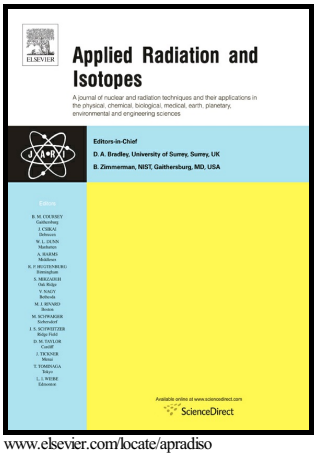

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Photo-peak area ratios for estimation of elemental concentration in aqueous solutions using prompt gamma measurements

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Abstract

The use of photo-peak area ratios are investigated for quantitative estimation of elements, particularly chlorine, in aqueous solutions using neutron induced prompt gamma measurements. A ratio of prompt gamma intensities avoids the need for estimating the incident total neutron fluence and is demonstrated for chlorine concentration estimation in NaCl solutions. Monte Carlo simulation results validated with experimental measurements support the present analysis. Use of several prompt gamma intensities instead of a single one improves the accuracy of the estimated results.

Keywords: Photo-peak ratio method, PGNAA, Monte-Carlo simulations, Chlorine.

1. Introduction

Prompt gammas emitted from neutron interactions with different elements are used as one of the important non-destructive technique for qualitative and quantitative elemental analysis of samples apart from other uses such as neutron dosemetry. Recently, the prompt gammas emitted from high density as well as borated high density polyethylene have been used to estimate the neutron ambient dose equivalent (Priyada and Sarkar, 2015; Priyada et al., 2016). The prompt gammas emitted from chlorine are considered as the secondary standard for the detector calibrations because of the high thermal neutron capture cross section of chlorine and also because of the wide range of high intensity gamma emissions up to 8.5 MeV (Molnár et al., 2004).

The Prompt Gamma Neutron Activation Analysis (PGNAA) technique has been used widely for detection of chlorine contents in the concrete structures for the early determination of the corrosion in the reinforcing steel bars (Mohamed et al., 2008; Naqvi et al., 2011; Naqvi et al., 2012) as well as for estimation of salinity in water to address the problems of dry land salinity (Borsaru et al., 2006). One of