THE RADIOCHEMISTRY LABORATORIES OF THE "INSTITUTO DE ENERGIA ATÔMICA", SÃO PAULO, BRAZIL

INFORMAÇÕES IEA Nº 18
Junho — 1970

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SÃO PAULO — BRASIL

THE RADIOCHEMISTRY LABORATORIES OF THE "INSTITUTO DE ENERGIA ATÔMICA", SÃO PAULO, BRAZIL (*)

Divisão de Radioquímica
Instituto de Energia Atômica
São Paulo - Brasil

Informações IEA Nº 18
Junho - 1970

(*) Reprinted from Journal of Radioanalytical Chemistry Vol. 4 391-396 (1970).

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Journal of Radioanalytical Chemistry Vol. 4 (1970) 391—396

Laboratory of the Issue

THE RADIOCHEMISTRY LABORATORIES OF THE "INSTITUTO DE ENERGIA ATOMICA", SÃO PAULO, BRAZIL

The Instituto de Energia Atômica is a joint enterprise between the Federal Government of Brazil (exercised by the Nuclear Energy Commision) and the State of São Paulo (exercised by the University of S. Paulo) and has been in activity since 1957. It is located on the campus of the University of São Paulo and has a staff of about 500 people including scientific personnel, technicians, general laborers and administration. The Instituto has a 5 MW swimming pool type research reactor and research and development activities are developed along the broad lines of nuclear and reactor physics, radiobiology, radiochemistry, metallurgy, nuclear and chemical engineering. Graduate level courses on various nuclear sciences are given in collaboration with the engineering school of the University.

The Instituto is situated in a rather rich State and city. But even so it has most of the peculiarities of a scientific institution in a developing country. One of the principal difficulties that such institutions have to face are lack of people since higher salaries industries absorb a large number of the yearly crop of science and engineering graduates.

When the activities of the Instituto de Energia Atômica started, in 1957, the staff of the Radiochemistry Division was made up of only two people and, of these, only one with formal training in radiochemistry. This forced those two people, who ideally or theoretically had chosen a scientific profession, to tackle quite odd problems such as installation of industrial size ion-exchanger tanks for reactor water treatment, help in the tile lining of the pool, study of corrosion of fuel elements, detection of fission products in the pool water and the like. These problems, fundamental for the start of activities of nuclear energy centers in developing countries, have been discussed, in detail, in reference.[1] Later on the staff was increased by two other people who had to be locally trained in radiochemistry. Radioactive counting equipment, by that time, were classical scaler (one), Geiger tubes and a home made single channel gamma spectrometer.

Radiochemical research work had to be carried out in parallel with classical chemical work, of a service nature, which had to be done in order to attend many of the requests of other Divisions and in order to solve other types of problems imposed by maintenance problems of the reactor.[2,3] In fact even a pilot plant

With the creation of a Chemical Engineering Division many of the classical chemical service functions of the Radiochemistry Division were allocated to that Division. Even so, some of ancient service functions still remained under the responsibility of the Radiochemistry Division. These can be classified under the broad aspect of chemical support and maintenance work for the reactor, involving reactor water purification, analysis for fission products in the water, study of corrosion of aluminum pieces, routine determinations of fall-out and alike. In this way, presently the Divison is dedicated almost only to actual radiochemistry work. Main activities are developed along activation analysis, isotopic dilution analysis, general tracer work and isotope production.[5]

Fig. 4. Hot cells for routine production of radioisotopes

Isotope production is carried out in ten hot cells which are operated for production of the radioelements mostly required for medical application such as ^{131}I, ^{32}P, ^{35}S, ^{82}Br, ^{42}K, ^{198}Au (colloidal), ^{24}Na. About 200 shipments per month are made. As an index of the amounts distributed, ^{131}I production may be quoted, that is, five curies per month. Distribution covers all Brazilian States and some South American countries.

Radiochemical analyses have been carried out by association of activation analysis and isotopic dilution. This technique has been applied in the cases where direct activation analysis presents some problems during the step of irradiation. In cases as these one would have to resort to separation of the elements to be analysed before irradiation of the matrix, with all the obvious and known inconveniences of prior separations. Such is the case, for instance, of analysis for

elements of atomic numbers from 30 to 64, in a uranium matrix, since those elements are formed in fission. Another case where direct irradiation of sample or matrix may not be advisable is when the matrix has a very high thermal neutron cross-section such as in the case for gold matrixes, due to neutron shadowing effects and handling of relatively hot samples. Primary and second-order reaction interferences or any nuclear reaction, with the matrix, that may form radioisotopes of the element being analysed may also hamper direct activation of samples. Direct irradiation of chemical reagents for activation analysis is also not always convenient due to radiolysis with eventual formation of gases and pressure build up that can rupture the containment vessel. In cases as these isotopic dilution will by-pass the inconveniences of direct irradiations. However, in isotopic dilution it is necessary to determine the specific activity of the isolated substance being analysed and this requires determination of its weight. Consequently, sensitivity of the method will be highly dependent on this weight determination. Frequently the amount of substance to be determined (gravimetry or other procedure) is very small and a very sensitive method would have to be used. In this case activation analysis for the determination of the recovered weight of substance being analysed by isotopic dilution will enhance the sensitivity of this last method. The association of those two methods has been applied to the analysis of impurities in analytical grade reagents, of arsenic in germanium, of copper in gold and of rare-earths impurities in a rare-earth matrix. Straight activation analysis methods, without association with isotopic dilution, have been used for the contemporaneous determination of gold and uranium in minerals; for the non-destructive analysis of hafnium in zirconium, of dysprosium in high purity erbium oxide and in holmium oxide, ytterbium in thulium oxide, silver in lead scraps and others. Most of these analyses were made in order to attend private industrial consultation. Some forensic applications have also been made as in the case of hair analysis for arsenic in cases of suspected arsenic poisoning and of comparison of glass fragments in automobile accidents. High purity waters have been analysed for chromium, copper and chlorine at the parts per billion level.

Tracer work is being developed along the line of the study of coprecipitation of high neutron absorption cross-section elements, such as cadmium, in ammonium diuranate precipitates, using EDTA to hold cadmium in solution as the chelate compound. Also, a detailed investigation of the coprecipitation behaviour of the copper hexamine complex with iron hydroxide precipitate is under study.

The Radiochemistry Division has participated, by invitation of the International Atomic Energy Agency, of various Study Group Meetings and Panels on Utilization of Research Reactors, held in South America and in Vienna, where the utilization of the reactor and reactor problems, from a chemical point of view, have been extensively discussed.

The Division is also actively engaged in the area of training in general radiochemistry and activation analysis. One-semester courses on those two subjects are given for graduate students of the University of São Paulo and also for new people in the staff of the Institute.

References

1. F. W. LIMA, Chemical Problems Arising in the Operation of a Swimming Pool Reactor and Uses of the Reactor in Chemistry. Proceedings of the Symposium on Programming and Utilization of Research Reactors, promoted by the International Atomic Energy Agency, Vienna 1961. Vol 3, Academic Press, London, 1962.
2. F. W. LIMA, Development of Radiochemistry Activities in New Research Reactor Centers. Proceedings of the IAEA Study Group Meeting on Utilization of Research Reactors, S. Paulo, 1963. International Atomic Energy Agency, Vienna, 1965.
3. F. W. LIMA, Chemical Support and Maintenance Work in Light-Water Moderated Research Reactors. In Technical Reports Series No. 71. International Atomic Energy Agency, 1967.
4. F. W. LIMA, A. ABRÃO, Produção de Compostos de Urânio Atômicamente Puros no Instituto de Energia Atômica. Publicação IEA No. 42, 1961. Declassified 1968.
5. F. W. LIMA, Isotope Production and Activation Analysis Using Research Reactors. Expert Contributions of the IAEA Study Group Meeting on Utilization of Research Reactor held in Bogota, 11—15 Dec, 1967. International Atomic Energy Agency, Vienna, 1968.