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Homogeneity evaluation of phosphorus-32 epoxy plaques to be used in the treatment of spinal and intracranial cancer by brachytherapy

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In Brachytherapy, radioactive source is positioned close to the tumor. The most important advantage is that the target region receives most of the dose, protecting the healthy tissues adjacent to the tumor region. In order to use these sources, a high dosimetric uniformity must be achieved, so a homogeneous dose delivery can be delivered to the target. In the present work, the consistency of the epoxy resin plate was evaluated using a methodology developed in the laboratory for the production of radiotherapy sources at IPEN / CNEN - SP. Several tests were carried out to determine the best mold for the source manufacture. It was concluded that polytetrafluoroethylene (PTFE), which is commercially known as teflon, obtained the best result, due to the ease unmold of the source after the resin curing process. The epoxy plaques were produced with resin 2220 and catalyst 3154 (Avipol), at a 2:1 mass ratio. To simulate the radioactive material, hydrochloric acid (HCl) equivalent to 5% of the total mass (resin + catalyst) is added. The epoxy resin cured for 24 h at room temperature. The thickness of the plaques was measured reaching an average value of 0.300 mm ± 0.070. The measurements were made with a micrometer, measuring 10 points of each plaque. The measures of width and length were not performed, as these parameters do not influence the uniformity of the dose. In order for the distribution of phosphorus-32 activity to be stipulated, a Monte Carlo Simulation using the MCNP code was performed. The maximum dose variation along the plaque, considering a totally uniform thickness of 0.300 mm, resulted in <0.5% up to 0.5 cm before the edge. The result of the simulation shows that with a uniformly thick plaque, the dose distribution trend is homogeneous. Based on the results, the epoxy polymer plaques are shown to be viable for use in brachytherapy, and the next step of the work will be the tests with radioactive material.