

Experimental study about Optimized Weight for radioactive waste drums as their type



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I. Introduction

Outline

- **Saturation of temporary radioactivity waste storehouse space**
- **Construction delay of low and intermediate-level radioactive waste repository**
- **Management reducing radioactivity waste pending issue comes to the front**

Directions

- **Optimizing weight of radioactive waste drums as their type**
- **Producing radioactive waste drums on the decrease**

II. Main subject

1. Waste drum spec and check list

Drum spec

- **Size** : $\Phi 567\text{mm}$ (inner diameter) \times 830 mm
(the inside height) \times 884mm(the outside height)
- **Body**
Cap and bottom : Cold-drawn steel plate 1.2mm
(KSD 3512)
- **Bolt shaped band** : Steel plate coated with zinc
2.1mm(KSD 3506)
- **Gasket** : Containing airtight



1. Waste drum spec and check list

Drum check list and standard

No	Items	Criteria
1	Water pressure Test	15.0 psig, 5 mins
2	Airtightness Test	7.0 psig, Sprinkling, Compression, Drop, Penetrating
3	Drop Test	1.2 m, 45°
4	Penetrating Test	1.0 m, weakness points
5	Compression Test	2.0 ton, 24 hrs

2. Waste drum packing standard

Notification of Medium or low level radioactive waste delivery rule (No. 2009-37)

No.12(Conditions of the package) Package shall be appropriated for the following conditions.

- 1. All wastes shall be packed by non-flammable container, and the container shall not have any defects in visual inspection.**
- 2. The package shall keep a structural wholesomeness when waste is expected to dispose. And the package shall endure an internal pressure increase by gas generated inside of the package.**

2. Waste drum packing standard

KHNP Standard : Radiation-12 (medium or low level radioactivity waste management)

Item	Packing Standard
Component	Impurities are not included
Filling level	over 85%
Water content	below 1% for high wholesomeness container, below 0.5% for the rest
Maximum weight	600kg(Steel drum)
Other Package requirements	<ul style="list-style-type: none">o It must be tighten when total radioactivity is over 74,000Bq/g for nuclide having half-life over 5 years among heterogeneous wastes (wasted filter, solid waste, etc.)o Incombustible container should have no problem at macrographyo It should maintain the structural wholesomeness and stand internal pressure increase

3. Current state of compressors as NPPs

NPP		Capability (ton)	quantity	NPP		Capability (ton)	quantity
Kori	Unit 1,2	30	2	Uljin	Unit 1,2	30	1
	Unit 3,4	30	2		Unit 3,4	30	3
		10	1		Unit 5,6	30	1
Yeonggwang	Unit 1,2	30	2	Wolsong	Unit 1,2	30	1
		10	1			10	1
	Unit 3,4	30	3		Unit 3,4	10	2
	Unit 5,6	36	1				

4. Current state of radioactive waste drum generation

States of waste drum generation in Yeonggwang unit 5, 6 for recent 3 years

Classification	2007	2008	2009	Total	Total Weight(kg)	Average Weight(kg)
Paper	44	46	25	115	15,379	133
Vinyl	49	59	25	133	20,014	151
Cotton	41	40	25	106	13,385	126
Rubber	11	18	13	42	6,740	161
Metal	21	19	13	53	13,759	260
Plastic	28	15	12	55	6,658	121

4. Current state of radioactive waste drum generation

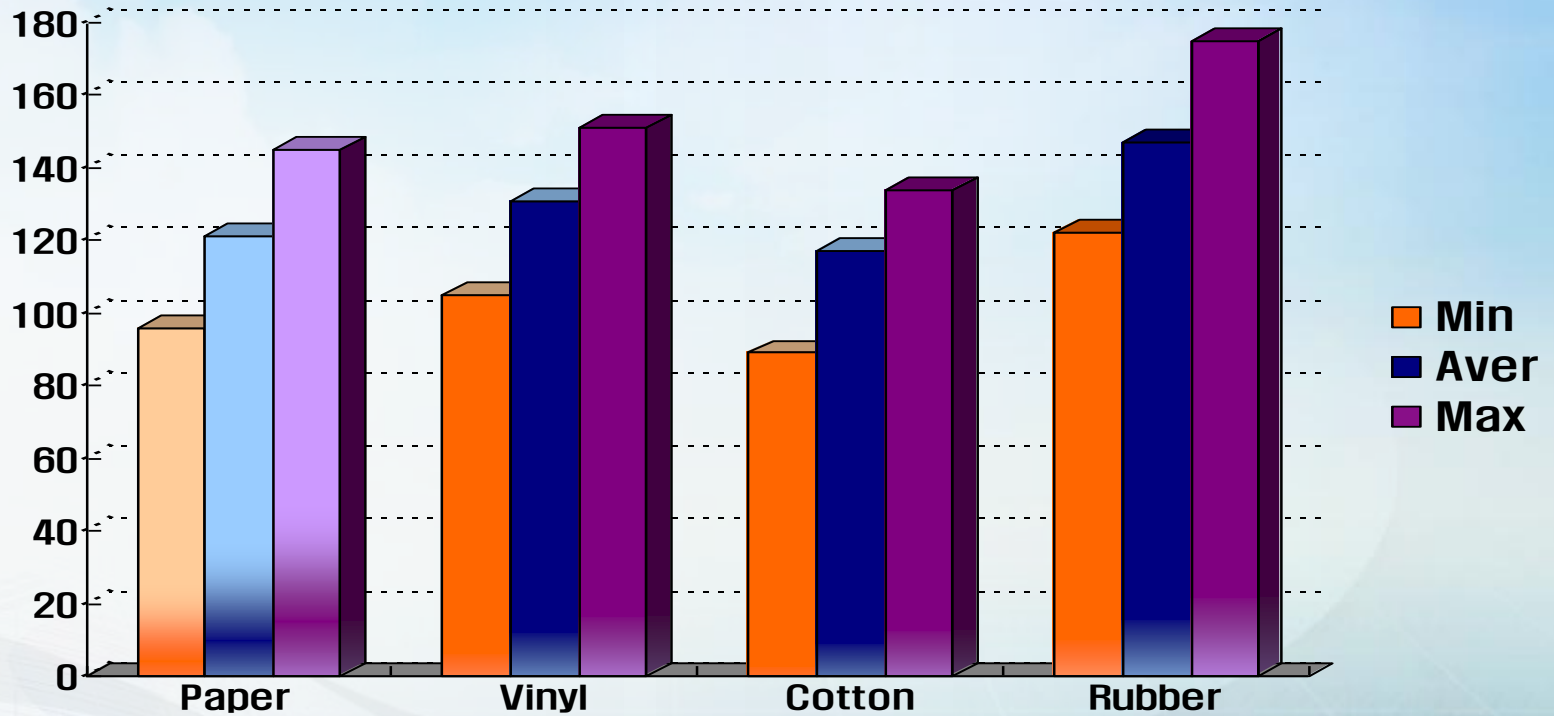
Average weight of the drums made in all NPPs

Period : from 2007 to 2009

Classification	Yeonggwang [Unit 5, 6]	A	B	C	D	E	F	G	H	I	Average Weight
Paper	133	117	137	135	121	106	120	113	96	116	119
Vinyl	151	128	130	133	145	120	150	123	105	126	131
Cotton	126	109	117	125	116	125	134	112	89	120	117
Rubber	161	144	149	122	128	150	175	152	139	-	147
Metal	260	217	220	225	224	241	252	220	363	176	240
Plastic	121	85	118	87	91	128	105	106	92	80	101

4. Current state of radioactive waste drum generation

Average weight of the drums made in all NPPs



Reference

We are reporting the check list before producing solid waste drum to improve quality and optimize drum weight

잡고체 폐기물 드럼 생성 전 점검표

가. 드럼 압축 작업시 점검사항

순번	항 목	상 태	작 업 일 시	작성자(서명)
1	압축기 동작상태 확인	<input type="checkbox"/> 만족		
2	드럼 외관상태 확인 (압축 전)	<input type="checkbox"/> 만족		
3	폐기물 종류 확인			
4	유리수 및 킬레이트제유무 확인	<input type="checkbox"/> 무		
5	유해물질 및 폭발성물질 유무 확인	<input type="checkbox"/> 무		
6	폐기물 성상별 표준무게 확인	<input type="checkbox"/> 만족		
7	드럼 외관상태 확인 (압축 중)	<input type="checkbox"/> 만족		
8	채움을 확인 (85% 이상)	<input type="checkbox"/> 만족		
9	드럼 외관상태 확인 (최종 압축 후)	<input type="checkbox"/> 만족		
10	드럼 외부 및 내용물 사진촬영	<input type="checkbox"/> 만족		
11	드럼 체결상태 확인	<input type="checkbox"/> 만족		
12	생성드럼 무게 확인	_____ kg		

나. 기타 점검사항

순번	항 목	점검 상태	작성자 (서명)
1	작업자 방호 및 안전장구 착용상태 확인	<input type="checkbox"/> 만족	
2	작업 후 작업장 주변 청결 및 정리정돈 상태 확인	<input type="checkbox"/> 만족	
3	작업장 전원 콘센트 및 전등 소등 상태 확인	<input type="checkbox"/> 만족	
4	드럼 일련번호 :		

○ 점검자 : (서명)
 ○ 확인자 : (서명)
 (서명)

5. Experiment for drum weight optimization



Preparations

- **Waste drum : 2ea(22.4kg/drum)**
- **Waste – Paper type**
 - **Paper clothing : about 500ea[(0.2kg/ea),100 kg]**
 - **Decon paper : about 300 kg**
- **Compressor : 1set (Capability : 36ton)**



5. Experiment for drum weight optimization

Filling method

■ Paper clothing

- **A** : Drum was filled with paper clothing uniformly with no considering paper clothing's shape. 
- **B** : Drum was filled with paper clothing after paper clothing had been rolled to be kept upright. 

■ Decon-Paper

- **C** : Drum was filled with decon-paper uniformly with no considering it's shape. 
- **D** : Drum was filled with decon-paper uniformly after paper had been spread out. 

5. Experiment for drum weight optimization

Weight comparison as filling method

Type	Paper clothing		Decon-paper	
	A	B	C	D
Case 1	68.7	69.8	151.5	155.5
Case 2	68.5	70.4	154.9	153.8
Case 3	69.1	70.0	152.9	156.0
Case 4	69.0	70.4	152.7	156.1
Case 5	68.8	70.2	150.8	154.9



Optimized weight as waste type and method

- Paper clothing
 - Filling method B, **70.4 kg**
- Decon-Paper
 - Filling method D, **156.1 kg**

5. Experiment for drum weight optimization

Drum weight as mixture rate of paper type

No	Mixture Rate	Weight (Theoretical)	Weight (Experimental)
	Decon-Paper : Paper Clothing		
1	9 : 1	147.4	149.2
2	8 : 2	138.8	143.8
3	7 : 3	130.2	137.2
4	6 : 4	121.6	132.7
5	5 : 5	113.2	127.1



Producing paper type waste on Yeonggwang unit 5, 6(2009)

- Total : 3,900 kg
 - Decon paper : about 3,500 kg
[about 90 %]
 - Paper Clothing : about 400 kg
[about 10 %]

※ Extraneous deformation of drum on 151.5kg compression

5. Experiment for drum weight optimization

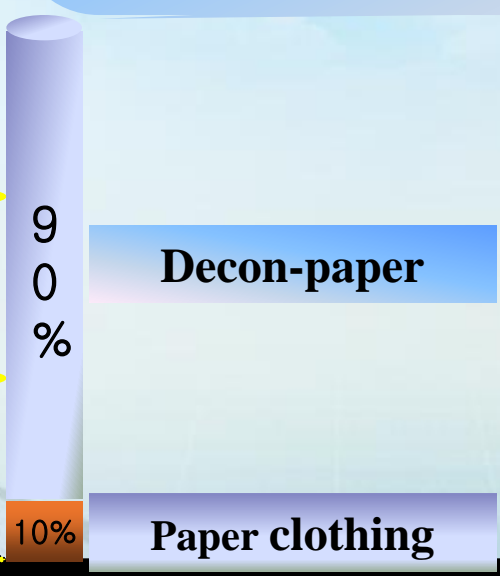
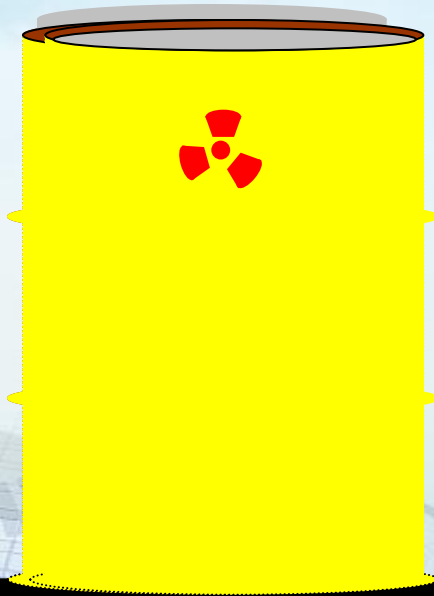
Theoretical Weight : 147.4 kg

Experimental Weight : 149.2 kg

Compression ratio of 9 : 1

Paper type Waste
about 2kg addition

↓
Addition compression possibility is about 2kg



5. Experiment for drum weight optimization

Economic efficacy as waste weight optimization

- Optimized weight for paper type : 149 kg
- Average weight of paper type for recent 3 years : 119 kg

30 kg

- Application of weight optimization for paper type waste
 - Total NPPs generating drum : 473 drums
 - Weight difference per a drum : 30 kg
 - Application of weight optimization : 354 drums are possible to be created

14,190 kg

- 14,190 kg = Reducing about 119 drums

Cost down about ₩1,190,000,000

**Reducing about
119 drums**

5. Experiment for drum weight optimization

Procedure of the test for drum weight optimization

Generate mixture rates considering production rate as waste type in NPPs

Compression work as result

Generate optimized weight as waste type

Optimization of waste drum weight
[Compression over optimum weight]

filling waste withdrawal bag to the optimized weight before the compression

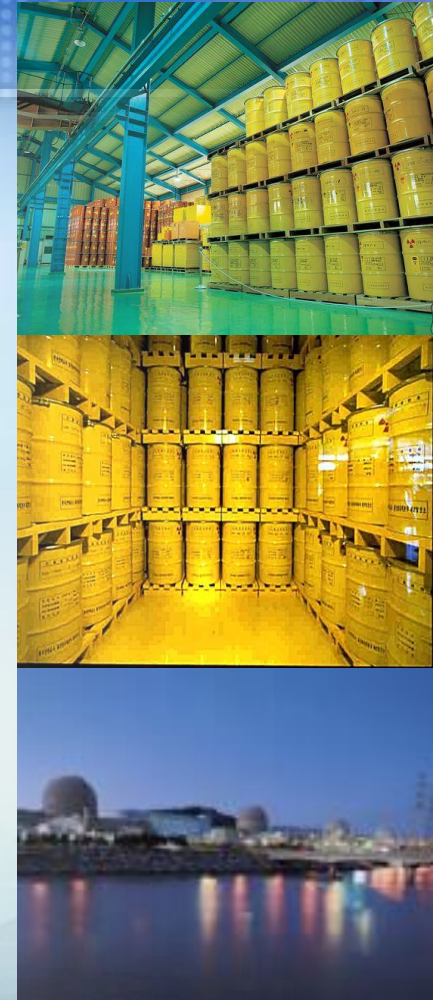
Compression

III. Expectations and conclusion

Expectations and conclusion

Experiment for drum weight optimization

- To perform a close quality assurance from the first (creation) step to the last(disposal) step and secure reliability.
- To generate waste drum had optimum weight by standardization.
- To reduce amounts of waste drum generation and cut the disposal cost.
- To satisfy transfer regulations of radioactive waste drum repository.



IV. Future plans

Future plans

Application of optimized weight for radioactive waste drum : 2011

- **2010.8 : Paper weight for Radioactive waste drum is optimized**
- **After 2010. 9**
 - **Testing and drawing a conclusion to optimize weight for drums filled with cotton clothes, vinyl resin, rubber or plastic material.**
 - **Studying what weight optimization should be taken and solving problems for optimization through some tests.**
 - **Weight optimization of radioactive waste drums as their type in conformity with the rule**

Thank you