Ion exchanger colorimetry as an analytical tool for microdetermination of copper

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Tin(IV) antimonophosphate has been used as a sorbing phase for the microdetermination of copper in the aqueous medium. Absorbance measurements have been made and calibration curve is applicable up to 80 µg/ml. Interference of some transition metal ions has been studied. This method can be applied to synthetic and commercial brass samples for the determination of copper.

A colorimetric method based on the direct measurement of the absorbance of the resin phase after the sorption of sample species has been developed earlier for the determination of some transition metals\(^3\). This ion exchanger colorimetric technique is more sensitive than the conventional methods. This paper describes briefly the micro determination of copper using Sn(IV) antimonophosphate\(^4\) as a sorbing phase.

Experimental
Tin(IV) antimonophosphate (c-SnSbP) mesh size (25-µ-125-µ) was used in the H\(^+\) form as a solid phase. Appropriate amounts of copper(II) acetate were dissolved in demineralised water to prepare solutions and standardised by the EDTA method\(^1\). All the chemicals used were of analytical grade.

A mixture of the exchanger(c-SnSbP) and the sample solution was shaken mechanically using a vibrating shaker (N.S.W., India). A slurry of the coloured exchanger granules was separated from the bulk of the solution and transferred into 1 mm glass cell by means of a dropper with a fine tip. The absorbance was then recorded with a Shimadzu spectrophotometer model UV-240 using c-SnSbP, shaken in demineralised water for the same period, as reference.

Sample solution (50 ml) containing 10-100 µg/ml copper(II) and 0.20 g of the exchanger was shaken for 24 h. The exchanger phase was separated and its absorption was measured at 820 nm.

Results and discussion
Copper(II) can be sorbed on the cation exchanger by ionic association as well as ion exchange. The exchanger phase absorption spectrum is similar to that obtained in solution but the maximum is shifted to longer wavelength (from 770 nm in solution phase to 820 nm in exchanger phase). Therefore, ion association phenomenon cannot be ruled out. Ionic bonding in similar systems has also been observed by other workers\(^3\). Hence absorption and ion-association are contributing to the net exchange of the cation.

Copper(II) could be quantitatively sorbed on the exchanger and the calibration curve was almost linear in the concentration range 10-80 µg/ml. The precision was measured for a system of 50 ml of copper solution and 0.20 g of exchanger. For five determinations with solutions containing 30 and 60 ppm of copper(II), the relative standard deviations were found to be 6.9 and 2.3% respectively.

The pH studies showed that the optimum pH range for maximum absorption is 4.5 to 5.5 and the highest value of absorption was obtained at pH 5.2. Time dependence curve of the absorbance of the exchanger after sorption showed that copper was completely removed from the aqueous phase within 12 h.

Interference by foreign ions like Pb(II), Zn(II), Co(II), Ni(II) and Fe(II) were studied with their concentrations exceeding the primary ion concentration by 7-10 times. Results indicate that cations other than Fe(II) and Co(II) did not interfere in the determination.

The present method was applied to the determination of copper in the commercial brass samples. Some synthetic and commercial samples of brass were analysed for copper by conventional titrimetry\(^5\) and the proposed method. The synthetic brass sample had a composition of copper (60%), tin (7%), lead (2%) and iron (1%). Results showed that for five determinations of each sam-
ple the average relative error was 3.33% and 3.12% for the synthetic and commercial samples respectively.

References