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QUANTITATIVE METHODS OF ^{238}U, ^{234}U, ^{228}RA, ^{226}RA RADIOISOTOPES IN GROUNDWATER SAMPLES

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ABSTRACT

^{238}U, ^{234}U, ^{228}Ra and ^{226}Ra radioisotopes are always existed in nature materials as well as in under groundwater. It is poison when they entered to human body and their radio-activity is assessed from mBq/l to kBq/l by WHO and UNSCEAR. Their radio-activity is high but the concentration of them is very low, and when simultaneous spectral measurement will be gotten interference, so it is difficult to precisely determine by conventional methods. In order to determine simultaneously the above isotopes, chemical separation methods, isotope enrichment, advanced measurements and processing techniques are required. In this topic will show the method for simultaneously determination of natural radionuclides in water samples.

Keywords: Radioisotopes, Groundwater, natural radionuclide.

1.INTRODUCTION

Many authors attempted to identify radionuclides in water samples but only determined the total alpha and beta activity (follow the Vietnam safety standards) or determine ^{238}U, ^{226}Ra, ^{222}Rn, ^{220}Rn with gamma spectrum and RAD-7, those methods are low accuracy, because low activity is difficult to determine by gamma for ^{238}U, ^{226}Ra isotopes (about mBq/L) and RAD-7 with high uncertainly [1-7]. There are some studies of ^{226}Ra and other isotopes in water samples [8-10]. These methods are used still many limited and unachievable efficiency: such as Non-overcome of "quenching" effect of chemical composition, color quenching of precipitation as well as low efficiency and resolution when measured with LSC. That chemical separation process, the radium isotope determination leads to obtuse spectrum due to the alpha absorption efficiency directly on MnO_2 deposition disc, for the low concentration samples will get high uncertainty. Other isotopes determined by gamma with high cost and low effective when using 200 liters of seawater. In addition, isotopes emit beta particle such as ^{228}Ra or other alpha particle such as ^{234}U has not been identified precise. During determination of uranium and radium isotopes in water samples, those authors also got many errors on spectra recording with noise from silicon, plutonium, americium, lead [11].

For abroad research have shown that the study of ^{238}U, ^{234}U, ^{228}Ra, ^{226}Ra isotopes in underground waters brought many new scientific knowledge and insights. Such as assessing environmental radiation safety, characteristics, distribution, relationship of isotopes in underground water, their relationship with geological formations, results will contribute to solving the problem of timing [12-19].

Water sample due to the specific characteristics of physical and chemical properties and low concentration of natural radionuclides, the determination of radionuclides require the technical conditions and ability of measure accurately such as chemical preparation, measurement techniques, analytical techniques as well as modern and appropriate equipment. In addition, domestic studies still have many limitations on modern technical, measurement methods and analysis approaches, leading to many unresolved points as well as improved accuracy. There are many issues has not yet solved. Therefore, the authors' research is completely appropriate and necessary.

2. METHODOLOGY

To determine the ^{238}U, ^{234}U, ^{228}Ra, ^{226}Ra isotopes in the studied samples, the samples will be chemical separation of each isotope in the form of salt precipitation (see Fig.1: schema of chemical

procedure and measurements of some radionuclides). Summary of the main steps of the separation process are as below:

Co-precipitation of isotopes ^{238}U, ^{234}U in $(NH_4)_2U_2O_7$ and MnO_2. After separating the precipitate above, it is dissolved in acid then the ^{238}U, ^{234}U component absorbed by Dowex system. After that ^{238}U, ^{234}U is washed and separated from the absorbed resin by acid and distilled water. Continue to carry out cleaning and removal of organic matter, the sample is dissolved in HCL1M acid and next step will deposit in membrane filter 0.1µm (^{238}U, ^{234}U samples). The ^{238}U and ^{234}U samples are measured by an alpha spectrometer.

The waste of all parts after ^{238}U, ^{234}U separation will be used to separate ^{228}Ra, ^{226}Ra, ^{210}Pb isotopes in the solid precipitate of Ba^{2+} compound. The achieved precipitate is washed to pH ~ 7, then separate ^{210}Pb by dissolving the precipitate in EDTA and precipitate with acetic acid again. The precipitate is separated and returned to neutral pH and moved into a vial. The ^{228}Ra, ^{226}Ra samples are added LS and measured within 25 days to achieve radioactive equilibrium between radium and its daughters. For samples of radium use alpha/ LSC. All alpha or alpha/beta measurement samples can be performed at the Nuclear Science and Technology Institute; VNU University of Science; the Federal of Geology and Rare radiation or in Poland or Hungary.

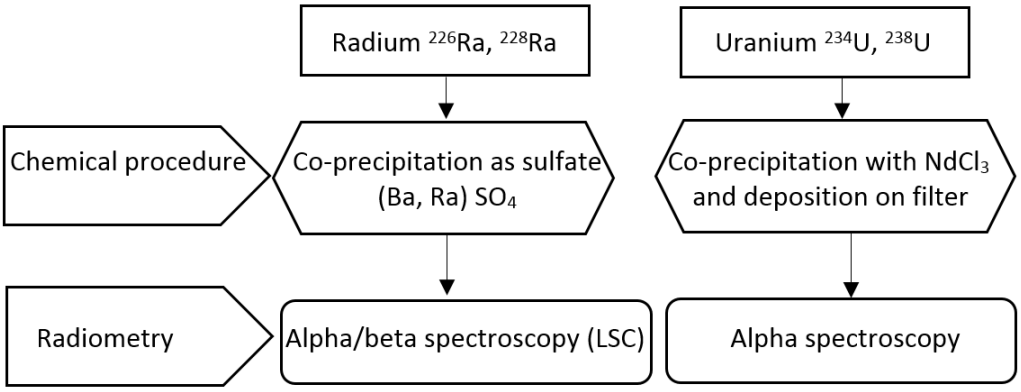

Fig. 1. Schema of chemical procedure and measurements of some radionuclides.

3. RESULT

The table 1 is the test result for the methodology to determine of the uranium, radium isotope concentrations in underground water in, Hoa Binh, North Vietnam. The result show various rank of concentration value of studied isotopes from LLD to few tens mBq/L. While Ra-228 is all under low limit detection, maybe the studied area have very low Ra-228 concentration. The detection limit for those radionuclide by alpha and LSC alpha and beta spectrum in water is 0.5mBq/l.

4. CONCLUSION

Determination natural radionuclides in underground water as well as drinking water samples is necessary. To determine for low concentration sample, the enrichment procedure is required which is performed though precipitating or co-precipitating compounds. To avoid and reduce the interference and noises, the chemical separation method is applied. To get high accurate measurement values, the advanced measurement and processing techniques are required also. The method for simultaneously determination of ^{238}U, ^{234}U, ^{228}Ra, ^{226}Ra radioisotopes in water samples (underground water) will be resolved problems present in Vietnam.

Table 1. The uranium, radium, polonium and lead isotope concentrations in underground water in, Hoa Binh, North Vietnam

Name of sample	U-238 (mBq/l)	U-234 (mBq/l)	Ra-226 (mBq/l)	Ra-228 (mBq/l)
n=6 (number of underground water samples with different depths)				
Groundwater	LLD-8.95	LLD-18.63	LLD - 29.20	LLD
Min	LLD	LLD	LLD	-
Max	8.95	18.63	29.20	-

LLD: Low limit detection

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