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Comparison of Electron Beam Attenuation in Samples of ABS and HIPS Plastics by Fused Deposition Modeling

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In this paper, the numerical simulation and the experimental study of the electron beams propagation in polymer materials suitable for the sample production by rapid prototyping technique were carried out [1]. To conduct experimental studies the sets of plates with various thicknesses were made of ABS and HIPS plastics by fused deposition modeling [1]. The combination of these plates allows measurements to be made in 1 mm increments.
Experiments were carried out for electron beams of linear accelerators TrueBeam 2.0 (Varian) for the energy range 6 –20 MeV and ONCOR Impression Plus (Simens) for the energy range 6 –18 MeV [2, 3]. Pre-calibrated GafChromic EBT3 polymer films were used as the detector [4]. The numerical model was created in accordance with experimental set-up.

Since the manufacturing process of the sample by fused deposition modeling is the formation of an objects from a thermoplastic mass by layer-by-layer volume alignment [1]. A distinctive feature of the printed samples is the lower actual density of the objects, in comparison with the density of the material (filament) of which they are made [5]. Taking into account this fact, the real density of the polymer plates was calculated and an additional correction of the numerical model was carried out.

On the concluding stage of the research the calculated and experimental data of the electron beam attenuation in samples made of ABS and HIPS plastics by fused deposition modeling were compared.

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Primary author: Mr CHEREPENNIKOV, Yury (Tomsk Polytechnic University)

Co-authors: Mr KRASNYKH, A. (National Research Tomsk Polytechnic University); Ms MILOICHIKOVA, Irina (National Research Tomsk Polytechnic University, 30 Lenin Avenue, Tomsk, 634050, Russian Federation); Mr STUCHEBROV, Sergei (Tomsk Polytechnic University)

Presenter: Mr CHEREPENNIKOV, Yury (Tomsk Polytechnic University)

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