Neutron activation analysis

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DETERMINATION OF k_0 AND Q_0 FOR $^{113}In(n,\gamma)^{114m}In$ REACTION WITH COVARIANCE ANALYSIS

Lívia F. Barros, Mauro S. Dias, Marina F. Koskinas, Ione M. Yamazaki, Renato Semmler, Rafael V. Ribeiro

Laboratório de Metrologia Nuclear (Nuclear Metrology Laboratory – LMN), Centro do Reator de Pesquisas (Research Reactor Center – CRPq), Instituto de Pesquisas Energéticas e Nucleares (IPEN-CNEN/SP), São Paulo, Brazil,
e-mails: liviabarros4@gmail.com, msdias@ipen.br, koskinas@ipen.br, yamazaki@ipen.br, rsemmler@ipen.br, rafaelvanhoz@outlook.com

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The use of k_0 *Method* for quantitative reactor Neutron Activation Analysis (NAA) is a well-known technique for determining multi-element concentrations in different materials. In order to achieve good results, there is a continuing need for improving the accuracy of k_0 and Q_0 parameters for several neutron capture reactions. $^{113}In(n,\gamma)^{114m}In$ reaction can be considered particularly interesting because k_0 and Q_0 discrepancies appear in the literature. This fact motivated the present work which is focused on the measurement of k_0 and Q_0 values for this reaction with the purpose of improving the existing data catalogues. The irradiations were performed near the core of the IEA-R1 4.5 MW swimming-pool nuclear research reactor of the Instituto de Pesquisas Energéticas e Nucleares (IPEN-CNEN/SP – Nuclear and Energy Research Institute), in São Paulo, Brazil. The distribution of epithermal neutron flux α in the IEA-R1 is close to zero at the chosen irradiation position, which favors to obtain Q_0 accurately. Two irradiations were carried out in sequence using two sets of samples: the first with a cadmium cover around the samples and the second without. The activity measurements were carried out in an HPGe gamma-ray spectrometer. Standard sources of ^{152}Eu, ^{133}Ba, ^{60}Co and ^{137}Cs supplied by the IAEA were used in order to obtain the HPGe gamma-ray peak efficiency as a function of the energy. The covariance matrix methodology was applied to all uncertainties involved. The final values for k_0 and Q_0 were compared with the literature.

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USE OF INAA IN THE HOMOGENEITY EVALUATION OF A BOVINE KIDNEY CANDIDATE REFERENCE MATERIAL

Liliana Castro, Edson G. Moreira, Marina B. A. Vasconcellos*

Instituto de Pesquisas Energéticas e Nucleares – IPEN-CNEN/SP, Av. Prof. Lineu Prestes 2242, São Paulo, Brasil, *e-mail: lcastroesnal@usp.br

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Evaluation of the homogeneity is a critical step in the preparation process of reference materials. The batch of material must be sufficiently homogeneous for the intended use and this must be reflected in the value assigned to the material uncertainty and by the minimum amount of sample for which the assigned values and their uncertainties are valid. To ensure the representativeness of the value assigned to the certificate parameters and their uncertainties, the assessment of the homogeneity of the material must be performed very carefully.

The present study describes the use of Instrumental Neutron Activation Analysis, INAA, for the homogeneity evaluation of a bovine kidney candidate reference material.

The mass fractions of some inorganic constituents (As, Co, Cr, Fe, K, Na, Se and Zn) were determined to evaluate the between and within bottle homogeneity, as well as the minimum amount of sample. For the between bottle homogeneity assessment the determinations were performed in ten bottles from the total batch of 176, chosen using a random stratified scheme. For the evaluation of the within bottle homogeneity and the minimum amount of sample one bottle was chosen, also using a random scheme.

Statistical analysis of the results was performed using Analysis of Variance (ANOVA) and multivariate techniques such as Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCA) were applied as complementary techniques.