ON-LINE ELECTROCHEMICAL DETERMINATION OF Cu(II) AND Pb(II) IN TAP-WATER AFTER PRECONCENTRATION ON NATURAL SPIDER SILK COLUMN

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Trace elements, especially heavy metals, are considered to be one of the main sources of pollution in the environment, since they have a significant effect on ecological quality. Different techniques and methods have been developed for trace metals determination. Heavy metal determination in environmental control is usually performed by spectroscopic, voltammetric or chromatographic methods [1]. Applications of voltammetric and amperometric measurements in flow analysis are even more broadly described in analytical literature. Another factor is more distinct improvement of the detection limit in hydrodynamic conditions for voltammetric signals in comparison to stationary measurements, which is related to the increased transport rate of analyte to the working electrode surface. Flow injection analysis can be applied with solid phase extraction (SPE). Analyte can be preconcentrated on the SPE column and then can be eluted a suitable solution and finally can be measured with on-line detection system [2]. Variety of natural and synthetic materials can be used for preconcentration process.

Aside from its excellent mechanical properties, spider silk (SS) would offer an active surface for heavy metal interaction due to its rich protein structure. In a recent study carried out in our lab, the potential use of SS as a sorbent of heavy metals from aqueous solutions is elucidated [3].

In this study spider silk column was used as a sorbent for preconcentration of Cu(II) and Pb(II). Single and multi-species biosorption experiments of heavy metals by natural SS were conducted using column experiments. After preconcentration step, elution was done by dilute HCl solution and flow injection analysis performed with amperometry and square wave voltammetry. On-line amperometric measurements were focused on optimization of the adsorption conditions for Cu(II) and Pb(II) ions, namely medium pH, buffer type and concentration, flow rate and electrode potential. Under optimized conditions, the detection limits were calculated as 70 ng/mL and 35 ng/mL for Cu(II) and Pb(II), respectively. However, amperometry suffers from selectivity if both ions are present in the sample solution as the elution curves overlap. Therefore, by using stopped flow technique close to the appearance of the reduction peaks, successive square wave voltammograms was recorded for monitoring both ions simultaneously. It was shown that well distinguished peaks were obtained with better signal to noise ratio. The results showed a decrease in the extent of metal ion uptake with lowering the pH. This method was successfully applied for determination of Cu(II) and Pb(II) in tap water.

References