Plastic scintillator (PS) has been proposed for both ID and 2D dose measurements for radiation therapy applications. For low energy photon modalities (e.g. brachytherapy) an efficient, water equivalent scintillator is needed. To perform 2D measurements high localization of the scintillation process is required. Guided by comparison of the mass energy absorption coefficients as a function of energy and of the dose distribution as a function of distance from the radioactive source, as modeled by Monte Carlo, a small quantity of medium atomic number (Z) atoms (e.g. 4%Cl) was added to a polyvinyltoluene (PVT) based PS to approximate closely (within 10%) the radiological properties of water in the 20-662 keV energy range. However, the scintillation efficiency of standard PS loaded with standard high atomic additives drops as much as 70%. We developed experimental techniques to assess the scintillation efficiency and locality of 15 new PS mixtures. These mixtures differ by the type of scintillation dyes and the type of compound containing the medium Z atom (Chlorine). To achieve higher material stability, 4-chlorostyrene was used as a loading compound to ensure polymerization with the PVT base. Three of the new PS materials exhibited scintillation efficiencies within 30% of one of the most efficient commercially available products (BC400), which is not water equivalent. These new scintillator materials are promising candidates for the development of an accurate and efficient radiation dosimetry method in brachytherapy.

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