^{210}Po IN DRINKING WATER, THE MCL, AND HEALTH EFFECTS OF LOW-LEVEL EXPOSURE

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In 2007, numerous private drinking-water wells were discovered with more than 500 mBq/L of ^{210}Po at the site of a childhood leukemia cluster in Fallon Nevada. The highest activity measured, 6.6 Bq/L, is the fourth highest value reported for the US (Seiler, 2011). ^{210}Po in ground-water rarely exceeds ~5 mBq/L because it rapidly binds to sediment. A geochemical investigation (Seiler *et al.*, 2011) evaluated the processes responsible for its mobilization from sediments in Fallon and compared common features of ^{210}Po-enriched groundwater from Fallon with ^{210}Po-enriched wells in Finland, and Florida and Maryland in the US. In the Finnish wells radon is extremely high and ^{210}Po is supported by ^{210}Pb, suggesting that ^{210}Pb and ^{210}Po from radon decay bind to colloidal material in the water column and do not settle out. In the Nevada and Florida wells, ^{210}Po is mobilized from the sediments in pro-cesses involving sulfate-reducing bacteria. Sufficient ^{210}Po exists in typical sediments that mobilization of only 1 percent of the ^{210}Po present in them can yield water with >1 Bq/L.

^{210}Po is a Group 1 human carcinogen. In US drinking water, ^{210}Po is not monitored directly but rather the adjusted Gross Alpha MCL of 555 mBq/L is used. A MCL specific for ^{210}Po based on a risk level of 10^{-4} for lifetime total cancer risk would have been 41 mBq/L, and 26 mBq/L based on a risk level of 0.5×10^{-4} for lifetime fatal cancer risk (USEPA, 2000). Thus, the adjusted Gross Alpha MCL that now regulates ^{210}Po is 10-20 times greater than a MCL specific for ^{210}Po would have been. The adjusted Gross Alpha MCL was chosen because of the expense of direct ^{210}Po analyses, and because ^{210}Po was assumed to be extraordinarily rare in drinking water when the rule was promulgated in 2000 (USEPA, 2000). The use of the adjusted Gross Alpha MCL to regulate ^{210}Po has serious flaws and ^{210}Po may not be as rare as USEPA assumed in 2000.

Seiler and Wiemels (2012) reviewed the biological effects of low-level exposure to ^{210}Po in drinking water and concluded female subfertility may be one of the most significant effects of low-level ^{210}Po exposure. ^{210}Po accumulates in the ovary where it kills primary oocytes at low doses (Samuels, 1966) and Finkel *et al*. (1953) concluded the ovary may be the critical organ in determining the lowest injurious dose for **^{210}**Po. Cells irradiated by α particles produce signals that can migrate substantial distances in tissue and cause death and chromosomal damage in un-irradiated cells. Low-level exposure to **^{210}**Po may have subtle, long-term biological effects because of its tropism towards reproductive and embryonic and fetal tissues where a single alpha particle may kill or damage critical cells even if they are not directly targeted.

References

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