Review of Radioactivity Concentration and NORM Management in Phosphate Industry

Jong Hyeok Park, Jae Kwon, Min Young Lee, Byung Min Lee, Kwang Pyo Kim*
Kyung Hee University

INTRODUCTION

Radiation exposure in phosphate industry

- Since 1990s, the possibility of exposure by high concentration uranium in phosphate deposits has been discussed.
- Phosphate deposits generally contain NORM including U-238 and Th-232.
- As a result, occupational exposure occur in phosphate industries.
- In addition, public exposure may occur by products containing the radionuclides.

Necessity to analyze radioactivity concentration and NORM management in phosphate industry

- The IAEA recommended that internal exposure should be considered for safety management of NORM industry workers.
- The internal exposure of workers is affected by radioactivity concentration of substances existed in NORM industry.
- Therefore, it is necessary to evaluate radioactivity concentration for exposure management.
- In this study, we analyzed radioactivity concentration in domestic and foreign phosphate industries.
- In addition, we compared IAEA recommendation and domestic NORM management system.

OBJECTIVE

Analysis of the status in phosphate industries

- To analyze the radioactivity concentration in foreign and domestic phosphate industries.
- To compare IAEA recommendation and domestic NORM management system

Analysis of the status in phosphate industries

Radioactivity concentration in foreign phosphate industries

- The IAEA evaluated 10 major industries related to phosphate industry.
- Among them, 6 industries related to raw materials and processed products in the domestic act on radiation in natural environment.
- The IAEA presented U-238 and Th-232 radioactivity concentrations by detailed process of each industry.
- The radioactivity concentrations of U-238 and Th-232 were 0.03 to 3.51 Bq/g and 0.001 to 11.0 Bq/g.

Radioactivity concentration in domestic phosphate industries

- In Korea, the KINS evaluated only one phosphate fertilizer industries.
- KINS presented U-238 and Th-232 radioactivity concentrations with the other naturally occurring nuclides like Ra-226 and K-40.
- The radioactivity concentrations of U-238 and Th-232 were 0.092 to 0.85 Bq/g and 0.0007 to 0.009 Bq/g.
- The radioactivity concentrations in Korea are more less than foreign phosphate industries.

Table 1. Comparison of radioactivity concentration in phosphate industry

Main industries		Detailed process	Radioactivity concentrations (Bq/g)	
			U-238	Th-232
IAEA	Phosphorite mining and milling	Mining	0.1 - 3	0.1 - 0.4
		Milling	0.2 - 2.5	0.01 - 0.1
		Transportation	0.03 - 0.18	-
	Phosphate production by wet processing	Sulfuric acid decomposition	0.10 - 2.6	0.001 - 0.39
		Hydrochloric acid decomposition	< 3.51	< 11.0
	Ammonium phosphate fertilizer	MAP, DAP production	0.25 - 2.96	0.003 - 0.30
	Super phosphate fertilizer	SSP production	0.41 - 1.10	-
		TSP production	0.22 - 2.10	-
	Nitride phosphate fertilizer	Nitride phosphate fertilizer production	0.26 - 0.40	-
	Animal feed	MCP-DCP animal feed production	0.06 - 2.47	0.07 - 0.426
KINS	Fertilizer production	Sulfuric acid decomposition	0.092 - 0.85	0.0007 - 0.009

Comparison of NORM management system in phosphate industries

- The IAEA recommended that the characteristics of process which are expected to have high radioactive concentrations like tailing and scale, should be reflected for safety management.
- In addition, the IAEA recommended radioactivity concentration criteria that U/Th series as 1 Bq/g and K-40 as 10 Bq/g.
- For more safety management of NORM industry, the IAEA recommended regulatory system including notification, registration and licensing based on graded approach
- In Korea, radioactivity concentration criteria that same with IAEA recommendation is applying.
- However, there is no specific guidelines reflecting process characteristics and no regulation system based on graded approach
- Therefore, it is necessary to introduce a guideline that reflects process characteristics and regulatory system based on graded approach.

Table 2. Comparison of NORM management system in phosphate industry

Division	Criteria	Safety management measurement
IAEA	1 Bq/g (U/Th) 10 Bq/g (K-40)	• Considering raw material, byproduct and residues • Considering process characteristics • Regulating by notification, registration and licensing
Korea	1 Bq/g (U/Th) 10 Bq/g (K-40)	• Considering raw material, by product and residues • Regulating by registration

CONCLUSION

- **For analysis of the status in phosphate industry, we analyzed radioactivity concentrations and NORM management system.**
- **It is necessary to reflects process characteristics and graded approach for NORM regulation system.**
- **This study can be used as a basis for deriving of regulation based on graded approach on the NORM industry.**

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