Title: The influence of thermal treatment on the structural properties and gamma rays shielding of bentonite clay ceramic

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Abstract: Bentonite clay has renowned in the gamma rays shielding field, as it is a natural, low-cost, obtainable, plentiful material and outstanding shielding ability. Bentonite clay was thermally activated at 900 °C, 1000 °C, and 1100 °C to acquire ceramic features with the desired porosity. Heat treatment of bentonite clay leads to mass loss due to dehydration and dihydroxylation process. The elemental composition of the different sintered bentonite ceramic samples was identified by X-ray fluorescence. The structure of bentonite ceramic samples was characterized by X-ray diffraction, particle size determination, and density measurements, moreover, a scanning electron microscope clarifies the surface morphology of the samples. Shielding measurements were investigated for different sintered bentonite ceramic samples against gamma rays using a sodium iodide detector and narrow beam transmission technique, in addition to two point sources Cs-137 and Co-60 which emits 662 keV, 1173 keV, and 1332 keV. It has been found that the ceramic samples sintered at 1100 °C have the best shielding parameters (linear attenuation coefficient, mass attenuation coefficient, half value layer, tenth value layer, and mean free path). Experimental values of the mass attenuation coefficient of the sintered sample at 1100 °C were compared with theoretical values estimated from both XCOM and Physics-X programs and found that there is a little difference between them that doesn't exceed 10%. At last, the radiation protection efficiency of all samples was calculated and concluded that the same sintered sample at 1100 °C is the optimum sample in all investigated properties.

Keywords: Bentonite clay; Gamma-ray shielding; Thermal activation; Ceramic materials; Sintering temperature;

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