

Detection by magnetic susceptibility for flow analysis procedures.

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ABSTRACT

The potential of the measurement of magnetic susceptibility as a quantitative detection mode for flow analysis procedures has been studied. The performance of an Evans-type balance, which is easily adapted to the monitoring of magnetic species in flowing streams has been evaluated. A preliminary study was performed to establish the analytical capabilities of the balance for the quantitative determination of cations in flowing streams. The balance was estimated to have sensitivities of 155, 276, 67 and 319 mV M⁻¹ for Fe(III), Fe(OH)₃, Cr(III), and Mn(II), respectively. Detection limits, based on concentration injected were between 25 and 50 µg ml⁻¹. Calibration curves were linear over two orders of magnitude. By locating a small mass of strong cation exchange resin between the poles of the magnets, the kinetics of uptake and release of cations from and into the flowing stream could be followed. Experiments involving both continuous flow and flow injection procedures with solutions of Cu(II) and Fe(III) were performed. The resin was most efficient at removing cations from flowing streams at low flow rates under both continuous flow and flow injection conditions, though the time taken to achieve saturation decreased with increasing flow rate. A simple study of the effect of pH showed the possibilities for the study of the cation-binding characteristics of such resins. The differential displacement of Cu(II) and H⁺ could be clearly observed, with the removal of the Cu(II) from the resin, by the passage of 10% v/v HCl through the column, proceeding at a slower rate than the uptake of Cu(II) from solution by the resin in the H⁺ form.

The measurement of magnetic susceptibility as the basis for quantitative analytical measurements of solutions has attracted little interest in comparison with electrochemical or spectroscopic methods. The analytical uses to which such measurements have been put may be surveyed in the biennial reviews in Analytical Chemistry, which in the years 1962 to 1984 [1,2] included magnetic susceptibility. From these reviews it is clear that the majority of applications concern measurements of the magnetic