

Radiation Dose Assessment to Workers in NORM Industries Applying External Dose Rate Mapping

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Potassium is one of the naturally occurring radioactive materials (NORM). Potassium contains ⁴⁰K which is natural radionuclide and it may cause radiation exposure to the workers in potassium handling industries. The objective of this study was to assess radiation dose to the workers for radiation protection purpose. External dose rates were directly measured and dose rate map was generated at 3 potassium handling facilities in Korea. Annual radiation doses to some target workers were calculated using measured dose rate and exposure scenario. Annual radiation dose to the workers ranged 0.003-0.364 mSv/y. The dose rate map and dosimetry methods developed in this study can be used for management of radiation exposure to workers in NORM industries. The results of this study can contribute to protect workers in NORM industries against ionizing radiation.

I. INTRODUCTION

Potassium is one of the naturally occurring radioactive materials (NORM). Therefore the workers in the potassium industry are subjected to radiation exposure. To protect the workers against ionizing radiation from NORM, a law of Natural Radiation Safety Management Act (NRSMA) was enacted in Korea 2012. The potassium industry is one of the main industries enforced by the law of NRSMA. Natural potassium contains 0.0118% of ⁴⁰K which is natural radionuclide (Ref 1). It decays to ⁴⁰Ca by emitting a beta particles and ⁴⁰Ar by emitting gamma radiation. The strong gamma radiation emitted from ⁴⁰K may result in radiation exposure to workers in potassium handling industries (Ref 2). However, the radiological risks to the workers have not been adequately addressed. The objective of this study was to assess radiation dose to the workers in potassium handling industries. To achieve the purpose we made external dose rate map at the industries and accessed external radiation dose to the workers.

II. MATERIALS AND METHODS

External dose rates were measured at major potassium handling facilities. At each facility, site was divided into several grids. External dose rates were measured for 3 times at center of each mesh and averaged. Each grid was classified into five groups depending on the measured dose rates. Table I shows dose rate measurement sites at 3 different potassium handling facilities.

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. We calculated external dose to the target workers using measured external dose rate and exposure scenario.

TABLE I. Dose rate measurement sites at 3 potassium handling facilities

Potassium handling facilities	Measurement sites
Facility A	whole site, warehouse, mixing area, packing area
Facility B	whole site, warehouse, mixing area, packing area, shipment area
Facility C	whole site, warehouse, input area, packing area

III. RESULTS AND DISCUSSION

Fig.1 shows external dose rate map at facility A. High peak dose rate was not found at the facility (left figure). However, relatively high external dose rate was found at some sites such as warehouse of facility A. Based on the external dose rate map, nine workers were selected for external dose assessment at the facility.

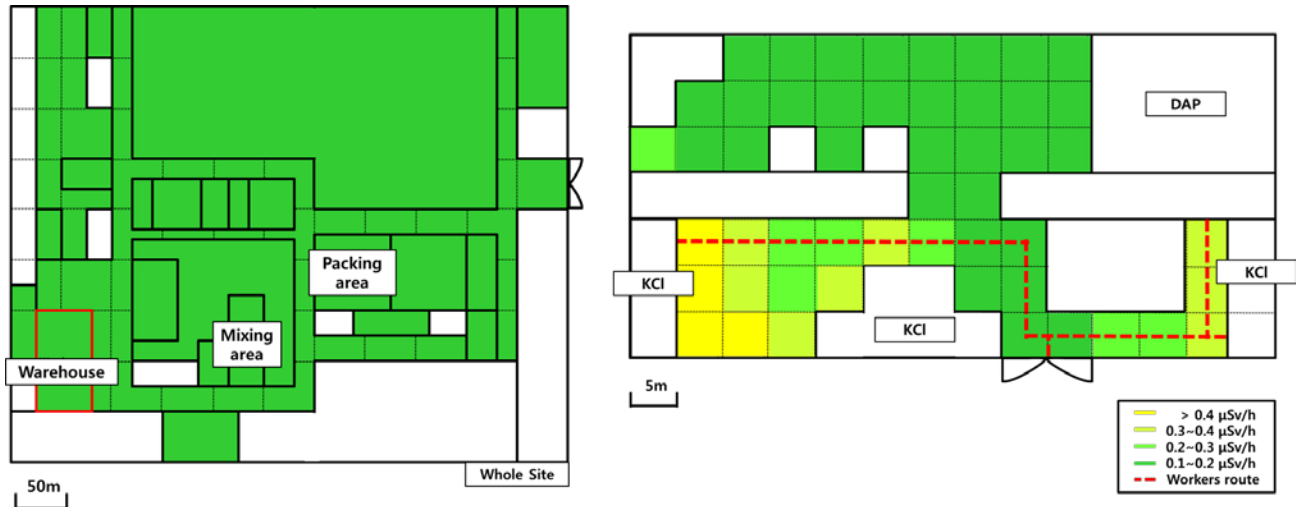


Fig.1. External dose rate map for potassium industry A (Whole site and Warehouse)

Annual radiation dose to the workers were calculated. Annual dose varied with workers, widely ranging 0.003-0.364 mSv/y. Radiation dose was the highest to a worker at packing area at facility B. It can be attributed that a large quantity of products was treated and working time was long at the packing area.

IV. CONCLUSIONS

External radiation dose to workers in potassium handling industries were assessed. For the dose assessment, external dose rates were directly measured and dose rate map was generated at 3 potassium handling facilities. Based on the external dose map, target workers can be selected effectively. External dose 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.

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