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THE COLORIMETRIC METHOD FOR THE DIRECT DETERMINATION OF SODIUM

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Caley and Foulk (5) in 1929 published an article dealing with both the gravimetric and colorimetric method for direct determination of sodium in waters by precipitating the sodium with a specially prepared solution of magnesium and uranium acetate in 6 per cent acetic acid, as magnesium uranyl sodium acetate, $Mg(C_2H_3O_2)_2 \,.\, Ng\,C_2H_3O_2 \,.\, 3UO_2\,(C_2H_3O_2)_2 \,.\, 6\ 1/2\ H_2O$. This salt is stable and can either be dried at 105°C and weighed or dissolved in H_2O and measured colorimetrically.

The sample of water containing approximately 5 mg. of sodium or less is placed in a 250 cc. Erlenmeyer flask just acidified with dilute hydrochloric acid, evaporated to dryness, the residue taken up with 5 cc. hot water, 100 cc. of the precipitating reagent added, and the flask is then placed in a water bath at the constant temperature of 20°C. and stirred vigorously and continuously with a stirrer attached to an electric motor for 30 to 35 minutes.

The solution is rapidly filtered through a Gooch crucible; the sodium magnesium uranyl acetate precipitate is washed with 30 cc. of 95 per cent Ethyl alcohol whose temperature is 20°C., and the adhering alcohol removed by drying in an oven. The precipitate is then dissolved in water at 70°C. and the volume made up to either 25, 50 or 100 cc., as estimated by the size of the precipitate. These solutions are compared to standards prepared in the same manner in a Duboscq Colorimeter.

An excess of precipitating reagent, 100 cc. for 2.5 mg. of sodium, must be used to insure complete precipitation of the sodium. Sodium magnesium uranyl acetate salt is soluble in Ethyl alcohol at 20°C. to the extent of 0.306 mg. per 100 cc. (5) Hence, a definite volume, 30 cc. was used to wash the precipitate free of reagent. This represents an error of -0.09 mg. per sample. This amount is so small that it may be neglected in water analyses. The washing correction may be eliminated by washing with 95 per cent alcohol saturated with the triple acetate salt. The precipitate of sodium magnesium uranyl acetate must be completely free of the alcohol, as a trace will in time reduce the sodium salt forming a bluish-black precipitate. Any traces of asbestos fibers in a solution for comparison changes the hue, making accurate comparisons impossible. These particles may subsequently be removed by filtering.

The presence of the ions of potassium, calcium, and magnesium which are common in water and do not materially cause high results until they exceed for potassium ten times that of sodium and for calcium and magnesium thirty times that of sodium; which ratios are usually greater than those commonly found in natural water; and even when exceeded the error is very, very small, almost negligible.

Comparisons could not be made in Nessler tubes with accuracy closer ± 0.3 mg, but with a Duboscq Colorimeter excellent checks were obtained. when the sodium content of the colored solution ranged between 0.3 and 60 mg.

The original color intensity of the standard does not change over a period of one month, even in the heat of the summer.

To determine the practicability of this method for a commercial water survey, duplicate determinations were run non-sucessively on forty-eight water samples ranging in sodium content up to 333 parts per million, and the results are as follows:

22 varied to within less than 1 p. p. m. of sodium
12 varied 1 p. p. m. of sodium
2 varied 2 p. p. m. of sodium
5 varied 3 p. p. m. of sodium
7 varied (average) 7 p. p. m. sodium

Average deviation from the mean is 1.8 p. p. m. with a maximum of 7.

Two different operators determined the sodium content of samples and the comparison of results is as follows:

Sodium Obtained By			
Operator A	Operator B	Deviation in	
p. p. m.	p. p. m.	p. p. m.	Grams
57	51	6	0.00033
102	100	2	0.00010
70	69	1	0.00005
74	80	6	0.00030
70	61	9	0.00045
112	128	16	0.00080
104	103	1	0.00005
95	108	13	0.00065

These determinations check favorably with gravimetric results and are sufficiently accurate for this type of work.

The sodium determination of about 140 water samples has been run and no greater number of cases of errors were found in the sodium results than were found in the determination of the other ions. The limiting factor governing the rate by which these analyses may be run is determined by the eye fatigue of the individual making the colorimeter readings. One worker may prepare, read, calculate, and record fifteen samples in eight hours, without a great deal of effort.

In conclusion it might be said for this method of determining sodium that is accurate to ± 7 p. p. m. (0.35 mg) of sodium, is close enough for commercial purposes, is reliable and is rapid, and does not necessitate the removal of other ions.

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