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Radiation Induced Environmental Remediation of Toxic Cr(VI) Heavy Metal in Aerated Neutral Solution under Simulated Industrial Effluent

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Background of the study:
Chromium(VI) heavy metal is a major water contaminant in most industrial effluents, due to its carcinogenicity and its impact on ecosystems, while Chromium (III) is non-toxic and is an important element for human metabolism. Cr(VI) can be reduced to Cr(III) by the superoxide $O2^{-}\bullet$ free radical radiolytically produced in aerated solution at neutral pH in the presence of formate.

Methodology:
The degradation of Cr(VI) was investigated by steady state gamma irradiation using a cobalt-60 source and by pulse radiolysis using a van de Graaff accelerator in aerated solution at neutral pH, which is close to natural conditions in most wastewaters.

Results:
The degradation of Cr(VI) increased linearly with the absorbed dose and was significantly enhanced by the added formate but not by the radiolytically produced hydrogen peroxide at this pH. The rate constant for this reduction was found to be 1.28 x 108 M-1 s-1 and the absorption spectrum of Cr(V) transient species was obtained. A partial recovery of Cr(VI) is observed over a period of ca. 5 ms following a second order kinetics with a rate constant 8.0 x 106 M-1 s-1.

Conclusion:
These outcomes suggest that gamma-irradiation of Cr(VI)-contaminated wastewaters and industrial effluents in presence of formate can be simple, effective and economical means for the remediation of this major contaminant.

Country/Organization invited to participate

Algeria

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