AbstractID: 3119 Title: Dose Response of Ion Exchange Resin Beads

Purpose: To investigate the x-ray dose versus ^{1}H NMR spin lattice relaxation (T_1) response of ion exchange resin beads, with and without ferrous ions.

Method and Materials: Strong acid cation exchange resin beads (Rohm and Haas, Amberlyst 15 Wet) were rinsed in distilled water and packed in plastic vials. Similar beads were treated to produce a 1 mM ferrous ion concentration inside the beads, then rinsed with distilled water, and finally packed in plastic vials. Sample vials were placed in a water phantom and exposed to 6 MV x-rays from 0 to 100 Gy. The T_1 for each sample was measured in a 1.5 Tesla MRI unit. Beads from two manufacturing lots, Lot 1 and 2, were tested. Density of the bead samples was 1.10 g/cm^3.

Results: Vials with beads containing ferrous ions exhibited a linear dose versus R_1 (i.e., $1/T_1$) response with slopes of 0.102 and 0.093 $sec^{-1}Gy^{-1}$ for respectively Lot 1 and Lot 2 beads. Vials of Lot 1 beads containing no ferrous ions exhibited a linear dose versus R_1 response with a slope of 0.083 $sec^{-1}Gy^{-1}$. Vials of Lot 2 beads containing no ferrous ions showed an exponential increase in R_1 of 2.4 sec^{-1} from 0 to 50 Gy with minimal increase in R_1 from 50 to 100 Gy.

Conclusion: For both bead lots, the beads containing ferrous ions exhibited similar linear dose versus R_1 responses. Beads containing no ferrous ions exhibited significant, but different dose versus R_1 responses. When the ferrous ions are present in the beads, a ferrous oxidation reaction appears to dominate the dose response. The results support the concept of using strong acid cation exchange resin beads containing ferrous ions to create a three dimensional dosimeter which can be evaluated using MRI.