A New Organic Reagent for the Colorimetric Determination of Iron(III) Ion; Phenothiazine Derivatives

By Masao MARUYAMA, Tomonori MIKI and Shogo UEDA

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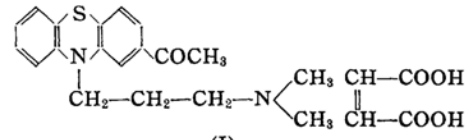
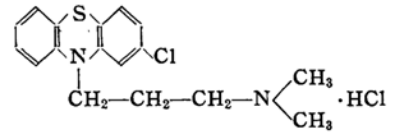
During the course of examinations on interactions between 2-acetyl-10-(3-dimethylaminopropyl)phenothiazine maleate (I) or 2-chloro-10-(3-dimethylaminopropyl)-phenothiazine hydrochloride (II), and metal ions in aqueous solution, it was found that these phenothiazine derivatives reacted with iron (III) ions to form a



(I)



(II)

markedly colored solution. Both I and II react specifically with iron (III) ions and not with other ions such as iron (II), copper, nickel, cobalt, titanium and lead. Qualitatively, this reaction enables the detection of iron (III) ions in a concentration of 0.5 γ/cc., and a determination can be made for iron (III) ions of 1 to 8 γ/cc.

The compound I forms a yellow solution in water so that II is better suited for the determination than I. Aqueous solution of a mixture of iron (III) and the compound II exhibits an absorption spectrum in the visible region, with absorption maximum at 512 mμ, as shown in Fig. 1, and the absorbance depends on the concentration of iron (III) ion and of the compound II. When the concentration

of II is above 0.2%, absorbance depends solely on the concentration of the iron ion.

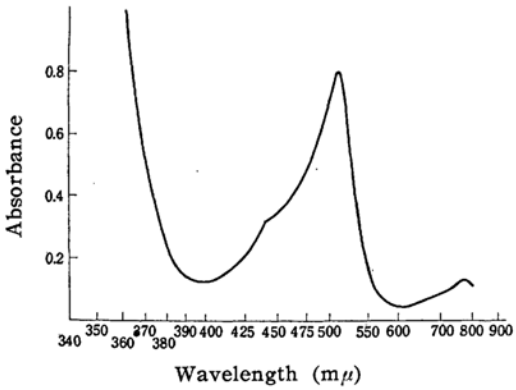


Fig. 1. Absorption spectrum of phenothiazine derivative with iron (III) ion in aqueous solution.
Contration of iron (III); 2.08×10^{-4}M/l.
Contration of the compound II; 4.82×10^{-3} M/l.
pH, 1.0 (H_2SO_4·aq.)

An examination showed that a linearity was established with iron concentrations of 1 to 8 γ/cc.

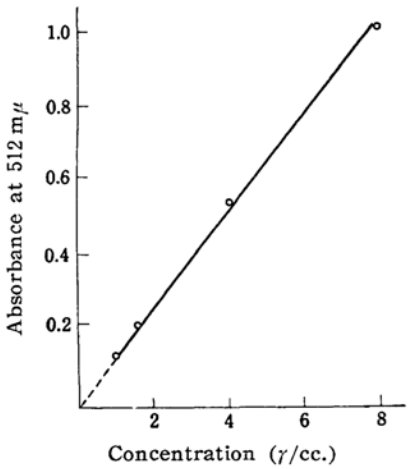


Fig. 2. Relation of iron (III) concentration to absorbance of colored solution.

As for the stability of the color developed, the color faded gradually with time but it was stable for 15 minutes after coloration.

In order to examine the effect of other metal ions, a sample solution containing iron (II), nickel, cobalt, copper, lead, titanium or chromium besides iron (III), in an amount 10 times that of iron (III) ion, was prepared, and caused to react with the compound II. It was found that the effect of these coexisting ions was negligible.

TABLE I
STABILITY OF COLORED SOLUTION
CONCENTRATION OF IRON (III): 4 γ/cc.
CONCENTRATION OF THE COMPOUND II: 2 mg./cc.

Time after coloration (min.)	Absorbance at 512 mμ
0	0.560
15	0.557
30	0.540
60	0.527

TABLE II.
EFFET OF OTHER IONS
CONCENTRATION OF IRON (III): 4 γ/cc.
CONCENTRATION OF THE COMPOUND II: 2 mg./cc.

Other ions (40 γ/cc.)	Absorbance at 512 mμ
—	0.560
Ni	0.551
Co	0.560
Cu	0.550
Cr	0.545
Ti	0.555
Pb	0.558

The presence of ethylenediaminetetraacetate interfered with this reaction.

Examinations are now under way on the effect of anions and on various problems, as well as the structure of the reaction product.

Shinagawa Plant, Sankyo Co., Ltd.
Nishi-shinagawa, Shinagawa-ku, Tokyo