DEVELOPMENT OF A NOVEL CE-XRF SYSTEM FOR THE DETERMINATION OF ELEMENTAL CONTAMINANTS AND THEIR SPECIATION IN COMPLEX WATER SYSTEMS

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The mobilization of an element, such as chromium, mercury, arsenic and lead, as well as its bioavailability and toxicity within the biosphere, depends on its chemical form. On-line species separation and detection is an essential way to elucidate elemental mobilization parameters. Capillary electrophoresis (CE) has emerged as a strong separation technique for elemental speciation. The lack of stationary phase allows for short separation times with higher efficiency, higher plate numbers, and smaller bandwidths than high performance liquid chromatography, while reducing the likelihood of breaking metal-ligand bonds. CE requires small sample sizes and reagent volumes, and has high cost-efficiency. UV-visible detection is commonly associated with CE. However, UV-vis is not capable of detecting inorganic ions or metal complexes due to low absorbance of these species. To resolve this limitation, inductively coupled plasma mass spectrometry is used, but the instrumentation is bulky and it is an expensive, destructive technique, which requires physical access to the mobile phase through a complex interface. Non-destructive on-line elemental detection is feasible by X-ray fluorescence spectrometry (XRF). New developments in XRF low-power tube and electrically cooled detectors have allowed the miniaturization of XRF instrumentation, and made it more cost and maintenance efficient. Our project aims to set up a low power XRF-detection system for CE in order to develop an elemental sensitive non-invasive detector for liquid-based separation techniques in complex aqueous matrices. Key parameters, such as windows, flow, detection limits, precision, and accuracy, will be evaluated. Once the laboratory setup is successfully established, it will allow for a sensitive and accurate probing of elements in the liquid phase and provide excellent conditions for the study of dynamic change in oxidation state during elemental migration focusing on separation of Cr, Hg, As, and Pb species.