ICP-AES WITH FLOW ON-LINE AND OFF-LINE SORPTION PRECONCENTRATION FOR TRACE ELEMENTS ANALYSIS OF SEAWATERS

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In the present work ICP-AES technique for simultaneous determination of heavy metals after sorption preconcentration with the use of the sorbent with confirmation flexible amino-carboxylic groups (DETATA) have been proposed to evaluate the environmental state of the Arctic seas and of different areas of the Black and Baltic sea. Two types of the dynamic version of sorption preconcentration off-line and on-line mode were used. Off-line and on-line systems including dynamic preconcentration on the DETATA-sorbents (USSR Patent 1702659 from 01.09.1991) and subsequent ICP-AES determination of Cd, Co, Cu, Fe, Mn, Ni, Pb, Zn, and V were also developed for seawater analysis.

As flow manifolds BPI-N and BPI-1 were used. The procedures of simultaneous preconcentration and elution of heavy metals for the columns of different volumes (0.03-0.16 ml) was studied in off-line mode. The flow rates of sample and eluent through the column were chosen.

The manychannels manifold BPI-N (Akvita) with microcolumns (0.16 ml) with DETATA-sorbent were used for preconcentration of heavy metals in off-line mode. An excellent efficiency of DETATA-sorbent offers simultaneous and quantitative recovery of heavy metals from large volumes of seawater (0.5-1L). These analytical procedures were performed in ship conditions, the analysis of eluates were performed by ICP-AES in stationary laboratory conditions. With a concentration coefficient of 200 the method allowed to determine Cd, Co, Cu, Fe, Mn, Ni, Pb, Zn, and V with detection limits of 0.01-0.3 μg/liter.

The manifolds BPI-1 (Cortec) was provided with microcolumns (0.03 ml) were used in on-line mode. The manifold BPI-1 was connected to the nebulizer of the ICP spectrometer ICAP 9000. A new software package as a DOS file was added into TermoSPEC software in order to connect ICAP 9000 with the manifold BPI-1.

The coefficient of concentration in off-line mode is the ratio of the volume of initial solutions and the concentrate. The "enhancement factor" (EF) of the analytical signal is used instead of the coefficient of concentration as the parameter that characterizes the efficiency of concentration for 1 min. are 17 (Cu); 15 (Cd, Zn); 14 (Co); 11 (Cr, Mn, Pb) and 10 (Fe, Ni, V) The detection limits reached are 10-20 times better in comparison with conventional ICP-AES Relative standard deviations for various elements are 0.02-0.06 for 1-10 μg/liter concentration range.

The methods developed were employed to analyze waters at different areas of the Black and Baltic sea and to monitor heavy metals content in the Kara sea and other water spaces along the sea way of the research ship «Academician Boris Petrov», were used also for analysis waters of Barents, North and White sea.