How to Overcome Analytical Challenges Commonly Encountered in the Analysis of Cr and Cr(VI) in Environmental and Biological Matrices

J. Verdonck[1], K. Poels[1], J. Vanoirbeek[1], E. Smolders[2], L. Godderis[1,3]*

[1]Environment and Health, Department of Public Health and Primary Care, KU Leuven, Leuven, Belgium, [2]Division of Soil and Water Management, Department of Earth and Environmental Sciences, KU Leuven, Leuven, Belgium, [3]IDEWE, External Service for Prevention and Protection at Work, Heverlee, Belgium

Chromium (Cr) mainly exists in the environment as trivalent Cr(III) and hexavalent chromium Cr(VI). Cr(III) is an important micronutrient, while Cr(VI) is an occupational lung carcinogen. The chemistry of Cr plays a major role in its cellular entry and toxic effects. A sensitive and robust method for the simultaneous determination of Cr(III) and Cr(VI) has been developed. The method uses a hyphenated micro liquid chromatography system coupled to inductively coupled plasma mass spectrometry (µLC-ICP-MS) [1]. The method incorporates an EDTA complexation step to stabilise Cr(III). The pH is adjusted to stabilize Cr(VI). Separation was achieved using an anion exchange micro-sized column. This presentation will highlight the analytical challenges (including pH dependency, contamination and soot deposit in ICP-MS) encountered during method development. The method has been applied to environmental and biological samples collected within a European human biomonitoring study [2]. The study aimed to harmonize procedures for human biomonitoring. Human biomonitoring indicates exposure to chemicals by measuring either chemicals or markers of subsequent health effects in body fluids or tissues. This presentation will highlight the harmonization challenges (including interlaboratory comparison and availability of certified reference materials [CRM]). The human biomonitoring study evaluated the occupational exposure to Cr(VI). Samples were collected from 299 workers and 103 controls. The principal biomarker used for biomonitoring of Cr(VI) exposure at the workplace is total amount of Cr in urine. The main limitation of this biomarker is that it is not specific for Cr(VI) since it reflects exposure to both Cr(III) and Cr(VI). We studied the use of potential more specific biomarkers, such as Cr in red blood cells (RBC) and Cr(VI) in exhaled breath condensate (EBC). Cr in RBC reflects the exposure specifically to Cr(VI) since only Cr(VI) is able to pass though the red cell membrane. Cr(VI) in EBC can give specific information on the Cr(VI) levels in the lungs (main target tissue). This presentation will highlight the main findings of this study related to the analytical challenges (including low levels and stability). As indicated in this study, the analysis of Cr or Cr(VI) in environmental and biological samples is subject to challenges. Precautionary procedures needs to be taken during method development, analysis, sampling and storage. For the future success of chromium speciation in EBC, CRMs in water or EBC needs to be made available.

[1] Elizabeth Leese, Jackie Morton, Philip H. E. Gardiner, Vikki A. Carolan, *Journal of Analytical Atomic Spectrometry*, **2016,** 31, 924-933.
[2] Tiina Santonen, et al., *Environmental research,* **2019,** 177, 924-933.