Study for Neutron Activation Analysis of subsurface contaminants using Nuclear Logging Sonde

Wooseong Hong[1], **Geehyun Kim**[2*]

[1]Department of Nuclear Engineering, Sejong University, Seoul, Republic of Korea
[2]Department of Nuclear Engineering, Seoul National University, Seoul, Republic of Korea
[*]E-mail: gk.rs@snu.ac.kr

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The feasibility study of detecting subsurface contaminants using nuclear logging sonde was performed by Monte Carlo simulation of the detector response to gamma-ray generated by the reaction of Am-Be neutron source in sonde with the contaminants in the subsurface environment. Based on previous research about standard samples of Korean rocks and mineral from the Korea Institute of Geoscience and Mineral Resources(KIGAM), five representative rock model is constructed. And, contaminated subsurface environment in the rock model was made with Trichloroethylene(TCE), a representative contaminant in the subsurface environment. The neutron induced gamma-ray energy spectrum was obtained by adjusting the porosity in the rock at 10% intervals within the range of 0–40% through the MCNP6 simulation. Capture gamma-ray peaks with 1.1646, 1.9578, 6.1103 MeV generated by the reaction of neutrons with chlorine, a major component of TCE, were analyzed. The tendency of the detector response from the rock with various contaminant concentration was confirmed by using the ″Peak ratio″, which means peak counts related to chlorine derived from the contaminated rock simulation are divided by the peak counts of uncontaminated. Using this factor, the minimum detectable concentration was derived. Through this simulation study, the correlation between TCE concentration and the detector response was confirmed. Additionally, a lab-scale experiment was constructed and performed, and validation was performed using experimental results.

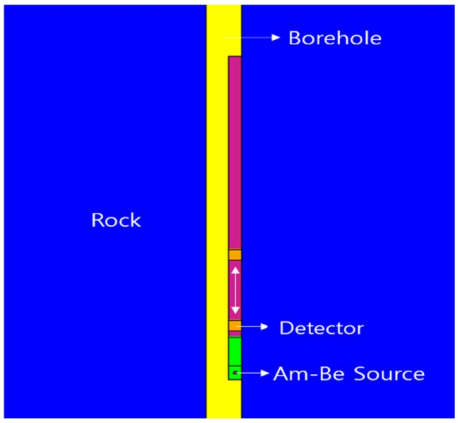

Fig. 1. Configuration of nuclear logging sonde model

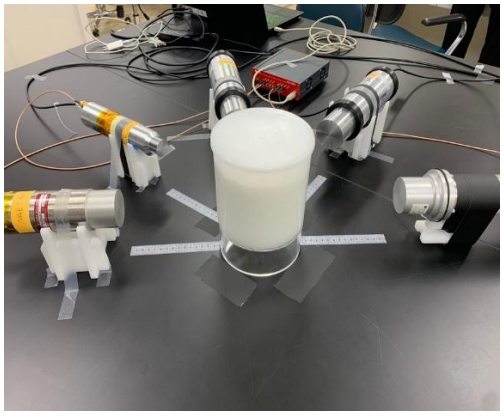

Fig. 2. Lab-scale experiment setup

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