KINETIC SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM AT TRACE LEVELS BASED UPON ITS CATALYZED REACTION OF CELECTINE BLUE BY BROMATE

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Owing to the toxic and essential nature of vanadium in environmental and biological systems, at nowadays there has been considerable interest in the determination of its content in different kinds of samples [1]. Among several analytical techniques for the determination of vanadium, spectrophotometric methods are very popular due to their simplicity and low-cost instrumentation. Various attempts have been made to modify these methods in order to improve their sensitivity and selectivity. A catalytic-kinetic determination of vanadium (V) was spectrophotometrically performed by exploiting the reaction of Celestine Blue being an oxazine group indicator dye. The V(V) catalyzed oxidation of Celestine Blue with potassium bromate, KBrO₃ was studied kinetically by using fixed-time method. The reaction was followed by measuring the decrease in absorbance at 645 nm. The effect of indicator dye concentration, inert salt effect, pH, activator type and concentration, bromate concentration, reaction time and temperature were investigated to achieve the selectivity and sensitivity of the analytical procedure. Under optimized conditions (6.39x10⁻⁵ M Celestine Blue, 5.0x10⁻⁴ M BrO₃⁻, 0.1 M pH: 2.0 phosphate buffer solution, 0.1 M Na₂S₂O₄ at 30°C) the V(V) was determined in the range 0.025 to 1 μg mL⁻¹ with a detection limit of 0.0091 μg mL⁻¹ and a relative standard deviation (N:5) 0.3-2.30 % for 0.04-1 μgV(V) mL⁻¹ by using the fixed-time method of 3 min. The effect of interfering ions on the accuracy of the results was investigated. The developed kinetic method is extremely sensitive, selective and simple. The method was applied successfully to the determination of vanadium (V) in the natural water samples and synthetically prepared water samples. Additionally, the speciation study of V(V) in the presence of V(IV) was also made. Especially, the kinetic determination of V(V) at 1:1, 1:5, 1:10 and 1:15 concentration ratios didn’t show any serious interfering effect. Interferences from diverse ions could be suppressed by the use of urea, H₂O₂, NaF, EDTA and Citrate as a masking agent. The results are a good agreement with the recovery of vanadium (V) added in the samples at known amounts.

References