FACTSHEET

702509

11/1/77

CENTER FOR HUMAN RADIOBIOLOGY

Fact Sheet on

Oxidation of Pu(IV) to Pu(VI) by Chlorine - Consequences for the Maximum Permissible Concentration of Plutonium in Drinking Water

It has been established that the chlorination of drinking water results in the oxidation of soluble plutonium to the hexavalent state. Experiments were carried out under conditions that closely simulate those for water treatment systems. (Chlorination is begun immediately after intake and the chlorine concentration is maintained at 1 to 10 ppm, depending on the bacterial concentrations in the resource water, during treatment. From the time of discharge to the distribution system to the time of consumption the chlorine concentration is about one ppm. The maximum elapsed time from initial chlorination to consumption is 24 hr.) Solutions of chlorine and tetravalent plutonium were added to Chicago drinking water and the solutions were analyzed for Pu(IV) and Pu(VI) after 24 hr. The plutonium (^{239}Pu) concentrations were 0.002 and 2 pCi/ml; the chlorine concentrations were 1.0 and 9.8 ppm. For these chlorine concentrations, the percentages of Pu(VI) were about 70 and 94, respectively, for both plutonium concentrations.

A consequence of these observations is that the present values for the maximum permissible concentrations (MPC) of plutonium in drinking water appear to be from three to four orders of magnitude too high. In calculating the MPC's the ICRP value of 3×10^{-5} was used for the gastro-intestinal absorption factor, f_1. This value was based on the results of experiments in which solutions of Pu(IV) were fed or administered intra-gastrically to animals. In establishing this value, it appears that due consideration was not given (1) to evidence in the literature that in the rat the value of f_1 for Pu(VI) is at least three orders of magnitude higher than that for Pu(IV) and that in man the value of f_1 for U(VI), a very close chemical analog of Pu(VI), is about 2×10^{-1}, and (2) to the possibility that Pu(VI) could be formed during water treatment and that Pu(VI) would not be reduced to Pu(IV) in the G. I. tract.

Prepared by R. P. Larsen

REPOSITORY Argonne/CHR
COLLECTION Records relating to Industrial Medical
BOX No. Exposure to Radium 88 124 ASH
FOLDER Binder #33 - CHR Fact Sheets Review Committee History of CHR from Anl Reports

0019686