A Conceptual Design of Crusher System for Radioactive Contaminated Concrete

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1. Introduction

In the radioactive waste storage facility at KAERI, about 2,000 drums of concrete have been stored since 1988. Those concrete have been managed without exact radioactivity data for each drum. During 16 years of storage, the radioactive nuclides in the concrete have decayed out a lot. As those concrete occupy about 20% of the storage capacity, it is necessary to treat them. The concrete is crushed and representative samples are taken to identify the radioactive characteristics of concrete.

This paper describes the conceptual design of crusher system for the developed concrete crushing, and sampling methodology.

2. Methods and Results

The radioactivity concentrations of contents of each drum were measured following the working procedure of Figure 1 developed at KAERI.

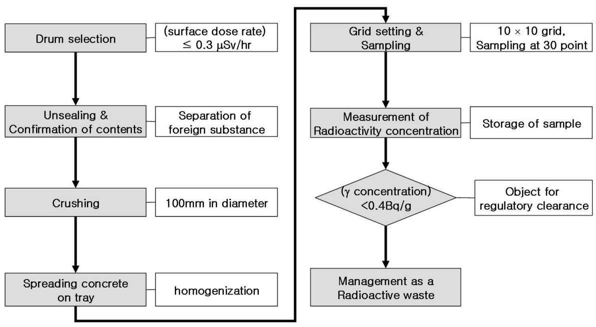

Figure 1. Working procedure for concrete crushing, sampling and identifying the radioactive characteristics

To measure the radioactivity concentration and to identify the radionulides in concrete, it is necessary to crush concrete and to make a sample for analysis out of 200L drum of concrete. As only small portion of a drum can be used as a sample, it is important that the homogeneous representative concrete samples are taken. In the storage facility, radioactive work is prohibited to prevent spreading of contamination. But it is time, labor and cost consuming to transfer concrete drum to other facility for sampling. So, to make an effective sampling, equipment was required for limiting contamination in the storage facility.

In this study, to make a representative sample out of homogenized concrete, some tools and equipments were developed and applied to the crushing and sampling. Airtight booth, ventilation system for airtight booth, jaw crusher, water spraying equipment for occurring dust, SUS tray and 10 × 10 grid were developed. In addition, drum lift and fork lift were applied at the sampling work.

2.1 Conceptual Design of Crusher System

The airtight booth was for time saving and limiting contamination during crushing in the storage facility. The booth had a dimension of 5,500mm (width) × 3,000mm (length) × 4,100mm (height). There are two parts of workspace in airtight booth as labeled on Figure 2. The jaw crusher is established in the upper part. The jaw crusher is designed for the rapid reduction of concrete into granular particles and requires sufficient of the crush ability. Concrete are placed into hopper of the machine and are crushed between two jaws in the interior of the machine. The movement of the jaws not only crushes the concrete, but also forces the discharge down and out of machine where it is collected in a new drum on the lower part in the booth. The jaw crusher is a shock load crushing device driven by a 440 volt 60 cycle 30 HP continuous motion motor that is coupled to the crusher by a belt pulley system. Because of routine maintenance requirements, the user of the jaw crusher must be familiar with much of the machine. In the description that follows, the numbers in parenthesis refer to various machine parts as labeled on Figure 3. The feed hopper (1) is located about mid-machine directly behind and above the stationary jaw shield plate. Beneath the stationary jaw shield plate is the jaw cam-lock (3) which is part of the securing apparatus for the stationary jaw (7). The adjustment hand knob (5) is located in the lower front on the right hand side of the machine. On the left side of the machine, directly opposite of the hand knob is the square-head adjustment locking bolt. To the left and right, behind the hopper are two grease caps (6) that grease bearings for the moveable jaw (4), a third grease cup is located further back on the machine in the center. Below the third cap on the back of the machine is the spring tod assembly (8), and beneath the spring rod assembly is a second oil cup. Under the machine is a space for the sample collection tray. The power control is mounted on the wall close to the crusher, and there is also a breaker box located close to the machine.

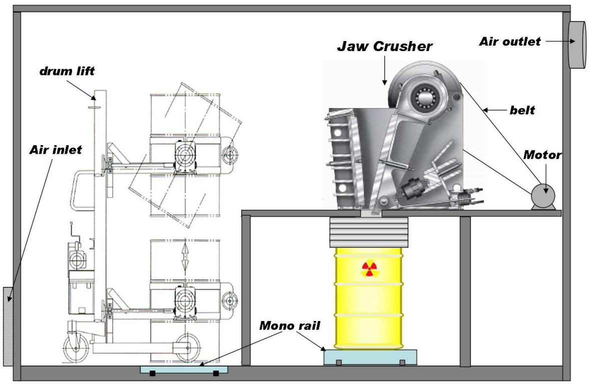

Figure 2. Side View of the Airtight Booth

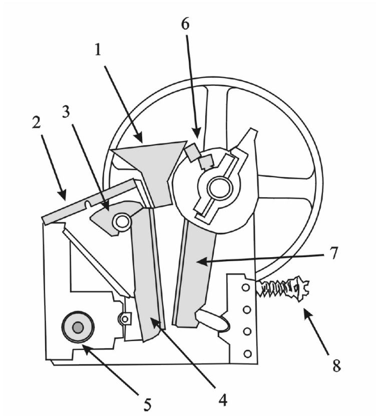

Figure 3. Side View of the Jaw Crusher

2.2 Other Equipment

During the concrete crushing operation, the dust can happen. The water spraying equipment that prevents the occurrence of the dust is attached. As the weight of concrete drum was over 200kg, the bottom board of the booth was strengthened by steel plate to uphold the weight of concrete drum and other equipment. For convenience, monorail for moving concrete drum, drop table at a wall, water inlet and a wall socket for electronic tool were installed in the booth. Also the cover and the body of the booth were manufactured separately for easy transfer of the booth.

The ventilation system is for the circulation of air and the provision of fresh air to workers in the airtight booth and the removal of radioactive dust generated from soil.

In addition, the ventilation system can reduce the internal exposure dose of workers. The dimension of the ventilation system was 860mm × 610mm × 610mm and it was composed of a ventilator, a pressure gauge, a pre-filter and a HEPA filter. For easy transfer, the ventilation system was made detachable and placed on a cart.

Additionally, SUS tray with a dimension of 1,400mm (width) × 1,400mm (length) × 320mm (height) was made. It was used for pouring the content of drum and could contain 2 drums of concrete particles. At the bottom of the tray, there was a hole to discharge concrete easily after sampling. The 10 × 10 grid was used for segmenting poured concrete particles into 100 sections evenly. Each section had its own number and samples were taken by 30 randomly selected numbers. Also, drum lift for management of drum with concrete and fork lift for tray will be applied at the work.

3. Conclusion

In this study, conceptual design of crusher system was developed to the concrete crushing and sampling. The results of this study can be applied to the treatment of radioactive concrete generated in large amount during the decommissioning of nuclear facility. In addition, the tools and working procedure developed in this study can be applied to the similar sampling work.

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