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Behavior of cadmium(II) in irradiated aqueous solutions

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The radiation removal of cadmium(II) from aqueous solutions in presence of different scavengers has been investigated. 100 mg/L of cadmium dissolved from Cd(NO₃)₂ requires dose of 15 kGy to be effectively removed from the system containing 1×10-2 mol/L of HCOOK as a scavenger of OH radicals. The positive effect of deaeration with N₂O or N₂ was observed in the range of lower doses. Similarly, the addition of solid promoters (bentonite, active carbon, zeolite, Cu₂O, NiO, TiO₂ and CuO) reduced the efficiency of radiation removal of cadmium. 25 % of dissolved cadmium is present in the solution before irradiation in the form of Cd(Formate)⁺, majority in form of Cd²⁺. Product of irradiation of the solutions containing Cd(II) is CdCO₃. In the system with cadmium dissolved from CdCl₂ radiation reduction takes place up to metallic cadmium. In the system with lower concentration of scavenger (1×10⁻³ mol/L of HCOOK) no radiation removal of cadmium occurs which was validated up to an absorbed dose of 100 kGy.
Systems contained organic complexants (ethylenediaminetetraacetic acid–EDTA and citric acid) were also studied. The solutions of Cd(NO₃)₂ containing initial concentration 27 mg/L of Cd(II) were mixed with 3×10⁻⁴ mol/L EDTA. The efficient degradation of cadmium complexed with EDTA proceeds up to 90 % at a dose of 45 kGy with addition of 5x10⁻³ mol/L carbonate as OH scavenger and simultaneously pH buffer (pH 10.5). Different OH radical scavengers (1×10⁻² mol/L and 1×10⁻³ mol/L HCOOK, 2×10⁻³ mol/L Na₂CO₃, 2×10⁻³ mol/L NaHCO₃, or 10 % methanol) were added to these solutions. In the presence of the carbonate, no effect of further addition of any other reagent was observed. The product of irradiation is CdCO₃. On the contrary, the presence of 1×10⁻² mol/L of HCOOK in the solution is necessary for the radiation removal of cadmium complexed with citric acid (1×10⁻³ mol/L) at pH 8. With increasing concentration of HCOOK (up to 5×10⁻² mol/L) decreases the pH value necessary for the radiation induced precipitation of cadmium from the aqueous solution. The efficiency could be enhanced by adding zeolite as a solid promoter in the irradiated system.

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