Sewage Filtration.

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The purification of sewage to an extent sufficient to prevent the pollution of streams and bodies of water situated in thickly populated districts is one of the most important sanitary measures that cities and towns are forced to consider and pay for. The problem is by no means new and the literature on the subject is voluminous, many plants are in operation and many failures have been made. It is somewhat surprising therefore, to find the public so ignorant of the subject that old and incomplete methods of disposal are frequently adopted with no better recommendation than that they have been in operation in other places.

The disposal of sewage on farming land is generally attractive, as few people are without the idea that refuse of all kinds may be disposed of and purified on land. This idea is, however, not based on any real knowledge of the chemical and biological action going on in the soil, but has generally been obtained from the unsanitary practices obtained in all communities and from articles describing the excellent results of successful sewage farming.

Of the newer methods of sewage treatment, much has been written lately, and it is likely that many cities will construct purification plants without taking into consideration the different conditions, and without understanding that there are many difficulties to be overcome before any plant can be operated to the best advantage.

The determination of the degree of purification required in any case and the best means of effecting it, are exceedingly difficult problems, and require special knowledge and skill in solving them; and the results obtained by any process will depend to a large extent upon the skill bestowed upon the design, and the care exercised in construction and operation.

It is perhaps fortunate that broad irrigation is the method of disposal most familiar to the public, as there can be no doubt that it is the method to be recommended before all others. Unfortunately, however, the primary requirement for successful sewage farming, a sufficient area of suitable and conveniently situated land, is seldom available, and in consequence other methods of disposal must be resorted to.

The best known and most extensively used of such other methods, chemical precipitation is now looked upon as being merely a sludge removing process, as it has been found that in nearly all cases further means of purification must be provided in order to remove the organic matter in solution.

The necessity of purifying the effluents from chemical precipitation works has hastened the development of artificially constructed filters, and the great cost of tanks and precipitants has made it necessary to devise other methods of sludge removal.

The process of purifying sewage has thus become separated into two distinct operations:—First, the removal of sludge or suspended matter. Second, the removal of dissolved impurities.

The former may be accomplished in many different ways, but the latter can only be accomplished in practice by filtration or by broad irrigation.

Sludge is commonly removed by one of the following methods.

1. Mechanical straining.
2. Sedimentation.
3. Chemical precipitation.
4. Rapid filteration through coarse material having air drawn into or forced through the filter.
5. "Septic tank" treatment or purification.
6. Treatment in "digesters" or "bacterial filters" of coarse material.

It is interesting to note that the most recently devised methods of sludge removal, with the exception of the septic tank system, are similar to the methods in use for the removal of dissolved impurities, and that all of them are designed to effect the decomposition of the solid organic matter by the action of the organisms contained in the sewage.

The experiments made at Lawrence, Massachussetts, and described in the reports of the State Board of Health, show that better results in further purification are possible when the process of removing sludge is similar to that following. It is stated that the effluents from rapid filtration tanks or beds become changed by chemical and biological action to such an extent that they do not give off offensive odors for some considerable time and in consequence are in more favorable condition to be acted upon by the nitrifying bacteria in the second filter.

The removal of dissolved impurities contained in sewage can only be accomplished by the action of bacteria, that is nitrification, and such action cannot take place in the absence of air. The power of any filter to purify sewage is shown by the Lawrence experiments to depend upon its ability to hold the sewage in contact with the bacteria existing on the surface of the particles composing the filter, in the presence of air, for a sufficient time to secure nitrification. It has therefore been found necessary to use filters of fine material and of considerable depth in order that the liquid may not run through from the top to bottom too quickly. These conditions necessitate a moderate rate of filtration per acre, and great care in operation to prevent clogging of the surface layers.

Recent practice and experiments both at Lawrence, Mass., and in England have shown that the excellent results obtained with sand filters may also be obtained with filters of coarse materials operated in a rather novel manner. These filters have a large proportion of open space and are provided with valves on the effluent pipes. The liquid is taken immediately into the body of the filter and kept there for a time sufficient to ensure the desired action; the valve on the drain pipe is then opened and the charge allowed to run off from below, air being thus drawn into the interstices. The filter is then allowed to stand empty for a short time previous to another filling and is also allowed a longer period of rest every seven or eight days.

These periods of rest and aeration are necessary for the establishment and cultivation of the organisms by the action of which purification is attained.

Mr. Dibden, chemist of the London county council, in a report to that body dated the first of November, 1896, thus describes the complex process going on within these filters: "The ordinary purification and other similar organisms, commence the work by breaking down the organic compounds and converting them into less complex forms, principally water, carbonic acid and ammonia, the nitrifying organism then acts upon the ammonia, the nitrogen being converted into nitric acid."

It is evident, therefore, that no new principle is involved in the design and operation of these so called "bacterial filters," but that the object of passing sewage through any filter, that is to bring the organic matter into contact with the bacteria located upon the particles composing the filter in such a manner that they will act upon it without being destroyed, is attained by an alteration in construction and operation from those with which we have become familiar.

The experimental filter of coke breeze, described by Mr. Dibdin in his report above referred to, and the filters in operation at Sutton, have proved that it is not only possible to purify sewage after the sludge has been removed, but that the sludge itself may be removed and destroyed by filtration. In order that this may be accomplished it would appear that the bacteria of purification, as well as the bacteria of nitrification, must exist in these filters. This, of course, Mr. Dibdin has mentioned, but it is nevertheless difficult to understand how it is possible in practice, to cultivate in one filter both anærobic and ærobic bacteria, and at the same time to prevent disease germs from passing through the filter.

No doubt the experiments and tests, at present being made both in England and Lawrence, Mass., will clear up all uncertainties of this nature, and it is to be hoped that information will also be gained in regard to the action of these filters during very cold weather.

Mrs. Somer—What delicately constructed things these big steamships are!

Mr. Somer—Why do you say that?

Mrs. Somer—Just think of the breaking of a screw disabling the whole ship.—Philadelphia North American.