Decontamination of Metal Radwastes using Machine Tools

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CONTENTS

1. Introduction
2. Metal Radwastes
   - Status of Treatments
   - Technology Developments
3. Conclusions

1. Introduction

Framework

- **Generation of Metal Radwastes**
  - Maintenance & Improvement of long-term operation NPPs
- **Treatment of Heavily Contaminated Metal Radwastes**
  - Lack of effective decontamination due to hand tools
- **Requirement for Less Than Limits Disposal**
  - Disposal regulations : The principles of IAEA/RS-G-1.7
  - Lack of processing technology for regulatory compliance

Improvement

- Limits of using hand tools : Bulk handling difficulties
- New technologies is required for bulk handling

2. Metal Radwastes

2-1. Status of Treatments in Korea

- **Generation of Metal Radwasets from NPPs**

  - **Facilities Improvement**

    - reactor building and auxiliary building

  - **Equipment Performance Improvement**

    - air and water purification systems

  - **Replace Aging Facilities**

    - various waste materials, grating, library, etc.

2. Metal Radwastes

Generation of Metal Radwaste Drum

Amounts of drums

- Average of about 200 drums occurred in last three years
- Increased volume of its disposal due to recycle activation

(units: drums)

Year / Unit	2007	2008	2009	2010 (July)
#1	247	136	95	3
#2	56	67	24	1
Total	303	203	119	4

2. Metal Radwastes

- **Storage of Metal Radwastes**

Managements

Unit	Item	Amount (tons)	Location	Remarks
#1	Air conditioning system, Toolbox	12	M-3	Decontamination
	Steel beam, Others	10	M-3	Storage
	RCP Main Flange Bolt	2	M-3	Storage
#2	Dryer, Fan housing	1.4	N-3	Decontamination
Total	-	25.4	-	-

2. Metal Radwastes

Treatments

1. Drum Storage

- Impossible to decontaminate metal radwastes
- After pretreatment and volume reduction

2. Attenuation Storage

- Long half-life radionuclide contaminated large facilities
- Complex geometry metal radwastes

3. Temporary Storage

- Its disposable metal radwastes (by level, type)
- Decontamination after temporary storage

2. Metal Radwastes

Decontamination

❖ General contamination

- After scrubbing, then high pressure steam or water cleaning

❖ Heavy contamination

- After grinding (0.1~0.2 mm), then high pressure steam cleaning

2. Metal Radwastes

Its Disposal Process

Transportation
(Decontamination site)

Decontamination

Radiation measurements

Classification and Numbering

Analysis and Packaging

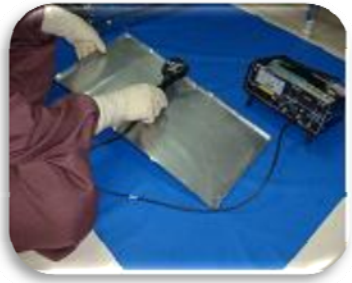
Transportation
(Its disposal storage site)

Scrubbing

High pressure steam

High pressure watering

Grinding


Measurements

Packaging & Storage

2. Metal Radwastes

- Comparison of its disposal regulatory standards

Nuclide	Concentration limit (Bq/g)			MDA (Bq/g)
	MOEST Notice/Korea	KINS	IAEA	
Co-60	Personal: 10μSv/year Groups: 1man-Sv/year proved less concentration	0.1	0.1	0.01
Cs-137		0.1	0.1	0.01
H-3	100	100	100	10
C-14	100	0.1	1	0.1

2. Metal Radwastes

- Decontamination issues

Hand tools grinding problems

1. Long time for working
2. Work processes delay due to add sticking
3. Not suitable for long-term operation of large quantities
4. Absence of mechanical equipment for cutting metal surface
5. Low efficiency and very dangerous for working

2. Metal Radwastes

2-2. Technology Developments

- **Needs**
  - To overcome the limitations of existing methods
  - To improve the working environment
  - To reduce the working time
  - To reduce costs and perform an efficient process

2. Metal Radwastes

- The purpose of technology development

Decontamination of Metal Radwastes using Machine Tools

Technology Developments

- Optimal process
- Improve efficiency
- Expanded its disposal
- Reduction Radwastes

2. Metal Radwastes

Configuration of equipments

Column

Milling machine units with base

Knee

Vertical adjustment of the table

Saddle

Table supported/Back and forth adjustment

Table

Fixed workpiece/Horizontal adjustment

Over Arm

Abber supporter supported

2. Metal Radwastes

Specification / NSM-T

- Size : 1,950mm(L) x 1,800mm(W) x 1,950mm(H)
- Power : 220V, 60Hz, 3-phase
- Main part Specification

Item	Detail	Unit	Value
Table	Working space	mm	1,100 x 280
	Maximum move distance/horizontal	mm	820
	Maximum move distance/back and forth	mm	360
	Maximum move distance/vertical	mm	450
	Maximum weight of workpiece	Kg	250
Column	RPM	RPM	Vertical 75~3,600 Horizontal 90~1,400
	Vertical move distance	mm	140
Equipment weight		kg	2,300

2. Metal Radwastes

- Major parts facility

Magnetic chuck

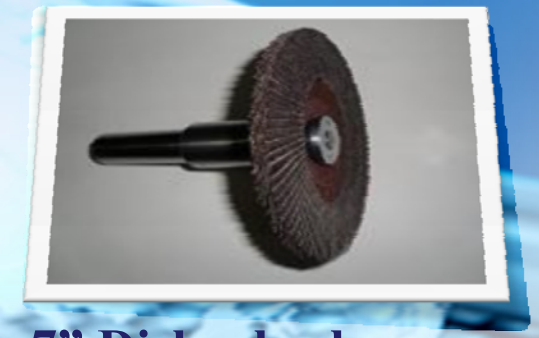
Dust collector

Air Purifier

2. Metal Radwastes

- Application tooling

For grinding



7” Disk wheel paper

2” and 4” Disk wheel paper

For milling

Ø25 End mill

Ø30 Long end mill

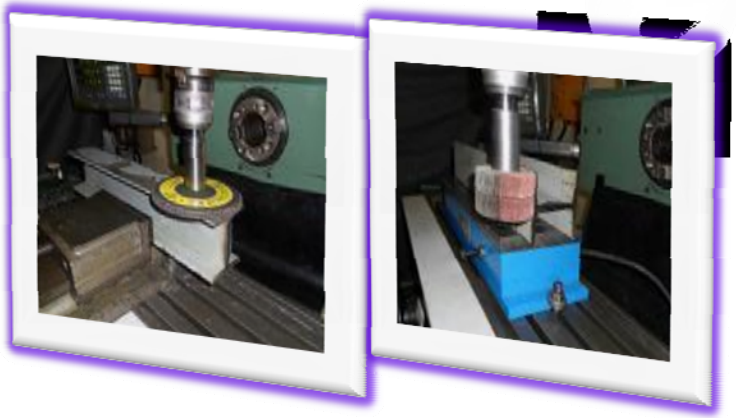
Ø50, Ø100 Face mill cutter

2. Metal Radwastes

How to apply

Grinding

- Vertical and horizontal grinding with 4”, 7” disk wheel paper : 400mm/min(0.2mm)



Milling

-Vertical milling with Ø30 long end mill : 240mm/min(0.3mm)
- Horizontal milling with 2”, 4” face mill : 300mm/min(0.3mm)

2. Metal Radwastes

- Actual Operation

2. Metal Radwastes

Before and after comparison

Working time and milling rate

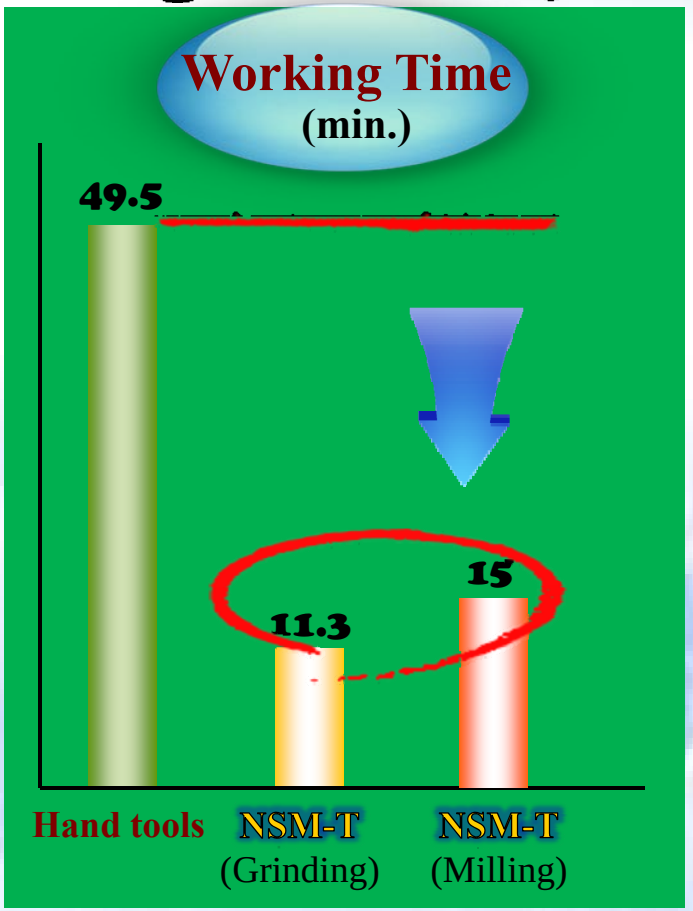
Item	Workpiece	Area (m^2)	Time (min.)	Thickness (mm)	Avg. Rate (m^2/min.)
Hand tools (Grinding)	Plate1	0.36(60x30)	36	0.1~0.2	0.01
	Beam2	0.54(15x60)	54		
NSM-T (Grinding)	Plate3	0.36	9	0.1~0.2	0.04
	Beam4	0.54	13.5		
NSM-T (Milling)	Plate5	0.36	12	0.3	0.03
	Beam6	0.54	18		

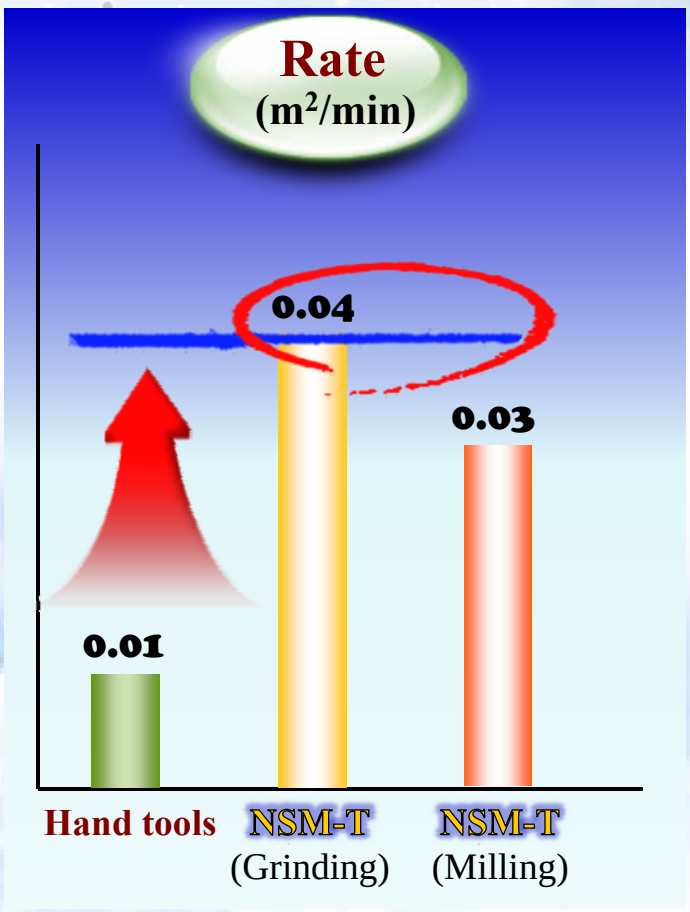
※ Preparation processes are excluded when working time calculating

2. Metal Radwastes

Changes in work efficiency

* Average standard area;0.45m^2





2. Metal Radwastes

- Comparison of waste generation

Hand Tools	Grinding/NSM-T	Milling/NSM-T
Size : 60*30cm , 10t	Size : 60*30cm, 10t	Size : 60*30cm, 10t
Volume : 1.8ℓ	Volume : 1.8ℓ	Volume : 1.8ℓ
Thick : 0.1~0.2mm	Thick : 0.1~0.2mm	Thick : 0.3mm
Wastes : 0.2ℓ	Wastes : 0.2ℓ	Wastes : 0.3ℓ

Use waste drum pore filler

2. Metal Radwastes

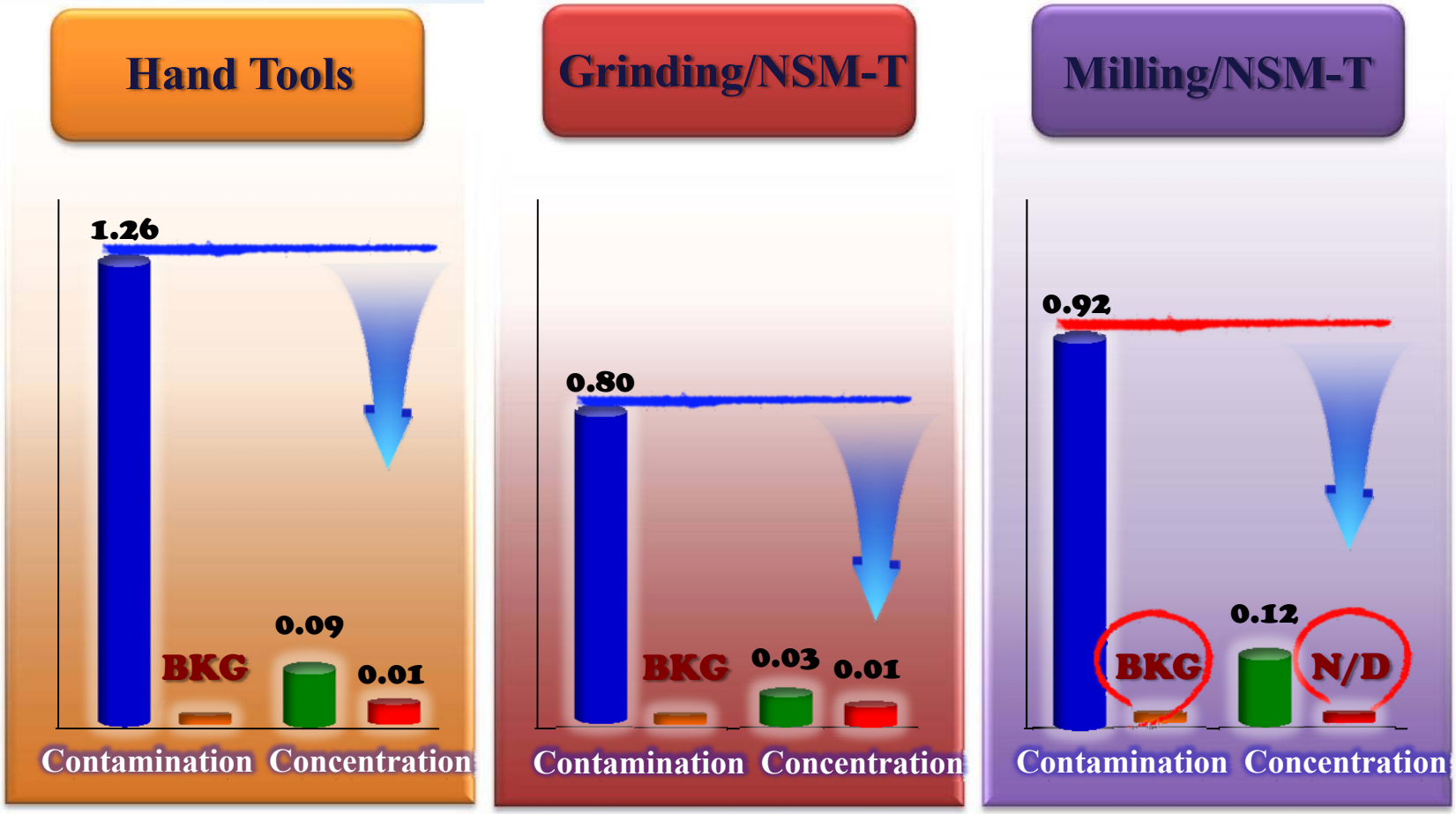
Radioactivity Analysis

Item	Workpiece	Contamination (Bq/cm²)		Concentration (Bq/g)		Grinding, Milling (mm)
		before	after	before	after	
Hand tools (Grinding)	Plate1	1.11	BKG	2.48E-02	N/D	0.1~0.2
	Plate2	1.18	BKG	2.24E-01	1.09E-02	
	Beam3	1.48	BKG	2.64E-02	1.27E-02	
NSM-T (Grinding)	Plate4	0.56	BKG	2.21E-02	N/D	0.1~0.2
	Plate5	1.11	BKG	3.01E-02	N/D	
	H Beam6	0.74	BKG	2.37E-02	1.33E-02	
NSM-T (Milling)	Plate7	0.48	BKG	1.03E-02	N/D	0.3
	Plate8	1.85	BKG	3.12E-01	N/D	
	Beam9	0.44	BKG	4.03E-02	N/D	

※ Surface contamination meter : Frisk-Tech
Radionuclide Analyzer : HpGe Gamma nuclides Analyzer

2. Metal Radwastes

- Changes in contamination



※ units : contamination(Bq/cm^2), concentration(Bq/g)

2. Metal Radwastes

- Process after improvement

Heavy

Normal

Step. 5

Fixed object

Step. 1

Pretreatment

Step. 6

Grinding, Milling

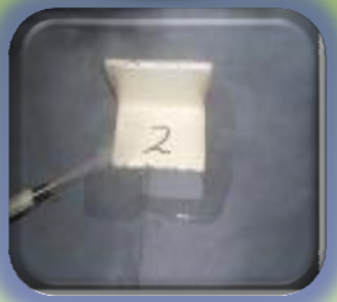
Step. 2

Scrubbing

Step. 7

Steam jet

Step. 3



Cleaning

Step. 8

Analysis

Step. 4

Measurements

2. Metal Radwastes

Advantages and disadvantages

	Advantages	Disadvantages
Hand Tools	Easy to handle Reduce workspace Various shapes application	Irregular cross-section Contaminants adhere Increased worker fatigue Massive dust
Machine Grinding	Suitable for paint removal plane Large amounts handling Regular cross-section Reduced working time	Ability to master Limited workspace Depending on shapes Dust generation
Machine Milling	Small dust Large amounts handling Reduced working time Adjustable milling thickness	Ability to master Pretreatments need Limited workspace Depending on shapes

2. Metal Radwastes

- **Application effects**

Decontamination process optimization for metal radwastes

To expand its disposal contribute to reducing radwastes

Measuring of surface cutting depth and decontamination of heavy contaminant on irregular surfaces

Increase operational efficiency by continuous treatment with large amounts of metal radwaste

Decrease production of drum by waste recycling (disposal costs reduced)

2. Metal Radwastes

Quantitative effects

Drum treatment costs
34,108,500 won

- **Purchase of drum**
  50drums X 74,000won/drum = 3,700,000won
- **Labor**
  50drums X 608,170won/drum = 30,408,500won

Drum disposal costs
224,525,000 won

- **Disposal costs**
  50drums X 3,853,000won/drum = 192,650,000won
- **Disposal fee**
  50drums X 637,500won/drum = 31,875,000won

Steel recycling
4,560,000 won

- **Steel recycling costs**
  12,000kg X 380won/kg = 4,560,000won

263,193,500won Reduction

- Reducing costs and cash equivalent drum: handles steels 12 tons (average 250kg/drum)

2. Metal Radwastes

- Qualitative effects

  - Radwaste reduction and treatment technology established
  - Additional secure storage space for temporary storage
  - Improve the drum treatment and care level by applying the entire company
  - Recycling of resources to contribute to the development of green industries

2. Metal Radwastes

Development Schedule

Planning and Performance

Planning Performance

Promotion details	2010 year										Rate (%)
	03	04	05	06	07	08	09	10	11	12	
Project Selection											100
Market Research											100
Apply Test											100
Equipment Installation											100
Field Demonstration											100
Equipment operating											-

2. Metal Radwastes

Human Resources and Budget

Manpower

- **Team Leader**: Seung Chun Lee
  - **Team**: Dae Seong Jang
  - **Team**: Byeong Jin Gu
  - **Team**: Gyeong Man Gu

Budget

Item	Detail	Amount(won)	Remarks
Equipment	Milling machine	18,000,000	-
Supplies	Application tooling	3,400,000	-
Additional expenses	Auxiliary tools	2,500,000	Scheduled
Other expenses	Market research and training	1,200,000	-
Total	-	25,100,000	

3. Conclusions

- Decrease production of drum by increasing its disposal
- Efficiency and Environment Improvement by Optimal operation
- Decontamination Process Standardization of its disposal metal radwastes
- Applied to various types of devices to reinforce and expanded device
- Metal hybrid decontamination techniques used and improved processing techniques

Thank you for your attention!!!

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