Ulitization of polymeric composites for neutrons and gamma-rays attenuation

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This thesis is concerned with the investigation of the mechanical, physical and radiation attenuation properties of some shielding materials. Selected shields of polyester styrene and epoxy composites were chosen to fulfill certain applications and are concerned for the present work. Both resins (Polyester and Epoxy) were filled with crushed magnetite, ilmenite and barite fillers, as well as, boron carbide -for homogeneous shields. Also, boron glass disks were coupled with the Epoxy Ilmenite formula in one assembly to perform multilayered shields. Both basic formulas and polymeric substances, in general, are hydrocarbonic substances which guarantee good neutron moderation and attenuation. Furthermore, heavy minerals and boron additives were employed for gamma rays attenuation and thermal neutrons capture respectively.Any material used for shielding purposes should fulfill some design criterion which includes mechanical and physical proficiency beside their main role as nuclear radiations attenuator. Therefore, mechanical properties as compressive, flexural and impact strengths were tested. Also, some physical properties as specific heat, electrical conductivity, water absorption and porosity were performed to monitor the composites usefulness as radiation shields.Radiation attenuation properties have been carried out using different thicknesses of the investigated composite samples and collimated radiation beams emitted from radioactive Pu-α- Be (5 Ci) and spontaneous fission 252Cf (100 μ g) neutron sources. Fast neutron and gamma ray spectra were measured by a neutron-gamma spectrometer with stilbene organic scintillator based on the zero crossover method of the Pulse Shape Discrimination (PSD) technique. This technique was used to discriminate against undesired pulses of recoil protons or electrons due to neutrons and gamma rays respectively. The spectrometer calibration such as linearity, plateau curve, discrimination capability and energy scaling were examined before and during the measurements. Thermal neutron fluxes measurements were carried out using thermal neutron detection system with a BF3 detector. The fluxes of different thicknesses for the concerned composites were obtained by integrating the net area under certain peaks (2.31 and 2.79 KeV).The measured results of fast neutrons and total gamma rays are presented in the form of displayed spectra (energy distribution) for the different thicknesses of the investigated composites. The integral fast neutron and total gamma ray spectra within the total energy ranges, as well as, thermal neutron fluxes, were obtained and used to plot relative attenuation relations. These relations were used to derive the macroscopic effective

-removal cross-section ΣR , total attenuation coefficient μ and macroscopic cross section Σ of fast neutrons, gamma rays and thermal neutrons respectively. Also, relaxation lengths (λ) and half value layers (HVL) have been evaluated for the concerned composites.MCNP-4C2 code and MERCSF-N program were used to calculate the macroscopic effective removal cross-section ΣR of fast neutrons. The experimentally obtained results and calculated parameters were compared, where reasonable agreement was recognized.