radioactive waste volume reduction. In the treatment of the clearance level radioactive waste, a large portion of the waste is surface contaminated radioactive waste. An analysis of surface contaminate radioactive waste's radioactivity is simple but has high uncertainty.

To reduce the uncertainty of surface contaminated radioactive waste's radioactivity analysis, one of the important factor is mass to surface ratio which is multiplied to measured value Bq/cm^2 to transfer Bq/g. In this paper we describes about method for increasing the accuracy of mass to surface ratio with simple statistical analysis.

2. Methods and Results

In this section some of the techniques used to increase the accuracy of radioactivity is described.

2.1 Adequate data to analysis

From a data analytics perspective, clearance level radioactive treatment is the process of collection and rearranging large amounts of information to extract meaningful data. It goes through a series of processes to extract standardized information such as length, weight, surface area, and radiological information from unstructured waste information, process it to meet legal conditions, and then compare it.

For clearance level radioactive waste treatment, on-site work is carried out by professional workers for work efficiency, and researchers create adequate form of data to submit to regulatory body from data generated at the site. In this process, incorrect data is often generated due to communication problems between researchers and filed workers who do not clearly understand the work process in the field.

One way to reduce errors that occur at this time is to analyze outliers in data generated in the field is often inconsistent and has little correlation, so it is not valuable as data for analysis. However, in the case of surface contaminants, the mass to surface ratio for converting specific radioactivity per area to specific radioactivity per mass is related for wastes of the same material and form.

For example, in the case of water pipes with the same material and standard, mass and surface area are proportionally increase with length. Therefore, surface area and mass are correlated and mass to surface ratio should have similar values.

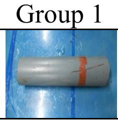
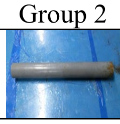
2.2 Outlier

For the same material, the mass to surface ratio has similar values, so when outliers occur it can be seen that there is a problem. In this section, boxplots and z-score values are analyzed to identify outliers.

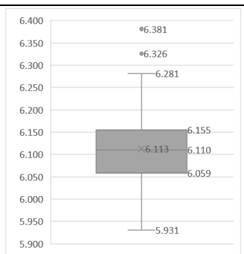
2.2.1 Box plot

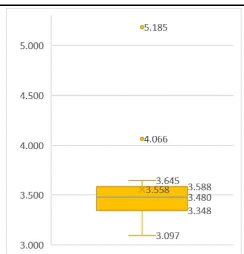
Water pipes were divided into 4 groups with similar shapes and materials. There are various shape and types of pipes, but we only collected information on pipes with a diameter of 22cm and 12cm which have a lot of data. Table 1. shows 4 types of pipes.

Table I: Water pipes categorization

Group 1	Group 2	Group3	Group4
			
Iron pipes	Iron pipes	Iron pipes (bended)	Stainless steel pipes
2R : 22cm	2R: 12cm	2R: 22cm	2R: 12c m

The quantiles and maximum and minimum values for each pipe type were obtained, and outliers were identified based on this. Anything above or below 1.5Q was considered as outlier.





Group 1	Group 2

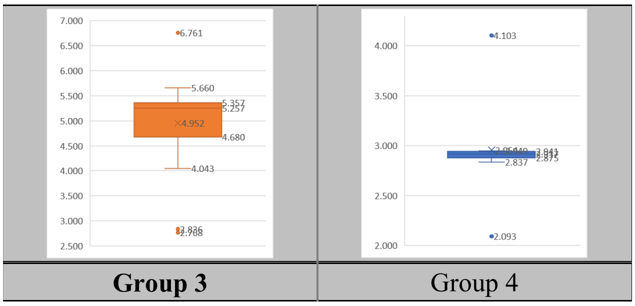


Fig. 1. Box plot and outlier of each types pipes

Table III: Outlier of each groups (based on box plot)

Group	No. outlier sample
Group 1	WP-68
	WP-79
Group 2	WP-35
	WP-41
Group 3	WP-1
	WP-8
	WP-11
Group 4	WP-89
	WP-91
	WP-92
	WP-96

2.2.2. Z-score

The mass to surface value were normalized and the z-score values were analyzed. Value exceeding z-score were considered outlier.

Table III: Outlier of each group (based on z-score)

No. Group	No. outlier sample	Z-score
Group 1	WP-68	2.85
Group 2	WP-35	2.89
	WP-41	3.75

The number of outlier according to the z-score value were calculate to be smaller than the outliers based on the box plot. This is because outliers are included in the normalization process, so judging outliers using only that method should be avoided.

2.3 Results.

As a result of checking the outliers derived from each method, the actual physical characteristics were different due to the different diameters of the pipes, bent shape, and connection parts. However, the outliers identified through z-score could not confirm all of the unusual features, and when confirmed through boxplot, they were classified as outliers even though there were no problem.

3. Conclusions

In the case of surface-contaminated clearance level radioactive waste, it is difficult to analyze accurate radioactivity if they do not reflect the specificity of the waste. To compensate for this, it seems possible to compensate for this by statistically analyzing the mass to surface values and checking some of them directly in the field. In the case of the large amount of construction site waste generated, there are many surface-contaminated radioactive wastes with same form, and it appears that the method can be applied to these wastes.

REFERENCES

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