

AN EXPERIMENTAL STUDY OF THE EFFECTS OF THRESHOLD AMOUNTS OF SODIUM HEXAMETAPHOSPHATE ON WATERS OF HIGH IRON CONTENT

Thesis for the Degree of B. S. MICHIGAN STATE COLLEGE R. G. Foster 1940







An Experimental Study of the Effects

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Threshold Amounts of Sodium Hexametaphosphate

on

Waters of High Iron Content

A Thesis Submitted to

The Faculty of

MICHIGAN STATE COLLEGE

of

AGRICULTURE AND APPLIED SCIENCE

BY R. G. Foster

Candidate for the Degree of

Bachelor of Science

June 1940



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PREFACE

This work has been compiled in an effort to condense all available information about sodium hexametaphosphate and its relation to public water supplies into a brief treatise on the subject. Laboratory experiments have been conducted in an effort to substantiate the claims of Calgon, Inc. who manufacture sodium hexametaphosphate and market it as "Calgon."

To one who may be interested in continuing this study a few suggestions are herewith presented from the author's experiences.

1. Calgon seems to interfere with the standard tests for iron in water supplies, (volumetric and gravimetric) with the exception of the standard colorimetric test. This is probably due to the surface activity of this material.

2. It must be borne in mind that Calgon does not precipitate or remove the iron present and therefore special consideration must be given to the laboratory methods adapted.

3. Stain tests should give some definite results but involve the use of large samples (two to five gallons). The limited time and transportation facilities from East Lansing to Williamston made it impossible for these tests to be carried out. Allowing the water, raw and containing various amounts of Calgon, to drip on white porcelain at about one drop per second for twelve hours, would, I believe, show some interesting results.

The Williamston water supply was selected because it gave a practical problem in high iron content water, and because Calgon, Inc. had Presented their product as a possible cure for "red water" and iron

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stains on sanitary fixtures.

This work, although only a beginning, may serve as a nucleus for further experiments which may confirm the possibilities of Calgon, in threshold amounts, as a conditioner for waters of high iron content.

The author wishes to acknowledge the cooperation of the Buildings and Grounds Department in making available a laboratory in which these experiments could be carried out without the disturbance of classes and short course students. The cooperation of Calgon, Inc. who furnished the sodium hexametaphosphate and extensive information about the product was very much appreciated. Mr. Love, President of the Village, and Mr. Bachman who is in charge of the water works equipment in Williamston, made available the samples necessary for these experiments. The report of previous tests made by Mr. B. Russell Franklin with the cooperation of the Michigan Department of Health, Laboratories and Bureau of Engineering, has proved invaluable.

R. G. Foster

East Lansing, Michigan May 29, 1940 WATER ANALYSIS & COAL TESTING LABORATORY

Buildings & Grounds Dept.

Power House

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M.S.C.

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Set-Up showing Iron Testing Equipment.

Set-Up showing Nalco Soap Hardness Testing ... Equipment.

A STUDY OF THE PROPERTIES OF

SODIUM HEXAMETAPHOSPHATE

Glassy sodium hexameta-phosphate (Na P O_3)_x, commonly termed Graham's salt, was discovered in 1833 by Thomas Graham.¹ For almost a century it remained a scientific curiosity, and not until Hall's use of this glassy form as a water conditioning² agent did it become commercially available. It is manufactured by Calgon, Inc. and is known as "Calgon." Though it is still commonly known chiefly as a water-treating chemical, in the past few years numerous other uses for (Na P O_3)_x. Calgon, have been developed, ranging from the treatment of occupational dermatosis³ to the tanning of leather.⁴

Since 1929, when the use of Calgon in the conditioning of boiler water was first visualized,⁵ its applications in water treatment have multiplied. It is not the purpose of this study, however, to review the softening of water by Calgon as a result of its property of forming a soluble complex with the calcium ion,^{6,7} although this has led to widespread utilization in textile processing, commercial and domestic laundering and mechanical washing of dishes and bottles, and cans, and to its potential use wherever scap is employed in water containing

¹Graham, Thomas, Trans. Roy. Soc. (London) 123: 253-84 (1833).

²Hall, R. E., U. S. Pats. #1,956,515, #2,035,652, #2,087,089.

³Jones, K. K., Murray, D. E., & Ivy, A. C., Ind. Med., 6: 459-62 (1937).

⁴Wilson, J. A., K. Amer. Leather Chem. Assoc. 32: 113 (1937).
⁵Hall, R. E., & Jackson, H. A., U. S. Pat. #1,903,041.
⁶Hall, R. E., U. S. Pat. Re. 19,719 (1935).
⁷Gilmore, B. H. Ind. Eng. Chem., 29: 584 (1937).

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the calcium ion. The following discussion will be directed instead to the ever more startling effect of a few parts per million of Calgon in preventing scale deposition and minimizing corrosion.

"Deposition of calcium carbonate from bicarbonate waters used as cooling media in condensers or heat exchangers is a widespread industrial problem as is the after precipitation of calcium carbonate in filters and pipe lines following lime and lime-soda softeners. To obviate formations of these deposites, various methods have been employed in the past, involving the use of tanin, partial neutralization with acid, or recarbonation, or deposites have been periodically removed by mechanical means or by disolving them in acid.

"A new method developed within the past three years depends upon the fact that Calgon present in the water to the extent of only a few p.p.m., will prevent precipitation when a high bicarbonate water is treated with an alkali or heated to a temperature not to exceed the boiling point. This threshold treatment has been applied successfully to remove old deposites as well as to prevent new ones in railroad, industrial, and municipal water softening plants and distributing systems, and in power plant, distillery, and oil refinery condensers.

"In once-through systems a continuous feed of from five to as little as one pound of Calgon per million pounds of water is employed. Where cooling water is recirculated through a spray pond or cooling tower, an amount is introduced in the make-up sufficient to maintain a similar range of concentration in the circulating tower.

"An advantage of the threshold treatment is the relatively high pH which may be maintained in order to decrease corrosion without causing

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precipitation of calcium carbonate."

When iron is corroded by water, the ultimate product of hydrated iron oxide may be either carried along to appear as "red-water" from the customer's tap, or it may be precipitated over the regions of corrosion. Eed water is commonly associated with relatively low pH and may be cured inmany cases by the addition of lime, caustic soda, or soda ash. Frequently, however, this type of treatment fails to stop the corrosion process and instead simply prevents "red-water" by precipitating the iron oxide, thus increasing tuberculation. It is true that^{at}_A sufficiently high pH, above the level usually preferred in water for human consumption, corrosion may almost completely disappear as the result of the formation of a relatively continuous and compact coating of iron oxide.

The use of a thin layer of calcium carbonate scale for corrosion control appears attractive to many. Unfortunately, its practical attainment has proven difficult due to the tendency for heavy precipitation near the plant, leaving the outlying sections of the distribution system unprotected. This difficulty may be overcome by using amounts of Calgon insufficient to completely prevent precipitation. "Sub-Threshold" treatment in this manner is being successfully used in several municipal water plants to spread the calcium carbonate deposite throughout the system. When the threshold treatment is used for the complete elimination of scale deposition one might expect an increase in corrosion, but actually such is not the case. Threshold treatment with a sufficient concentration of Calgon definitely inhibits corrosion at the same time keeping the metal surface free from scale.

¹Rice, Owen & Partridge, E. P., Ind. Eng. Chem. Chem. 31:58 (1939).

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Laboratory corrosion tests on black-iron pipe have indicated that threshold amounts of Calgon exert a very pronounced inhibitory action upon the corrosion not only at high, but also at lower pH values; for example, pH = 6. In fact, the inhibitory action appears even more pronounced at the lower pH values. The small amount of corrosion which occurs in the presence of threshold quantities of Calgon forms rust which is darker in color, appears much more dense, and is more highly adherent.

To those who give greater weight to the field of experience than to laboratory experiment, it should prove significant that with threshold treatment in use in hundreds of plants to obviate calcium carbonate scale in condensers and heat exchangers of all types, not one case of corrosion of metal surfaces laid bare and kept bare by treatment has been reported, although specific information has been requested from many plants where trouble might be anticipated.¹

How It Works

In brief, it is believed that the precipitation of calcium carbonate is prevented by threshold treatment because the Calgon has the ability to segregate nuclei of calcium carbonates as rapidly as they develop in the water, so that in effect it is possible to stabilize a condition of rather extreme supersaturation with respect to this substance. It has been found that Calgon is very strongly adsorbed on the surface of many metals, metal oxides, and salts. No undue exercise of imagination is required, therefore, to picture the adsorption of metaphosphate

¹Rice, Owen, & Hatch, G. B., J. A. W. W. A. 31:1179 (1939).

whenever calcium and carbonate ions begin to build from solution the lattice of what is referred to as a crystal nucleus. By isolating each nucleus as it is formed, from further contact with the water its growth into a microscopically observable crystal is prevented.

Where calcium carbonate has already been deposited from a water as may be the case in incrusted filter sand, enough Calgon must be supplied to cover this curface in order to completely inhibit further crystalization from solution.

An adsorbed film which can, in effect, shut off calcium carbonate from solution so completely that no further crystal growth occurs might well account for the observed effect of Calgon upon the rate of corrosion of an iron surface. Indeed it has been noted in experiments with iron pipe in the laboratory that a metal surface over which threshold treated water is passed for a long period of time frequently develops characteristic interference colors, although no phosphate deposite can be observed. While continued investigation may reveal more clearly the fundamental mechanism by which Calgon produces its remarkable effect in threshold treatment, it seems evident that formation of a film, perhaps only of molecular dimensions, is involved.

Toxic Effects

Is it safe to use Calgon in water intended for human consumption? The best answer to this comes from feeding experiments on animals conducted both in this country and in Great Britain. In one set of experiments four groups of rats were supplied for six weeks with drinking water containing respectively 0, 2, 20, and 200 p.p.m. of Calgon. There

was no significant difference between the average increase in weight in the various groups and all remained in a completely healthy condition. The lack of any adverse effect of Calgon, even when used in concentrations many times greater than those employed in threshold treatment, was confirmed at the end of a six-week test by examination of the bone structure of the rats.

Mr. Waring of the Ohio Department of Health states that "Calgon Inc. furnished me with a statement based on two years research by the dean of the Medical College of Northwestern University as to the physiological effects of extreme amounts of this material, to the effect that it is harmless to the human system."¹ Solutions of Calgon of any strength are not only harmless to the skin but actually exert a beneficial action upon it.²

1 18th. An. Report of Ohio Conference on Water Purification, p. 87. 2Jones, K. K., Murray, D. E., and Ivy, A. C., Industrial Medicine, 6:459 (1937).

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THE PROBLEM

Information facts and figures from municipalities where Calgon has been used are somewhat difficult to obtain. It has been used with some degree of success at Columbus, Ohio where Mr. Hoover¹ has conducted some extensive experiments, the results of which he sums up as follows: "At almost all line-soda ash water softening plants, the pipe lines carrying softened water from the settling or carbonation basins to the filters become heavily incrusted. If the velocity is high, the scale is very hard; if low, the scale is soft and mushy. At Delaware, Ohio, the carrying capacity of the line from the basins to the filters has been greatly reduced due to the formation of a hard adherent incrustation on the pipe walls. Calgon treatment, using 5 p.p.m., later 2 p.p.m., then one and finally $\frac{1}{2}$ p.p.m., was applied over a three month period. This treatment was of little or no value toward clearing out the line. Why it did not prove more effective in the pipe line will no doubt be discussed by Mr. Rice. The treatment, begun on May 25th, 1938 did, however, produce some very remarkable results in another respect. During the first 24 days of May, the alkalinity of the settled water at Delaware averaged 69 p.p.m., whereas the average alkalinity of the filtered water during the same period was 33 p.p.m. The drop in alkalinity through the filters was 36 p.p.m., a reduction of 54%. During the last six days of May when Calgon was being applied ahead of the filters, the alkalinity drop was practically zero. The settled water averaged 61 p.p.m. and the filtered water 60 p.p.m.

¹Hoover, C. P., Chemist-in-Charge, Columbus, Ohio.

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"Records at Delaware for 5 years previous show an average alkalinity drop through the filters of 46% (from 69 to 37 p.p.m.). This means that the filters remove about 40 tons of CaCO₃ per year,--a really good service. During the time the Calgon treatment was in operation, the filters did nothing toward softening the water. In other words Calgon stabilized the water and it did not break down while going through the filters. This result was more interesting to me than had the pipe line been freed of the scale because it seems to indicate that:

"1. Calgon should be added to the filtered water instead of to the settled water.

"2. The addition of Calgon to the filtered water will stabilize it and prevent formation of scale in the distribution system.

"3. The reaction of the Calgon treated water will be the same many miles from the plant as when just leaving the plant.

"4. Calgon treated water with a high pH value can be pumped into the distribution system without fear of deposites and with greater expectation of non-corrosion."

Mr. Rice explains the pipe line condition as follows: "A possible explanation of the failure of threshold treatment to clean up this line is that the velocity of the water through the pipe was so slow that the scale was not removed. With higher velocities the softened scale would be washed away and a fresh surface continually presented to the action of the Metaphosphate. Where this occurs a slow removal is usually obtained. This may amount to as much as one-half inch per

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to Manual of

Hoover, C. P., 18th An. Report of Ohio Conf. on Water Purif. p. 84.

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Application of the Calgon treatment to the municipal water supply at Williamston, Michigan was started Oct. 2⁴, 1939 and is still being continued, in the face of none too satisfactory results.²

A well was drilled and equipped to furnish the City of Williamston with a constant fresh water supply. The former supply, intended and used for fire protection only, pumped water from the river into the mains only when a fire broke out. The mains were drained after each fire which left them dry the majority of the time. Removal of sections of these old mains showed that they had become incrusted with a scale after years of service.

With the installation of the new well many unusual conditions were encountered. First and foremost a general complaint of red water and iron deposites on sanitary fixtures was voiced by consumers. This condition prompted more serious complaints from sections where new pipe lines were installed in the distribution system, than in the sections where old lines were used. This would indicate that the scale deposite in the old pipes has some beneficial effect on the present supply.

Treatment has been applied at the well at rates from 2 p.p.m. to 8 p.p.m. of Calgon and has received favorable comment with respect to improved water supply from a few users. Tests were carried out under the direction of B. R. Franklin, district Sanitary Engineer, with the cooperation of the Michigan Health Department, Laboratories and Engineering Division. Iron contents were found to vary from 1 p.p.m. Fe_2O_3 to

¹Rice, Owen, 18th An. Report of Ohio Conf. on Water Purif. p. 86.
²See Report to Michigan Department of Health, p. 15.

as high as 30 p.p.m. with little possibility of correlation between the values.¹ The Standard Colorimetric test was used for iron content.

If Calgon in threshold amounts has any effect on the iron present it should be that of holding the iron in solution and preventing precipitation.² This iron would certainly show up when the Colorimetric test is run.

A drip test for iron stain was run by the author on a sample of raw water directly from the well. Definite iron stains were visable on white porcelain after the water was allowed to drip at the rate of about 10 drops per minute for 12 hours. Further tests showed very little if any effect from the addition of Calgon in 2, 4, 6, 8, 10 p.p.m. quantities.

It was noted that samples taken from the well at 3 P. M. remained clear with only a slight precipitation after 12 hours. Samples taken at 8 A. M. showed definite cloudiness after 2 hours, and iron precipitation accumulated as time elapsed to the 12 hour limit when tests were discontinued.³ Calgon seemed to have very little effect on the precipitation regardless of the amount added (2 to 10 p.p.m.) within the limits of threshold treatment, unless the sample was dosed within two hours of time of sampling.⁴ This would tend to substantiate the theory of surface-activity of Calgon in prevention of precipitation of the iron.

¹Samples taken at the well and at various points on the distribution system, between 8-29-39 and 3-11-40.

²See p. 5 (How It Works). ³See Table No. 1 p. 19. ⁴Sample #1 & #2. Table No. 1.

The "shots" of "red-water" as mentioned in Mr. Rice's letter¹ to the Michigan Department of Health may be due to a condition of the well itself rather than to deposits in, or loosened from, the mains. Colorimetric tests on raw water from the well at various times of day, and with the pumpsstarted for sampling, and running when sample was taken, show a wide variation in iron contents (Table III).² The samples were perfectly clear when taken, showing no coloids or suspended iron oxide. When these samples were two to three hours old, definite colloidal formations or cloudiness with subsequent precipitation of iron were observed in all cases. When the pump was started for sampling the latter condition was much more pronounced than if the pump had been running long enough to effect a draw down of the well. (See Table III, Samples #9, 10, 11, 12).

Tests on filtered samples containing various amounts of Calgon showed that very little of the iron was held in solution as a result of the addition of Calgon.³ A portion of raw water from a five gallon sample, number 9, showed 7.0 p.p.m. of iron by the Standard Colorimetric Test⁴. Similar tests on treated samples showed a like amount, 7.0 p.p.m., or iron in the unfiltered samples. Portions of the same treated samples which were first filtered and then tested showed a residual iron in solution of from 0.15 p.p.m. to 0.4 p.p.m. This indicates very little

¹Galgon Inc., O. Rice to Michigan Department of Health, R. J. Faust. Feb. 7, 1940. See copy p. 18.

²Field Test for Iron as outlined on p. 13 run on Sample #1 to #8, inclusive.

³Table III, Sample #9, p. 21.

4Analysis of Water & Sewage, Theroux, Eldridge, & Mallman (1936) p. 25. effect from the addition of Calgon.

If Calgon prevents precipitation of calcium and magnesium salts by the method described on page 4, the total hardness, as indicated by the "Soap Method"¹ should show a decrease upon addition of threshold amounts of Calgon to the raw water. This was not substantiated by tests on Williamston water as shown in Table II, page 20. The values presented in Table II show no appreciable effect of the addition of Calgon on the total hardness. It may be found necessary to previously treat raw water with lime² or soda-ash, or soften with zeolite, if Calgon is to accomplish a stabilization and hold the Calcium and Magnesium in solution.

¹National Aluminate Co. Standard Soap Test.

Letter Calgon Inc. to Michigan Department of Health, See Copy, p. 18.

Field Test For Iron

(1) Measure out a 100 cc sample of water to be tested and pour same in glass cylinder or Nessler tube.

(2) Add 1 cc of dilute hydrochloric acid (1 volume of concentrated acid to 3 of water) by means of a pipette.

(3) Add two drops of the KMnO₁ solution (6 grams of potassium permangenate to 1 liter of distilled water).

(4) Allow this to stand for 5 minutes and if color does not persist add more $KMnO_{j_1}$ solution.

(5) Add 5 cc of the KCNS solution (2 grams of potassium thiocyanate in 1 liter of distilled water).

(6) Compare the brown color which has formed with standard tubes made up as follows:

- (6a) Place 100 cc of distilled water in Nessler tube
- (6b) Add 1 cc of HCl solution
- (6c) Add 5 cc of KCNS solution
- (6d) Add 1 cc at a time of the standard iron solution until color of standard is same as sample. Or prepare a set of standards with various amounts of the standard iron solution.

(7) Calculations. Parts per million iron (Fe) = cc of standard iron solution used x 0.2.

NOTE: Standard Iron solution. Dissolve 0.140 grams of ferrous ammonium sulphate crystals, FeSO₁₄(NH₁₄)₂SO₁₄.6H₂O, in about 50 cc of distilled water, add 5 cc concentrated sulphuric acid. Warm this and add KMnO₁₄ solution until pink color persists. Dilute to 1 liter.

COPY

MICHIGAN DEPARTMENT OF HEALTH

Lansing, Michigan

April 16, 1940

Mr. Richard Foster Buildings and Grounds Department Division #8 Michigan State College East Lansing, Michigan

Dear Mr. Foster:

As you requested we are sending you herewith copies of the following letters received by us:

January 2, 1940 from B. Russell Franklin

February 7, 1940 from Calgon, Inc.

March 15, 1940 from B. Russell Franklin

This correspondence is in regard to Calgon treatment of the water at Williamston.

Yours very truly.

MICHIGAN DEPARTMENT OF HEALTH

(Signed) Raymond J. Faust, Asst. Engr. Bureau of Engineering

BJT:rcm

COPY

INGHAM COUNTY HEALTH DEPARTMENT and MICHIGAN TRAINING CENTER

January 12, 1940

E. D. Rich, Director Bureau of Engineering Michigan Department of Health Lansing, Michigan

Dear Col. Rich:

The treatment of the Williamston public water supply with Calgon has met with the mild success as is indicated by the data below.

The laboratory data shows some reduction in total iron content expressed in terms of Fe_2O_7 . However, the water still contains an excessive amount of iron, is objectionably hard, and is unsatisfactory to the users.

Date of			Soap	Calgon Treatment
Collection	Point of Collection	<u>Fe203</u>	Hardness	at time
8-29-39	804 S. Putman	14.3		Not treating
9-18-39	Direct from well	1.7	432	Not treating
10-27-39	804 S. Putman	8.5	-	бр.р.т.
10-30-39	804 S. Putman	14.3		2 p.p.m.
11-10-39	804 S. Putman	22.9	480	2 p.p.m.
11-14-39	804 S. Putman	14.3	400	2 p.p.m.
11-20-39	804 S. Putman	7.4	500	2 p.p.m.
11-24-39	302 E. Grand River	2.8	520	2 p.p.m.
11-30-39	502 E. Grand River	4.3	460	2 p.p.m.
11-30-39	603 S. Putman	6.3	460	2 p.p.u.
12-13-39	734 S. Putman	6.8		бр.р.т.
12-21-39	620 N. Putman	1.1		бр.р.т.
12-28-39	830 W. Grand River	1.28		6 p.p.m.

The records of the city show that between 10-24-39, when treatment was started and 10-28-39, 23,180 gallons of water were used. Treatment during this period was at the rate of 6 p.p.m. of Calgon. From the 28th of October to December 13, treatment was carried on at 2 p.p.m. and 117,050 gallons of water were used. From December 13 to December 18, treatment was increased and 6 p.p.m. of Calgon and 49,630 gallons of water were used. The hydrants were flushed three times during the period of treatment, once on October 27, once on December 18, and at one other time, the date of which is not available at this time. Treatment is now being carried on at the rate of 6 p.p.m. The above analyses would indicate that it is better to treat this water at the rate of 6 p.p.m., than at 2 p.p.m.

Because of the variation in the chemical analysis and the question as to the actual results being achieved, a brief survey was made on December 21 and 22. Twenty-one homes where city water was being used were visited and the owners questioned as to their opinion of the water since treatment. Eleven of these people had noticed some improvement in the taste and odor of the water, twelve noticed some slight improvement in the color condition, two people felt that there was some improvement in the hardness, while five individuals felt that there was no improvement. Two users felt that the water was now satisfactory, and one individual thought the water was satisfactory, anyway, even before treatment. One person questioned had a regular zeolite water softener in the home and felt that the undesirable redness in the water increased or decreased in direct proportion to the need regeneration of the softener. Hence, when the water softener was properly used in this home, the water was satisfactory.

It would seem from the above that some only slight improvement has been noticed in the water supply. Whether or not there has been sufficient improvement to warrant the continuance of treatment is problematical. In view of the relative low cost of this treatment, it is probably wise to continue it for a few months longer, but certainly not if the treatment were expensive.

Very truly yours,

(Signed) B. Russell Franklin, Chief Sanitarian

cc: Mr. Harry A. Love Village President Williamston, Michigan

> Mr. Walter A. Zimmer Wolverine Engineering Co. Mason, Michigan

COPY

INGHAM COUNTY HEALTH DEPARTMENT and MICHIGAN TRAINING CENTER

March 15, 1940

Mr. E. D. Rich, Director Bureau of Engineering Michigan Department of Health Lansing, Michigan

Dear Col. Rich:

Supplementary to my report of January 2, 1940 on the treatment of the Williamston water supply with Calgon I am filing herewith the additional data. The laboratory samples have shown a considerable variation, and in view of the entire treatment period of four months and the information that we have at hand, it would seem to me that a treatment of this supply with Calgon for the purpose of overcoming the undesirable "red water" is a failure, and I would advise that the treatment be discontinued. The additional data follows:

Date of Collection	Point of Collection	Fe203	Calgon treatment at time
1-12-40	804 S. Putman	18.3	None
1-12-40	620 N. Putman	1.0	None
1-12-40	830 W. Grand River	5.7	None
1-12-40	200 E. Grand River	3.4	None
2-28-40	725 W. Grand River	21.4	бр.р. m.
2-28-40	801 S. Putman	14.3	6 p.p.m.
3-11-40 Hydrant W*	end of W. Gr. River	17 . 1	gp.p.m.
3-11-40	118 Riverside	30 .	8 p.p.m.
3-11-40	High School	5•7	8 p.p.m.

*Mains flushed on this day. Sample at hydrant at end of West Grand River taken after flushing.

Yours very truly,

(Signed)

R. Russell Franklin Chief Sanitarian

cc: Harry A. Love, Village President, Williamston

> Walter A. Zimmer, Wolverine Engineering Co., Mason

COPY

CALGON, INC.

300 Ross Street Pittsburgh, Pa. February 7, 1940

Mr. R. J. Faust, Assistant Engineer Michigan Department of Health Lansing, Michigan

Dear Mr. Faust:

Thank you very much for your letter of January 23 enclosing a copy of Mr. Franklin's report on water conditions at Williamston.

The data given in Mr. Franklin's report could be interpreted as indicating that the addition of Calgon has deflocculated the iron oxide previously precipitated in the mains and that by the last two weeks of December most of this deposit has been removed. I am a little bit concerned because the tests made on December 21 and 28 show less iron than was present in the well water on September 18.

If we assume that there has not been a decrease in the iron content of the well water, this would mean that some precipitation of iron is still taking place in the mains. I would consider that Threshold Treatment was doing a perfect job if it were holding all the iron in solution and in suspension so that none precipitated in the distribution system. This would mean that all of the water would have a fairly large amount of iron in it, but it would be uniform and no one would get the very large "shots" of "red water."

Of course, this water should be softened with lime if it is ever to be satisfactory but if the addition of Calgon will prevent the deposition of iron in the mains, it will be of some help. I will greatly appreciate receiving a copy of Mr. Franklin's next report when this is available.

Yours very truly,

CALGON, INC.

(Signed) Owen Rice, Research Engineer TABLE NO. I

COLORIMETRIC & SETTLEMENT TESTS

C	10 P.P.M.	raw >>	Cry. Huy whippy	*	*	1	1		* *	٨	*
n Added	8 ppm	< '>			te red color upt 4 - 10	be dosed	61014 1-10				07-6
(a/go	6 p.p.m.	^	1. 1-10 Crystals	Condition	fluffy-son Increased	e it could	bluish tur > Raw	01-1 Sui	ing 1-10	10 NO PPT.	8 P.M. 5.1
ater -	4 P.D.M.	e as raw	Increase pp	Colloidal	- Whi	robid befor	Tnereasing	bl. Increas	bl. Increasi	easing 1-	1 to #5 a
CC. RON W	2. p.p.m.	< - Sam	W. Kall		as raw	yellow - to	Y			- bl. decr	13e paralle
100	1 p.p.m.	Cl. pp1 <raw< td=""><td>Sl.yel.ppt.</td><td>Y</td><td>Some hore f</td><td>- Jurnea</td><td>Turbid < Raw</td><td></td><td>NY Y</td><td>¥</td><td>pt. otherw</td></raw<>	Sl.yel.ppt.	Y	Some hore f	- Jurnea	Turbid < Raw		NY Y	¥	pt. otherw
Raw &	Distilled		1	Hlement	Hry Rd. ppt	4 Rd. FI.		No ppt.			SI. more p
	Row	c/. b/.	Hy. Rd gr. ppt.	Some Se	Huy. Cg. Rd. ppt.	Turbid - yel	No ppt bl.	cl. y el No ppt.	Rd.gr.ppt.	CI. yel. No ppt.	Y
Date	Time	5-8-40	5-14-40 10P.M.	5 8-90 8 P.M.	5-19-90 11 P.M.	5-14-40 10 P.M.	5-14-40	5-15 ×	5-19-40 8 P.M.	5-16.40 2 P.M.	5-19-40 9 P. M.
Samule	Sample No.		N N		3	4	6		v	Ś	

-ABBREVIATIONS -

A colloidal. ppt - precipitate. A colloidal. ppt - precipitate. A colloidal. ppt - fron oxide red SI. - Slight Wht - White White White Witent yel. - yellow Will A colloidal. precipitate. A colloidal. colloidal. A colloidal. colloidal. A colloidal

bl. - bluish colloidal. cg. - Clinging cl. - Cloudy Cry - Crystals f. - flocculent gr - Granular Hvy. - Heavy

TABLE NO TI

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TABLE NO. IT SUAP HARONESS'

-					-					-	-
c	-KEMARKS-	Not Treated		Not Treated				Not Tested			
NOY	.mgg 01		/6.6	1	20.3	18.7	21.1		22.3	21.5	
R GAL	D B PPM		19.0		19.9	18.7	21.9	ŀ	22.3	23.5],
NS PL	5 FATE		16.7		19.9	1.61	21.9		22.3	28.7	
GRAI	A PPM.		16.7		1.61	20.7	22.7	I,	22.3	29.7	
535 IN	CALGO		13:5		1.61	21.1	23.1	-	22.7	23.9	
RDN	wdd		18.7	I	18.7	21.1	24.3		22.7	20.3	
HA	RAW		16.5		/3./	20.3	25.1	ľ	21.1	23.5	
vo	VOI	T for details	:	:	-	:	:				Contraction Contraction Contraction
ĸ	Descripti	See Table IL					•	•			1001001
Samole	No	1	~	Э	4	5	9	2	80	Ø	

(14.575cc. Samples)

If SB.3cc. Sample is used, one cc of Nalco Standard Soap Solution used indicates Igrain per gal. of total hardness. Lather factor = 0.5 cc. & must be subtracted from cc. used. If 14575 c.c. Somple 15 used (c.c. of std. Soup x 4)- 0.5 = g.p.g hordness.

TABLE NO. III IRON CONTENT - IN PAM.

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- Std. Testa Unfiltered - Field Test. Somple turned cloudy. : Run Unfiltered Remarks Unfiltered Unfiltered Unfiltered Unfiltered Not Treated Unfiltered : Filtered Filtered Filtered Filtered Filtered Filtered -No Iron .. : "10. : \$ G # : : 3. Aprox. 1000gol. pumped beliveen Theroux, Eldridge & Mallman p 25. 33 0.0 udd01 4 O.O 0.4 3.0 0.4 7.0 0.2 1.2 3.0 1.5 × 0 Calgon Added 4 ppm 6 ppm 8 ppm 0.35 0.0 0.0 0.0 1.2 4 0.3 4.0 1.0 2.0 7.0 3.0 0.2 2.0 0 0.35 4.0 0.4 0.4 0.0 3.0 5.0 7.0 0.2 4.0 1.2 0.3 × 0.0 0.1 3.0 6.0 0 35 0.3 4.0 7.0 0.4 6.0 4.0 1.2 ppm. Fe in Raw Water 0.35 2 ppm. 0.35 40.0 3.0 0.3 6.0 7.0 1.6 10.0 0.3 0.1 0.4 mddy 035 1.2 3.0 7.0 6.4 4.0 0.0 10.01 0.15 7.0 0.9 R 0 2. Std. Iron test - Analysis of Water & Sewage, 12.0 10.0 0.0 2.0 12.0 RAW 2.0 0.8 3.0 00 1.0 0.9 0 1.0 0 0 N test run on Somple " 3, 10, 11, 12. Time between Collection & Dosage 2 34 Hr. Not Dosed 12Hr. Dosed 180 12 110 1 \$ HC 6 HPS. / HC. Late 1 HP. Running Smin 20 min 35 min. Storted Started Started Running Running Started or Started " " : : : 5.16-40 5-20-90 9:20 A.19. 5-25-40 9:25 A.M. 5-17-40 8 A.M. 5-25-40 5-25-40 9:40 A.M. 9:554.11. Date & Time 5-7-40 3:30 P.M. Std Iron 5-15-90 5-25-40 6 2. 40 5-8-70 5.14.40 101.07 81.12 Sampled 8 A.M. 5 103 Somple ~ 20. 2 6 1 2 8 6 4 2 3 5

ROOM USE DINLY





