

SEWAGE DISPOSAL.

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Civilization and education has been accompanied by a wonderful growth of cities and has made the problem of sewage disposal one of civic, state and national importance.

Sanitation becomes of greater importance as communities become more congested.

It is only of late years that this question has received proper attention, the greatest progress having been made in the last few decades. The combined efforts of the scientist, chemist and engineer have been called upon to help solve this problem of ever-increasing importance.

Improper disposal of sewage has caused directly or indirectly a large percentage in the typhoid mortality rate.

The gathering of large numbers of people calls for additional safeguards and means of sanitation. In some instances sewage can be disposed of by dilution, discharging direct into large bodies of running water; but most streams are as a rule not of sufficient size, or are already so polluted that additional sewage would increase the burden already too large.

Generally sewage is diluted with the entire water supply of a city and is a dirty appearing water, containing a greater or less percentage of organic matter. There is usually enough organic matter present to make it disagreeable and to cause odors. The presence of various disease germs also make it a source of pollution to water bodies.

In general all methods of sewage treatment employ the principle of reduction through microscopic organisms. Bacteria of various kinds attack the organic compounds reducing them to simpler forms, doing so through successive stages. Reduction takes place through two classes of bacteria, namely aerobic (thriving in the presence of oxygen), and anaerobic (thriving in the absence of oxygen). These two processes occur in septic, Imhoff or other tanks and in various forms of filters.

The most prevalent form of getting rid of sewage is by dilution. Where the stream is sufficient in size to allow proper oxidation the sewage

will be properly taken care of without objectionable odors. Such a stream however should have a flow of about 300 cubic feet per minute for each 1,000 inhabitants. Instances where disposal by dilution alone is sufficient are not many and usually some additional treatment is necessary, suitable to local conditions.

If the stream into which the sewage is to be discharged allows of partial dilution, treatment by some properly designed form of tank may be

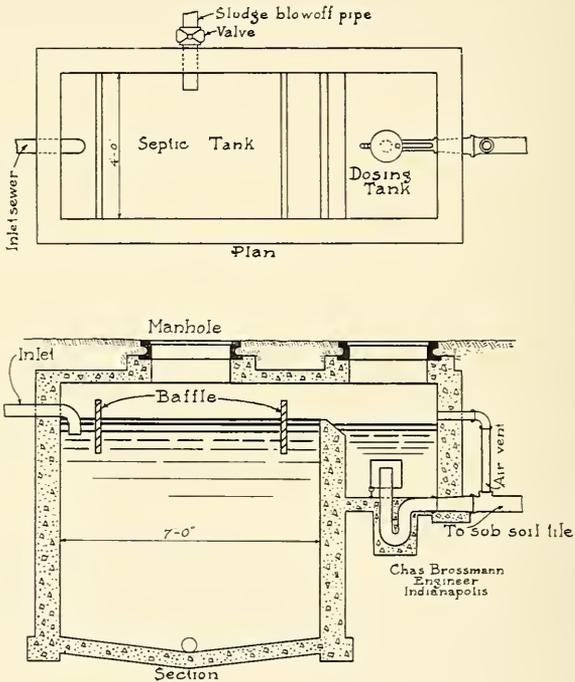


FIG. 1.

Type of Septic Tank Suitable for Ordinary Dwelling.

sufficient, but tank treatment alone will not always suffice. Tank treatment is but a step in the purification of sewage and should usually be followed by some form of filtration or after treatment. Various forms of tanks can be used but the type and size that insures the best results can only be determined after proper investigation of all conditions—as the number of people, amount of sewage, the rate and the time of flow, the

location of adjacent property and the size of the water course into which the treated sewage is finally discharged; all are important and enter into the proper solution of this important question. ?

Tank treatment, therefore, is essential as the first step in sewage reduction, and is necessary in order to retain and break down the solids, but it must not be supposed that it purifies the remaining sewage liquor. The tank treatment is necessary in preparing the sewage liquor for further purification. Such tanks can be made in the form of plain settling tanks, a septic tank, or a combination of both.

The public will universally call any tank (even a cesspool) a septic tank, and usually they believe that a septic tank absolutely purifies the sewage. Such is not the case, a reduction from thirty to sixty per cent. of

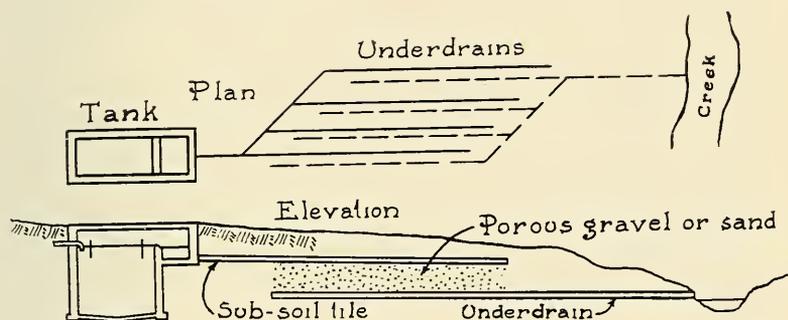


FIG. 2.

Septic Tank and Natural Sand Filter for Small Installations.

suspended matter and around thirty per cent. in organic matter is usually what takes place. The tank will not take care of very fine particles or colloidal matter. Such matter (colloidal) being in condition just between suspension and solution. The best results are obtained when the solids are taken out or retained as quickly as possible and the subsequent liquor remaining immediately treated. It is important that liquor be not retained too long or it will become in a toxic condition. Time is an important element in the proper design of a tank, also the state of the sewage in reaching the tank.

Septic tanks are usually designed for a rate of flow, of from eight to sixteen hours. The more modern type of tank with two compartments, one for settling and one for sludge digestion, are usually designed with a rate of flow of half (or even less) than the above.

The septic tank is usually a rectangular shaped chamber with several baffle boards, extending across to break the flow of the sewage. Such tanks should be covered as the organisms that break down the solids (known as anaerobic bacteria) thrive best in the absence of air and light. Septic tanks usually take some time to become operative, a scum mat forming at the top and sludge at the bottom. At intervals such tanks must be cleaned of the sludge. It was formerly supposed that just as much solid matter was turned to liquid and gas to offset the amount of solids

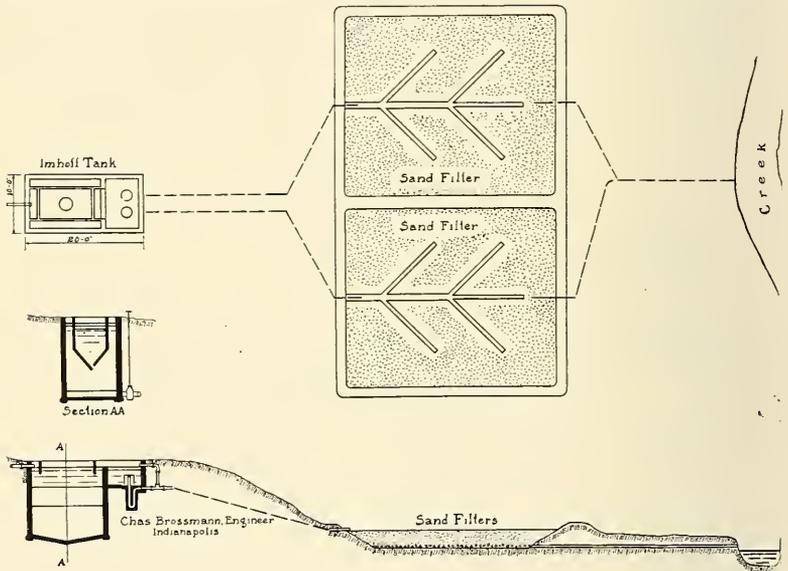


FIG. 3.

Imhoff Tank and Sand Filters Installed at Indianapolis Country Club

coming in, however, it has usually been found necessary to clean out the resultant sludge at intervals. (See figure 1.)

The Imhoff type of tank consists of two chambers, one for settling and one for the deposit and digestion of sludge. Such a tank, while somewhat more expensive than the plain tank is smaller and will give more uniform results, besides offering better means for after-treatment of the liquid and assuring a better solution of the sludge problem. (See figure 4.)

This type of tank has an upper settling chamber with a slotted opening at the bottom. The sewage in flowing through the upper chamber deposits

the solids into the sludge chamber below. In the sludge or digestion chamber below, the solids and organic matter is gasified and liquified independent of and without disturbing the settling matter above.

The gases of decomposition and the constant agitation in the lower part does not disturb the sewage in the settling chamber, furthermore albumen from the fresh sewage is not constantly added to the septic sludge; hence there is less odor and the sewage liquor is delivered in a fresher condition for after-treatment. The sludge from this type of tank dries out quicker, is in better condition for disposal, has less water content, and has different characteristics than sludge from a shallow tank which is kept in



FIG. 4.

Imhoff Tank, Julietta, Ind. Note Formation of Sludge on Sides.

constant contact with the sewage. Such double tank sludge soon becomes spadable like garden compost.

The tank treatment should be followed by dilution or some form of filtration. In some cases the sewage liquor from tanks can be discharged into a water-course. Usually it is necessary to use some form of filter or nitrification bed. This can be done in the following manner:

(1) In small plants by discharging the sewage into tile laid near the surface of the ground. Such ground must be suitable for the sewage to percolate through to a subdrainage system below. Such ground should be gravelly or of sand. (See figure 2.)

(2) By discharging the sewage into contact beds, viz., a water-tight bed, filled to a depth of several feet with broken stone or other hard

material, the sewage being automatically discharged on to the bed, retained a fixed period, and then discharged from the bed. In such a bed absorption and oxidation of the organic matter is accomplished by aerobic bacteria, viz., those which thrive in the presence of air. (See figure 5.)

(3) Sand filters: As the sewage from tanks can be discharged on sand filters—automatically dosed as in contact beds. Such sewage covers the surface of the bed and gradually works through to the underdrains below, the action being that of filtration and nitrification. If a very pure effluent is desired the sewage can be discharged from the tank to the con-

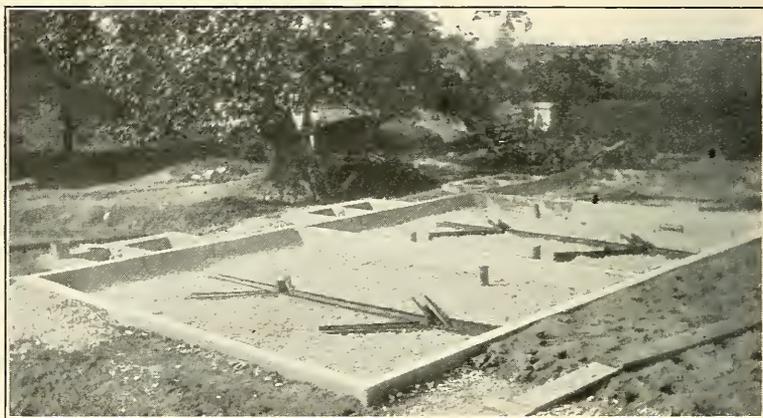


FIG. 5.

Contact Beds, Julietta, Ind.

tact bed and then be treated through the sand filters. In a properly designed plant this will give a very clear effluent. (See figure 6.)

Sprinkling Filters: In the larger plants sprinkling filters are largely used. These consist of beds of broken stone, usually of a depth of six feet or more and are arranged for good underdrainage. The sewage is automatically discharged over the top of the bed by sprinkling nozzles; trickles down through the stone and out through the underdrains. Such beds can be worked at a higher rate than any of the preceding methods, hence a smaller area is required, which makes this method more adaptable for large installations.

DISPOSITION OF SLUDGE.

The real problem in sewage disposal plants is the sludge problem. Engineers are just learning how to make sludge but in most cases have not found a satisfactory solution in disposing of it. In larger plants the sludge question is the stumbling block.

Sludge may be roughly divided in two classes, that from shallow tanks and that from deep tanks. Sedimentation tank sludge is a black semi-

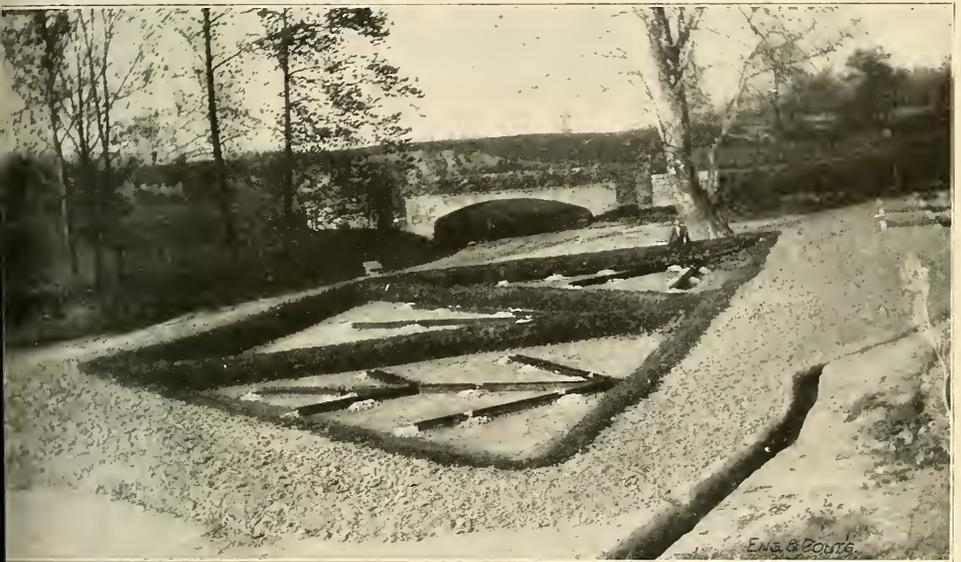


FIG. 6.

Sand Filters, Julietta, Ind.

liquid mass which on being exposed to the air becomes offensive, giving off much gas and odor. The water contained from such sludge is usually 90 to 95%.

The sludge from septic tanks ranges all the way from 8 to 45 cubic yards per million gallons of sewage. Septic sludge which has been retained in tanks for a number of months undergoes a great change. The organic matter is attacked and partly gasified and liquified, which reduces the amount of sludge. Such sludge in well operated tanks is a con-

centrated mass containing from 80 to 90% of water; there is not as much odor to septic tank sludge as to the fresh sludge from the plain settling tanks.

The above outlines the principal methods of sewage disposal. It must however be borne in mind that the proper method is wholly decided by local conditions. Care must be exercised in order that the various factors affecting the problem be carefully considered.

A fuller realization of the sewage disposal problem is being evidenced throughout the country as the years go by, both by the state and health officers and city officials. The State has done a great deal of preliminary work in the way of sanitary surveys and this work should be heartily indorsed and commended. However, there is still much to be done, and

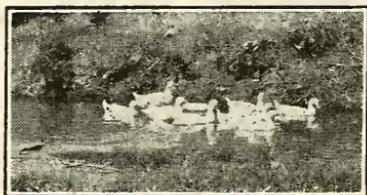


FIG. 7.

Water Fowl in Stream, Julietta, Ind., 100 Feet Below Sewage Plant.

Photo taken 2 years after plant was installed. Formerly all waterfowl died from drinking water.

undoubtedly some method of maintaining public control of the streams will have to be devised before the question of pollution can be properly taken care of.

There are so many different factors entering into this question that the best solution can only be worked out with a proper organization which will take into consideration every phase of the question and which can reach every district, affected, whether this territory be in one or more States. The state authorities should be given the power to pass upon every sewage disposal problem and they should have the proper means and support for doing this.

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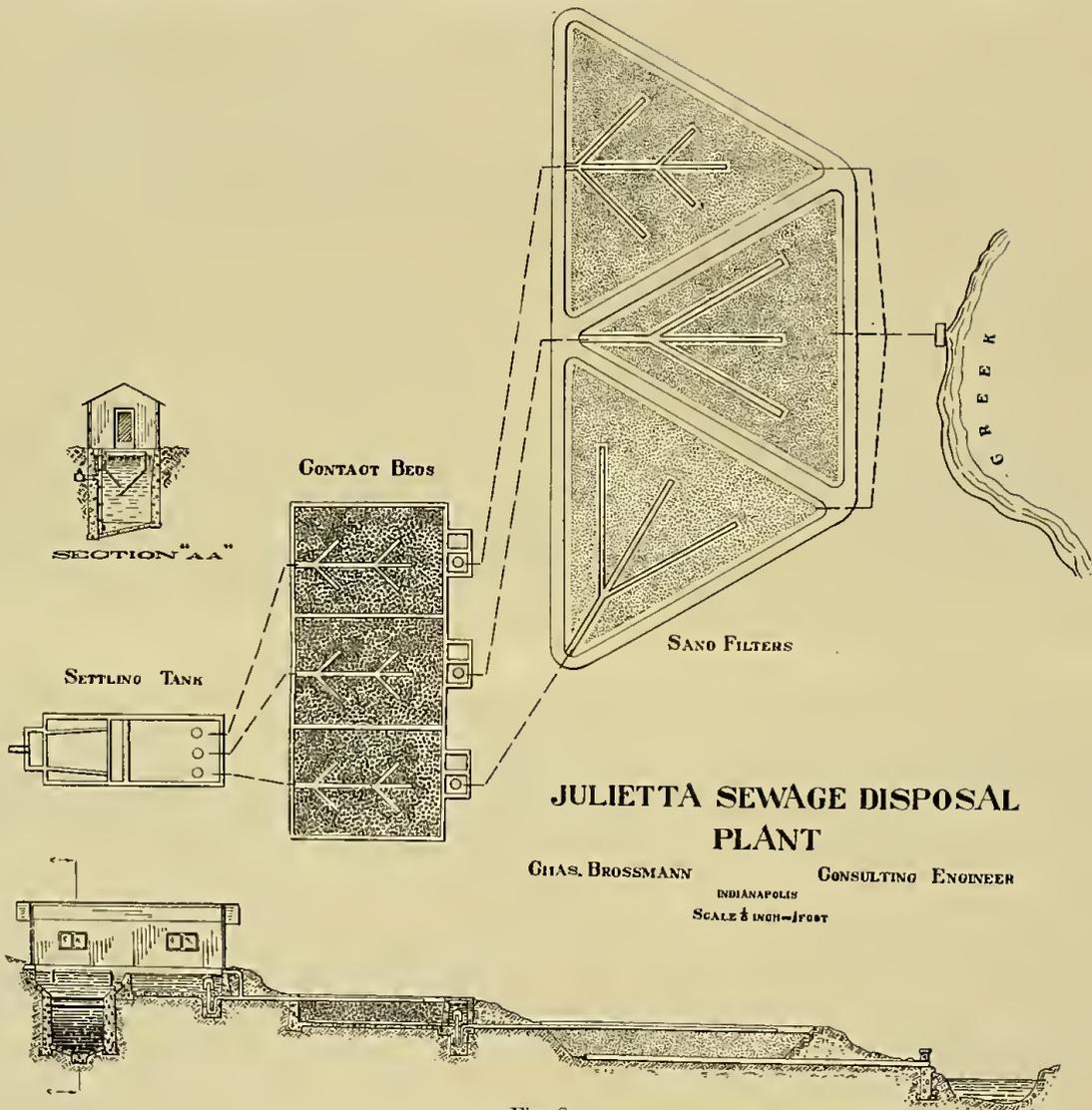
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**JULIETTA SEWAGE DISPOSAL
PLANT**

CHAS. BROSSMANN CONSULTING ENGINEER
INDIANAPOLIS
SCALE $\frac{1}{8}$ INCH = 1 FOOT

Fig. 8.

General Plan. Section of Julietta Sewage Plant Showing Imhoff Tank,
Contact Beds and Sand Filters.