

Applications of the neutron activation analysis technique in the Argonauta research reactor of the IEN

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¹ SEREA, IEN, ²DIRA, IEN

Keywords: Argonauta research reactor, AAN.

This summary presents a brief survey of possible applications of the thermal neutron activation analysis (NAA) technique, using the Argonauta research reactor and the Nuclear Measurement Laboratory (LMN) in the Nuclear Engineering Institute (IEN).

NAA is a multi-element analytical technique that is used for both the identification and quantification of stable chemical elements found in several types of samples, that is, it is possible to identify the elements as well as their concentrations [1]. The activation by thermal neutrons represents the greatest part of the periodic table, which strengthens the feasibility of this work.

The method consists of the irradiation of stable atomic nuclei by thermal neutrons generated by the Argonauta research reactor, transforming them into excited nuclei, which disintegrate by the emission of radiation, as illustrated below in Figure 1.

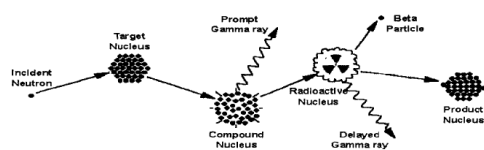


Figure 1. The interaction between thermal neutron and stable target nucleus

During the disintegration process of such radionuclides, detection systems appropriate to the type of radiation emitted shall be used.

The various types of radiation that can be emitted, gamma radiation offers the best conditions for its detection and, consequently, for the identification of radionuclides formed, as having their unique properties like the half-life and the radiation energy emitted.

There is a minimum set of requirements to use the NAA technique. To do this, a neutron source, a nuclear instrumentation suitable for the detection of emitted radiation, and a detailed

knowledge of the reactions by the interaction between neutrons and target nuclei [2].

In the current configuration of the Argonauta research reactor the maximum neutron flux is of the order of 10^{10} neutrons/cm².s, being enough for the use of the NAA technique.

Among the various possibilities of applying the NAA technique, due to a social issue, health and the environment will be more prominent.

Health applications: In the nutritional field, there is the possibility of studying the determination of elemental concentrations in plants, in seasonings, in grains with emphasis on the different types of rice and beans, in fruits and in varieties of meats. Such information is important to know precisely the mineral composition of these foods and to facilitate their indication in food diets. Studies on metal concentrations in human hair, nails and blood can also be developed and it will be used to correlate the obtained results with possible pathologies

Applications in the environment: Studies on the elemental concentrations of heavy metals in soils and atmospheric particulates resulting from environmental pollution, with the mapping of areas and the establishment of a database to compare with the maximum limits allowed by the organs environmental conditions. The research line that employs the NAA technique was reactivated by researchers recently incorporated into the team of the Argonauta research reactor of the IEN, for this development are also underway the modernization of the LMN, which will count on the purchase of new equipment through resources of the IEN and, also, the loan signed in contract with partner institutions

References

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