

USING HUMAN SWEAT TO EXTRACT CHROMIUM FROM CHROMITE ORE PROCESSING RESIDUE: APPLICATIONS TO SETTING HEALTH-BASED CLEANUP LEVELS

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Chromite ore processing residue (COPR) containing measurable levels of hexavalent and trivalent chromium [Cr(VI) and Cr(III), respectively] has been used to fill in low-lying areas in Hudson County, N.J. While it has been demonstrated that direct dermal contact with solutions containing Cr(VI) may elicit allergic contact dermatitis (ACD) in previously sensitized individuals, it is unknown to what degree skin moisture may solubilize Cr(VI) from COPR adhering to skin. An accurate estimate of this extraction potential is necessary to establish COPR concentrations of Cr(VI) and Cr(III) that are protective of eliciting ACD in sensitized individuals. The purpose of this study was to measure the extractable fraction of Cr(VI) and total chromium [Cr(III) and Cr(VI)] in soils impacted by COPR using human sweat as the extractant. Human sweat was collected from seven male volunteers. Samples of COPR material containing the following Cr(VI) and total chromium concentrations were collected: Cr(VI), 16, 136, and 1240 ppm; total chromium, 932 and 6660 ppm. The samples were sieved to obtain a uniform particle size <500 μm . The samples were then mixed with human sweat at 30°C for 12 h, after which the sweat was filtered and analyzed to determine the dissolved concentration of Cr(VI) and total chromium. The data from these analyses show that no detectable levels (limit of detection = 0.010 ppm) of Cr(VI) were leached from COPR containing 16 ppm Cr(VI). At Cr(VI) concentrations of 136 and 1240 ppm, less than 0.1% of the Cr(VI) present in the COPR sample was extracted into sweat, and sweat concentrations were 0.133 ppm Cr(VI) or less. Similarly, the amount of Cr_{total} extracted was 0.3% or less at COPR concentrations as high as 6600 ppm Cr_{total}, and sweat concentrations were 2.3 ppm Cr_{total} or less. If a minimum concentration of 10 ppm (Bagdon and Hazen, 1991) to 54 ppm (Paustenbach et al., 1992) Cr(VI) in sweat is required to elicit an ACD response in chromium-sensitive individuals, the current study results suggest that a COPR Cr(VI) concentration of at least 10,000–54,000 ppm would be required to elicit ACD. If 500 ppm (or greater) of solubilized Cr(III) is required to elicit an ACD response (NIDEPE, 1992a), then a COPR concentration of 250,000 ppm Cr(III) or greater would be required to elicit an allergic response. These results suggest that ACD is unlikely to occur as a result of environmental exposure to the COPR.