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Research Article

Computation of Neutron Coefficients for B_2O_3 reinforced Composite

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Abstract:

Radiation is an important phenome and is used in different area since its discovery. Although there are different types of radiation, neutron is one of the most interesting types as it is an uncharged particle. This character made neutron is more dangerous radiation types than others and thus protection from neutron effect requires more care. In this paper neutron attenuation coefficients of B_2O_3 reinforced composite have been investigated using Phy-X/PSD software.

1. Introduction

Radiation is an important phenome and has been used in many different fields such as medical science, energy sector etc. Although there are different types of radiation, neutron is one of the most interesting types as it is an uncharged particle. This character made neutron is more dangerous radiation types than others and thus protection from neutron effect requires more care. There are many different works were report in this field including lead and led based materials [1-5]. As the neutron interaction with material are mainly through (n,p) reaction, this leads to use low atomic number materials as shielding materials to be protected from neutron [6-20]. As the neutron uncharged particle, it has weak interaction processes with a medium and this results deep penetrate into materials. Thus boron is one of the main material for this purposes [21-36]. The neutron interaction with matter is expressed with the neutron cross section (σ_t) and it can be expressed as in equation 1.

$$\sigma_t = \sigma_s + \sigma_a \qquad (1)$$

here σ_s is the scattering while σ_a is the absorption of neutrons.

The attenuation for neutron is expressed the fast neutron effective removal cross section (FNRCS) which express neutron shielding properties. It is given using equation 2.

$$\Sigma_R = \Sigma_i \rho_i \left(\frac{\Sigma_R}{\rho}\right)_i \qquad (2)$$

In this paper neutron attenuation coefficients of B_2O_3 reinforced composite have been investigated using Phy-X/PSD.

2. Materials and Methods

The neutron attenuation coefficients are obtained in terms of FNRCS. The materials used for this work is Al_2O_3 composite where B_2O_3 were used in different rate of 45, 50, 55, 60, 65, 70 (mol%). The addition of B_2O_3 in composite is to see whether is it possible to increase neutron shielding properties. When B_2O_3 rate is changed in composite the Average molecular weight (g/mol) of composite and thus density for composite changed. These results were shown in Figure 1 and Figure 2 respectively where it is seen that both quantities have been increased linearly with the increasing B_2O_3 rate in composite. The parameters have been obtained for six different types materials using Phy-X/PSD online code which is a free online platform [37].

3. Results and Discussions

The calculations result of FNRCS of six different types of composites where B_2O_3 have been used, are shown Fig. 3 where it is seen that the FNRCS increased with the increasing B_2O_3 rate. This is

interesting and expected results as boron is well known element for neutron absorption. The relation between Neutron attenuation coefficients and Average molecular weight is displayed in Fig. 4 where it is clearly seen that over 97% correlation has been obtained between two parameters.

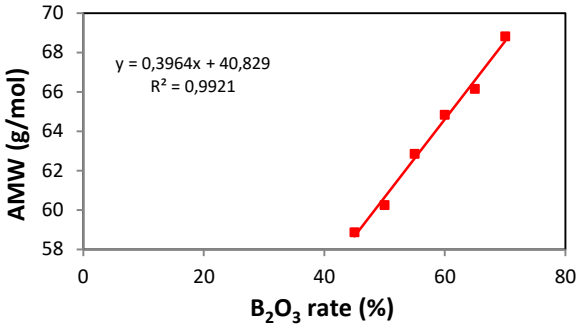

Figure 1. *Average molecular weight (g/mol) as a function of B2O3 rate in composite*

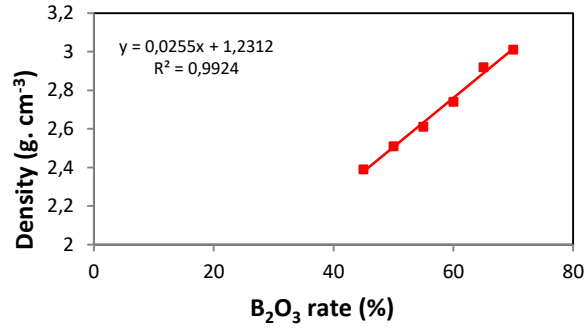

Figure 2. *Correlation between B_2O_3 rate and density of composite materials*

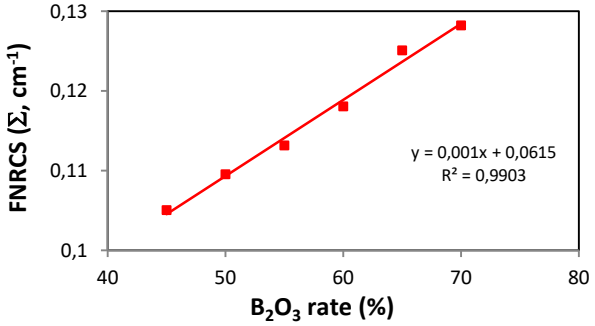

Figure 3. *The FNRCS as a function of B_2O_3 rate in composite*

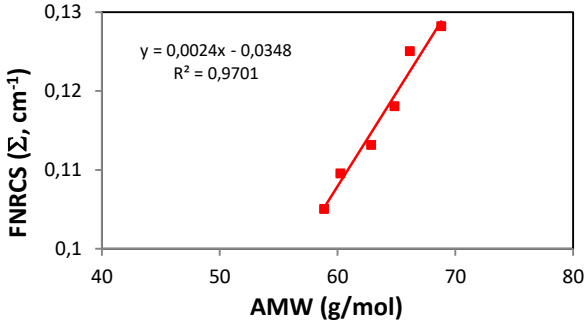

Figure 4. *Correlation between Neutron attenuation coefficients and Average molecular weight*

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- **Ethical approval:** The conducted research is not related to either human or animal use.
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