Uranium Concentration of Contaminated Zone due to the Cover Depth for Self-Disposal

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1. Introduction

It is necessary for us to perform permanent disposal of uranium contaminated soil and concrete wastes. There are several radioactive material disposal methods such as regulation exemption, decontamination and long term storage. To acquire radiation dose under self-disposal from them, the study on decontamination of some uranium contaminated soil and concrete wastes was performed using electrokinectic-electrodialytic [1-8].

In this study, we evaluated radiation dose due to cover depth on contaminated zone such as uranium contaminated soil and concrete wastes under radiation dose limit using RESRAD Version 6.5. At first, the calculation of the radiation dose on the contaminated zone are carried out. The second, the uranium concentration of contaminated zone due to the cover depth are also analyzed. The uranium contaminated soil and concrete wastes under radiation dose limit by decontaminating them have application to self-disposal of contaminated zone.

2. Simulation

2.1 Input Data

To perform the quantity (4,500,000kg) of contaminated zone, the calculating conditions of radiation dose on contaminated zone due to the cover depth are as follows. The area of contaminated zone is 1,500 ㎡. The thickness of contaminated zone is 2 m. The length parallel to aquifer flow is 43.702m. The quantity of contaminated zone is 4,500,000kg. The age of the residents on contaminated zone is 15 years old. The period of evaluation on the contaminated zone is from regulation exemption of uranium contaminated soil and concrete wastes till 1,000 years.

The external radiation dose, dust intake and secondary radiation dose on the workers of contaminated zone are regarded. All the radiation doses of the residents on contaminated zone are regarded with external radiation dose, dust intake, secondary radiation dose, fruit, vegetable and grain consumption, leaf vegetable consumption, milk consumption, meat and poultry consumption, fish consumption, other seafood consumption, soil ingestion, and drinking water intake. The calculation of radiation dose due to the cover depth on contaminated zone is carried out using the RESRAD Version 6.5.

2.2 Calculation Results

Table I show uranium concentration, radiation dose of person, radiation dose of residents on contaminated zone due to the cover depth for self-disposal.

Table I: Calculating Results

Cover Depth (m)	1	1.5	2	3
Concen-tration (Bq/g)	1.81	2.82	4.55	4.55
Radiation Dose of Person (10μSv/y)	5.525	3.547	2.196	2.196
Radiation Dose of Residents (man·Sv/y)	0.0188	0.0121	0.0075	0.0075

Fig. 1 show uranium concentration on the contaminated zone due to cover depth. As the cover depth increases, the uranium concentration has an increasing trend. The uranium concentration at 2m of cover depth rapidly increased up to 4.55(Bq/g). The uranium concentration over 2m of cover depth is constant as 4.55(Bq/g). It realizes that the cover depth on the contaminated zone is adequate at 1m under the condition of quantity (4,500,000kg) of contaminated zone.

Fig. 2 show uranium radiation dose of a person on the contaminated zone due to the cover depth. As the cover depth increases, the radiation dose of a person has a decreasing trend. The radiation dose of a person showed a rapidly decreasing trend from 1m of cover depth to 2m of cover depth. The uranium radiation dose of a person over 2m of cover depth is constant as 2.196(μSv/y).

Fig. 3 show uranium radiation dose of residents on the contaminated zone due to cover depth. As the cover depth increases, the radiation dose of residents has a decreasing trend. The uranium radiation dose of residents over 2m of cover depth is constant as 0.0075(man、Sv/y).

Therefore, it realizes that the cover depth of contaminated zone is adequate at 1m from the quantity (4,500,000kg) of contaminated zone.

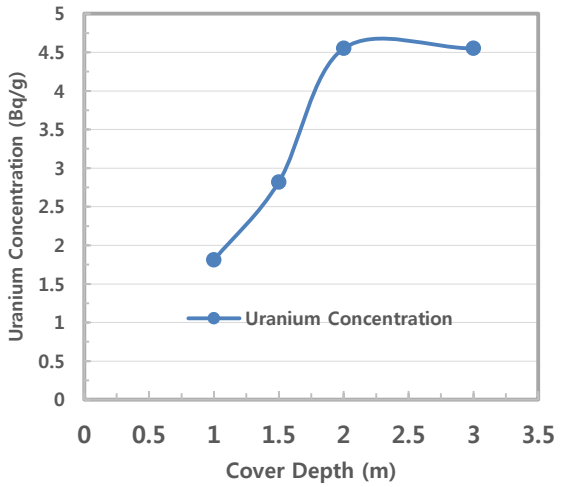

Fig. 1. Uranium concentration vs. cover depth.

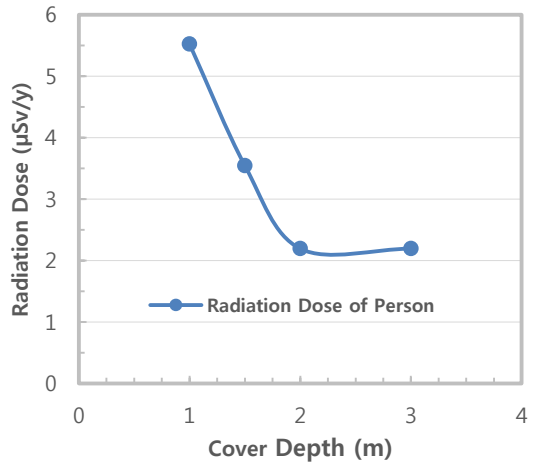

Fig. 2. Radiation dose of a person vs. cover depth.

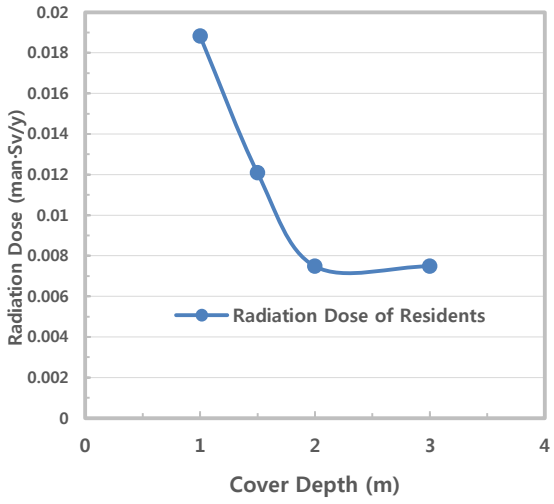

Fig. 3. Radiation dose of residents vs. cover depth.

3. Conclusions

To acquire radiation dose under self-disposal from uranium contaminated soil and concrete wastes, we decontaminated some uranium contaminated soil and concrete wastes using electrokinectic-electrodialytic.

To perform self-disposal on the quantity (4,500,000kg) of contaminated zone, the calculating conditions of radiation dose on contaminated zone due to the cover depth are as follows. The area of contaminated zone is 1,500 ㎡. The thickness of contaminated zone is 2 m. The length parallel to aquifer flow is 43.702m. The age of the residents on contaminated zone is 15 years old. The period of evaluation on the contaminated zone is from regulation exemption of uranium contaminated soil and concrete wastes till 1,000 years.

The calculation of the radiation dose on contaminated zone are carried out. The uranium concentration of contaminated zone due to the cover depth was also analyzed. as the cover depth increases, the uranium concentration has an increasing trend. As the cover depth increases, radiation dose of a person has a decreasing trend. As the cover depth increases, the radiation dose of residents has also a decreasing trend. The uranium contaminated soil and concrete wastes under radiation dose limit by decontaminating them have application to self-disposal of contaminated zone. It realizes that the cover depth on the contaminated zone is adequate at 1m from the quantity (4,500,000kg) of contaminated zone.

Acknowledgement

This work is supported by the Ministry of Science, ICT and Future Planning of the Republic of Korea.

REFERENCES

[1] G. Kim, U. Park, S. Kim, W. Kim, J. Moon and J. Hyun , Decontamination of Gravels Contaminated with Uranium , Annals of Nuclear Energy, Vol. 72, pp. 367-372, 2014.
[2] G. Kim, H. Won, W. Oh and C. Jung, A Study on Aging Effect in Removal of Radionuclides from Soil by Electrokinetic Method, J. Korea Society of Waste Management, Vol. 21, No.3, pp. 243-252, 2004.
[3] G. N. Kim et al. Development of Complex Electrokinetic Safety Assessment Technology of Residual Radation of Soil and Uranium Decontamination Method for Soil Contaminated with Uranium, Electrochimica Acta, Vol. 86, pp. 49-56, 2012.
[4] K. Lee, K. Kim, K. H, M. Song, S. Kim, C. Lee, S. H, Kang, Development of Safety Assessment Technology of Residual Radiation of Soil and Uranium Sludge Waste, KAERI/CM-738/2003.
[5] S. Shin, K. Kang, H. Kim, J. Son, Y. Choi, Studies on Test and Immobilization and Clearance Methodology for Soil and Uranium Wastes, KAERI/CM-785/2003.
[6] Y. Nam, K. Lee, C. Lee, D. Yook, S. Lee, Y. Lee, M. Ahn, J. Park, A Study on the Environmental Effect Assessment for the Disposal of the Regulatory Cleared Soil and Concrete Waste, KAERI/CM-1029/2007.
[7] K. F. Eckerman, J. C. Ryman, External Exposure to Radionuclides in Air, Water and Soil, EPA-402-R-93-081, 1993.
[8] C. Yu, A. J. Zielen, J. J. Cheng, D. J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo III, W. A. Williams, and H. Peterson, User's Manual for RESRAD Version 6, Environmental Assessment Division, Argonne National Laboratory, 2001.