Using "Big Science" to Evaluate Metal Removal[1]

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Abstract: X-Ray Absorption Spectroscopy (XAS) is a powerful tool to examine the oxidation state and chemical form of metals removed during treatment that offers an alternative to the time consuming and often less definitive sequential extraction methods traditionally used. Peat media that had been effectively removing chromium, cadmium and zinc from stormwater was analyzed to identify the form of the attenuated chromium. Based on the chemistry of the input water, much of the chromium appeared to be present as a fine particulate. The peat media has a size distribution similar to coarse sand which typically can filter particles 10 – 20 microns in size but is not expected to remove the fine chromium particles. The media has also removed similar fine particulate copper and aluminum from mine water. The removal of fine particulate chromium and the lack of any chromium release in a standard TCLP test suggest that the mechanism might involve some type of chemical bonding or microbial removal as opposed to filtration alone. Understanding the specific removal mechanisms will help to predict how effective the media may be with retaining other metals from various mine wastewater streams. In 2018 samples of the media were collected to help identify the specific retention mechanisms. DNA was extracted from solid peat samples and incubations containing hexavalent chromium and spent peat media were setup in both aerobic and anaerobic conditions. Samples were analyzed with X-ray fluorescence mapping and X-ray Absorption Spectroscopy to identify the location of chromium relative to peat particles and form of the removed metals. Preliminary data show that microbial reactions do not appear to play a major role in chromium removal and that the removed chromium is associated with the media and is present primarily as a chromium organic complex and as chromium hydroxide.[3]

Additional Key Words: chromium, x-ray absorption spectroscopy, peat sorption media, X-ray fluorescence mapping.

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3. Work reported here was conducted near 42° 36' 11.03" N; 83° 155' 57" W.