AbstractID: 6554 Title: On the use of ice as a water-equivalent solid medium for brachytherapy dosimetry measurement

Purpose: It is well-known that fluctuation in chemical compositions can lead to significant errors in the dosimetry of low-energy brachytherapy sources using the traditional "water-equivalent" solid phantoms. The aim of this work was to investigate the feasibility of using ice as a consistent water equivalent solid medium for low-energy brachytherapy dosimetry.

Methodod and Materials: The MCNP Monte Carlo code was used to compute the solid-phantom-to-water conversion factor for ice (R_{ice}) and for SolidWater™ (R_{SW}) irradiated with mono-energetic photons of 10 keV to 2.0 MeV and photons of six brachytherapy sources at various physical distances from the source. The R_{SW} for different chemical compositions observed in SolidWater™ was also calculated. The feasibility of making precise ice phantoms was explored theoretically from an engineering point of view.

Results: The uncertainty associated with the chemical composition of the SolidWater™ phantom can cause large errors in R_{SW} for photons emitted by ^{103}Pd source: 9% at 1 cm, 47% at 5 cm and 72% at 10 cm radial distance while ice would be free from such errors. However, due to its lower physical density compared to liquid water, the R_{ice} was found to depend on both the photon energy and distance from the source. At the distance of 1 cm used in reference dosimetry, R_{ice} varied from 0.890 at 15 keV to 1.015 at 50 keV. A practical approach for making ice slabs with pre-designed molds of brachytherapy sources and dosimeters was proposed.

Conclusions: A comprehensive set of R_{ice} has been calculated for mono-energetic photons and for photons emitted by existing brachytherapy sources at various measurement depths. Using R_{ice} with an ice phantom would eliminate errors resulted from chemical composition fluctuations in traditional SolidWater™ phantom while retaining the positioning advantages of a solid phantom. Experimental measurements using ice phantom are being planned.