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Hexavalent chromium in solid samples in the environment - determination methods and case studies

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Tanneries and leather processing facilities may contaminate the environment with huge amounts of chromium, which impose environmental threats particularly in case of partial oxidation to the hexavalent state. But hexavalent chromium is also stable in mineral fertilizers and can be formed during basic slag production. Apart from inhalation of chromate containing dusts, hexavalent chromium is highly hazardous and rather mobile in aquifers, unless reduced. Extractions from contaminated solids may suffer from incomplete extraction or speciation changes in either direction. Within a series of extractions, recoveries of K2CrO4, CaCrO4, BaCrO4 and PbCrO4 additions to fertilizers and soils into extractants like ammonium nitrate, phosphate buffer, and hot alkaline extraction (EPA method 3060A) were tested. Further on, the photometric determination with diphenylcarbazide may suffer from salt effects and colours of the extracts. A ring test of four samples was performed (by BAM in Berlin/Germany) to test the precision of the alkaline extraction according to the EPA method 3060A, in order to certify a standard reference material. The photometric determination after ion chromatographic separation and post column derivatization did not yield significantly different results with respect to direct photometry or ICP-OES measurement. As examples for environmental contamination, case studies from Dhaka in Bangla Desh, as well as from 2 small Austrian sites are given. In Dhaka, chromium concentration may reach more than 1 % in the soil, but high levels of organic carbon largely prevent chromium oxidation. To the contrary, at a site of a former shoe factory in Upper Austria, chromate was still appreciably high under grass cover. After fertilization of arable soils with hexavalent chromium containing basic slags, however, no hexavalent chromium could be detected.