

QUANTIFICATION OF TOTAL CHROMIUM AND HEXAVALENT CHROMIUM IN WATER BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY

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The two primary oxidation states of chromium in natural waters, Cr(III) and Cr(VI), differ significantly in biological, geochemical and toxicological properties. Whereas Cr(III) is considered essential for human in glucose, lipid and protein metabolism, Cr(VI) is toxic because of its ability to oxidize other species and its adverse effects on the lung, liver and kidney. Because of the different toxicities and bioavailability of Cr(III) and Cr(VI), determination of the total chromium content does not give full information about possible health hazard. Hence monitoring of the concentration of the separate chromium species is of great importance. Many different techniques have been in use for Cr containing samples preparation and metal ions speciation: ion chromatography, flow injection analysis, and atomic absorption spectrometry (AAS).

Procedures for the quantification of total chromium and hexavalent chromium in water samples are presented. For the quantification of total chromium and hexavalent chromium in water Chromabond NH₂ columns (aminopropyl phase with a 3ml volume and 500mg of sorbent) obtained from Machery- Nagel (Duren, Germany) were used.

The pH value of the water sample was adjusted to 5.5 using acetic acid or sodium acetate and sample was aspirated through the previously conditioned column. The column contents were dried under vacuum and the hexavalent chromium selectively linked was eluted with nitric acid and quantification was performed by Electrothermal Atomic Absorption Spectrometry (ETAAS). For the detection of total chromium, Cr(III) was transformed into Cr(VI) by oxidizing the sample with 1% K₂S₂O₈ solution and AgNO₃ at 100°C for 15 min. Oxidized solution was eluted through a Chromabond column and total Cr level was quantified by ETAAS using the same instrumental conditions as for hexavalent chromium. Total chromium was also quantified directly in the water samples using ETAAS. The temperature programme of the graphite furnace, the use of chemical modifiers, the atomic technique employed and the effectiveness of deuterium background correction were investigated. Chromium was reliably determined by without chemical modifiers or background correction.

The detection limits were 0.4 and 0.5µg/l for total chromium and hexavalent chromium respectively. The linearity changed under the optimized conditions was 0.4 - 50µg/l and 0.5-50µg/l and the relative standard deviation was less than 3.5%. The validation of both procedures was performed by the standard addition method and the recoveries were higher than 96% in all cases. It is proved that the method can be successfully employed as an alternative to the commonly used preconcentration and speciation analytical techniques. The direct procedure was adopted for the estimation of total chromium in water samples because both procedures applied for total chromium gave similar results. The methods were applied to the determination of total chromium and hexavalent chromium in 40 water samples.