



Contribution ID: 356

Type: Poster

Behavior of cadmium(II) in irradiated aqueous solutions

Thursday, 22 April 2010 12:00 (20 minutes)

The radiation removal of cadmium(II) from aqueous solutions in presence of different scavengers has been investigated. 100 mg/L of cadmium dissolved from $\text{Cd}(\text{NO}_3)_2$ 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 N_2O or N_2 was observed in the range of lower doses. Similarly, the addition of solid promoters (bentonite, active carbon, zeolite, Cu_2O , NiO, TiO_2 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 $\text{Cd}(\text{Formate})^+$, majority in form of Cd^{2+} . Product of irradiation of the solutions containing Cd(II) is CdCO_3 . In the system with cadmium dissolved from CdCl_2 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 $\text{Cd}(\text{NO}_3)_2$ 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 5×10^{-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 Na_2CO_3 , 2×10^{-3} mol/L NaHCO_3 , 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 CdCO_3 . 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.

This work was performed under the auspices of Ministry of Education, Youth, and Sports grant MSM 68-4077-0040.

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Session Classification: Poster Session - Radiation Chemistry

Track Classification: Radiation Chemistry