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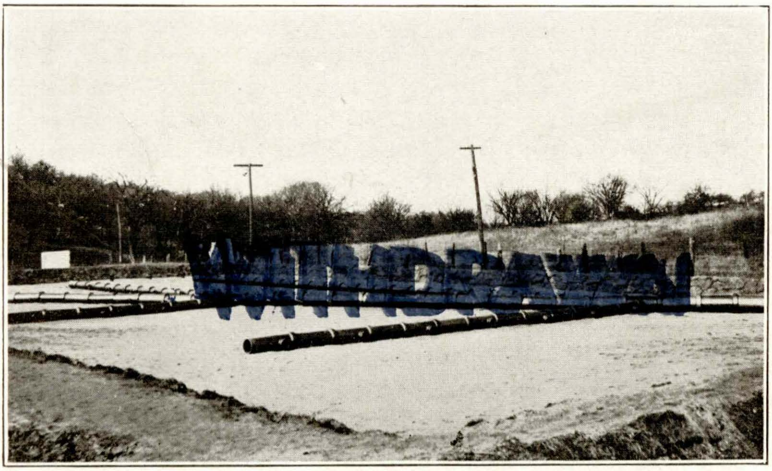
THE OPERATION AND CARE OF SEWAGE DISPOSAL PLANTS



BULLETIN 16

ENGINEERING EXTENSION DEPARTMENT
TECHNICAL SERVICE

AMES, IOWA

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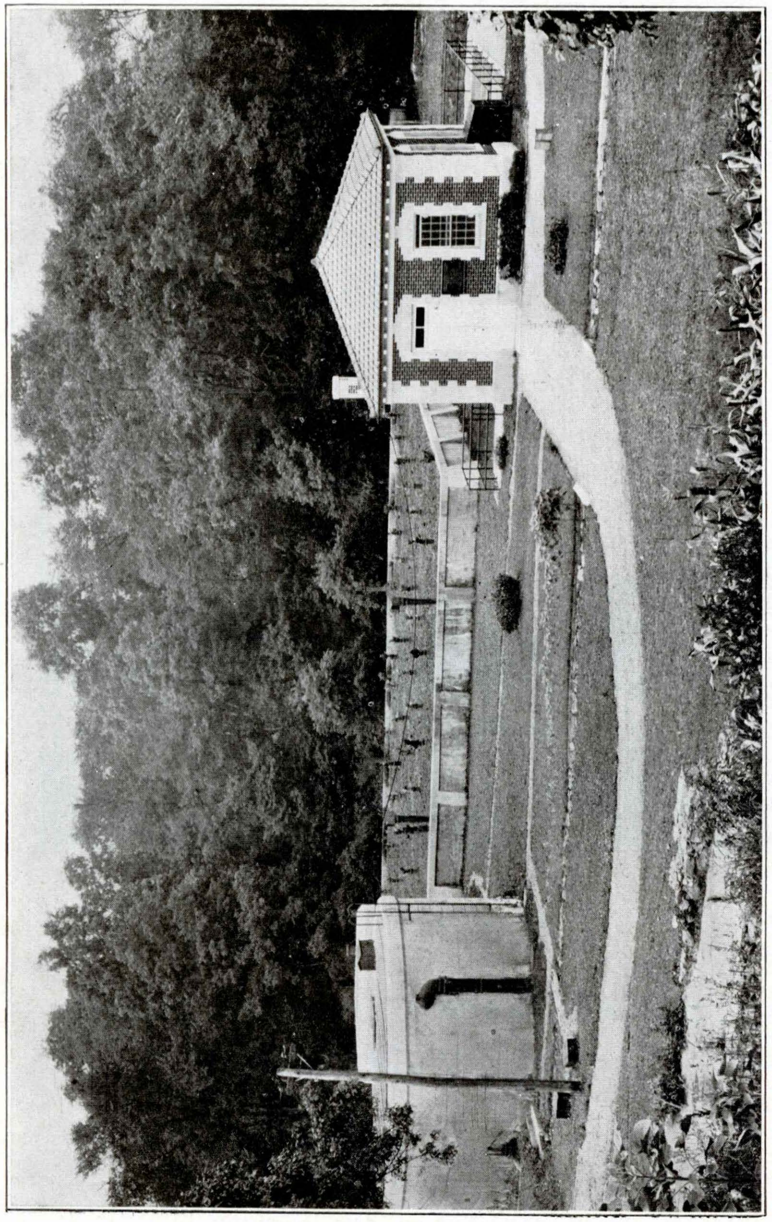


SEWAGE DISPOSAL PLANT AT HARRISON, N. Y., SHOWING WHAT CAN BE DONE TO BEAUTIFY SUCH PLANTS.
Photo by courtesy Alexander Potter, N. Y.

The Operation and Care of Sewage Disposal Plants

By D. C. Faber, Industrial Engineer.

The fact that many sewage disposal plants in Iowa are practically out of commission is an evidence that no matter how well a sewage disposal plant may be designed and installed, it will not do its work in a satisfactory manner without the necessary care. That the question of the operation and care of such plants has not been given the attention it deserves was emphasized recently by the remark of a councilman from an Iowa town, who said that the town had constructed a sewage disposal plant, supposing that the problem was solved for all time and that further attention would be unnecessary.

CONFERENCE FOR SEWAGE DISPOSAL PLANT OPERATORS.

In order that the importance of the proper operation of such plants might be brought to the attention of those in charge, a conference for sewage disposal plant operators was held at Iowa State College, Nov. 2 and 3, 1915. The program consisted of talks and demonstrations on the operation of sewage disposal plants, all explaining the necessity for better operation, and suggesting how the same might be secured. On the second afternoon inspections were made of a number of plants, which were found to be working with various degrees of efficiency, further emphasizing the importance of this subject. On this program the college enjoyed the co-operation of Mr. Lafayette Higgins, Engineer, Iowa State Board of Health; Mr. Langdon Pearse, Engineer in Charge of Sewage Disposal Investigations, Sanitary District of Chicago; Mr. C. P. Chase, Consulting Engineer; Mr. C. H. Currie, Consulting Engineer, and Mr. L. E. Rein, Pacific Flush Tank Co. Local men appearing on the program were Dean A. Marston, Prof. M. I. Evinger, Prof. R. W.

Crum, Prof. Max Levine and Mr. C. S. Nichols. The following cities and towns were represented: Audubon, Cresco, Dayton, DeWitt, Grinnell, Lamoni, Nevada, Oelwein, Sheldon, Sibley and Tipton, and the Board of Control of State Institutions.

This bulletin is issued to present in condensed form some of the important points brought out at the conference. Those who attended were supplied with complete notes at that time.

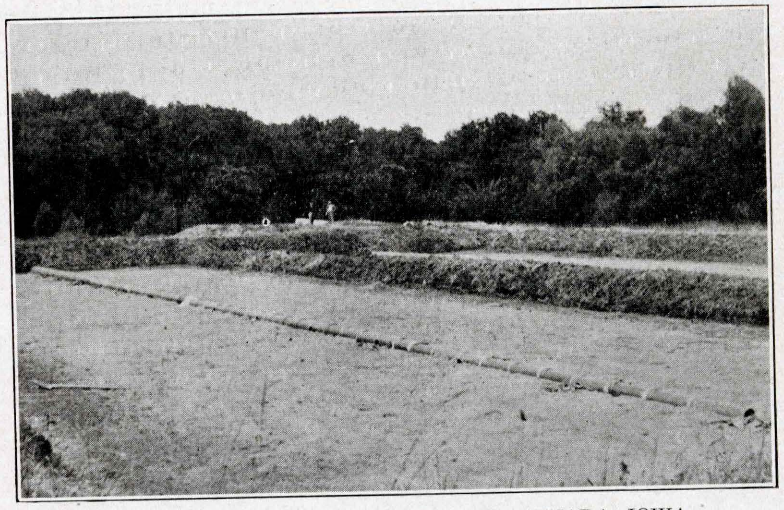
It is planned to hold another conference on this subject during the coming year, which should be of value to every city in the state having a sewerage system.

STATUS OF SEWAGE DISPOSAL IN IOWA.

The question of sewage disposal has been receiving more careful attention of late than ever before, on account of the recognized dangers of pollution of streams and other bodies of water into which untreated sewage is allowed to flow. While Iowa law on the subject of stream pollution is rather indefinite with reference to sewage disposal, it has generally been held by the state at large as forbidding the pollution of streams by such means. The State Board of Health requires that sewage should be purified to the degree of non-putrescibility, before being emptied into streams or other bodies of water. In order to meet this requirement, some form of treatment is necessary, to remove the organic matter from the sewage. Organic matter is present in sewage in considerable quantity, both in the form of suspended solids and in solution.

In general, the process of purifying the sewage consists of preliminary tank treatment followed by filtration. About 60 municipalities in Iowa at the present time have sewage disposal plants. The plants most commonly found consist of septic tanks and intermtitent sand filters. Imhoff tanks have been installed in a number of instances and sprinkling filters are to be constructed in at least two cities. While there is no doubt that most of these plants were constructed according to plans correct in principle, many of them are not

working satisfactorily. This condition is due in some cases to incorrect principles of design; in others, to original lack of capacity; or use of unsuitable filter material; or to the fact that the plants have not been increased in size proportionally to the demands made on them; but on the whole, lack of proper attention is to blame. Even where plants have been found too small, increased care in many cases could be made to offset the lack of capacity. All plans and specifications for water works, sewers, sewage disposal plants and garbage disposal plants must be submitted to the State Board of Health for approval, but, unfortunately, because of inadequate appropriations, this supervision does not extend to the operation of the plants after construction, unless conditions become so bad as to be a menace to the health of the community.



INTERMITTENT SAND FILTERS AT NEVADA, IOWA.

OPERATION OF SEWAGE DISPOSAL PLANTS.

In addition to suggesting the care which should be given to the different parts of a sewage disposal plant, in order that it may do its work properly, brief mention is made of the function of these parts in the purification of sewage. When the several parts of a sewage disposal plant are understood, the necessity for proper operation and care becomes apparent.

GRIT CHAMBERS.

In the case of combined sewerage systems, which take care of the storm water from the streets as well as sanitary sewage, more or less sand, gravel and mud enter the sewers. If a sewage disposal plant is operated in connection with such a system, it is desirable to remove this heavy mineral matter before the sewage enters the tank, and for this purpose grit chambers are designed.

As grit chambers have no other function than the removal of heavy mineral substances from the sewage, they should be so designed that the sewage remains in the chamber only long enough for these materials to settle out. The flow should not be slow enough for organic matter to be deposited. As most Iowa sewage disposal plants have been built in connection with sanitary sewers only, grit chambers are not commonly installed, as they have little value in such cases.

A grit chamber will settle out sand, gravel and mud until it gets full, when it ceases to be of any use whatever until it is cleaned. Such a chamber should be so arranged that when it needs cleaning the contents can be discharged by gravity upon a lower area.

The operator of a sewage disposal plant which is provided with a grit chamber should see that this chamber is cleaned out frequently, without waiting for it to become so full that it is rendered inoperative.

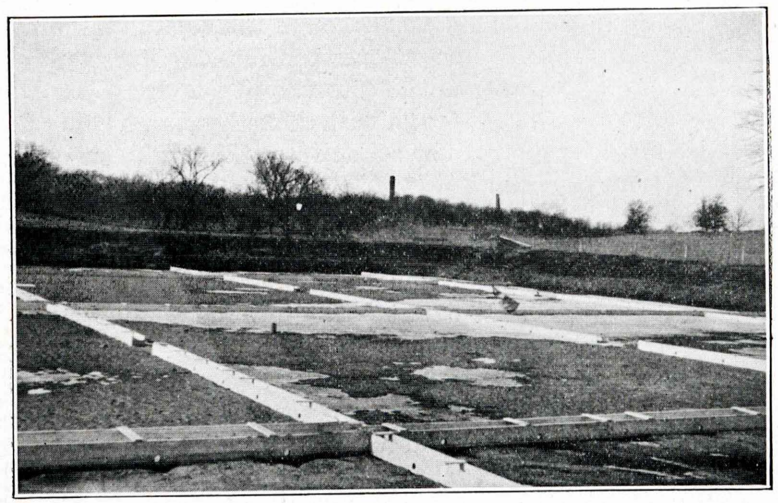
SEWAGE TANKS.

The purpose of sewage tanks is to remove and partially destroy or liquify by bacterial action the suspended solid matter in the sewage. Sewage tanks, therefore, do the same work as cess pools in separating the solids from the liquid part of the sewage; in fact, such tanks may be considered as improved and enlarged cess pools.

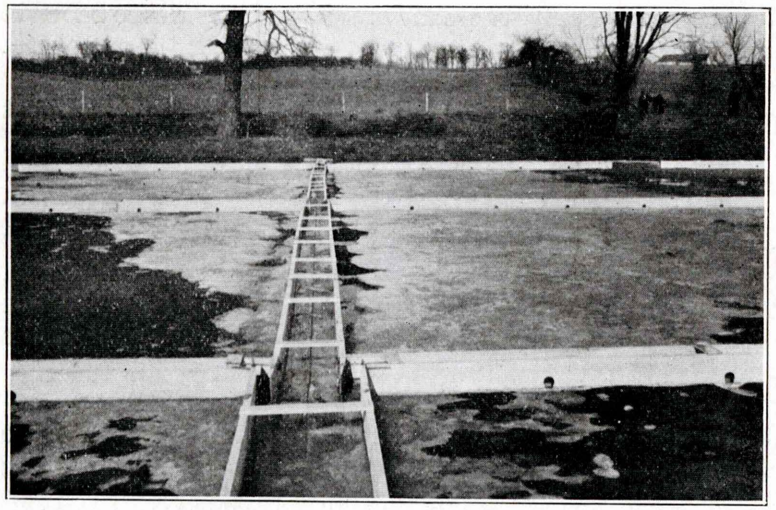
The bacterial action which takes place in the sewage tank is largely due to the so-called "anaerobic" bacteria,

which can live only where air is not present. These bacteria use as food the organic matter which has settled out of the sewage in the form of sludge, and thereby partially destroy it. In order that the bacterial action may take place most effectively, the contents of the tank should not be disturbed by the inflow or outflow of sewage. However, at the very best, the amount of purification which can be effected by bacteria in the sewage tank is comparatively small; it does not usually exceed 25% to 40%. The effluent from such tanks must be considered a foul and dangerous liquid, which cannot be safely discharged into drains, ditches or streams without further purification.

Septic tanks are usually built of concrete, are rectangular in shape, from 6 to 8 feet deep and of a size sufficient to hold from four to six hours maximum flow of sewage. Baffles are usually provided at the entrance to deaden the current and to deflect the suspended matter toward the bottom of the tank, where the sludge collects, and where bacterial action takes place, causing partial purification. If the sewage is not disturbed by the flow through the tank, a scum usually forms on the surface, due partly to materials originally lighter than water and partly to the bacterial action in the tank. This scum may become several inches thick, and thus



INTERMITTENT SAND FILTERS AND DISTRIBUTING TROUGHS AT FAIRFIELD IOWA.



VIEW OF MAIN DISTRIBUTING TROUGH, SHOWING GATES FOR REGULATING FLOW TO LATERALS. FAIRFIELD, IOWA.

keep out both light and air from the sewage, producing conditions particularly suitable to bacterial activity and purification.

The sludge is not entirely destroyed by bacterial action, but continually accumulates in the tank and must be removed from time to time. Although the septic tank ordinarily requires no other attention than the removal of sludge, it is no uncommon thing to find one so full of sludge that the sewage flows through with difficulty, there being no chance for separation of the solids from the liquid, let alone septic action.

Such a tank ought to be arranged so that the sludge can be drawn off from the bottom and discharged on to a lower area or sludge bed; where this cannot be done, sludge pumps should be provided. It ought never to be necessary to remove the sludge by hand labor through the manholes. After the sludge has drained and dried it can be easily loaded on wagons and disposed of in the case of small cities by spreading on fields and plowing under. Large cities might find other methods of sludge disposal necessary.

While the sewage tank is usually the most popular part

of the sewage disposal plant, on account of the fact that it does not require much attention, it can do its work only if the sludge is removed from time to time, without allowing the tank to become filled.

The Imhoff, or so-called two-story tank, is a form of sewage tank which has recently been introduced into this country. These tanks, which consist of two compartments, one above the other, have a much smaller area than ordinary septic tanks, but are much deeper, often having a depth of 30 feet or more. The separation of the suspended matter from the liquid takes place in the upper chamber and the sludge collects in the lower one, where it is not disturbed by the flowing sewage. The bacterial action is the same as in the ordinary type of tank. The bottom of the Imhoff tank is made sloping to more readily concentrate the sludge, which is drawn off on to a sludge area. This type of tank requires much more attention than an ordinary septic tank.

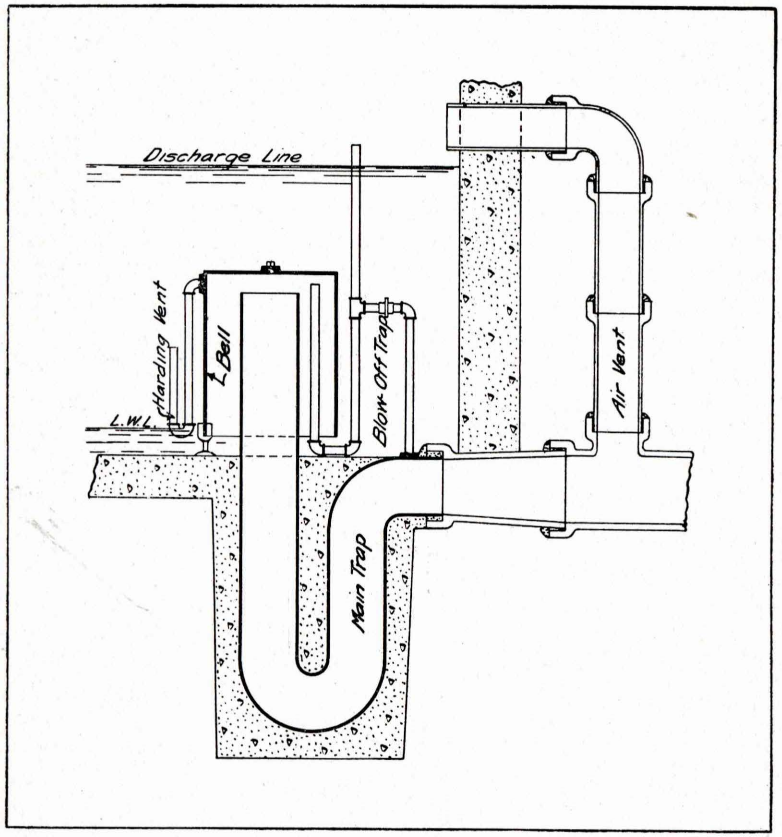
DOSING CHAMBERS.

The dosing chamber is a compartment added to the sewage tank, into which the liquid of the sewage flows after passing through the tank. The dosing chamber serves to collect the liquid sewage until enough has accumulated to cover one of the filter beds to a depth of about 3 inches, when the chamber is automatically emptied by means of a siphon. A dosing chamber is necessary because sewage must be applied to filter beds intermittently, and because it is impracticable to distribute sewage uniformly over the beds unless there be a rapid flow, such as takes place when the dosing chamber is emptied.

The dosing chamber must be kept free from sludge, in order that the siphons may operate properly.

SIPHONS.

Siphons are installed at the outlet of the dosing chamber for the purpose of providing automatically for the intermittent application of large doses of sewage to the filter beds. Siphons appear in various forms in different plants,



MILLER SINGLE SIPHON.

depending upon the size of the plant and the number of filter beds. Where there is more than one filter bed, the siphons are arranged to apply the contents of the dosing chamber alternately to the different filter areas. Sewage siphons were introduced for the purpose of making the operation of the disposal plant as nearly automatic as possible. Since siphons are installed to do away with the attendance which would otherwise be required, the importance of keeping them in working order need hardly be further mentioned.

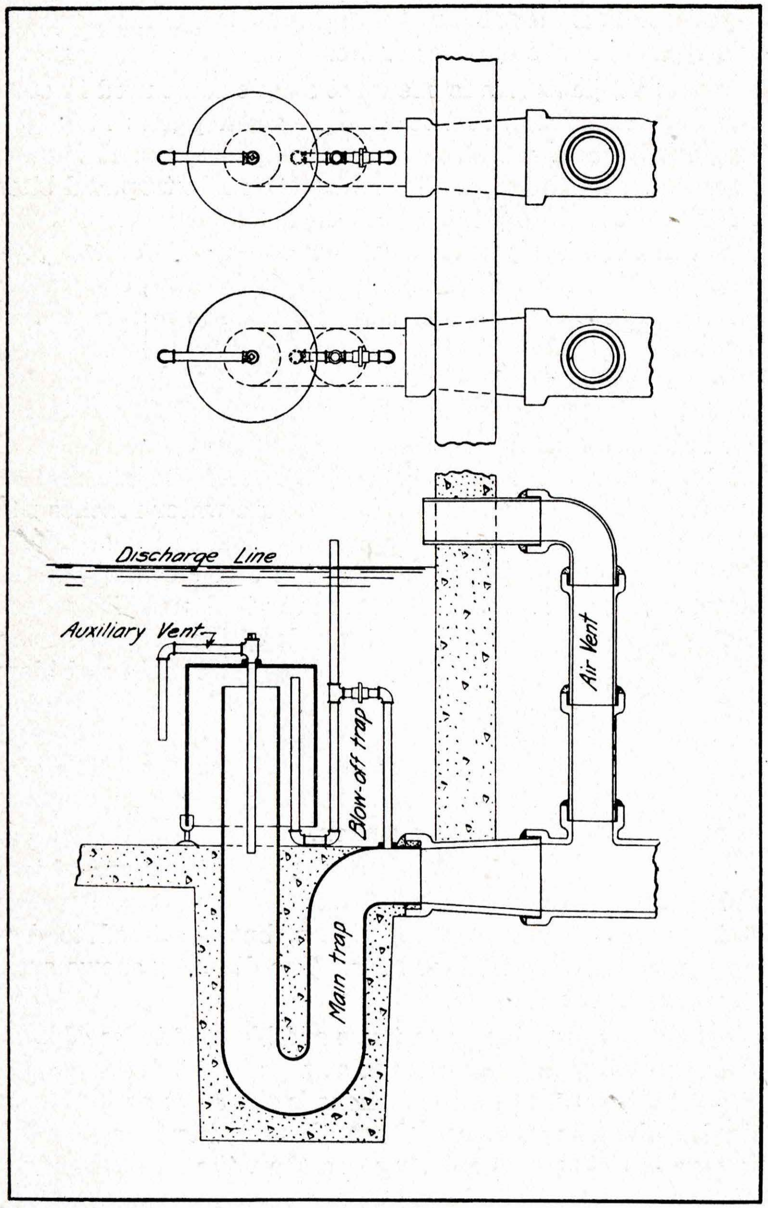
The forms of siphons most commonly used in Iowa plants are the Miller single and Miller double alternating

types, for this reason the principles of operation of these two types only are discussed here.

The single siphon is the most simple form used in sewage disposal plants, and is used in small plants having a single filter bed. A diagram of a single siphon is shown. After starting the siphon by filling the main trap and blow off trap with water, the operation is as follows: As the liquid in the dosing tank rises to the open end of the vent on the side of the bell casting, the vent is filled, completely sealing the trap. A further rise of liquid in the tank exerts a pressure upon the air confined in the siphon and forces the water in the long leg of the main trap down toward the lower bend. The water in the leg of the blow off trap inside the bell is also forced downward by this pressure. As soon as the pressure becomes great enough to force the seal of the blow off trap (which will be when the water reaches the discharge line in the tank) the air confined in the siphon is released, the siphon fills with sewage and discharge takes place. The sewage is drawn down in the tank until it reaches the lower bend of the vent on the side of the bell, when the siphon is broken and discharge ceases. The main and blow off traps being filled with sewage, the siphon is ready for the next operation, which will take place when the sewage level in the tank has again reached the discharge line. The distance from the discharge line to the low water line is known as the drawing depth of the siphon.

A system of double alternating siphons consists of two siphons of the same size and design installed in the dosing chamber without connecting piping, but arranged to discharge on to separate filter beds. The diagram shows such an arrangement.

Starting with the main traps and blow off traps of both siphons filled with water, as the sewage in the dosing chamber rises, the action on the siphons is the same as that on a single siphon, as explained above. During the time that the sewage is rising in the dosing chamber, the water is being gradually forced out of the traps of both siphons, until the seal of one is broken and the siphon operates. Due to the fact that no two siphons are exactly alike, one of them will



MILLER DOUBLE ALTERNATING SIPHON.

discharge under a slightly smaller head than the other. This explains why they do not discharge at the same time, when they are first put in operation. The second siphon is left with its seal unbroken, but with about half the original amount of water in the main trap, whereas the first siphon having just operated, has a full trap. The result is that on the second filling of the tank the second siphon, or the one with the weakened seal, is discharged. On the third filling of the tank, these conditions are reversed and the first siphon having the weakened seal is again operated. Thus it is seen that while it is a matter of accident which siphon operates first when the plant is started up, they alternate regularly thereafter.

In order to control the operation of siphons in proper sequence where more than two are installed, a system of connecting piping is required; however, the action of the siphons is practically the same in all cases.

The failure of sewage siphons to operate properly is usually due to one of two causes; either an air leak in the bell or some part of the piping connected to the bell or the clogging of the apparatus. As any air leaks usually show up shortly after the plant has been built, very few cases of trouble arise from that cause. On the other hand, many cases of trouble are caused by clogging.

An accumulation of sludge around siphons is quite likely to cause clogging. For this reason such accumulations should be prevented and the siphons should be kept clean.

FILTERS.

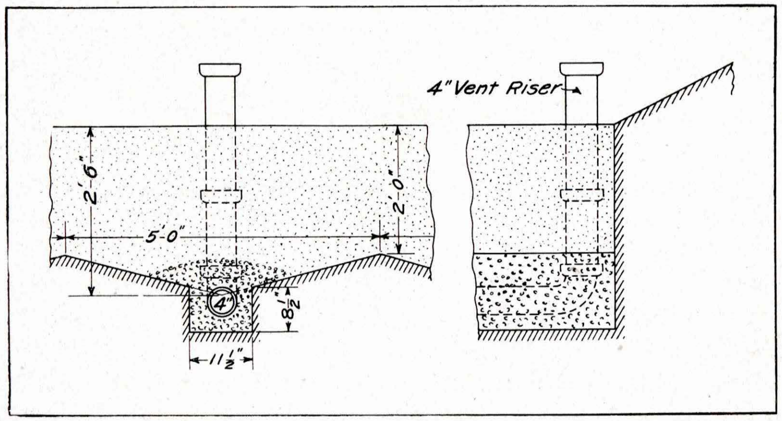
After the sewage has passed through the tank, in order to carry on the process of purification to the point where the effluent can be discharged safely into a stream or other body of water, it is necessary to filter the same. There are two types of filters which are in general use at present, intermittent sand filters and sprinkling filters. Sand filters are in common use in Iowa, although installations of sprinkling filters are being made at the present time.

Sand filters should be made of clean, coarse sand. For satisfactory operation, the sewage must be applied to them in intermittent doses, and the surface of the sand kept in such loose and clean condition that the sewage will disappear entirely within a very short time after the application of each dose of the sewage. Sand filters will not work satisfactorily when the surface is kept flooded, as under these conditions the bacteria which effect purification cannot exist.

In sewage filters, the purification is effected by the agency of "aerobic" bacteria, or those which require oxygen to live. In the case of sand filters, the purification germs do the most of their work at the surface of the filter.

When a sand filter is constantly kept flooded with sewage, the aerobic bacteria cannot live, because they have no means of getting oxygen. By applying the sewage in intermittent doses, which disappear after the application of each dose, air is drawn down into the pores of the sand as the sewage disappears and oxygen is supplied to keep the bacteria which cause purification alive. Hence, the surface of sand filters must be kept loose and clean.

Mr. Lafayette Higgins, engineer of the Iowa State Board of Health, recommends the construction of sand filters according to the following diagram. Mr. Higgins states that the general idea of this form of filter originated at Iowa State College.



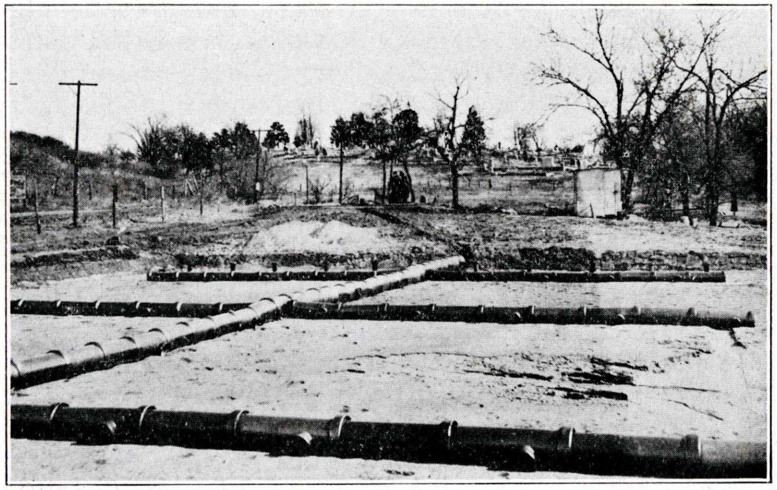
FORM OF INTERMITTENT SAND FILTER RECOMMENDED BY STATE BOARD OF HEALTH.

The construction shown provides for a clear depth of 24 inches of filter sand above the summit of the slopes which form the shallow valleys, the valleys being 6 inches deep. At the bottom of the valleys shallow trenches are made, in which are placed the under-drains. Under, around and over the under-drains is placed selected gravel of small size. At the head of the under-drains are placed suitable risers, extending one foot above the top of the filters. A slow gradient may be given the under-drains by deepening the trenches toward the outlets of the drains. The under-drains, which are five feet apart, connect into an interceptor drain of sewer pipe of rather large diameter, in ordinary cases, 12 inches. These under-drains may be constructed of hard burned farm tile 4 inches in diameter, or of 4 inch sewer tile. In either case, the pipe should be in foot lengths.

Some engineers supply enough gravel to entirely fill the valleys. Other engineers have steepened the valleys greatly, some of which designs use a minimum amount of gravel, while others entirely fill the valleys. Other engineers carry the excavation uniformly over the entire bed and provide 6 inches of gravel, under which gravel the under-drains are placed, usually in trenches. Such designs usually require 24 inches of sand and 6 inches of gravel, plus the gravel under and around the drains.

The design as shown provides for 3811 cubic yards of sand and gravel per acre, of which about 530 cubic yards are gravel. If an average depth of 6 inches of gravel be provided as a base for 24 inches of sand, and the under-drains laid 5 feet apart in trenches with gravel beneath and around the drains, such gravel will amount to about 1130 cubic yards of gravel per acre. There is, therefore, a difference of 600 cubic yards of gravel in these two methods. Part of the extra cost thus incurred would be offset by the release of the labor of grading the valleys in the bottom of the filter beds, but there would remain an excess cost which should be avoided in most cases.

Suitable sand for intermittent sand filters has been variously specified by different engineers. Some specify a clean, coarse, sharp sand, and again there are some engineers who



INTERMITTENT SAND FILTER AND DISTRIBUTERS AT ALBIA, IOWA.
ANOTHER VIEW OF SAME PLANT IS SHOWN ON FRONT COVER.

simply specify clean sand. There seems to be one point of agreement, and that is that the sand should be clean, although this requirement has not been made for many years, and many failures of filter plants have been partly due to the fact that the sand used contained a considerable percentage of silt. The State Board of Health has given the matter of choice of filter sand a great deal of attention, and should be consulted concerning the suitability of any proposed sand, either for new filters or for replacement in old ones.

The gravel used in the bottom of the filters surrounding the underdrains prevents the sand from entering the underdrains and assists in the aeration of the beds. Evidently very coarse gravel is not suitable.

The usual size of filter bed is about 50 feet by 150 feet, the number of such beds in any plant depending upon the amount of sewage to be disposed of.

The sewage is distributed uniformly over the filters by means of distributors of sewer pipe, concrete or wood. Views of filter beds showing the distributors are shown.

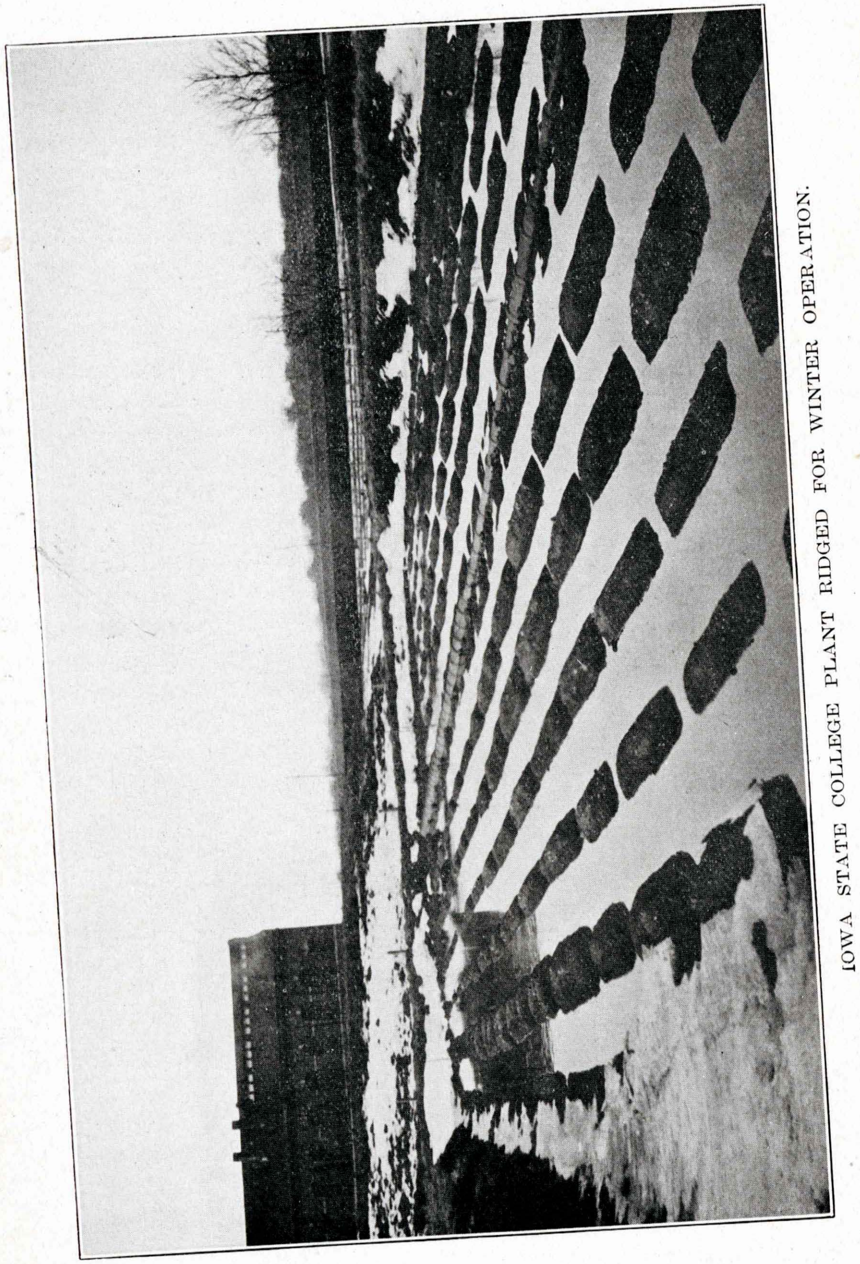
Filter beds constructed according to correct principles may be operated at rates varying from 100,000 to 150,000

gallons per acre per day, if properly taken care of. At present filter areas generally are calculated on the basis of one acre of filter for each 100,000 gallons of sewage per day. Results of experiments show that the most desirable dosing for filter beds with sewage which has undergone preliminary tank treatment, is sufficient sewage to cover an area equal to that of one filter to a depth of about three inches. The rate of operation depends largely upon the amount of care which the filters receive.

A common cause of trouble is the overloading of the filter due to an increase in the amount of the sewage as the community grows, or increased use is made of the sewers. Additional filter beds must be added to take care of the increased amount of sewage, as soon as the original filters become overloaded. Increased operating care often can be made to take care of overloads, temporarily at least. As an example of this, the college plant recently has been working successfully at the rate of about 350,000 gallons of sewage per acre of filters per day. This was possible only by keeping a man continually on the job, who gave the strictest attention to operating details. As soon as cold weather set in it was found impossible to maintain this high rate, and the college experience is all against the wisdom of rates higher than 150,000 gallons per acre per day.

To secure satisfactory results, the surface of filter beds must be kept clean and open and practically level. Whenever sewage stands on the beds over a few minutes after dosing, indicating a temporary clogging of the surface, such clogging must be remedied. This may be done by breaking up the surface, ordinarily less than one inch in depth. When such treatment no longer gives the desired result of rapid disappearance of the dose of sewage, it may be necessary to remove the scum, or deposit, formed on the surface and with it a small amount of sand. Such removal will usually total less than two inches per annum, but whatever the amount may be, it must be removed. The proper care of filter beds requires the services of at least one intelligent workman for each plant, and more for large plants.

The operation of sand filters in the winter is more diffi-



IOWA STATE COLLEGE PLANT RIDGED FOR WINTER OPERATION.

cult than at other times. For one thing, the cold weather lessens bacterial activity to a certain extent, thus making it difficult to secure as high a degree of purification as in warm weather. As a matter of fact, it seems to be the general opinion that a high degree of purification is not as necessary in winter as in the summer.

In order to prevent the freezing of the sewage on the surface, thus sealing the filters and rendering them inoperative, filter beds are usually "ridged" for cold weather operation, so that when the beds are dosed the sewage flows in the gutters formed between the ridges. If freezing takes place, the ice formed on the top of the sewage will remain suspended on the ridges and succeeding doses of sewage will flow underneath the ice. The ridges should be thrown up every three or four feet, and not be any higher than necessary to prevent freezing at the surface of the bed. At the close of the cold period the valleys between ridges must be freed from all deposit, or scum, before leveling down the ridges for warm weather operation. All dirty sand should be removed at this time, in order to keep the beds clean.

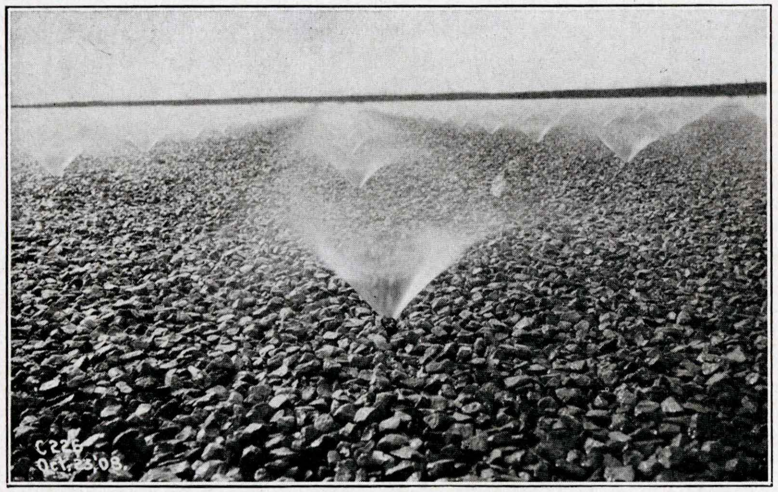
Sprinkling filters are made of coarser material than sand filters. Usually pebbles screened free of sand, or crushed stone are used, the sizes commonly used being from 1/4 inch to 2 inches. A filter of this coarse material has air passages throughout of sufficient size to permit the circulation of air when the sewage is trickling through, and hence the aerobic bacteria can be kept alive even when the sewage is applied continuously. However, it is necessary to have the sewage sprayed over the surface, as otherwise it would flow through this coarse material so quickly as hardly to come in contact with the bacteria at all, and it would fill the pores of the material so as to exclude air and destroy the bacteria of purification. In such plants the sewage is usually sprayed over the surface from nozzles, and in passing through the air the drops of sewage are freed from objectionable gases and take up oxygen.

The effluent from a good sand filter, properly cared for, is clear and odorless, and has a very small percentage of bacteria left in it. The effluent from sprinkling filters is not nearly so good in appearance as that from sand filters, and will have a much higher percentage of germs remaining, but if the sprinkling filters work properly, the effluent therefrom will not be subject to further putrefaction.

CAUSES OF SEWAGE DISPOSAL NUISANCES

While a sewage disposal plant is not inherently a nuisance, cities having such plants are legally responsible for their operation, to the extent of being liable for any damages resulting from their failure to operate efficiently, no matter what the reason for such failure may be.

In order that a sewage disposal plant may not be the cause of a nuisance the entire plant should be kept in good condition. Practically all nuisances in connection with such plants can be traced directly to failure to give them proper attention.

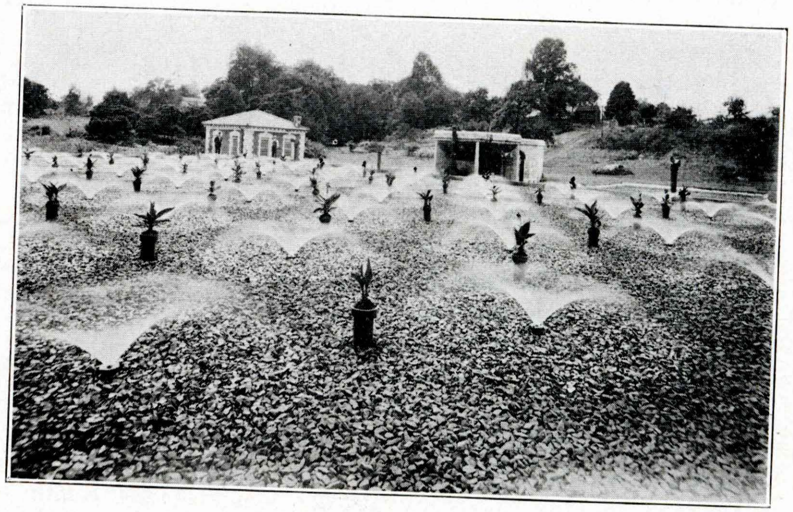


A LARGE SPRINKLING FILTER, COLUMBUS, OHIO.

Sewage disposal plants are usually placed as far as possible away from dwellings. While it is perfectly possible to operate such plants without giving offense to nearby property holders, no one cares to have such a plant nearby if it can be avoided. Wherever the plant may be located, its appearance should be considered. Weeds and grass should

be cut at regular intervals. Some communities are making commendable efforts to beautify their sewage disposal plants. The illustrations show what can be accomplished in this direction.

A common source of sewage disposal nuisance is pollution of the stream below by sewage which has not been sufficiently purified, and is putrescible. The filter beds should not be allowed to get into such condition that it becomes necessary to by-pass sewage into the water course. Unfortunately, Iowa towns have been hampered in the construction of sewage disposal plants by lack of funds. On this account only such filter areas as are considered absolutely necessary are built, with the result that they are soon overloaded and get into bad condition.



SPRINKLING FILTER AT HARRISON, N. Y., THE APPEARANCE OF WHICH HAS BEEN IMPROVED BY PLANTING.
Photo by courtesy Alexander Potter, N. Y.

For proper maintenance additional filter area should be provided as soon as the original beds become overloaded. Often times, due to neglect, the upper part of the filters becomes dirty, causing ponds of sewage to form on the beds. This is probably the greatest source of trouble in sewage disposal plant operation.

Failure to promptly remove the sludge from the tank may result in solid matter being carried on to the filters, causing them to clog. When large quantities of sludge are removed from the tank at one time, there is liable to be considerable odor while the sludge is drying. This is another argument for frequent cleaning of the tank.

Industrial sewage often causes nuisances around disposal plants. A common cause of trouble is creamery waste, which contains small particles which do not decompose readily during treatment. Grease in any considerable quantity is a source of difficulty. Grease traps are effective in such cases only when cleaned out very frequently. Packing house sewage and gas plant refuse are frequently sources of nuisance around sewage disposal plants. Such wastes should be given special treatment before being allowed to enter the sewers, and in some cases must be disposed of otherwise.

RECOMMENDATIONS ON OPERATION

A sewage disposal plant can not be operated directly by the city council any more than a water supply system could be handled in that manner. The plant should be in charge of some one who is responsible to the council for its satisfactory operation. The man in charge should see that the necessary work around the plant is done regularly and should have authority to hire the necessary labor done.

In connection with the operation of the plant, permanent daily records should be kept of the amount of sewage; the condition of the tank, dosing chamber, siphons, filters, etc.; the work done at the plant, etc. A form of record is suggested on the following page. Each superintendent should have blank records for suitable data concerning his own plant. These records are of special value in case of enlargement of the plant; in showing the cost of operation, and in case legal questions concerning the plant arise.

The whole problem of satisfactory sewage disposal plant operation is that of having some one responsible in charge of the plant to see that it is kept in good condition.

CITY OF..

DAILY SEWAGE DISPOSAL PLANT RECORD

Date....................191.... Temp............ Rain or Snow............In.

Gallons of Sewage.................. ....

Condition of Grit Chamber ....

Condition of Sewage Tank..

Condition of Sludge..

Condition of Dosing Chamber..

Condition of Siphons ....

Condition of Valves ....

Condition of Filter No. 1..

Condition of Filter No. 2..

Condition of Filter No. 3..

Condition of Filter No. 4..

Condition of Filter No. 5..

Condition of Filter No. 6..

Character of Effluent ....

Condition of Outlet Stream..

Was any Sewage by-passed around Tank?..........................

Why? ....

Was any Sewage by-passed around Filters?..........................

Why? ....

General Condition of Plant ....

Work done on Plant today..

Remarks ....

....

Signed..