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GRIT CHAMBERS AND SEWAGE SCREENS

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CONFERENCES on sewage treatment are held annually at Iowa State College under the auspices of the Engineering Extension Department. These meetings are of a practical nature and are arranged for municipal officials and all others directly or indirectly responsible for the operation of sewage-treatment plants.

This publication is one of the more general papers that were presented at the 1926 conference. Several others from this meeting are to be published. In addition to the more formal papers, considerable time on the program was devoted to the consideration of sewage-treatment plant construction and operation, as well as to the individual problems of those in attendance.

GRIT CHAMBERS AND SEWAGE SCREENS

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The annual conference on Sewage Treatment is held for the benefit of those city and town officials of the State of Iowa interested in the operation of sewage works already constructed. In this discussion of Grit Chambers and Sewage Screens, therefore, an effort will be made to present useful information in non-technical form. As by far the majority of plants now in operation in Iowa serve municipalities with populations ranging from five hundred to two thousand, emphasis will be placed on equipment of types and designs usually found in installations of relatively small capacity, suitable for such communities.

The use of grit chambers and coarse screens usually forms the first step in sewage treatment, regardless of the size or type of the plant. Generally speaking, they are used in conjunction with the plant for protective purposes; that is, to free the sewage entering the plant from such material as would injure pumps or other machinery, or interfere with the proper progressive treatment of the sewage. In other words, the grit chamber is designed to remove sand, stones, and similar heavy materials, while the coarse screen removes the large lighter material, such as sticks and rags. Either of these classes of matter would injure pumps or fine screens, and heavy mineral matter in any quantity hampers the digestion and pumping of the sludge, while the lighter material helps to form a floating scum which is to be avoided.

Many of the older sewer systems were a combination of sanitary drains and storm water sewers. They not only carried off the household wastes, but took care of the surface water from the streets as well. The first street washings of each storm carried great quantities of sand and pebbles. It was, of course, necessary to remove this heavy material before the sewage entered the treatment works proper. Also at times of heavy rainfall the sewers flowed full and the velocity was high. The only way to remove these heavy solids was to slow up the velocity sufficiently to allow the stones and sand to settle out. This was accomplished by running the sewage through a small tank or grit chamber which served to widen the area of flow, checking the speed or velocity, whereupon the objectionable material settled to the bottom and the sewage passed on through to the tanks. If this grit chamber was designed to serve its purpose during times of heavy rainfall when the rate of flow was high, trouble was encountered during dry seasons, when no storm water was running and only domestic sewage was carried by the sewers. A grit chamber big enough to slow up the heavy storm water run-off

would during the dry season slow the smaller flow of domestic sewage to such an extent that organic matter would settle and become septic. The grit chamber then became a miniature septic tank, interfering with the delivery of fresh sewage to the main tanks.

Under today's conditions, nearly all our sewerage systems have been separated so that the storm water is disposed of in one system of sewers, and the house drainage and industrial wastes in a separate system. The quantity of stones, sand and grit in the sanitary sewer system is, therefore, greatly reduced and the variation in flow during rains is not nearly as marked as it is in the combined system. A considerable quantity of grit still finds its way into the sanitary sewers through vent-holes in street manhole covers, from automobile wash-racks, etc. The grit chamber is still a necessity, though a troublesome one.

The average sewage disposal plant is designed to care for the entire population within the sanitary districts, and the several units of the plant are amply large to take care of the situation when all houses have been connected with the sewer system. Yet, during the first few years of a plant's operation, the quantity of sewage reaching it is only a small proportion of its capacity. During these first few years, the rate of flow is small. The velocity of the sewage passing through the grit chamber is therefore low, and as before stated, organic matter is deposited and the grit chamber becomes septic.

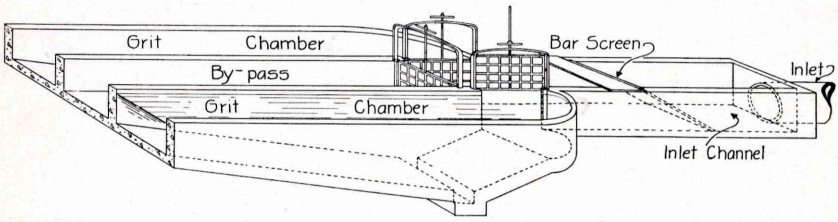
Quite often no means of cleaning the grit chamber except by shoveling is provided. The result is that it is seldom cleaned. The actual grit is mixed with foul-smelling organic matter and usually no means of disposal is provided. You have no doubt seen grit chambers so clogged with sludge and scum that only a narrow flow area was left for the sewage to pass through, thus defeating its purpose and rendering it the foulest place about the plant. Some grit chambers are provided with a valved outlet and a by-pass line to the outlet stream, whereby the operator can drain them frequently during times of high water when the filth will be carried away without apparent damage. Other plants have no river or stream outlet, hence no such easy way of disposal presents itself.

I think our tendency as engineers is to design grit chambers too large. I believe that if half the grit chamber area in most of the plants I have seen, including those of our own design, were walled off and the capacity cut in half, the grit would still deposit and a great deal of the organic matter would not. In come cases, this could easily be done by providing duplicate chambers, one to operate while the other is being cleaned. The discussion of the disposal of the grit chamber sediment will be left until the matter of screens has been discussed.

Sewage screens are of two general classes; coarse screens for the removal of sticks, rags and similar foreign materials; and fine screens for the removal of as much organic matter as possible.

Coarse bar screens, or gratings in conjunction with grit chambers are good insurance for the satisfactory operation of the balance of any plant, small or large. Fine screens, mechanically operated, are advisable only in large installations warranting the constant employment of caretakers. Screens having coarse openings larger than one-half inch are usually termed "coarse screens," although most coarse screens have one-inch openings or larger.

There are four general types of fine screens; the band screen, the wing screen, the drum screen and the inclined disc screen. The band, or revolving screen, consists of a broad belt of fine screen material running over two broad rollers, which are power-driven. The lower roller is of open construction and offers but little resistance to



Grit chamber and coarse screen.

the passage of sewage through it. It is set well below the level of the sewage in a rectangular shaped flume or channel. The upper roller is set well above the level of the sewage and the revolving belt connects the two at an angle of about thirty degrees with the horizontal. The rollers revolve and the up-stream belt moves slowly upward as the sewage passes through, carrying the screened material on its surface. A revolving brush near the upper roller cleans the belt screen and deposits the screenings in a trough ready for disposal.

The wing, or shovel vane screen, operates like the stern paddle-wheel of a river steam-boat, the paddles being replaced by fine screens and the wheels set across the sewage channel. The floor of the sewage channel is hollowed out, so that the edge of the screen makes a close contact with it, forcing all the sewage to pass through the screens. These paddle screens are cleaned by brushing after they have reached the point above the sewage level.

The drum screen is a long revolving cylinder. The sewage flows into one end of this cylinder and as it rotates the screenings are carried upward and dumped on a conveyor which runs through the cylinder near the top from end to end. The screen is cleaned by jets of air or water.

The inclined disk-end cone type consists of a large circular disc of perforated brass set down in the sewage channel on such an incline that its upper half is above the water level. As the disc revolves, the sewage flows through the fine slots in the disc, and the

screenings are carried up above the water level and brushed off by revolving brushes.

In the majority of installations, these fine screens find a variety of uses. Sometimes they precede the further tank treatment and in some cases they are located between the tanks and trickling filters for the purpose of reducing the amount of clogging in the nozzles.

In the last analysis the problem of the sanitary engineer is to remove objectionable matter from sewage at the least possible cost. Each city or town has its separate problem. In many cases the fine screen has proven its worth, though they are not generally necessary or adaptable to the majority of small town plants thus far constructed in Iowa, and they are therefore simply mentioned in passing.

There are two general types of coarse screens; the rack, and the grating. You are all familiar with the rack. It is simply a series of parallel bars or rods extending from well above the sewage level to the bottom of the rectangular channel through which the sewage is flowing. The grating is built and placed in the same manner, except that it has cross bars at frequent intervals, reducing the size of the screen openings. The rack type predominates.

As before stated, the coarse screen is usually set in connection with the grit chamber, and sometimes between the grit chamber and the tank, the latter location seems to be advisable. Sewage passing through the coarse screen often eddies, and these eddies tend to cause a deposit of the heavier organic matter. The chance of this deposit occurring in the grit chamber where it is not wanted is less if the screen follows the grit chamber than if it precedes it. Set at an angle of about thirty degrees with the vertical, the rack type of coarse screen is easily cleaned with an ordinary hand rake, so constructed that its teeth mesh with the bars of the rack. They should be cleaned at frequent intervals.

A clogged screen causes organic matter to deposit in the grit chamber. It frequently raises the water level in the grit chamber to such an extent that the sewage is backed up in the inlet sewer for a considerable distance causing deposit of sludge in the sewer itself, and the formation of scum. I have seen a serpent of scum six hundred feet long come winding out of an inlet sewer when a screen was first cleaned and the water level lowered.

And now comes the question of how to best dispose of the screenings and the accumulations in the bottom of the grit chamber. Operators have told me that they raked the screens regularly and put the screenings over into the main tank as being the easiest way of getting rid of them. In such a case, the screen is a nuisance to the operator and of no benefit to the plant. While the trash on a coarse screen or on the bottom of a grit chamber is not strictly sewage or sludge, it is so saturated with organic matter, partially decomposed, that it is offensive to the eyes and nose and cannot well be drawn

out on the sludge drying bed. The best solution of the problem is to dig a pit near the grit chamber outside the plant and bury the trash, covering it well with earth.

For small plants a pit four feet square and five feet deep will take care of several months' accumulations without offense and without any great expenditure of labor. The cleaning and burying should be done at regular intervals of, say, once in two weeks in the plant caring for populations of from eight hundred to one thousand. There is much more chance of getting this work done in frequent installments which do not call for much labor, than there is of getting a nasty, distasteful job of considerable size done once a year. The only tools necessary are a garden rake with teeth properly set, a square end shovel bent to scrape the bottom from above, and a galvanized bushel basket. This work is just as essential to the complete and proper operation of the plant as any other single detail.

Like many other details of plant operation, the care of the grit chambers and sewage screens is a small matter if attended to, but a big item if overlooked.

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