

## **COMBINATION OF THE PROMPT NEUTRON CAPTURE METHOD WITH OTHER NEUTRON METHODS FOR SUBSTANCE ELEMENTAL CONTENT ANALYSIS**

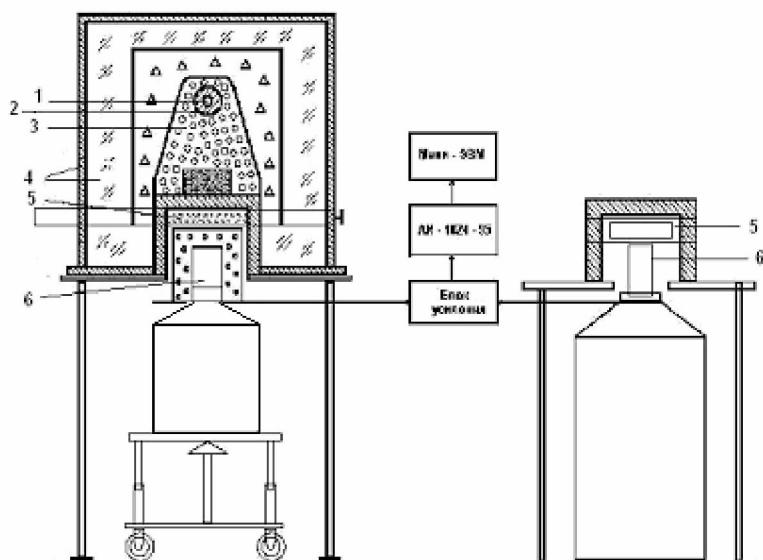
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Neutron analysis method of determining element composition has found wide range of applications in industry due to different types of interaction of neutron with substances /1/. With the aim of widening the circle of problems to be solved, on the basis of the device /2/ for determining the elemental content of substance, possibilities of combining the method based on the use of neutron capture gamma-ray spectrometry with other neutron methods; in particular neutron activation analysis and neutron absorption analysis were studied.

Developed laboratory of model experimental device based on the  $\text{Cf}^{252}$  radionuclide – neutron source with yield of  $1,5 \times 10^7$  neutron/sec. By means of using neutron capture gamma - radiation spectrometry the possibilities of determining some elements (H, B, N, S etc.), which are not determined by widely used activation analysis method.

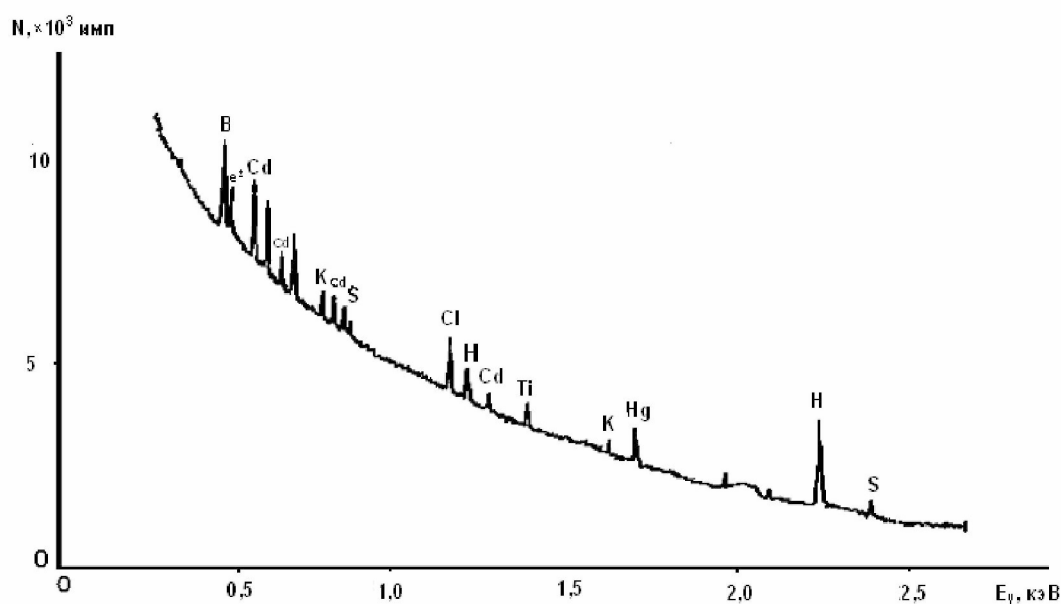
Fig.1 shows design of laboratory model of the experimental device. Measurement of geometry and the construction materials of experimental device allows maximal flux of thermal neutrons on the investigated samples with minimal amount of fast neutrons and disperse gamma-rays.



**Fig.1.** Laboratory model of the experimental device.

Measurement system consists of semiconductor Ge(Li) – detector with 40 cm<sup>3</sup> sensitive crystals and 4,5 keV energy resolution on the line of Co<sup>60</sup> with energy of 1333 keV and multichannel pulse analyzers AI – 1024 – 95. For example, to investigate samples one can get mine rock, technological products and standard reference material samples.

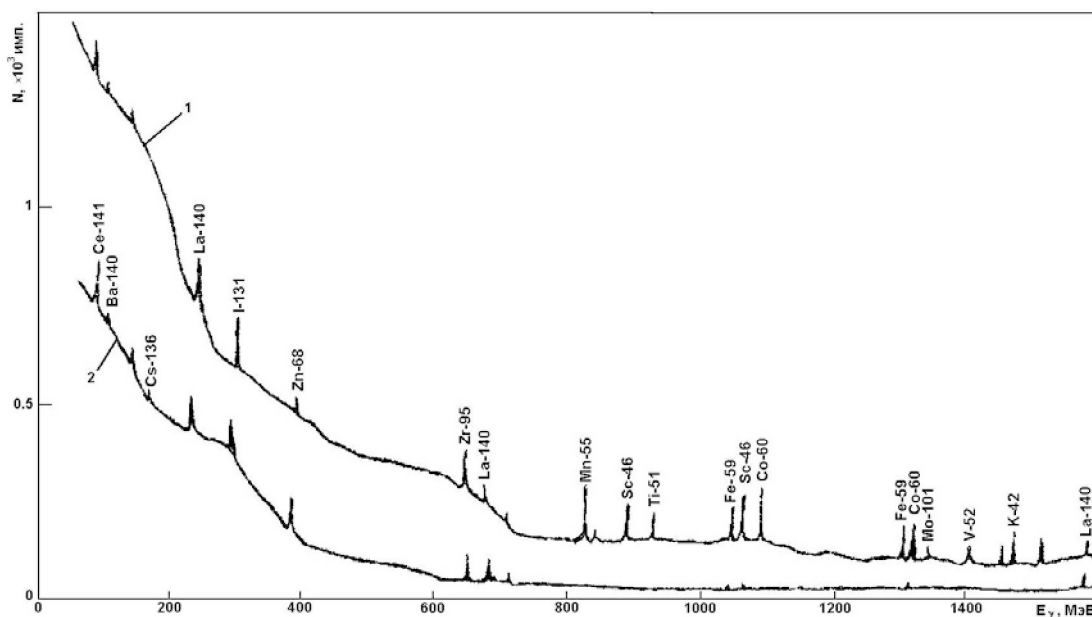
Fig.2 shows neutron capture gamma-ray spectra of the model samples within 30 min measurement.



**Fig.2.** Neutron Capture gamma-ray spectra of the model samples.

By using this experimental device the possibilities for determination of some “well” active elements (K, Al, Fe, Mn, Ti, Sc, etc) in mining and technological samples by the neutron activation analysis method was studied. During the time of irradiation (60 min) the experimental device gave resolution analytical peaks of these elements. Fig.3 shows spectra of gamma-ray of reference sample and background. Intensive gamma-lines of following radionuclides stand out most: Al-28 (1778 keV), K-42 (1524,7 keV), Sc-46(889 keV and 1120 keV), Ti-51 (928,5 keV), V-52 (1434,4 keV), Fe-59 (1099 keV and 1291,6 keV), I-128 (442 keV), La-140 (1596 keV), Mo-101 (1187 keV and 1357 keV).

Sensitivity of determination in both methods depends on analytical peaks area and mainly on background level under them. Correlations of analytical peaks areas  $S(AA)/S(NCG)$  were calculated, where  $S(AA)$  – peak area in activation analysis and  $S(NCG)$  – peak area in neutron capture gamma-ray spectra. This data is necessary for choice of methods. For example for S-37 (3103 keV) – AA and S (840,3 keV) – NCG the correlation  $S(AA)/S(NCG) = 0,0008$ , for Cd-117m (1996 keV) – AA and Cd (558,3 keV) – NCG the correlation  $S(AA)/S(NCG) = 0,00002$ . One can make a conclusion about priority of applying of this or another method based on the following: if the meaning of correlation  $S(AA) / S(NCG) > 1$ , the method of activation analysis is to be applied. If the values of correlation  $S(AA) / S(NCG) < 0,1$ , the method of neutron capture gamma-ray spectrometry is to be applied. But if the meaning  $S(AA) / S(NCG)$  is within the limits from 0,1 to 1 the method is to be chosen depending on the given task.



**Fig.3.** Spectra of gamma-ray of sample and background

Experimental works on determination of some elements with large cross-sections of capture (B, Cd, Sm) by absorption of neutrons in the investigated substance, i.e. using the neutron absorption analysis method with absence of other large capture cross section elements in the samples were conducted. In this studies CF-252 radionuclide source with the yield of  $1,5 \times 10^7$  neutron/sec was used. The flux of thermal neutrons is measured by dosimetric equipment – “KRAN- 1” and neutron counter.

The experimental data shows possible application of this method as supplementary methods of analysis.

## REFERENCES

1. Kartashev E.R., Shtan A.S. Neutron methods of analysis of content of a substance. M.; Atomizdat, 1978., 160 p.
2. Aripov G.A., Kurbanov B.I. / Device for determining element content of a substance. // Patent of the Rep. of Uzbekistan, № 1DP 04491, 2001.