

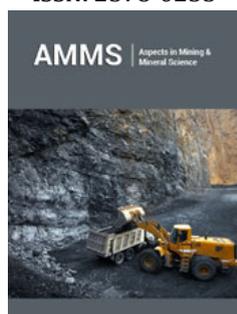
# Manufacturing the Equipment for Reduction of Radioactive Wastes on the Wire Using Blasting Gun Process

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## Abstract

This study explains how to manufacture the equipment for removing radioactive wastes on the wires generated during the decommissioning process of nuclear facilities. The method involves spraying pressure treatment process to separate the aggregates from the wire; the latter of which contain the majority of the radioactive contaminants. The process acted to weaken the chemical bond between the wire and aggregate components on the wire. As a result of the decontamination test of the flat nozzle and the round nozzle, the decontamination area of the flat nozzle increased compared to the round nozzle, but the decontamination rate decreased. In the case of a round nozzle, the sprayed dry ice pellets collide with the surface of the wire and decontamination occurs almost simultaneously. On the other hand, in the case of a flat nozzle, it takes about 1 second or more to decontaminate one area. If the electric wire moves before one area is decontaminated, there is a possibility of deterioration of decontamination performance.

**Keywords:** Decommissioning waste; Pressure treatment; Flat nozzle; Round nozzle; Wire

## Introduction

Decommissioning is one of the most important steps in the nuclear industry and decommissioning process involves decontamination, decommissioning, waste disposal and environmental treatment, usually lasting 10-20 years [1-4]. Various types of waste generated during the decommissioning of nuclear power plants and the amount of wire waste needs to be considered. It can vary greatly depending on the type of facility, operational history, and regulatory standards [5,6]. This represents a significant technical challenge to any decommissioning project. Further, the disposal costs for the generated wastes are a significant part of the total budget for any decommissioning project [7]. Targeted treatment of the wire wastes to maximize the achievable volume reduction, for example by allowing significant volumes to be released as clearance, is one option available to reduce costs and final radioactive waste volumes destined for disposal. The IAEA define clearance as “the removal of radioactive materials or radioactive objects within authorized practices from any further regulatory control by the regulatory body” [8]. In other words, when the radionuclides are removed from the radioactive waste, through some form of treatment, and the remaining radioactivity of the waste is lower than the regulation criteria stipulate, then the treated waste could be disposed of as general industrial waste. In the case of Korea, a low and intermediate-level radioactive waste disposal facility that could dispose roughly 800,000 drums (200L per drum) of radioactive waste has been constructed [9]. The facility uses two disposal methods, underground silos and near-surface disposal. The underground silo disposal method uses a silo built into a rock cavern within the bedrock or under the ground at 80–130m below sea level and is designated for low and intermediate-level radioactive waste [10]. The near-surface

disposal, for disposing of the very low-level radioactive waste, is a method using a natural or artificial barrier at a depth of about 30 m sub-surface and is covered with soil after being filled [11]. As a result of the decontamination area test of the flat nozzle and the round nozzle, the decontamination area of the flat nozzle increased compared to the round nozzle, but the decontamination rate decreased. In the case of a round nozzle, the sprayed dry ice pellets collide with the surface of the wire and decontamination occurs almost simultaneously. On the other hand, in the case of a flat nozzle, it takes about 1 second or more to decontaminate one area. If the electric wire moves before one area is decontaminated, there is a possibility of deterioration of decontamination performance.

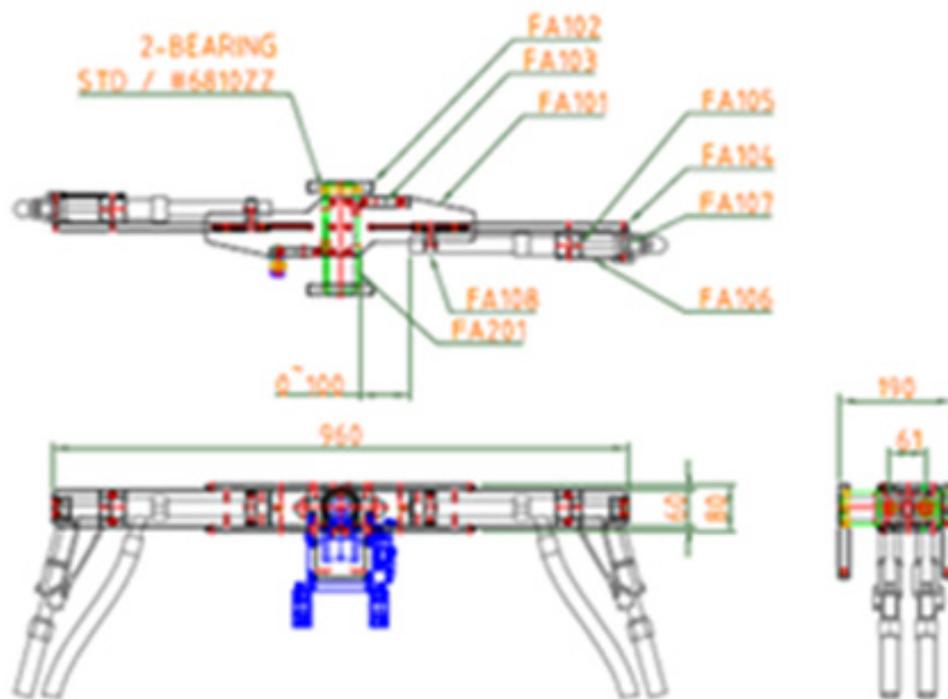
**Experiment**

We simulated aged wire conditions using wire obtained from demolished buildings, which had a similar age to that of decommissioning wire waste. The purpose of the experimental program was to evaluate the separation efficiency of contaminants from the wire by air pressure treatment. To prepare the simulated surface contaminated wire, pre-cut wire was submerged in a 1L grease solution (nonradioactive) and left undisturbed until the

solution dried naturally through evaporation (~1 month). In the experiment, two types of wire, non-contaminated or contaminated, were used. First, the non-contaminated wire was used to optimize the treatment conditions. Next, the previously optimized conditions were applied to the contaminated wire.

**Results and Discussion**

In order to decontaminate all surfaces of the electric wire considering the decontamination area by the circular nozzle, the electric wire or the blasting gun must be rotated. The wire fixing method was decided by referring to the results of the evaluation of the equipment using the wire rotation method among the lab-scale mechanical decontamination equipment. In the case of the wire rotation method, it cannot change flexibly in response to wires of various thicknesses, and there is a large deviation in the degree of decontamination according to minute changes in equipment. Also, it is impossible to fix all parts of the wire with a large roller because the degree of bending of the incoming wire is severe. Therefore, it is designed in such a way that the blasting gun rotates even if the design becomes more complicated and the equipment becomes larger as shown in Figure 1.



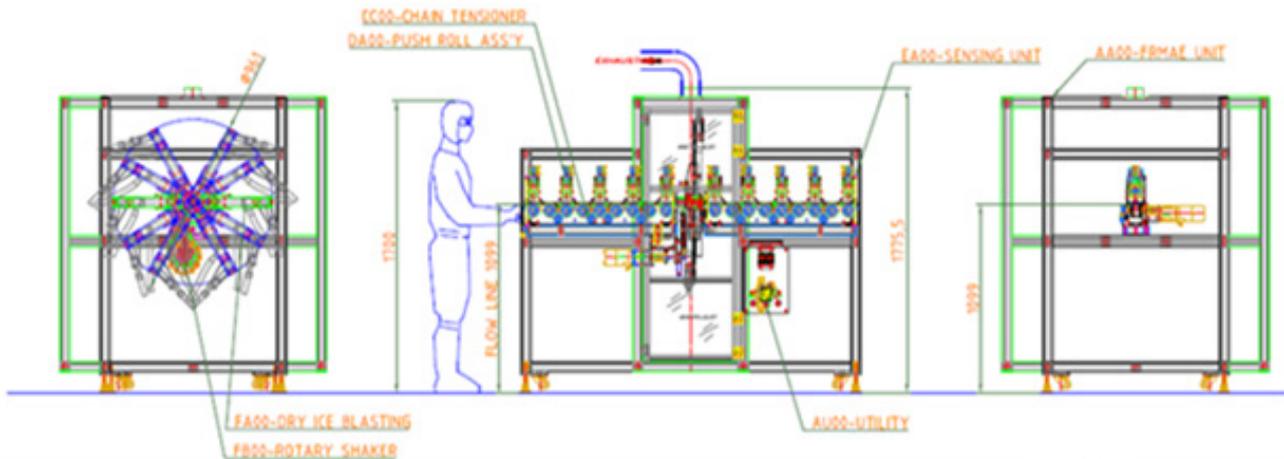
**Figure 1:** Design of blast gun.

Circular nozzle and the area where the flat nozzle are sprayed horizontally. The surface area is the widest with the circular nozzle, while the velocity is relatively slow compared to the circular nozzle in the Table 1. Figure 2 shows the design of decontamination equipment. The wire movement method applies the wire fixing method rather than rotating the wire. In the wire rotation method, decontamination is performed while moving and rotating the wire at the same time by rotating a disk at an angle to one side. Figure 3

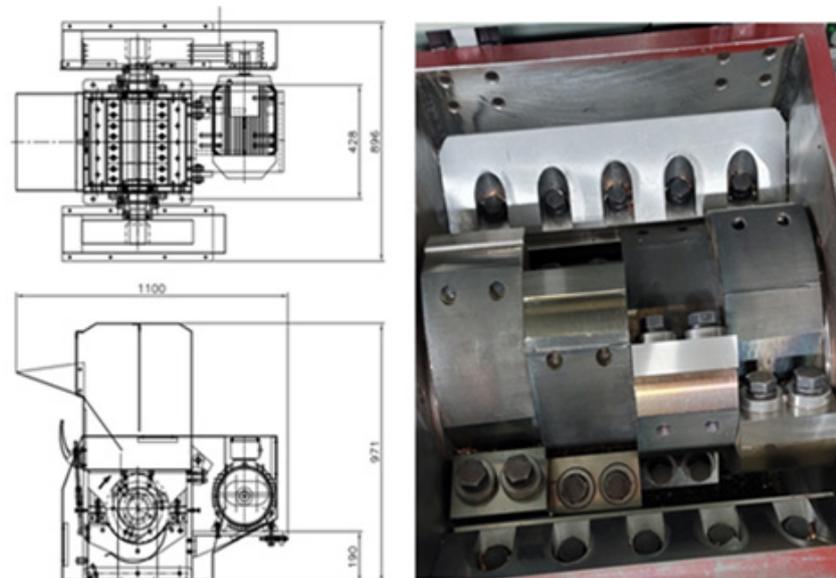
is the shape of the waste wire grinding/screening system grinding part schematics and device photo.

**Table 1:** Decontamination length and time according to each nozzle shape.

	Circular Nozzle	Horizontal Flat Nozzle
<b>Distance (mm)</b>	17.39	15.08
<b>Time (sec)</b>	1	1.5



**Figure 2:** Design of decontamination equipment.



**Figure 3:** Waste wire grinding/screening system grinding part schematics and device photos.

## Conclusion

Evaluation of the air injection results are very low on all contaminant targets. There is little decontamination effect, especially for contaminants such as lakka and water-soluble paints. On the other hand, dry ice injection can make 70% of decontamination. However, in order to save the dry ice consumed when decontamination, first remove the vitreous contaminants through the air spray, and the sticky contaminants are determined by using both air and dry ice, judging that it is efficient to decontaminate with dry ice. As a result of the decontamination area test of the flat nozzle and the round nozzle, the decontamination area of the flat nozzle increased compared to the round nozzle, but the decontamination rate decreased. In the case of a round nozzle, the sprayed dry ice pellets collide with the surface of the wire and decontamination occurs almost simultaneously. On the other hand, in the case of a flat nozzle, it takes about 1 second or more to decontaminate one area. If the electric wire moves before one

area is decontaminated, there is a possibility of deterioration of decontamination performance.

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