

Development of Radioactive Soil Segregation System for NPP site remediation

Sang Chul Lee^{a*}, Jae Mun Han^a, Min Jung Kim^a, Jin Hee Kim^a
^aR&D Division, Hyundai E&C., 17-6, Mabuk-ro, 240beon-gil, Giheung-gu, Yongin-si
*Corresponding author: lsc237@hdec.co.kr

1. Introduction

The permanent stop of Kori-1 is decided on June, 2017. The decontamination and decommission (D&D) of nuclear power plant will be started in earnest in Korea. But there is no D&D experience in commercial NPP in Korea. In part of site remediation for radioactive contaminated soil, there are only some studies with pilot test level such as electrokinetic-flushing equipment [1]. Although the technology has a good decontamination efficiency, it requires high cost and long process time. Therefore it is inadequate for commercial NPPs. In case of overseas remediation solutions, they are applied by the difference of regulation in Korea. The previous decontamination solutions are focused in washing process to separate the radionuclides such as Cesium-137 and uranium from contaminated soil. But because such radionuclides combine with soil strongly, the direct separation of radionuclides is difficult and inefficient. Therefore, in this study, the system by which the contaminated soils from all the soils can be separated partially, is developed instead of the direct separation of radionuclides. The segregation are consist of two steps as particle size separation and radio activity level separation. By the new segregation system, the amount of radioactive waste can be decreased to 80%.

2. Methods and Results

In this section the characteristics of radioactive soil is presented. With regard to the characteristics of radioactive soil, the process of the radioactive soil treatment is suggested for the reduction of the radioactive waste. To establish the suggested process, the radioactive soil segregation system is developed. In this section, the design and manufacturing process of the radioactive soil segregation system are presented.

2.1 Characteristics of radioactive soil

In this study, to evaluate the characteristics of radioactive soil, the soils generated in the D&D process of Research reactor are used. Fig 1 presents the difference of the radioactive level of soils by the particle size in consideration of washing. Generally as the size of soil become larger, the activity become lower. The activity of the soil of more than 1mm is lower than the regulation criteria, 0.1Bq/g of Cesium-137 without the washing process. Therefore the washing process is not required for the soil of more than 1mm to be separated

as non-radioactive waste. In case of the soil between 0.075mm and 1mm, after washing, the parts of the soil can be sortable as non-contaminated soil. For the soil between 0.075mm and 1mm, the washing process can be considered. Lastly the activity of the soil below 0.075mm cannot be lower than the regulation criteria even after the washing. The soil below 0.075mm is discarded as radioactive waste without the washing process.

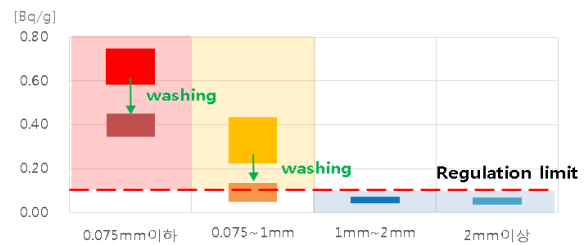


Fig. 1. Activities of the soils by the particle size in consideration of washing process

Before the final disposal of the soil, the radioactivity measurement of the soil is necessary to confirm whether the activity of soil is lower than the regulation criteria. The second separation is performed by the result of the measurement. In this study, the hydride segregation process using the separations by the particle size and the activation level of soil is suggested. Fig 2 presents the process of the suggested segregation for the radioactive soil in NPP remediation site. By this hybrid segregation process, the amount of radioactive waste can be decreased to more than 80%.

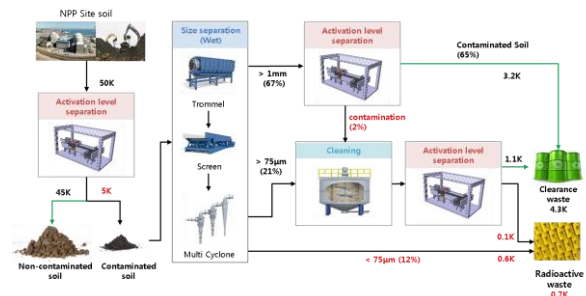


Fig. 2. Process of the hybrid segregation using the separation by the particle size and activation level

2.2 Particle size separation system

The particle size separation system is the first part of the radioactive soil segregation system. The efficiency of the particle size separation is increased using the multi-step equipment such as vibrating screens and cyclone. Fig. 3 presents the process of particle size separation. The separation efficiency of the system is better than 85%.

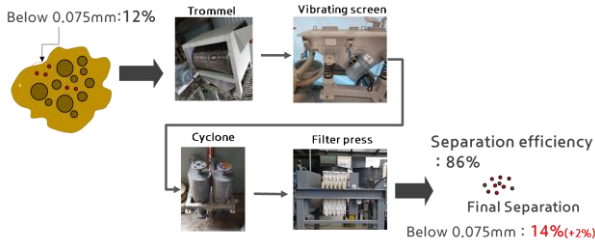


Fig. 3. Process of the particle size separation

Fig. 4 shows the particle size separation system. The system emits the separated soil by particle to the activation level separation system using the automated conveyor system.



Fig. 4. Particle size separation system

2.3 Activation Level Separation System

By the automated conveyor system, the separated soils of more than 0.075mm is inserted to the activation level separation system. Because the activities of the separated soils by particle size are dependent on their size, the activity of the soil above 0.075mm is expected to be below the regulation criteria of 0.1 Bq/g. The small part of the soil above 0.075mm will be regarded as the contaminated soil. For the effective separation of the small amount of contaminated soil from plenty of soils, the activation level separation system with two step is suggested. In the first step, the system distinguish the existence of the soil contamination simply. After then, in the second step, the system evaluate the radioactivity inventory of the soil by the detailed measurement. Fig. 5 presents the process algorithm of the activation level separation system.

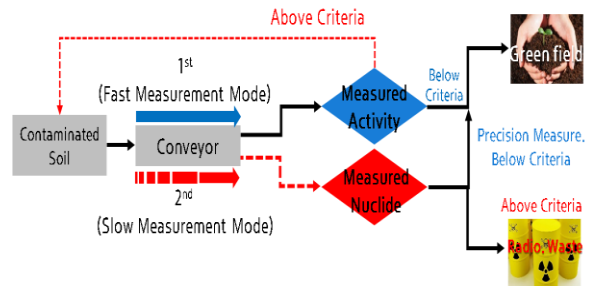


Fig. 5. Process algorithm of the activation level separation system

Fig. 6 shows the activation level separation system. The similar systems in the United States and Japan was applied for the remediation of the site contaminated by radioactivity [2, 3]. Because the LLD (Lower Limit of Detection) of overseas systems is higher than our domestic criteria, it is difficult of overseas systems to be applied in domestic NPP sites. In this study, the LLD of our system is achieved to almost 1/10 of domestic regulation criteria. To achieve low LLD of the system, large size detector, background shielding and various correction method of temperature are used.



Fig.5. Activation level separation system

3. Conclusions

In this study, the radioactive soil segregation system is developed using the difference of the particle size and the radioactivity level of contaminated soil. By this system, the amount of radioactive waste will be decreased to almost 80%. But the pilot test of this system isn't performed for a real radioactive contaminated soil. After the pilot test of a real radioactive contaminated soil, the correct separation efficiency for radioactive contaminated soil can be evaluated.

REFERENCES

- [1] Gye-Nam Kim, Development of Electrokinetic-Flushing Equipment for a Remediation of Soil Contaminated with Radionuclides, J. of the Korean Radioactive Waste Society, Vol.6(1), p.1-9, 2008.
- [2] Alejandro U. Lopez, and Jeffrey W. Lively, "Application of soil Segregation Technology: Reducing Uncertainty and Increasing Efficiency at an NRC test reactor Decommissioning site", WM2011 Conference (2011)
- [3] ANTECH, Soil Measuring and Segregation System (SMSS) Model 3107-1000.