

ASSESSING THE HUMAN HEALTH RISKS POSED BY CHROMIUM-CONTAMINATED LAND IN GLASGOW AND ITS ENVIRONS

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Like many cities throughout the UK, Glasgow has a long history of both urbanisation and industrialisation, resulting in elevated concentrations of potentially harmful elements (PHEs). Between 1830 and 1968 Glasgow was home to one of the world's largest producers of Cr-based chemicals. Chromite ore processing residue (COPR) arising from the factory was used as infill material across large areas of SE Glasgow, resulting in widespread land contamination with Cr(VI), a known human carcinogen of significant mobility. A recent survey by the British Geological Survey (BGS) of Glasgow and its surrounding urban environment has highlighted numerous sites with total Cr concentrations exceeding soil guideline values (SGVs) generated by the Contaminated Land Exposure Assessment (CLEA) model.

There is anecdotal evidence of higher cancer rates in SE Glasgow, where many of the Cr-contaminated sites are found. Indeed, it is known that there is a higher incidence of childhood leukemia in SE Glasgow. Epidemiological studies have not been able to find a definitive link between leukemia rates and distance from contaminated sites in general, but concluded that further research is required. For Cr-contaminated sites to pose a risk to human health there must be a pathway between the soil Cr source and the human receptor. Under current risk assessment models it is assumed that, after oral ingestion of contaminated soil (one major pathway of exposure), there is complete absorption of Cr into the bloodstream. This is a very conservative assumption as it makes no acknowledgement of the geochemical form of the Cr present, for example Cr associated with silicate minerals may have a greater stability than that associated with carbonate minerals under stomach acid conditions.

As part of a current research project, the bioaccessibility of Cr has been assessed using a physiologically based extraction test (PBET) on 27 selected soils. This method simulates the chemical and kinetic conditions of the human gastrointestinal environment, giving a more accurate assessment of the potential exposure to a contaminant. While Cr concentrations in seven samples were above the SGV (200 mg/kg), only one had a bioaccessible Cr content (1160 mg/kg) greater than SGV. In addition, the solid phase distribution of Cr within each soil sample was determined, using a nonspecific extraction method combined with chemometric data processing. Combining these methods it has been possible to identify the likely mineral sources of bioaccessible Cr within a soil sample. From this a better understanding of the factors controlling Cr bioaccessibility can be gained, allowing better assessment of risks posed to human health, although due consideration must be given to the speciation-related toxic properties and capacity for absorption of Cr(VI) and Cr(III) in the human body.