

Evaluation of Cr(VI) pollution caused by dumped chromium slag at the urban park in Tokyo

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1 Introduction

A chromate manufacturing plant operated in the Komatsugawa area, Tokyo, until 1972. The chromium slag generated during manufacturing is buried underneath Ojima-Komatsugawa Park, which lies in Koto-ku and Edogawa-ku. In an attempt to deal with the chromium slag, the Tokyo Metropolitan Government applied a FeSO_4 treatment to reduce Cr(VI) to Cr(III), and the industrial waste which contained the chromium slag was covered with soil. However, Cr(VI) was often found in environmental water from this area after it had become a park. Here we report the remarkable pollution of Cr(VI) at Ojima-Komatsugawa Park.

2 Experiment

Samples of meltwater, snow, and soil were collected in January 2013, at the northern site of the Gathering field in Ojima-Komatsugawa Park. After sampling, the soil samples were extracted with 4 M HNO_3 for 42h at 25 °C, and the extracted solutions were centrifuged at 4000 rpm for 15 min and filtrated with a 0.22 μm membrane filter. The meltwater and snow samples were filtrated with a 0.22 μm membrane filter. These filtrate solutions were used for analysis. The total Cr concentration was measured by ICP-OES. The Cr(VI) concentration was measured by 1,5-diphenylcarbazide (DPC) absorption spectrophotometry using a UV/VIS spectrophotometer. Further, Cr(VI) in soil samples was analyzed directly by using XANES. The Cr K-edge XANES spectra were measured in the fluorescence mode using a Lytle type detector at the BL-9A equipped with a double crystal monochromator of Si(111).

3 Results and Discussion

High levels of Cr(VI) contamination in meltwater, snow, and soil samples were detected. In the meltwater and snow samples, Cr(VI) concentrations were 11.8-37.0 mg L^{-1} [1]. The highest concentration value (37.0 mg L^{-1}) was in excess of up to 740 times the Japanese regulation value (0.05 mg L^{-1}).

In the soil sample collected at the point where the meltwater sample with the highest Cr(VI) concentration was collected, the total Cr concentration was very high, and the Cr(VI) concentration was relatively high (330 mg kg^{-1} , 2.19 mg kg^{-1} , respectively) [1]. Cr(VI) concentration in this soil is lower despite the high total Cr concentration because Cr(VI) was reduced to Cr(III) by organic matter

in the soil and FeSO_4 , which was sprinkled as a reductant in April 2012.

The valence of Cr in this soil sample was measured by using XANES. The pre-edge peak at 5992 eV, which is characteristic of Cr(VI), did not appear as shown in Figure. This data was collected one month after sampling, and all of Cr(VI) in this soil was reduced to Cr(III). Although all of Cr(VI) in the soil was reduced, reduction steps from Cr(VI) to Cr(III) are not clear under existence of organic matter and FeSO_4 . Further, the valence of Cr should be measured directly just after sampling because the reduction of Cr(VI) to Cr(III) starts immediately when Cr(VI) is released in the soil.

Based on these ideas, we are planning to measure continuously the oxidation state changes of Cr(VI) in polluted soil samples with high time resolution for several hours. It is considered that measuring by QXAFS method is important to clarify the detailed reduction behavior of Cr(VI) in soil.

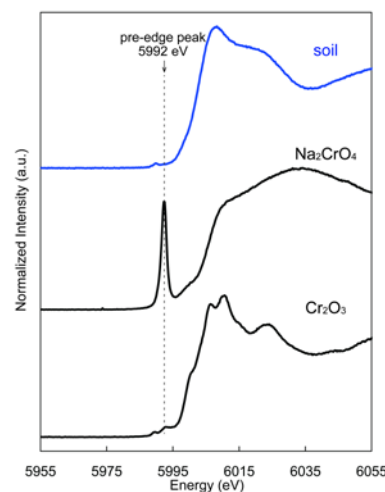


Figure: Cr K-edge XANES spectra of the soil sample and Cr reference materials. Blue line; the soil sample, Black lines; reference materials (Cr_2O_3 as Cr(III) and Na_2CrO_4 as Cr(VI), respectively)

References

- [1] M. Hori *et al.*, *J Mater Cycles Waste Manage*, 2013, accepted.

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