Experiment on Physical Desalinization of Uranium-contaminated Gravel Surface

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1. Introduction

Radioactivity-contaminated soil generated after the dismantling of nuclear facilities includes a large amount of gravels. Such gravels are not free from the contamination by radioactivity, like the soil contaminated by radioactivity, and in fact most gravels are contaminated by uranium. As a means to desalinize uranium-contaminated gravels, we have conducted experiments by applying soil washing. As a result, the method to wash uranium-contaminated gravels could not get satisfactory desalinization rate. During the long oxidization process it was judged that uranium penetrated inside the gravels, so we tried to increase the desalinization rate by fragmentizing them into pieces and then washing them. The desalinization rate after fragmentizing the gravels into pieces and washing them brought a satisfactory result. However, we could obtain desired concentration for gravels with high uranium concentration by fragmentizing them and breaking them further into even smaller pieces. Likewise, desalinization using soil washing process is complicated and has to go through multiple washing steps, resulting in too much of waste fluid generated accordingly. The increase of waste fluid generated leads to the increase in by-products of the final disposal process later on, bringing a not good economic result. Furthermore, taking into account that the desalinization rate is 65% during soil washing process, it is expected that gravel washing will show a similar desalinization result; it is considered uneasy to have a perfect desalinization only by soil washing.

Thus this research attempted desalinization of uranium-contaminated gravels by applying grinding method, a physical desalinization of surface technique, instead of a method of fragmentizing and washing pebbles in pieces. The grinding method is actually used in the primary desalinization process in order to desalinize radioactivity-contaminated concrete. This method does desalinization by grinding the radioactivity-contaminated area of the concrete surface with desalinization equipment, which enables a near-to-perfect desalinization for relatively thinly contaminated surface. Likewise, this research verified the degree of desalinization by applying the grinding method and comparing it to the fragmentizing-washing method, and attempted to find a method to desalinize uranium-contaminated gravels more effectively.

2. Experimental and Results

We extracted gravels from uranium-contaminated soil stored in the research institute, and desalinize the gravel surface with grinding equipment inside the glove box in order to prevent dust scattering that can occur during the grinding process. We categorized the samples into low concentration, medium concentration, and high concentration depending on the concentration of uranium-contaminated gravels. As for the thickness of grinding, we first desalinized 1mm and measured uranium concentration; in accordance with the desalinization rate, we grinded additional 2mm, desalinizing a total of 3mm to compare desalinization rate. As for the desalinization rate, the initial concentration of uranium in gravels was checked through Multi-Channel Analyzer (MCA), and the concentration after desalinization was measured to calculate the desalinization rate.

Fig. 1 Decontamination of uranium by grinding method.

Fig 1 is a process of grinding uranium-contaminated gravels; we first grinded 1mm of the uranium surface, measured the uranium concentration and grinded additional 2mm to desalinize when necessary. However, the gravel surface was not even and was harder than concrete, so we faced many difficulties in grinding and it was a more difficult process than we thought.

Table Ⅰ: Removal efficiency for Uranium in gravel

	Low conc. (Bq/g)	middle conc. (Bq/g)	High conc. (Bq/g)
Ci	2.7	7.6	12.7
1mm	2.2	6.4	10.1
3mm	1.7	4.2	7.4

The concentration of uranium before desalinizing the uranium-contaminated gravels was confirmed as 2.7 Bq/g, 7.6 Bq/g, and 12.7 Bq/g. The concentration of uranium measured after grinding 1mm using the desalinization equipment was 2.2 Bq/g, 6.4 Bq/g, and 10.1 Bq/g, which did not show a satisfactory desalinization rate through the primary desalinization only. Thus we grinded additional 2mm to desalinize; the results were 1.7 Bq/g, 4.2 Bq/g, and 7.4 Bq/g, and the desalinization rate appeared to be 37%, 44.7%, 41.7% each. Such results were similar to the difficulties that occurred during the washing-desalinizing process; it was a result confirming that uranium had deeply penetrated inside the gravels as they were exposed to the contamination of uranium for a long time.

3. Conclusions

In order to desalinize uranium-contaminated gravels more effectively and compare to the existing washing-desalinization method, we conducted a desalinization experiment with grinding method that grinds gravel surface. As a result, the average desalinization rate of the grinding method was about 40%, showing a significantly lower desalinization rate than the washing-desalinization method. Despite desalinizing up to 3mm of the gravel surface, since the desalinization rate appeared to be low we could reconfirm that the inside of the gravels were contaminated by uranium, like the washing-desalinization. Moreover, since gravels have stronger hardness than concrete their surfaces are not easily grinded, through which we could learn that it was not easy to desalinize the gravels compared to washing-desalinization. Consequently, because the grinding method is harder to desalinize than the washing method and its desalinization rate demonstrated relatively low values, it was determined that the washing method was more desirable to desalinize uranium-contaminated gravels.

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