Extraction & Spectrophotometric Determination of Vanadium(V) with Salicylaldehyde Thiosemicarbazone

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Vanadium(V) forms a 1:1 (metal:ligand) yellow coloured complex with salicylaldehyde thiosemicarbazone (SAT) in n-butanol. The yellow coloured complex is quantitatively extracted from acetic acid medium by n-butanol. Beer’s law is obeyed in the range 0.5-6.5 ppm of metal. Large number of foreign ions do not interfere.

Maximum absorbance was observed in the acetic acid concentration range of 0.06-0.08 M. However, an acid concentration of 0.07 M was chosen for the present study.

The system obeyed Beer’s law in the range 0.5-6.5 ppm of vanadium. The optimum concentration range for the determination of vanadium was evaluated from Ringbom plot and found to be 1.5-5.00 ppm. The Sandell’s sensitivity was 11.84 ng V cm$^{-2}$. The molar absorptivity of the complex at 375 nm was 4300 litre mol$^{-1}$ cm$^{-1}$. The sensitivity of the proposed method is more than that of some of the methods reported

Among various solvents tried (benzene, toluene, dichloroethane, nitrobenzene, chloroform, carbon tetrachloride, methyl isobutyl ketone, amyl alcohol, cyclohexanol, n-butanol) only n-butanol was found suitable. This is probably due to the fact that the reagent is fairly soluble in this solvent.

The effect of some of the ions which are often found in association with vanadium in soils and plant materials was studied. For these studies different amounts of ionic species were added to 50 μg of vanadium in 15 ml solution and V(V) estimated by the recommended procedure. 20 mg each of phosphate, nitrate, sulphate, perchlorate, alkali and alkaline earth metals do not interfere in the estimation while U(VI), Mn(II), Zn(II), Fe(III), Al(III) in large amounts, Se(IV) (4 mg), Mo(VI)(0.6 mg), Cr(III)(0.4 mg), Cu(II)(0.1 mg) (in the presence of thiosulphate); and Co(II), Ni(II), W(VI), Ti(IV), Zn(IV) (50 μg each) are tolerated. Chloride (4 mg), citrate, tartrate, oxalate (0.4 mg) are also tolerated.

The precision of the method was determined by taking 10 measurements each containing 5 ppm of metal. The relative standard deviation was found to be 1.53%.

The composition of the complex was determined by Job’s method of continuous variation and the mole ratio method and was found to be 1:1 (metal:ligand). The stability constant of the V-SAT complex was determined to be $1.8 \times 10^5$.

References

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