

NEUTRON ACTIVATION ANALYSIS SERVICES

Vasconcellos, M.B.A.

Centro do Reator de Pesquisas - IPEN/CNEN-SP

Keywords: neutron activation analysis; geological; environmental; biological; archaeological.

Neutron activation analysis is one of the most relevant applications of nuclear research reactors. Due to the high neutron fluxes available in these reactors, it is possible to analyze a great part of the elements of the periodic table with good sensitivity, precision and accuracy. In most applications, the method used is instrumental neutron activation analysis, INAA, which consists in submitting the samples to be analyzed to a neutron flux and measuring the induced radioactivity in a gamma-ray spectrometer. Instrumental neutron activation analysis is a versatile method which can be applied to a wide range of matrixes, such as biological (hair, nails, bones and tissues in general), geological (rocks, soils, ores), environmental (aerosols, waters, sediments), metallic (metals or alloys), archaeological (pottery, coins), industrial (plastics, foams, resins) diets and foodstuffs, and many others. The elements that are generally favorable for INAA are: Ag, Al, As, Au, Ba, Br, Ca, Ce, Cd, Cl, Co, Cr, Cs, Cu, Eu, Fe, Ga, Gd, Hf, Hg, Ir, K, La, Lu, Mg, Mn, Mo, Na, Nb, Nd, Pb, Pt, Rb, Sb, Sc, Se, Sm, Ta, Ti, Tb, Th, U, V, W, Yb, Zn, Zr. By using a suitable combination of irradiation, delay and measuring times, it is possible to make multielemental analysis, i.e., in the same sample it is possible to determine about 20 to 30 elements. The results of the chemical elements analysis are reported as mg/g (or mg/kg) or mg/kg depending on the kind of samples that are being analyzed and on the concentration levels.

Generally at least two determinations are made for each sample and the delivery time of the analysis is in the range from one to four weeks, depending on the half-lives of the radioisotopes that are being measured. In special cases, when a higher sensitivity is desired or there is strong interference from the matrix elements, radiochemical neutron activation analysis, RNAA, can be applied. This method consists of applying chemical separations, based on methods such as distillation, precipitation, ion exchange or solvent extraction, depending on the elements of interest, after submitting the samples to a neutron flux. In the biennium 2002-2004, 425 samples were analyzed by INAA, mainly from requests of internal clients.

From the external clients, most of the requests were for analysis of uranium and thorium. Other routine services carried out by the Neutron Activation Analysis Laboratory were gamma-ray spectrometric measurements of the water of the reactor swimming pool, which were 416.

NEUTRON IRRADIATION AT IEA-R1 RESEARCH REACTOR

Jesus, A.F.; Vaz, A.C.A.; Sara Neto, A.J.; Pires, A.L.; Loyola, C.A.; Iglesias, C.R.; Nohara, C.S.; Araujo, E.G.; Longo, E.S.; Salzano, I.; Cardenas, J.P.N.; Berretta, J.R.; Mello, J.R.; Tondin, J.B.M.; Fernandes, O.J.; Félix, O.C.; Souza, S.P.; Frajndlich, R.; Lima, T.C.; Ricci Filho, W.; Leite, S.V.; Maciel, G.F.; Massaki, H.T.; Carvalho, M.R.; Yavanovich, M.; Martins, M.O.; Yokoyama, S.; Silva, R.V.F.; Santos, E.N.B.; Coti, T.N.; Rodrigues, V.G.

Centro do Reator de Pesquisas - IPEN/CNEN-SP

Keywords: research reactor, neutron activation.

In the triennium 2002/2004 the IEA-R1 Research Reactor had operated most of the time at a reactor power of 2 MW and 3MW and the reactor operation schedule of 38 and 64 hours per week. The Operation and Maintenance Area of the IEA-1 Research Reactor is composed by three groups as follows: a) operation group b) maintenance group c) technical support group. Operational group has a crew of 22 operators responsible for the reactor operation, placement and disposal of irradiation samples in the reactor core, tests, experiments and control of operational documents. Maintenance group has 10 technicians for the preventive and corrective reactor systems maintenance, study of ageing and maintenance registrations.

Technical support group, formed by two people, is dedicated to neutronics and thermohydraulics calculations. In this triennium, to given an example of previous years, several changings in order to achieve reactor modernization has been done to increase the reactor power from 2 to 5 MW. The increase of the reactor power and the change in the operation schedule from 38 to 64 weekly has the objetive of starting molybdenum (^{99}Mo) and telurium (Te-130) irradiations to produce the tecnecium generators and iodine for medical purposes.

Among the main modernization projects, it is possible to mention the acquisition and introduction of 10 reflector elements and 3 irradiation devices made of beryllium in the reactor core, introduction of four isolation valves in the Pneumatic Irradiation System to avoid pool emptying, maintenance of two primary and two secondary water pumps of the reactor cooling systems, maintenance of the water cooling tower of the secondary system, the construction of a irradiated sample transfer system, control and safeties bar and pool water purification replacement. Monthly, the Reactor Operation and Maintenance Area issue a report [1] containing the monthly activities of the reactor. This report enclose the number of reactor operation schedule, energy dissipated in this period, reactor core configurations, chemical and physical characteristics of the water systems, radioisotopes concentration in the pool water, number of reactor shutdown, number of irradiated samples in the reactor core and pneumatic system and, finally, the radioprotection data.

The main operational parameters of the biennium are: Reactor power: 2MW and 3 MW Time of reactor operation in hours: 5557 Energy dissipation in MWh: 13550 Number of samples irradiated in the reactor core: 3247.