

SPECTROPHOTOMETRIC DETERMINATION OF IRON(III) AND VANADIUM(V) BASED ON  
THE SOLUBILIZATION OF THEIR 8-QUINOLINATES BY SODIUM DODECYL SULFATE

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8-Quinolinol complexes of iron(III) or vanadium(V) are made water soluble in the presence of enough sodium dodecyl sulfate (SDS) to form the micelle and each of the solubilized complexes shows stable coloration for at least 2-3 days. This observation provided a basis for the simultaneous determination of microgram quantities of iron(III) and vanadium(V) without either solvent extraction or masking agents.

It is well known that various metal ions react with 8-quinolinol to form the complexes insoluble in water. An extraction of the complex of iron(III) with chloroform affords a spectrophotometric method for the determination of iron(III), which has been extensively and currently used. Vanadium(V) also has been determined by this method ; the extracted complex of vanadium(V) as well as iron(III) has the absorption maximum at the wavelength relatively free from interferences of other metals. However, iron(III) and vanadium(V) greatly interfere to each other.<sup>1-3)</sup> Furthermore, the extraction procedure is more or less complicated.

On the other hand, a characteristic property of a surface active agent to dissolve water-insoluble organic compounds is called the solubilization. In the field of the trace analysis, many workers have investigated the spectrophotometric determinations of metals with organic reagents in the presence of the surface active agent.<sup>4,5)</sup> In our previous paper,<sup>6)</sup> we have reported the determination of iron(III) based on the coloration of the 8-quinolinol complex of iron(III) solubilized by sodium dodecyl sulfate (SDS) which is one of the most typical anionic surface active agents.

The recent investigation revealed that the 8-quinolinol complex of vanadium(V) is solubilized by SDS and the solubilized complex shows stable coloration for at least 2-3 days. In this study, a method is developed for the determination of vanadium(V) as well as simultaneous determination of vanadium(V) and iron(III).

When 5 ml of a 1 % 8-quinolinol solution is added to a standard solution of vanadium(V), a blackish precipitate of 8-quinolinol complex is formed. By addition of SDS, the precipitate dissolves in the concentration region above the critical micelle concentration (CMC) of SDS,<sup>7)</sup> resulting in a clean greenish-black solution. The solution is adjusted to pH 4.6 and then made up to 50 ml with distilled water.

Figure 1 shows the absorption spectrum of the solubilized 8-quinolinol complex of vanadium(V) in addition to that of iron(III) described in our previous paper<sup>6)</sup>; two absorption maxima appear at 410 or 560 nm for vanadium(V), and at 460 or 580 nm for iron(III), respectively. Beer's law holds for 1-14 ppm of vanadium(V). The effect of pH on the absorption spectra was investigated; the absorbance for vanadium(V) is constant in the pH range from 4.3 to 4.7, while for iron(III) that is constant above pH 4.5. Furthermore, it is revealed that the alkaline solution of vanadium(V) has no absorption at a wavelength longer than 500 nm. Thus, when iron(III) coexists with vanadium(V) and pH is adjusted to 8.0, the absorption spectrum (curve 3 in Fig. 1) indicates that the absorption above 500 nm, especially at 560 or 580 nm is due to only iron(III).

The determinations of both iron(III) and vanadium(V) up to 10 ppm in synthetic mixtures were carried out by preparing two kinds of the solutions at pH 4.6 and 8.0 in the same manner as mentioned above; iron(III) is determined from the absorbance at 580 nm of the solution of pH 8.0 against the reagent blank, while vanadium(V) is determined from the absorbance at 560 nm of the solution of pH 4.6 against the solution of pH 8.0. The favorable results for both determinations are obtained with a relative error of  $\pm 1$  %, and each 2 ppm of Al, Ni, Cr, Pb, and Co do not interfere in the determinations.

In this work, the coloration of 8-quinolinol complex of vanadium(V) as well as iron(III) can be observed in the aqueous solution by the addition of enough SDS to form the micelle. In addition, the simultaneous determination of vanadium(V) and iron(III) can be made without separation of both metals. The present method seems to be more simple and rapid than the extraction spectrophotometry. This method also permits the determination of iron(III) up to 10 ppm in the presence of 1000 times as much vanadium(V) without a masking agent such as hydrogen peroxide.<sup>3)</sup>

It has been generally believed that the interior of the micelle is in the state of the liquid hydrocarbon. The complexes of iron(III) and vanadium(V) are little dissolved in water until the CMC of SDS is reached. The solubilization of the complexes may be caused by the incorporation of them into the interior of the SDS micelle.<sup>8)</sup>

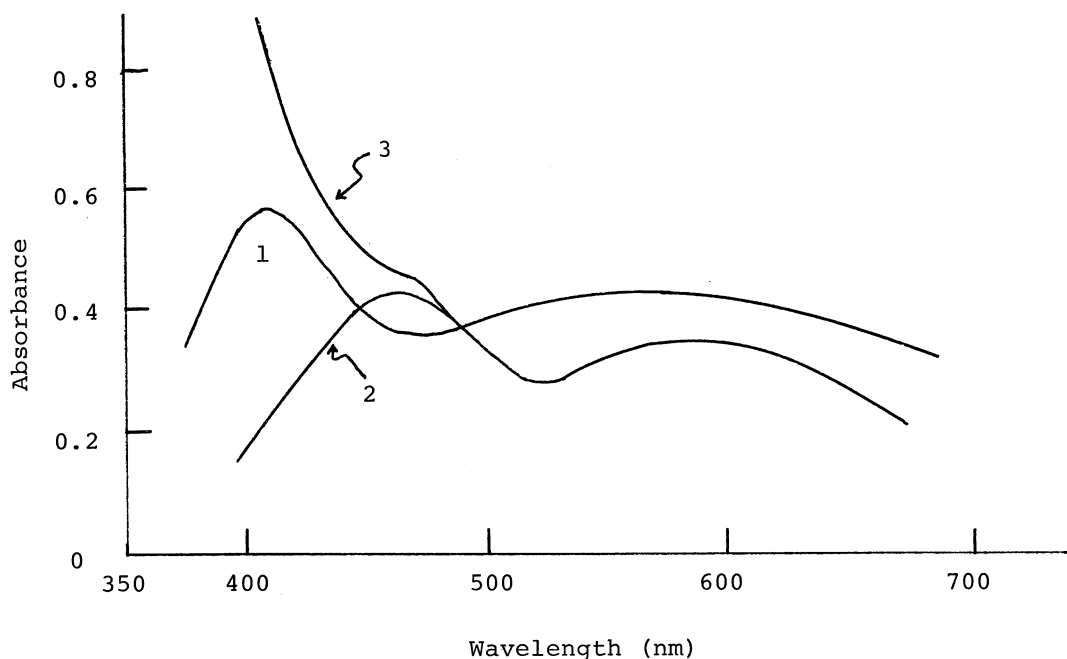


Fig. 1 Absorption spectra

1 : V(V)-8-quinolinol complex, pH 4.6

2 : Fe(III)-8-quinolinol complex, pH 4.6 (or 8.0)

3 : V(V) + Fe(III)- 8-quinolinol complex, pH 8.0

Ref. : reagent blank

V(V) : 448  $\mu$ g/50 ml, Fe(III) : 265  $\mu$ g/50 ml,

1 % 8-quinolinol soln. : 5 ml, 0.625 mol/l SDS soln. : 4 ml

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