

EFFECTS OF GAMMA-RADIATION ON POLY ISOBUTYLENE

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Received: 25 January 2020, Revised and Accepted: 17 March 2020

ABSTRACT

Radiological parameters such as Mass attenuation coefficient (μ_m), effective atomic numbers (Z_{eff}), electron densities (N_{eff}), total cross-section (σ_t) & electronic cross-section (σ_e) have been computed and investigated for poly-isobutylene using NaI (TI) scintillation counter and XCOM program. The gamma ray photons were detected by using NaI (TI) detector with resolution of 8.2 % at 662 keV, using radioactive gamma ray sources ⁵⁷Co, ¹³³Ba, ¹³⁷Cs, ⁵⁴Mn, ⁶⁰Co and ²²Na. Values of μ_m for the poly-isobutylene decrease with increasing energy. An experiment is done to avail the radiological data on poly- isobutylene and to check the effects of gamma radiation produced on material with different energy ranges. It is found from the present investigation that the investigated results found immense importance in radiation industry, dosimetry, polymer industry etc.

Keywords:-Mass attenuation coefficient, effective electron density, poly-isobutylene.

INTRODUCTION

The use of radiation & radiology increases day by day accordingly people were exposed to the harmful radiations and may affected. The study of mass attenuation coefficient (μ_m), effective atomic numbers (Z_{eff}), electron densities (N_{eff}), total cross-section (σ_t) & electronic cross-section (σ_e) found too much importance in many fields such as medical field, structure modification, agriculture industry etc. [1]. Nowadays the study on the dosimetric materials has been increased. Many researchers studied and investigated the effects and properties produced by gamma-ray using various research methods [2-6]. Radiation induced effects in many materials investigated [9-10]. The poly isobutylene can be used as a phantom or as tissue substitute material because it has C, H and O elements. From the present study it can be concluded that mass attenuation coefficient (μ_m) is the fundamental parameter to investigate other radiological parameters such as atomic cross-sections (σ_a), electronic cross-sections (σ_e), effective atomic numbers (Z_{eff}) & effective electron densities (N_{eff}). A work is done to check the radiological effects produced due to gamma-radiation on poly isobutylene and to provide literature which is not available for the present material. The results investigated in the present work could be useful in the dose rate measurement and radiation shielding against gamma radiation. The investigated values of mass attenuation coefficient of gamma rays and x-rays on dosimetric, biological & shielding materials found immense importance in many fields [13, 14].

EXPERIMENTAL

Radioactive sources having energies 122, 279, 320, 364, 637, 1115, 1408 keV were used for irradiation on the poly isobutylene. The gamma ray photons were detected using NaI (TI) detector with resolution of 0.101785 at 662 keV. Signals from the detector were enlarged and analyzed with 8K MCA. The effectiveness of NaI (TI) detector is higher at low source energy (Mohamed Abd-elzaher).

Table1: Gamma-ray parameters for poly isobutylene

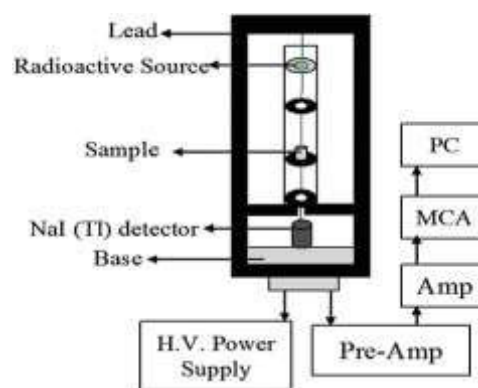


Fig 1. Schematic view of the experimental set-up.

The uncertainty in determined experiment is found to be 1-4 % (Mustafa Ramep Kacal). To use poly isobutylene as radiation target we use KBr press machine to prepare pellets having same thickness (0.13 g/cm²) and then filled in a cylindrical plastic container having the same diameter as that of sample pellets. An travelling microscope is used to determine the thickness of the prepared pellets. We made some experiment with the empty sample container and found that attenuation of photons of the empty containers were negligible. The experimental part is discussed in [8]. In this work mass attenuation coefficient (μ_m), atomic cross-sections (σ_a), electronic cross-sections (σ_e), effective atomic numbers (Z_{eff}) & effective electron densities (N_{eff}).were calculated from formulas reported elsewhere [7-8, 11].

PIB	122 keV		279 keV		320 keV		364 keV		637 keV		1115 keV		1408 keV	
	Exp.	The.	Exp.	The.	Exp.	The.	Exp.	The.	Exp.	The.	Exp.	The.	Exp.	The.
μ_m	0.1642	0.1637	0.1309	0.13	0.1142	0.1147	0.1111	0.1104	0.0901	0.0908	0.0681	0.0692	0.0615	0.061
σ_t	15.2921	15.2455	12.1908	12.1070	10.6355	12.5400	12.0100	12.0900	8.3930	8.4563	6.3422	6.4447	5.7275	5.6810
σ_e	5.7345	5.7171	4.5716	4.5401	3.9883	4.7025	3.3300	3.3100	3.1474	3.1711	2.5200	2.4167	2.1478	2.1304
Z_{eff}	2.6667	2.3866	2.6667	2.4366	2.6667	2.4537	3.6066	2.4630	2.6667	2.4774	2.5167	2.4933	2.6667	2.4975
N_{eff}	3.4360	3.0751	3.4360	3.1395	3.4360	3.1616	4.6472	3.1736	3.4360	3.1921	3.2556	3.2127	3.4360	3.2180

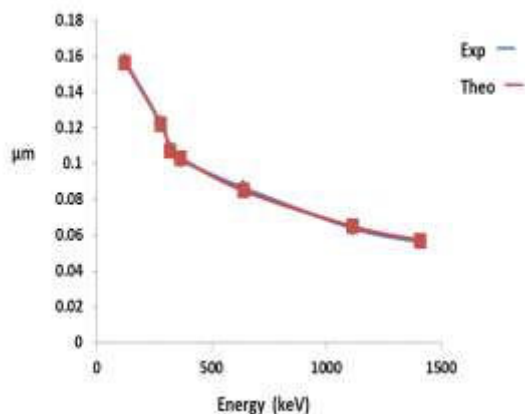


Fig. 2: Variation of μ_m with photon energy

CONCLUSION

It can be seen from the present experimental work that the poly isobutylene used in this investigation shows good attenuation properties at low energy photons and can be used as gamma ray shielding material. The investigated and calculated values of radiological parameters from XCOM could be found beneficial uses viz. electronics industry, constructions, plastic industry, agriculture industry, medical field etc.

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