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The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by Carlos Werter del Plaine for the degree of Civil Engineer. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Civil Engineer.

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The Disposal of Creamery Wastes

A THESIS

Submitted to the Graduate Faculty

of the

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by

Carlos Werter del Plaine

In partial fulfillment of the requirements

for the

degree of

CIVIL ENGINEER

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The Disposal of Creamery Wastes.

The dairy industry in Minnesota and in many other states is one of the most important branches of agriculture. This is an industry which is constantly increasing with the development of the country. Unfortunately, in the process of the production of butter there is also produced at creameries a certain amount of waste material which is of no particular value and which, under certain conditions, may cause a serious nuisance.

In the manufacture of creamery butter the buttermilk is withdrawn after the churning, stored temporarily, and later taken away by the farmers to be fed to their hogs. The butter is washed from one to three times, thus producing a large volume of waste which contains considerable organic matter. Added to this is the water used in washing floors, churns, milk cans, butter utensils, bottles, ripening vats, and pasteurizers, clear water used in the pasteurizers and cooling devices, and at times includes refuse testing acids. Generally, the waste contains small quantities of fat, casein compounds,

albumen, milk sugar, and lactic acid. This waste putrefies, although not so rapidly as domestic sewage, and produces a very offensive odor.

In order to appreciate more fully the importance of the dairy waste problem in Minnesota, it should be remembered that there are in this state at the present time about 830 creameries in operation, at which nearly 140,000,000 pounds of butter are produced annually[1]. Assuming on a conservative basis that 1 1/2 gallons of waste are produced for each pound of butter, it is found that a total of about 200,000,000 gallons of waste is discharged from the creameries every year, or an average of 241,000 gallons per creamery per year, equivalent to approximately 1,000 gallons per creamery per working day.

If the creamery is so situated that the waste can be discharged into a stream of running water or a relatively large lake where it can be adequately

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1. Minnesota Bulletin of Information on Creameries for 1921, page 23.

diluted, the problem of disposal is not a serious one, for the reason that dairy waste, although capable of creating a nuisance, is not especially dangerous to health. In order to take care of the waste properly, the stream should have a volume from 100 to 500 times the volume of the waste, depending on the concentration of the latter. There should be no pools below the point of discharge, as this would lead to the sedimentation and eventual putrefaction of the organic matter in the waste. Where no such stream or lake of sufficient size is available, the problem becomes a serious one from a sanitary point of view, because dairy waste, if not adequately diluted, becomes very offensive. In fact it is one of the most offensive wastes with which sanitarians have to deal.

Some creameries discharge their waste into cesspools. This method of disposal is usually but a temporary expedient due to the fact that the organic matter tends to clog the most porous soils, and eventually the cesspools will cease to function.

A large number of creameries in this state are situated near the business centres of towns. Many

of these towns have no sewer systems. In some of the towns where there are sewer systems the proportion of creamery waste to domestic sewage is so great that it interferes with the operation of the municipal sewage treatment plant, making it necessary in some instances to provide an independent outlet or to treat the waste before discharging it into the sewers.

The majority of the creameries in Minnesota are cooperatively owned or patronized by farmers. Wherever creameries are located in towns, they tend to bring in the farmers' trade, which is a desirable feature from the merchants' standpoint. Whenever there is trouble about the disposal of the creamery waste and the use of the sewer system is denied the creamery, bad feeling is likely to be created between the municipality and the farmers.

Although no record of the number of complaints or inquiries regarding the disposal of creamery wastes has been kept by either the Minnesota State Board of Health or the Minnesota State Dairy and Food Department, both of these departments have received scores of letters asking for advice regarding

this troublesome problem, and the number of these is increasing constantly.

It is therefore necessary that some satisfactory method of treatment of the creamery wastes be provided, which can be used when the ordinary means are not available.

Plate I[2]

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The "Bread and Butter" state of the U. S. A. Each dot represents a creamery.

2. Minnesota State Food and Dairy Department, Bulletin of Information on Creameries, Cheese, Ice Cream Factories and Commercial Creameries. St.Paul, Minn., 1921

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Chapter II.

Review of Waste Treatments Practise.

The disposal of creamery wastes has been a problem in every dairy country in both Europe and America. Many attempts have been made to solve it by various methods, and success has been achieved in some cases. It is well here to review some of the investigations and experiments made on both sides of the water, in the disposal of creamery wastes.

The following significant quotations regarding early work on creamery wastes are taken from A. E. Kimberly's, The Disposal of Wastes from the Dairy Industry.

"The earliest work (1887) upon the treatment of dairy industry wastes is that of Mueller who recommends precipitation, with calcium sulphate, vitriols and leachings of manganese. He would employ no chemicals that would hinder putrefaction. Using a 5% solution of ferric sulphate and a small quantity of hydrochloric acid, he succeeded in abating a serious nuisance from creamery

wastes at Greifswold."[1]

"Opperman (1902) suggests dilution in running streams. He opposes physical or chemical treatments since he considers that these processes prevent the needed putrefaction of the wastes. In the absence of suitable dilution, he would consider broad irrigation or the discharge of the wastes into earth basins or ditches in porous soil. He states that the method may at best be criticized from the standpoint of odors and that it cannot be used adjacent to the creamery building or near dwellings."[2]

"Hamilton suggests neutralization with lime followed by precipitation with sodium silicate. He points out that the sludge produced may be used as fertilizer."[3]

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1. Mueller - Milch Zeitung, 1887, p. 119. (quoted here from Kimberly, A.E., The Disposal of Wastes from the Dairy Industry).
2. Opperman, - Mölkerei Zeitung, No. 5 - 1902. (quoted here from Kimberly, A.E., The Disposal of Wastes from the Dairy Industry).
3. Hamilton, - Revue generale du lait Vol. IV p 190. (quoted here from Kimberly, A.E., The Disposal of Wastes from the Dairy Industry).

Chemical treatment of dairy wastes, followed in some cases by land treatment or percolating or contact filters seems to be the general practise in foreign countries.

"At the Pasteur Institute at Lille, France, experiments were conducted in 1910 with septic tanks and coarse grained filters. As a result of laboratory tests, Calmette suggests a plant for the treatment of 5 cubic meters (1321 gallons) of butter factory wastes per day on a basis of the total discharge in two hours as follows: A storage basin of 5 cubic meters (1321 gallons) capacity; a dosing tank of 150 liters (39.6 gallons) capacity, and a trickling filter 3 x 4 x 2 meters deep (9.84 x 13.12 x 6.56 ft. deep) of slag. It is stated that a plant so constructed was in operation treating daily from 4,000 to 5,000 liters (1057 - 1321 gallons) of butter factory wastes. On the basis of an average of 1189 gallons in 18 hours, the rate of treatment on the filter is about 535,788 gallons per acre

in 24 hours."[4]

The Royal Commission on Sewage Disposal of England[5] investigated dairy wastes disposal conditions in Ireland, as recorded in the 9th report published in 1915. Inquiries into the methods of disposal at 398 creameries elicited the following information:

Discharged into the village or town sewer	16
Carted away	3
Discharged by gravitation or pumped over land	21
Discharged into a river or stream	310
Discharged into a septic tank	8
Discharged into a septic tank with subsequent treatment in bacterial beds	7
Total	398

The following extracts are quoted from The Purification of Dairy Wastes, by G. Bertram

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4. Calmette, - Rescherches d'epuration des eaux d'egont. Vol. VI (quoted here from Kimberly, A.E., The Disposal of Wastes from the Dairy Industry.)
5. Great Britain, Royal Commission on Sewage Disposal, 9th Report, 1915.

Kershaw.

"The results obtained by septic tank treatment of dairy wastes are by no means sufficiently authenticated to warrant the adoption of this process in preference to precipitation."

"Grass land is especially benefited by the careful application of dairy wastes."

"Greasy solids are apt to coat the sewers and cause nuisance in hot weather."

"Concerning the rate of treatment of dairy wastes upon land, much will depend upon the quality, from 3,000 to 4,000 gallons per acre per 24 hours of settled or strained liquors is probably a safe dose. Much depends, however, upon the nature of the intermittency of the irrigation."[6]

In this country considerable work has been done in the attempt to find some method of disposing of creamery wastes which shall be economic-

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6. Surveyor and Municipal and County Engineer, London, December 25, 1914, p. 736.

al, efficient, and simple. After the establishment of co-operative creameries this problem became so important that the United States Public Health Service, various State Boards of Health, and State Agricultural Experiment Stations have made investigations along this line, and from time to time have published pamphlets as to their findings and recommendations.

In 1899, the Massachusetts State Board of Health suggested filtration of creamery waste through sand, if buttermilk were kept out, but said, "The rate at which a filter receiving these liquids can be operated and satisfactory results obtained is much less than with equal quantities of ordinary domestic sewage, and if too high a rate is used, the filters will become offensive in the summer season."[7]

In 1914 the New Jersey State Board of Health stated that "The problem of satisfactorily treat-

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7. State Board of Health of Mass., Annual report for 1899.

ing and disposing of creamery wastes is a difficult one, and offers a very fertile field for research and experimentation." In discussing treatment they said further, "The experiences in the field have tended to show that in cases where milk of lime is applied regularly in sufficient quantity, and a subsequent storage or settling period of 8 to 12 hours is provided, the effluent will be fairly well clarified and will not produce a local nuisance at the point of discharge."[8]

In Wisconsin, wastes from the dairy industry have been the cause of much stream pollution. It may be of interest to quote an early case brought into court. Judge Cassoday in Price v. Oakfield Highland Creamery Co., (1894) 87 Wis. 536. N.W., said, "The deposit of refuse from a creamery into the bed of a stream flowing through plaintiff's land and near his buildings, polluting the water and giving off noxious gases affecting the use and

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8. State Board of Health of New Jersey, Annual report for 1914.

enjoyment of the plaintiff's property is a nuisance."[9]

"A creamery company will be enjoined from causing offensive waste matter to flow upon another's pasture to its injury."[9]

In 1911, James T. Bowles, Chemist of the Wisconsin State Hygienic Laboratory, conducted a series of experiments on butter factory wastes. His work dealt with the treatment of the waste by septic tanks. His conclusions may be summarized as follows:

1. The septic tank will dispose of creamery waste.

2. A retention period in a septic tank of six days will effect a reduction of from 60 to 65% of the organic matter.

3. It is a cheap method.

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9. Price v. Oakfield Highland Creamery, 1894, 87 Wis. 536, 58 N.W. 1039, 24 L.R.A. 333

4. It is applicable, alike to both large and small creameries.[10]

In 1915, the Agricultural Experiment Station of the University of Wisconsin published a bulletin on The Disposal of Creamery Sewage, by E. H. Farrington and G. J. Davis, Jr. Their conclusions[11] are:

1. Creamery sewage is not so quickly purified as city sewage.

2. A pit or cesspool is not a satisfactory receptacle for creamery sewage.

3. A filter bed is fully as important as a septic tank in the process of purifying such sewage.

4. A creamery sewage tank should be large enough to hold at least three days' sewage.

5. Objectionable odors about filter beds may be avoided by sprinkling chloride of lime over the bed.[11]

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10. Bowles, J.T., Septic Treatment of Creamery Sewage, Engineering Record. Vol. 64, 1911, p. 419
11. The Disposal of Creamery Sewage, Agricultural Experiment Sta. Univ. of Wisconsin, Bull.No.245, Feb. 1915

In 1916 - 17, an experimental investigation of the treatment and disposal of creamery wastes was carried out by the United States Public Health Service, at the plant of the demonstration creamery at Grove City, Pa. A septic tank and two sand filters were used. The experiment was moderately successful, but it is interesting to note the following statements made by Earle B. Phelps in the U.S.P.H.S. Bulletin on Treatment and Disposal of Creamery Wastes. "While it is probable that with careful operation the plant described will not give rise to objectionable odors, the possibility of nuisance can not be entirely overlooked. For this reason it is desirable wherever practicable to locate the plant at some distance from dwellings and from the creamery and to cover the tank with a tight board cover. In view of the rather common use of septic tanks in connection with the disposal of creamery wastes, it ought to be emphasized that the septic tank itself does not constitute a system of final treatment . . . . The primary functions of a septic tank is to prepare the waste for further oxidation, and the use of the sand

filter for this purpose makes it possible to discharge a final waste which is practically unobjectionable."[12]

In Minnesota, a modified type of Imhoff tank has been used at two or three creameries. These tanks were constructed from plans prepared by the State Board of Health and were of an experimental nature. The results with this type of tank were not entirely satisfactory although the effluents produced compared favorably with that from the ordinary septic type of tank used for this purpose.

During the winter of 1921 - 1922, the experiments described in the following pages were carried on at Forest Lake, Minn., at the Co-Operative Creamery owned by the Twin City Milk Producers Association.

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12. Phelps, E.B., United States Public Health Service, 1919, Reprint No. 496 from the Public Health Reports, Dec. 6, 1918, Pp 2169 - 2174

Chapter III.

It is quite evident from the reports of previous investigators that the creamery waste problem is one which cannot be satisfactorily solved by any simple, inexpensive, and automatic process. Local conditions will necessarily influence the solution of each individual problem.

For the purpose of this thesis it is assumed that the situation is one requiring a relatively high degree of treatment, producing an effluent which is inoffensive and colorless, and which can be carried on at a reasonable cost for material and labor.

Time and facilities would not permit of investigating more than one process. After a review of the work of previous investigators the chemical precipitation process was selected as offering a field of study with a reasonable probability of success. Arrangements were made through the Division of Sanitation of the State Board of Health with the Twin City Milk Producers Association to carry on experimental work at the Forest Lake Creamery operated by this company. This arrangement was

made for the reason that it was considered desirable to conduct the experiment under as nearly normal creamery operating conditions as possible.

Forest Lake is a small village in an agricultural district on the Northern Pacific railway, twenty-five miles north of St. Paul. The creamery is located two blocks from the business centre of the town, and is served by farmers from the surrounding country. During the year 1921, 190,000 pounds of butter were produced at this creamery.

In the first stages of the experiment, samples of the creamery waste from the Forest Lake Creamery were shipped to the State Board of Health Laboratory. The first samples were collected by employees in the creamery. The results were unsatisfactory because these samples varied so widely in quality. Later the samples were collected by the investigator in order to get them as nearly representative of the day's run as possible.

Treatment with aluminum hydroxide was first tried, but with unsatisfactory results. Some organic matter was precipitated, but the waste remained milky in appearance and putrescible.

Dr. C. J. V. Pettibone, of the College of Medicine, gave some valuable assistance by outlining the laws governing the precipitation of the organic matter from the waste. Casein is quite a strongly acid protein. Proteins carry negative charges in alkaline solution, and positive charges in acid solution. The original protein has some organic acid group which unite with sodium hydroxide (Na OH) to form a sodium salt of the protein. From this, sodium ionizes carrying positive charges, negative charges remaining on the protein molecule. Thus to precipitate the protein in an alkaline solution a positive ion will be desirable, as the precipitated material is a compound or a salt. On the basis of this reasoning, a salt of copper or iron should be a satisfactory precipitant in alkaline solution.

Treatment of the creamery waste with sodium hydroxide followed by copper sulphate was tried, and the solid matter precipitated successfully leaving a clear effluent, thus proving the correctness of Dr. Pettibone's suggestions. But the use of these chemicals would be a greater financial burden than

any creamery could bear. The problem then resolved itself into a search for equally efficient but inexpensive chemicals. Ordinary slaked lime and copperas (iron sulphate) were experimented with because both are relatively inexpensive and easy to obtain, copperas being a by-product of the iron industry. Approximately one hundred experiments were made with 1000 c.c. samples of creamery waste in the attempt to find the proportions of the two chemicals, and the method of application which would produce the best results. These experiments with the 1000 c.c. samples showed that by dissolving 60 grains of slaked lime in 1000 c.c. of the waste, and then adding 30 grains of iron sulphate, a precipitate, bluish-green in color was formed which immediately settled to the bottom, leaving a clear supernatant liquid. About fifteen samples of this clear supernatant liquid was subjected to the relative stability test as described in the 4th edition, Standard Methods for Examination of Water and Sewage, as published by the American Public Health Association. A relative stability of about 68% was noted in nearly every instance.

As soon as it was definitely settled that these amounts of lime and copperas were suitable for the treatment of the waste produced at the Forest Lake Creamery, experiments were continued on a larger scale at the creamery. Altogether sixteen trips were made to Forest Lake for this purpose. The experimental plant used at the creamery consisted of a fifty gallon cask equipped with apparatus for stirring the waste treated. Concrete was poured into the bottom of the cask to form a conical bottom. Waste could be drawn from the lowest point in the bottom by means of a pipe equipped with a gate valve. The cask was set on a raised platform about three feet above the floor. Forty gallons of waste were treated at a time. This waste was collected by means of a large dipper from the floor drain and poured into the cask by hand. In this way it was felt that representative samples could be obtained.

Lime, in the proportion of 60 grains to 1000 c.c., was dumped slowly into the waste by hand, and stirred for several minutes. The iron sulphate was

Plate II[1]

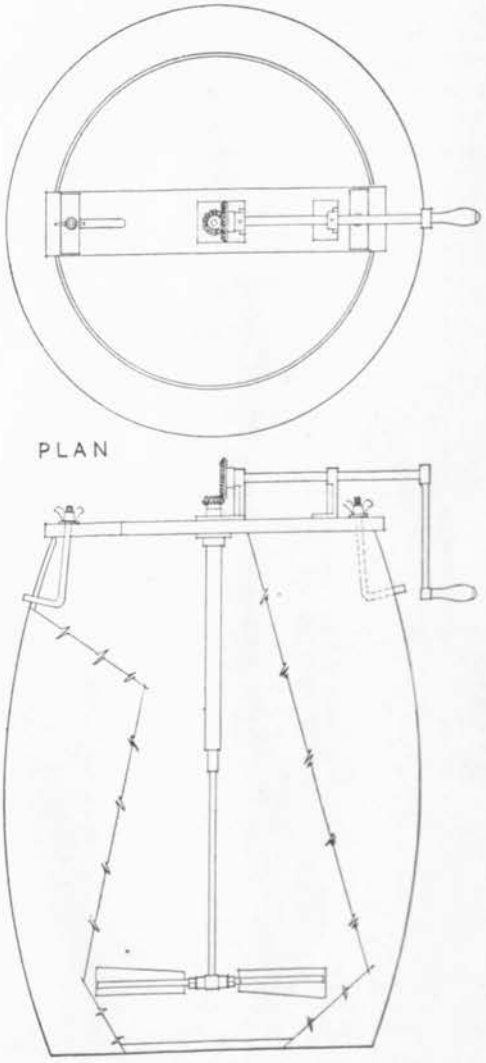

FIG. 2.—Mixing device, assembled.

by permission

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1. Whittaker, H.A., Hypochlorite Treatment of Water Supplies, Reprint No. 261 from the Public Health Reports, Washington, 1915

dissolved in warm water, and applied to the waste while the stirring proceeded. The agitation was continued until the chemicals were thoroughly mixed with the waste. Contrary to expectations a satisfactory reaction was not obtained at all times at the beginning of the tests at the creamery. The first failure was found to be due to the presence of testing acids (sulphuric) in the waste making neutralization difficult. Continual irregular results led to an investigation of the dissolved oxygen content of the waste as a possible cause of the difficulty. This showed the waste to be very low in and sometimes devoid of dissolved oxygen. Accordingly a coil of lead pipe with holes in it was placed in the bottom of the cask, and air pumped into the waste by means of an automobile pump, while the stirring was in process. It was found that this aeration produced a satisfactory reaction. The supernatant liquid which resulted from this chemical treatment proved to be stable, colorless, and entirely free from turbidity. The forty gallons normally treated gave about 32 gallons of clear supernatant

liquid which could be syphoned off, and about 8 gallons (20 per cent) of sludge, containing approximately 90% of water. The following tables show the analyses of creamery wastes and effluents, and other data obtained by analyses made in the laboratory of the Division of Sanitation, Minnesota State Board of Health and elsewhere.

Table I.

Comparative Analyses of Creamery Wastes.
(parts per million)

No.	Oxygen Consumed	Acidity	Suspended Solids	Total Solids
1.	2,989	502	3,567	10,648
2.	1,470	240		
3.	994	135	962	
4.	480	544	2,475	
5.	261		668	
6.	767	236	833	
7.	1,285	220	1,114	

1. Twin City Milk Producers Association Creamery, Forest Lake, Minn.
2. Sunbury Co-Operative Creamery Co., Sunbury, Ohio. Ohio State Board of Health.
3. Royal Commission on Sewage Disposal, England 9th Report Dairy; No. 68.a
4. Butter Factory, Zanesville, Ohio. Ohio State Board of Health.
5. Garnet Creamery, Wisconsin. Engr'g Record, 1911, Vol. 64, p. 419.
6. Demonstration Creamery, Dairy Division, Grove City, Pa. Pa. Nov., 1916.
7. Ibid, March 1917.

Analyses were made of the supernatant liquid remaining above the sludge twelve hours after treatment of the waste, and of the effluent obtained from straining the sludge through cloth.

Table II.

Representative Analyses of Treated Waste at the Twin City Milk Producers

Creamery at Forest Lake, Minn.
(parts per million)

	Raw Waste	Clear Liquid	Liquid Strained from Sludge	Water from Well in creamery
Oxygen Consumed	2,989	415.4	455.2	
Acidity or Alkalinity	502	---	---	---
	---	1196.0	2040.0	352.0
Suspended Solids	3,567	None	---	
Total Solids	10,648	7286	---	388.0
Total Solids	12,328	8884		
Total Hardness	---	1130.0	---	325.0
Bacteria per c. c.	too numerous to count (million per c.c.)	2.0 (1-25-22)	---	---
		14.0 (3-2-22)	---	---

Oxygen consuming power reduced 86%
Total solids reduced 31.6%
Suspended solids reduced 100. %
Bacteria reduced 99.99+%

Table III.

All figures in pounds per 1000 gallons of waste.

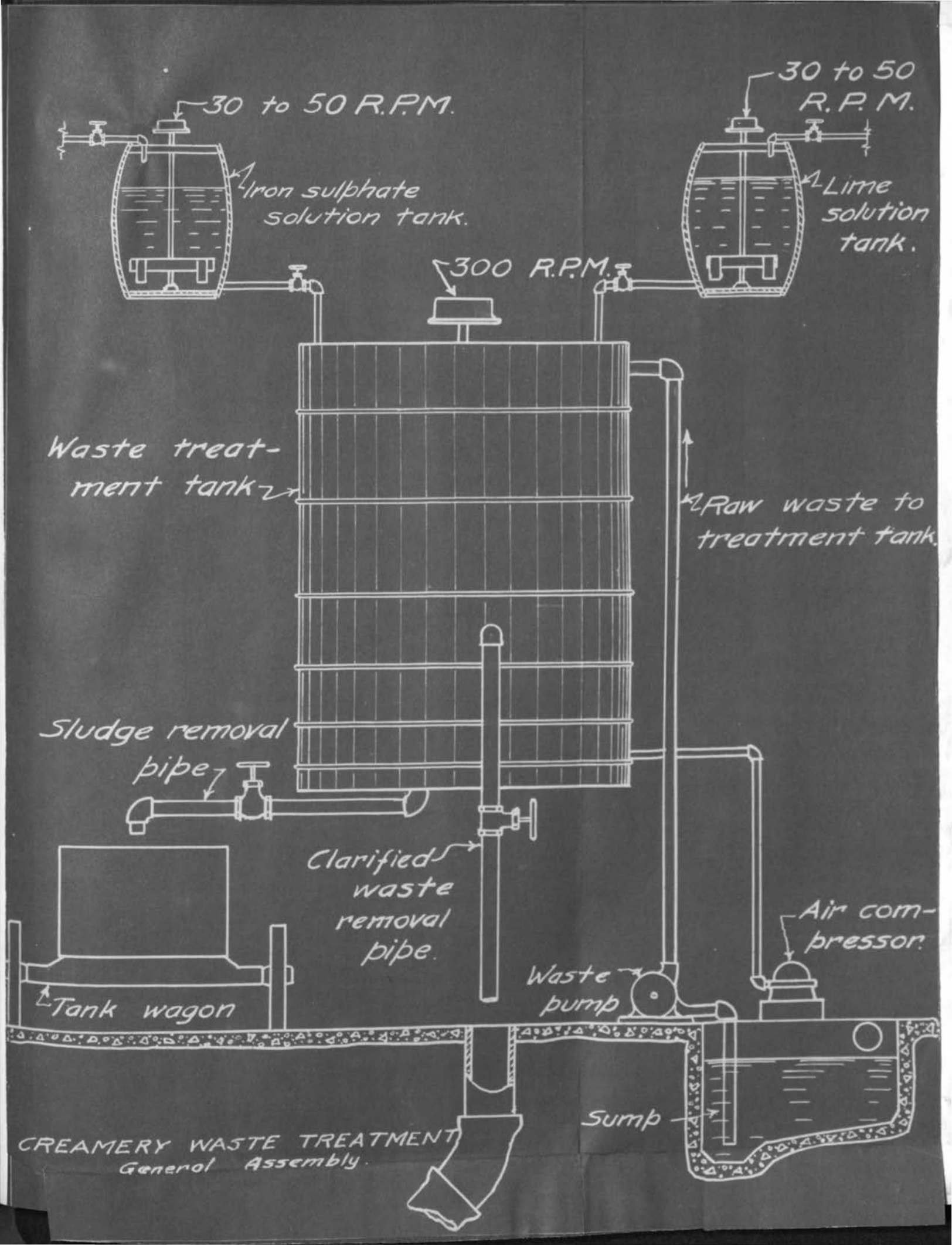
Date 1922	Total wt. of dried sludge	Weight of Lime	Weight of Iron Sulphate	Total wt. of Chem-icals	Total wt. of milk solids
Feb.24	74.82	34.2	17.1	51.3	23.52
Mar. 2	68.15	"	"	"	16.85
Mar.15	71.23	"	"	"	19.93
Mar.23	75.63	"	"	"	24.33

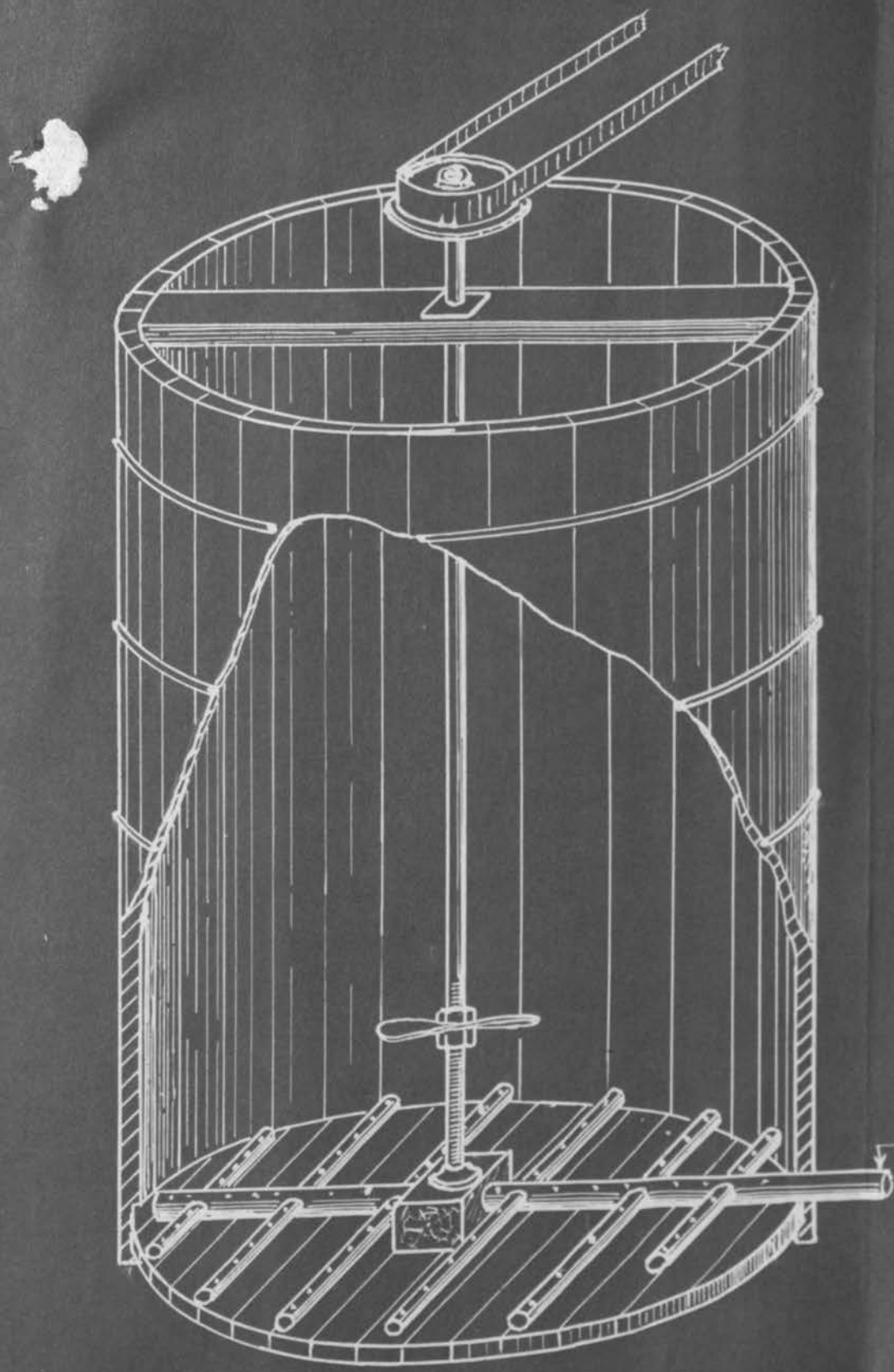
Considerable experimenting was done to find a practical means of removing the water from the sludge, either by filtering through muslin, or through a wire screen overlaid with excelsior. Neither of these methods proved satisfactory. In the first, it was found that the muslin gathered a coating of the sludge which became impervious and kept the water from draining away. Even when considerable pressure was applied, the water did not drain well. When the combination of excelsior and wire screen was used, it was found that the sludge was so liquid that it ran through, only a very small percentage adhering to the excelsior. The

experiments with the sludge showed it to be of a stable nature, and although allowed to stand in the creamery for more than three weeks, it did not become putrescent or offensive.

It was finally decided that the simplest and most successful method of disposing of the sludge was to run it out on a bed of ashes, which would absorb the water readily and allow evaporation. The excess ashes and sludge could be, from time to time, hauled away and used for filling.

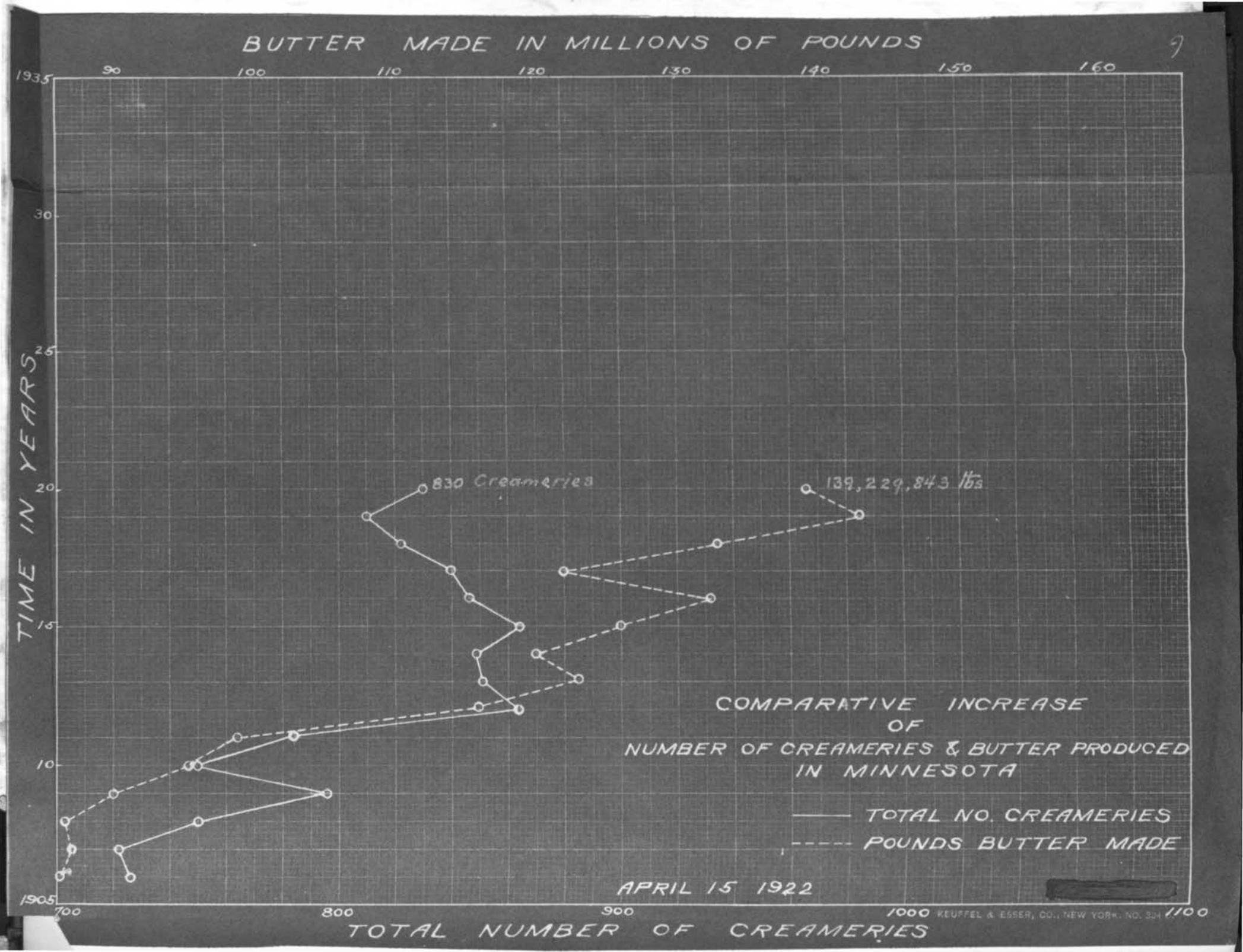
Two drawings have been prepared to show the principle of operation of a typical plant for treating creamery waste with chemicals. The problem at each creamery would be different owing to varied local conditions. Any particular arrangement of plant would not be applicable to all installations. The general idea conveyed by these drawings could be adapted to suit the local needs in most instances.


30 to 50 R.P.M.
Iron sulphate solution tank.
30 to 50 R.P.M.
Lime solution tank.
300 R.P.M.
Waste treatment tank
Raw waste to treatment tank.
Sludge removal pipe
Clarified waste removal pipe.
Air compressor
Waste pump
Tank wagon
Sump
CREAMERY WASTE TREATMENT
General Assembly.



Note - Compressed air manifold - 1" main - ½" laterals, with 1/16" holes 3" on centers. Set manifold in the clear above floor.

CREAMERY WASTE TREATMENT.
Mixing Tank.


BUTTER MADE IN MILLIONS OF POUNDS
90
100
110
120
130
140
150
160
1935
30
25
20
15
10
1905
TIME IN YEARS
830 Creameries
139,229,843 lbs
COMPARATIVE INCREASE
OF
NUMBER OF CREAMERIES & BUTTER PRODUCED
IN MINNESOTA
TOTAL NO. CREAMERIES
POUNDS BUTTER MADE
APRIL 15 1922
700
800
900
1000
1100
TOTAL NUMBER OF CREAMERIES
KEUFFEL & ESSER CO., NEW YORK. NO. 324

Summary and Conclusion.

These experiments demonstrate:

1. That the treatment of creamery waste can be successfully carried on where it is necessary to obtain a high degree of purification.

2. That on account of the cost and labor involved, this method of treatment should only be considered where it is impossible to dispose of the waste by dilution alone or by dilution preceded by plain sedimentation.

3. That wherever this treatment is considered, efforts should be made to exclude from the waste all testing acids and clear water used for pasteurization and cooling purposes only.

4. That this process can be carried on without the production of offensive odors.

5. That the success, like many other chemical processes, depends largely upon the intelligence of the operators.

It is also evident from Plate V that there is a tendency toward a decrease in the number of creameries in Minnesota. The output of butter, however, is increasing. Consequently the problem of creamery waste disposal will steadily become more important.

Appendix.

Since the experiments as described in this thesis were completed, correspondence with the Merrell Soule Co., of Syracuse, N. Y., has shown that this company have a plant in operation at Little Valley, N. Y., where a similar process is used successfully. A short description of this plant will be of interest.

Two chemical precipitation tanks are used, two sludge settling tanks, and an experimental filter press. The wastes amount to from 13,000 to 23,000 gallons per day, depending on the time of year. Copperas and lime are the chemicals used, in the following proportions:

	per gallon	per million gallons
Copperas	24 grains	1.71 tons
Lime	27 "	1.93 "

The iron sulphate is added first, and the mixture stirred up thoroughly with compressed air, then lime water solution is added until the mixture shows neutral.

Their letter and bulletin of March 22, 1922

says, "This should make a good clear sediment, but it sometimes fails to work as it should, and we then go through with the operation again but of course it is not necessary to use as much of the sulphate of iron or of the lime as we did the first time."

The following table of analyses was made on Nov. 10, 1914:

Parts per million

	Imhoff cone c.c. 1 hour	Turbidity	Oxygen consumed 10 min. boiling	Free ammonia	Organic Nitrogen	Putrescibility days
Raw Wastes	0.2	250	190	1.12	16.48	3
Tank Effluent	0	less than 7	94	1.28	4.32	5

The raw wastes received at the plant during the inspection were comparatively weak for creamery wastes, and is probably due to the fact that the wastes consist chiefly of washings of the utensils, since all of the cream, skimmed milk, and buttermilk are utilized. This accounts for the considerable difference between the amounts of chemicals used by this company, and

those used in the experiments at Forest Lake. At the latter, all clear water used in cooling devices is run straight into the sewer and is kept out of the wastes.

In a report dated Feb. 23, 1915, the chief engineer of the New York State Dept. of Health wrote as follows, "The treatment of the wastes by chemical precipitation was apparently carried on in an efficient manner and at the time of inspection was producing a clear and fairly stable effluent.

2. The discharge of the effluent of this character into the stream did not produce any objectionable pollution of the stream and in all probability would not do so at times of low flow.

3. The removal of sludge in the tank wagon, either with or without pressing, and placing it on cultivated lands disposes of it in a satisfactory way.

4. According to information obtained as to experience in 1914, the plant is incapable of properly treating strong wastes derived from the manufacture

of cheese, and that the condition of the permit as issued prohibiting the discharge into the precipitation tank of all such wastes should be strictly complied with."

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C O P Y

March 21, 1922

State Board of Health,
St. Paul, Minnesota.

Gentlemen:

As president of the Village Council of Arlington, Minnesota, I am writing you for information as to the best course to pursue, and what our authority is in the matter of sewerage disposal, particularly that from our creameries, generally known as creamery waste.

We have a creamery connected with each of our drains which are used as sewers, and empty into a creek, which at times becomes dry, and then the creamery waste becomes a nuisance to the neighborhood of the outlet of the sewers and also injurious to cattle pastured there.

The council has under consideration the installation of an Imhoff tank, but are told that this will not take care of the creamery waste, which is exactly what we desire to get rid of, as I am satisfied that if this is eliminated from the sewerage that we will not have any complaint about our sewer outlets.

Is there any way in which the creameries can take care of their waste, and how can we compel them to do so, or must the village provide a way to dispose of it?

Any information or suggestions you can give us or instructions how to proceed will be greatly appreciated.

Yours very truly,

A. C. BUCK
President Village Council