

4. The effect of acid and alkali can be explained on the assumption of adsorption, making due allowance for concentration and chemical change.

5. Briggs' results as to temperature effects with water have been confirmed with non-aqueous solvents.

6. The valence rule does not hold with the non-aqueous solvents studied.

7. The order of adsorption of ions and their relative adsorption varies with the solvent employed.

8. The concentration curve exhibits a maximum with non-aqueous solvents and the flow at low concentration is in the same direction as that of the pure solvent.

9. The addition of water to non-aqueous solutions changes the endosmose in the direction it would manifest in pure water, the first additions showing the greatest effects.

10. The direction of endosmose (as here measured) is not determined by the dielectric constant ratio, although this probably does measure the magnitude of flow.

11. The Hofmeister series is not consistent when considering endosmotic effects in non-aqueous solvents.

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A COLORIMETRIC DETERMINATION OF HYDROGEN PEROXIDE

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The yellow color produced by the action of hydrogen peroxide on a molybdate in acid solution was first observed by Schön¹ in 1870. In 1890 Denigès² described the reaction, but immediately M. L. Crismer³ called attention to Schön's work and to his own discovery of the reaction in 1888.⁴ He also pointed out that the yellow substance had been isolated by Baerwald,⁵ who assigned to it the formula $18\text{MoO}_3 \cdot 14\text{NH}_3 \cdot 3\text{H}_2\text{O}_2 \cdot 18\text{H}_2\text{O}$. Nagel and Muthman⁶ have studied the action of conc. hydrogen peroxide on molybdic oxide and picture the formation of ozomolybdates, that is, a molybdate compound containing an oxygen atom of a peroxide nature.

¹ Schön, *Z. anal. Chem.*, [9] **41**, 330 (1870).

² Denigès, *Compt. rend.*, **110**, 1007 (1890).

³ Crismer, *Bull. soc. chim.*, [3] **6**, 22 (1891).

⁴ Crismer, *Gaz. med. Liège*, **7**, 77 (1888).

⁵ Baerwald, *Ber.*, **17**, 1206 (1884).

⁶ Nagel and Muthman, *ibid.*, **31**, 1836 (1898).

Denigès used a solution of ammonium molybdate in conc. sulfuric acid, but Crismer properly pointed out that under these conditions minute quantities of phosphoric or silicic acid would also give a yellow color. He himself used citric acid, which was without this defect.

The formation of the yellow color, which develops at once, permits the rapid colorimetric determination of hydrogen peroxide. For a permanent standard, potassium chromate can be used. Four-tenths g. per liter is a convenient concentration.

The method is as follows. In a 50cc. volumetric flask are placed about 30 cc. of water, 10 cc. of a 5% solution of citric acid, 1 cc. of the unknown dil. hydrogen peroxide solution, and slowly, after mixing, 1 cc. of a 10% ammonium molybdate solution. Water is added up to the mark and the contents of the flask are thoroughly mixed.

The concentration of the acid and of the molybdate may be varied considerably without affecting the color. Variations in room temperature are likewise unimportant. Using nitric acid the color is proportional to the peroxide present, but the color is less than half of that developed with citric acid. It is important also that the reagents be added in the order given. With Crismer's procedure, namely, adding the acid to a mixture of the peroxide and molybdate, the amount of color developed is very uncertain.

In the following determinations, the results were checked by permanganate titrations. The determinations were made in the Dubosq colorimeter, the standard being set at 20. Using the standard recommended above, the chromate being 99.4% pure, the following formula applied: $x = 0.05467/\text{unknown reading}$, where x is equal to the number of grams of peroxide in the 50 cc. of solution.

H ₂ O taken, by permanganate titration	Found Mg.	Difference Mg.
4.288	4.205	+0.083
1.860	1.829	+0.031
0.930	0.935	-0.005

The method is simple, short and accurate and permits the determination of much smaller quantities of peroxide than the permanganate method.

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