Monte Carlo simulation enhancement of neutron backscattering from buried CHNO materials using a carbon reflector

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الملخص-:

أجريت محاكاة مونت كارلو لحساب النيوترونات المرتدة المرنة لمصدري النيوترونات Cf-252 و Pu-Be من مواد تحتوي على عناصر الكربون والنيتروجين والأكسجين والهيدروجين ومدفونة في التربة. وأظهرت نتائج الدراسة حصول تعزيزلقمم أطياف النيوترونات المرتدة لجميع العينات عند استخدام عاكس من الكربون ضمن التصميم الهندسي.

Abstract

Monte Carlo simulations of elastically backscattered neutrons (EBS) from materials containing C, H, N and O elements buried in soil have been carried out. Five different samples were studied and two point neutron sources, Cf-252 and Pu-Be, were employed in the calculations. It was found in this study that the EBS neutron peak spectra were enhanced for all the samples when carbon reflector is considered within the geometry.

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Introduction

Detection and identification of hazardous materials has become a problem of concern for researchers. During the last two decades, at least 73,576 casualties in 119 countries have been identified .The most common hazardous materials often contain the elements H, C, N and O. Examples are TNT (C_7 H_5 N_3 O_5) ,Cocaine (C_{17} H_{21} NO_4), Morphine ($C_{17}H_{19}NO_3$), RDX ($C_3H_6N_6O_6$) and Urea ($CH_4N_2O_5$) . Therefore, nuclear techniques based on neutron backscattering have been employed to detect and identify such materials (1-7).

There are more than one detection approach based on neutron backscattering (8-12). The model used in this study involves a point fast neutron source of Cf-252 or Pu-Be to irradiate a matrix of soil within which a sample is buried containing C, H , N and O elements. The nuclei of these elements will cause the incident neutron to be elastically backscattered, and this can be used as a mark of these elements. Those EBS neutrons are then detected by an array of point detectors placed at fixed positions sideways from the point neutron source. The elements used in the samples interact with neutrons of different energies. Hydrogen interacts with relatively low neutron energy compared to Carbon, Nitrogen and Oxygen require higher neutron energies to be involved in interaction .Therefore, the two neutron sources Cf-252 and Pu-Be with average energies of 2 MeV and 5 MeV, respectively, are quite appropriate to cover interactions with all those elements . The use of carbon reflector within the setup geometry proved to be very useful in the enhancement for EBS neutron peak spectra for all samples. In addition, the use of a sizeable reflector slab above the neutron sources is expected to reduce the radiation dose when it is used in field work

The MCNP modeling

A Monte Carlo computer code was utilized to calculate the elastically backscattered (EBS) neutrons from hidden dangerous materials in soil or large container such as explosives and drugs. In this study, a soil matrix with dimensions of 100 cm x 100 cmx 50 cm and an