Development of Radioactive Waste Drum Cutting System Using STD-11 Cutter

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1. Introduction

The radioactive waste drum is generated during the drum treatment of the radioactive waste. Especially, in the process of repacking after the integrity test (harmful substance and free moisture content) of the produced drum, the drum is broken and a lot of waste drum is generated. The waste drums produced in this way are packaged and stored in a designated place in accordance with the regulations on radioactive waste disposal or recycled through self-disposal process after decontamination process.

As a conventional disposal method, there is a method of reducing the volume by cutting the drum using oxygen welder, plasma cutting machine, grinder, etc. However, cutting method using this sort of things invariably accompanies flames, smokes and dusts which can cause high risk of fire hazard and safety concern as well as diffusion of contamination by secondary waste. In addition to that, it also has disadvantage of difficulties in securing analytical reliability owing to self-shielding effect of representative sample caused by fusion of sample's cutting surface.

In order to solve the problems of the conventional cutting method a safe cutting device has been developed.

2. Development of Radioactive Waste Drum Cutting System using STD-11 Cutter

2.1 Basic structure and cutting principle of cutting device

Basic configuration of the cutting apparatus is as follows;

- Lower rotary shaft fitting with lower cutter for cutting the drum and upper rotary shaft fitting with upper cutter
- Guide roller mounted between lower rotary shaft and upper rotary shaft for supporting peripheral of drum from bottom side
- Rotary drive mechanism for rotating the lower rotary shaft and the guide roller

The lower cutter and upper cutter are each composed of first and second cutting elements arranged at predetermined interval on the respective lower rotary shaft and upper rotary shaft.

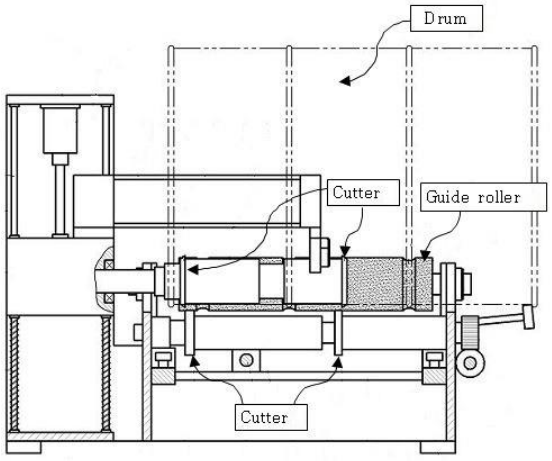

Fig.1. Basic configuration of cutting device.

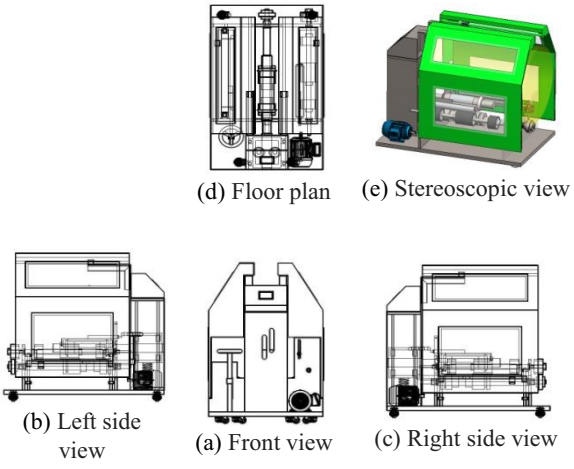

Fig. 2. Outline drawing of cutting device.

The working principle of the cutting apparatus is that a waste drum is mounted between the lower cutter and the upper cutter to lower the upper cutter to the cutting position and simultaneously rotate the lower cutter and the waste drum to cut the drum in the circumferential direction.

Two pairs of the lower cutter and the upper cutter

are provided so that cutting is performed for the two portions in one-time driving, so that the operation can be performed quickly.

During drum cutting operation, the drum is rotated and at the same time, the position of the guide roller which supports peripheral of the drum at the bottom side can be adjusted by linear moving mechanism. This will enable this cutting apparatus to cut the waste drum in various sizes.

2.2 Cutting device and cutting drum Specification

Table 1. Cutting device specification

division	Prototype	Finished
size (m)	1.5(W)×1.4(D)×1.2(H)	1.3(W)×0.8(D)×1.2(H)
weight (kg)	About 800 kg	About 600 kg
motor	1,700 rpm (Gear ratio 1/10)	1,440 rpm (Gear ratio 1/60)
Power supply	220V / 380A	220V / 380A
noise	Average 60 dB	Average 60 dB
Cutter Material	STD-11	STD-11
Device Photos		

Table 2. Cutting Drum Specifications

division	Design specification	
	320 L	200 L
thickness (mm)	Galvanized steel sheet 1.2(KSD 3506)	Cold rolled steel plate 1.2 (KSD 3512-SPCC)
size (mm)	ø660(inner diameter) × 955(height)	ø567(inner diameter) × 884(height)

3. Characteristics and composition of Cutter (STD-11)

STD-11 is a KS (Korean Standard) symbol, and JIS (Japanese Standard) symbol SKD-11 is also used. STD is an abbreviation of 'Steel Tool Dies'. It is a classification symbol for cold-alloy tool steel on material classification, and 11 means type.

Unlike carbon tool steels, cold alloy tool steels generally contain a small amount of silicon, manganese, nickel, chromium, tungsten, and vanadium in addition to carbon in an amount of 2 to 3%. Alloying elements improve wear resistance by forming carbides.

Table 3. Chemical composition (wt. %)

C	Si	Mn	P
1.40 ~ 1.60	≤0.40	≤0.60	≤0.030
S	**Cr**	**Mo**	**V**
≤0.030	11.00~13.00	0.80 ~ 1.20	0.20 ~ 0.50

Table 4. Heat treatment temperature (˚C) and hardness

Heat treatment temperature (˚C)			Hardness	
Annealing	**Quenching**	**Tempering**	**Annealing**	**Tempering**
800~ 870	1000~ 1050	550~ 680	≤255	≥58

4. Conclusions

Newly developed Radioactive Waste Drum Cutting System using STD-11 cutter makes it possible to do drum cutting job cleanly and safely without risk of fire hazard and accident experienced in the conventional cutting method due to flame, smoke, dust, noise, etc. Its clean cutting operation can also make it possible to reduce rad-waste by increasing the probability of being recycled as self-disposal after decontamination for relatively low polluting waste drums.

In addition, since operation of the device is designed easily, cutting operation is very convenient and simple, and working efficiency can be improved. Further more, the device is compactly designed and thus, working space can be sufficiently secured without any difficulty.

REFERENCES

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