External Dose Assessment to Workers in a NORM Industry Applying External Dose Rate Map

Seung Woo Ji[1], Jung Hwan Jang[1], Do Yeon Kim[1], Jeong Hwan Yoon[1], Jae Kook Lee[1, 2], and Kwang Pyo Kim[1*]

[1] Kyung Hee University, 1732 Deokyoung-daero, Giheung-gu, Yongin-si, Gyeonggi-do, Republic of Korea

[2]Korea Institute of Nuclear Safety, 62, Gwahak-ro, Yuseong-gu, Deajeon, Republic of Korea

[*]kpkim@khu.ac.kr

1. Introduction

Naturally occurring radioactive materials (NORM) contain natural radionuclides. Therefore the workers in the NORM industries are subjected to radiation exposure. A new law of Natural Radiation Safety Management Act was enacted in the Korea to protect workers against ionizing radiation from NORM.

Potassium is one of the NORMs. Natural potassium contains 0.0118% of ^{40}K which is natural radionuclide [1]. It decays to ^{40}Ca by emitting a beta particles and ^{40}Ar by emitting gamma radiation. The strong gamma radiation emitted from ^{40}K may result in radiation exposure to workers in potassium handling industries [2]. However, the radiation exposure to workers in potassium industry has not been adequately addressed. The objective of this study was to assess external dose to workers at potassium industry applying external dose rate map.

2. Materials and Methods

The external dose rates were measured at major potassium handling facilities using portable survey meters. At each facility, site was divided in to several grids. External dose rates were measured for 3 times at center of each mesh and averaged. Each grid was classified into four groups depending on the measured dose rates. Table 1 shows major three potassium industries and their processing area.

Table 1. Major potassium industries and processing area

Facility	Major processing area
I	Warehouse, Packing area A, B
II	Warehouse, Mixing area, Packing area
III	Input area, Drying area, Packing area

Target workers for external dose assessment were selected based on the external dose rate map. Most of the target workers spent time within the grid with relatively high external dose rate. Exposure scenario was analyzed by interview with target workers. We calculated external dose to the target workers using measured external dose rate and exposure scenario.

3. Results and Discussion

Fig. 1 shows external dose rate map at whole site of facility II. The external dose rates at most of potassium facilities were background level.

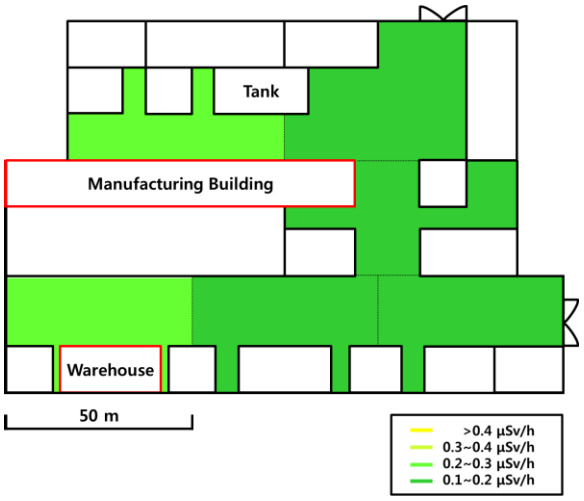

Fig. 1. External dose rate map at whole site in the facility II.

Fig. 2 shows external dose rate map at warehouse of facility II. Relatively high external dose rate was found at some sites such as warehouse in the facility II. At the some sites such as warehouse, a large amount of potassium compounds were handled. Based on the external dose rate map, 9 processing area were selected for external dose assessment at potassium facilities.

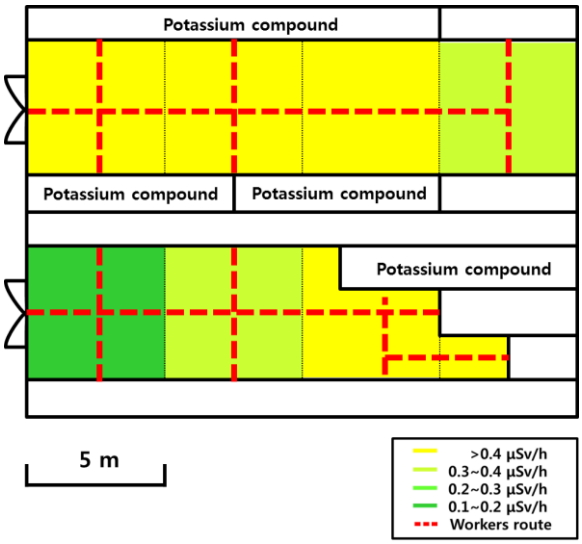

Fig. 2. External dose rate map at warehouse in facility II.

Fig. 3 shows annual radiation dose to the workers at potassium industries. Annual dose varied with workers, widely ranging 0.011 - 0.368 mSv/y. Radiation dose was the highest to worker at packing area A in the facility I. It could be contributed that working time at packing area in the facility I was higher than other processing areas.

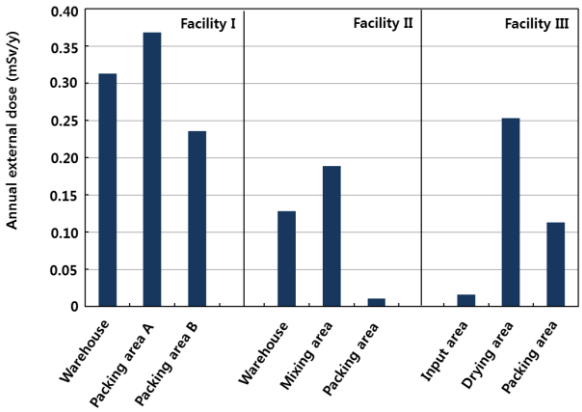

Fig. 3. Annual external dose to workers at potassium industries.

4. Conclusion

External radiation dose to workers in potassium handling industries were assessed in this study. External dose rates were directly measured and dose rate map was generated at 3 potassium facilities for the external dose assessment. Based on the external dose rate map methods given in this study, target workers can be selected effectively. External dose rate map also can be used for management of radiation exposure to workers. The results of this study can contribute to protect workers in NORM industries against ionizing radiation.

ACKNOWLEDGMENTS

This work was supported by a grant from “Establishment of Technical Basis for Implementation on Safety Management for Radiation in the Natural Environment” carried out by Korea Institute of Nuclear Safety.

REFERENCES

[1] FPTRPC, Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials, Canadian NORM Working Group of the Federal Provincial Territorial Radiation Protection Committee (2011).

[2] K. Emumejaye, Determination of ^{40}K Concentration in Some Powdered Milk Samples Consumed in Delta State, Nigeria, IOSR Journal of Applied Physics, 2(3): 8-12 (2012).