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Analytical application of 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene in spectrophotometric determination of nickel(II)

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ABSTRACT

Spectrophotometric determination of Nickel(II) has been done using 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene at 375nm. The molar absorptivity and Sandell's sensitivity values are 9431 $dm^3\ mol^{-1}\ cm^{-1}$ and 6.15 ng cm^{-2} respectively. The Beer's law is obeyed in the range (1 to 6) × 10^{-5} M.

Key words: Hydroxytriazenes, Spectrophotometric determination, Nickel(II).

INTRODUCTION

A number of hydroxytriazenes[1-7] have been used as spectrophotometric as well as metalochromic indicators.We report here spectrophotmetric determination of Nickel(II) using one such hydroxytriazene, 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene.

EXPERIMENTAL

3-Hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene was synthesized by the reported method[8]

Stock Solution

A 1.0x 10^{-2} M stock solution of Nickel chloride hexa hydrate(BDH) was prepared in distilled water. Few drops of (1 M) concentrated hydrochloric acid were added to prevent hydrolysis. The solution was standardized with EDTA solution at pH 10-11 using murexide[9] as an indicator. A 1x 10^{-2} M solution of the reagent 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene was prepared in alcohol. Tris-buffer (1%, w/v) was prepared. A UV/VIS. Systronic 106 Spectrophotometer and a pH Scan 2 tester were used .

Method

Spectrum of 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene was measured in the wavelength region 360 – 460nm against solvent blank. Nickel and 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene solutions were taken in 1:5 ratio and the spectrum of Nickel complex was recorded against reagent blank in the range 360-460 nm. The working wavelength was found to be 375 nm. A set of solutions containing Ni(II) and 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene reagent in ratio 1:5 was prepared and pH was varied between 5 to 8. The pH range of constant maximum absorbance was found to be between 6.7 to 7.5. Composition of the complex was determined by Job's method and moles ratio method of Yoe and Jones. The study revealed that composition of Nickel(II) complex is 1:2 (M:R). Absorbance of set of six solutions containing Ni(II) to 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene in ratio 1:5 was measured at corresponding

working wavelength against reagent blank. Beer's law was obeyed in concentration range $1x10^{-5}$ to $6x10^{-5}$ M. Interference of 23 cations and anions in the determination of nickel was studied. To the set of solutions containing nickel to reagent 1:5 ratio, 10 ppm of different foreign ions were added at optimum conditions. Absorbance was measured against reagent blank. Those ions, which did not interfere at 10 ppm level their interference was again studied at 50 ppm level. In case no or little change in absorbance was seen as compared to the absorbance without any foreign ion, then for those ions interference was studied again at 100 ppm level. However tolerance of still higher concentration was not studied.

RESULTS AND DISCUSSIONS

Nickel(II) was found to form 1:2 complex with 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene

Stability constants

Harvey and Manning's method[10]and Purohit's method[11] have been used to determine the stability constants. Validity of the methods can be confirmed from the value of log β obtained from both the methods. Value of log β obtained by Harvey and Manning method and Purohit's method were 9.32 and 9.38 respectively. The log β values agree quite well. Further the precision studies were carried out by measuring the absorbance of 10 sets of solution containing 5.86 ppm of Nickel(II), and title reagent in 1:5 ratio, under optimum conditions. The absorbance was measured against reagent blank at working wavelength (375 nm). Nickel was successfully determined at 5.86 ppm level with good precision.

The value of ΔG obtained for the Harvey and Manning method and Purohit's method were –12.79 and –12.89(kcal/mole) at 27°C respectively.

Interference of several cations and anions in the determination of nickel was studied at 10, 50 and 100 ppm level. Interference was studied using following 23 cations and anions viz. Na^+, K^+, NH_4^+, Ba^{2+}, Mn^{2+} Co^{2+}, Pb^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+}, Mg^{2+}, F^-, Cl^-, Br^-, I^-, NO_2^-, NO_3^-, SO_4^{-2}, WO_4^{-2}, CO_3^{2-}, $S_2O_3^{2-}$ $C_2O_4^{2-}$ CH_3COO^-. It was seen that at 100 ppm level the ions which still did not interfere are, Na^+, K^+, NH_4^+, Ba^{2+}, Mg^{2+}, Cl^-, Br^-, I^-. F^-, SO_4^{-2}, WO_4^{-2}, NO_2^-, NO_3^-, CO_3^{2-}, CH_3COO^-. However tolerance of higher concentration was not studied. Thus it can be seen that nickel(II) can be determined even in presence of number of interfering species present at 100 ppm level. Thus from the above studies it can be concluded that 3-hydroxy-3-methyl-1-(4-sulphonamidophenyl) triazene can be used successfully for spectrophotometric determination of Nickel(II).

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