

A SYSTEMATIC ANALYSIS OF THE
SCHENECTADY CITY WATER SUPPLY.

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A thesis, presented to the Department
of Chemistry of Union College, in partial
fulfillment of the requirements for the
degree of Bachelor of Science in Chemistry,
by

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INTRODUCTION

A systematic analysis of the Schenectady City water supply was undertaken to determine whether the chemical composition of the water varied in any definite manner during the Winter and Spring. Particularly close check was kept on the composition during the period of spring freshets.

THEORETICAL

The analysis of drinking waters is probably one of the most common analyses because the purity of our drinking water must always be constantly assured. The American Public Health Association publishes a very complete book on the "Standard Methods of Water Analysis". This book contains all of the better systems of water examination and as a result was used as a text.

The tests included in a complete examination of water can readily be divided into three groups or classes. The tests in class A are physical, those of class B are biological, and those of class C are chemical. The State Water Department conducts a semi-annual examination of Schenectady for a series of fourteen factors. When this student undertook this problem he had visions of conducting just such an examination but he found that the time required for such an investigation far exceeded his time so it was found necessary to limit the examination to calcium and magnesium content determination, p_h determination and determination of total solids. These four tests give an accurate check upon all the important variations in composition of the water.

The tests included in class A are of great importance in the examination of a given water sample, but because of the extreme physical purity of Schenectady water, they all give negative results. Some of the more important of these tests are color, odor, turbidity, and taste. Likewise, Schenectady water is relatively biologically pure. In order to obtain any accurate count on the bacteria and microscopic animals in Schenectady water a very powerful and expensive microscope would have had to have been purchased.

EXPERIMENTAL

A. Total Solids Determination

Total residue on evaporation or total solids and suspended solids. In the case of Schenectady water the suspended solids are negligible. Therefore, when I evaporated 100 cc. of the unfiltered sample in a weighed nickel evaporating dish, I am obtaining the weight of dissolved solid. I found that the evaporation of 100 cc. of the sample could be accomplished in one hour if a nickel evaporating dish was used. A sloping glass lid was kept over the evaporating dish to insure protection against dust, or any weighable particals which might land in the dish and thus affect the reading.

B. Magnesium and Calcium Content Determination

About 80% of the solids found in Schenectady drinking water are due to magnesium and calcium; thus if we keep a check upon the variation of these solids we will have some valuable information to correlate with the before-mentioned total solids investigation.

I. Various methods for the calcium and magnesium determination were found and considered. The best method and the most accurate method of obtaining these results is to carry out a complete mineral analysis as described in A.P.H.A. Standard Methods of Water Analysis. ⁽¹⁾ This method was dis-

carded because of the time factor. In order to run one of these mineral analysis upon a daily sample it would have used up the entire period allotted for work. In working an analysis such as the state conducts semi-annually this method should be used.

II. The second method for this determination is also listed in the A.P.H.A. book.⁽²⁾ This method is commonly known as the Soap Method because the titrating solution is an alcohol-soap solution. Two reagents are needed for this method.

(a). Preparation of Standards

1. Standard calcium chloride solution made up as follows. Dissolve 0.5 gr. of pure calcium carbonate in a little diluted hydrochloric acid. Wash down with carbon dioxide free distilled water and neutralize with ammonium hydroxide to very slight alkalinity using litmus as an indicator. Make up to 500 c.c. with carbon dioxide free distilled water and store in a glass stoppered bottle. One c.c. of this stock solution presents 1m.g. of Calcium Carbonate.

2. Standard Soap Solution. Make up by shaking 10 grams of pure castille soap in 1 liter of 80% grain alcohol. Allow this solution to settle over night, then decant off super-natant liquid.

After the preparation of these solutions titrate the soap solution and dilute with 80% grain alcohol until 1 m.l. of the soap solution equals 1 m.l. of the standard calcium chloride solution, make proper

allowance for the "lather factor" is defined as the amount of standard soap solution required to produce a permanent lather in a 50 c.c. portion of distilled water.

(b). Procedure upon Sample. Measure 50 c.c. of the water sample to be examined into an 8-ounce glass-stoppered bottle. Add small amounts of the standard soap solution and shake vigorously after each addition, until a permanent lather that will last five minutes is obtained. Note and record any false end point which is the dividing line between calcium and magnesium salts. The final burette reading minus the lather factor, when multiplied by 20 gives the hardness in terms of calcium carbonate as parts per million. The difference between the false end point and the final end point when multiplied by 20 gives the parts per million of magnesium as magnesium carbonate in the sample.

III. A third method for this determination was found in Cohn-Indicators and Test-papers.⁽³⁾

"A colorless, 1:10,000 aqueous solution of para nitrophenol is distinctly colored yellow by a trace of alkali, and hence the indicator is sufficiently sensitive to serve in a 1:5,000 solution for the calculation of the hardness of spring or well water. This is done by adding 5 c.c. of the titrating solution to 100 c.c. of the water sample and to 100 c.c. of distilled water, in separate beakers. The well-

water acquires a more-or-less deep yellow color, according to its degree of hardness, while the distilled water remains colorless. To the latter, normal postassa (potassium hydroxide) solution is added drop by drop until a color equal in depth to that acquired by the sample is acquired. Each cubic centimeter of solution added will represent 0.00028 grams of Ca O.

This method as presented by Cohn appears to be a fairly easy colorimetric method of checking the results obtained by the soap method, but upon trial it was found to be far more inaccurate than Cohn claims it is. He claims that this method should be good for a calcium determination to ± 3 P P M.

C. p_h Value Determination

At the start of the year I used a La Motte apparatus for this test, but I found that a large number of these buffer solutions were moldy, thus they were rendered inaccurate. But some buffer solutions were made up using one-tenth normal potassium-thallate and diluting acetic acid solutions. These buffers were made by Griffith and Cooney and were checked by them on the quinhydrone electrode apparatus and were found to be extremely accurate. These buffers gave excellent results.

DISCUSSION OF RESULTS

It is quite apparent that the P_h value of the various samples vary more by chance than by any definite scheme. The total solids results on the other hand show that there is a definite lowering as winter leaves. Over the period of Spring high water this decrease amounted to about 20 P.P.M. Likewise, the determinations carried out upon the calcium and magnesium content show that these values dropped respectively 11 P.P.M. and 5 P.P.M.

SUMMARY

The analyses carried out show that

1. the total solid content of the Schenectady City drinking water decreases quite regularly during the spring months, and
2. the calcium and magnesium contents likewise, decreases quite regularly, and
3. also it appears that the P_h value of the samples change only by chance.

BIBLIOGRAPHY

1. Standard Methods of Water Analysis--(A.P.H.A.) Pg. 68, 69
2. Standard Methods of Water Analysis--(A.P.H.A.) Pg. 29, 30, 31
3. Indicators and Test Papers -- Cohn Pg. 121
4. Examination of Water -- Mason (Entire book)
5. Water Purification Plants -- Stein

Chapter on Physical and Chemical
Tests for Water

TABLE A

Data upon Calcium and Magnesium Content

Date of Sample	True end point in terms of C.C. of Standard Soap Solution	False end point in terms of C.C. of Standard Soap Solution	Difference	Parts per million of Calcium in terms of Ca CO_3	Parts per million of Magnesium in terms of Mg CO_3
March 10	6.49	5.61	.88	129.8	17.6
13	6.62	5.42	1.20	132.4	24.0
15	6.51	5.46	1.15	130.2	23.0
20	6.50	5.21	1.29	130.0	25.8
22	6.59	5.29	1.30	131.8	26.0
23	6.62	5.32	1.30	132.4	26.0
26	6.53	5.42	1.11	130.6	22.2
28	6.48	5.28	1.20	129.6	24.0
April 3	6.50	no result		126.0	no result
6	6.41	5.21	1.20	128.2	24.0
9	6.28	no result		123.6	no result
11	6.29	5.22	1.07	123.6	21.4
13	(Could obtain no checks upon results for this days sample. Nine runs were made and no three checked each other.)				
16	6.27	5.26	1.01	125.4	20.2
18	6.16	5.11	1.05	123.2	21.0
23	5.82	5.02	.80	116.4	16.0
25	5.81	5.04	.77	116.2	15.4
27	5.87	4.97	.90	117.4	18.0
30	6.13	5.10	1.03	122.6	20.6

TABLE B
TOTAL SOLIDS DATA

Date of Sample	Parts per Million (P.P.M.)
March 10	194
13	182
15	190
20	177
23	180
28	175
April 3	185
6	178
9	174
11	175
16	178
18	175
25	170
27	174
30	170

T A B L E C

P_h Determination Data

Date of Sample	P_h Valve
March 10	7.8
13	7.8
15	7.6
20	7.6
22	7.8
23	7.8
26	7.8
28	7.8
3	7.8
6	7.8
9	7.8
11	7.4
13	7.8
16	7.7
18	7.8
23	7.5
25	7.8
27	7.7
30	7.5

Other total solid content determinations.

Date of Sample	Parts per Million
Oct. 30	222
Nov. 8	226
Nov. 12	202
Nov. 15	210

(The above results were obtained while using porcelain evaporating dishes.)

Dec. 13	207
Jan. 8	201
Jan. 17	196

(The last three determinations were made using the newly obtained nickel evaporating dishes.)