offal or refuse animal or vegetable matter of any kind whatsoever, into any river, stream or other water, any part of which is navigable or which flows into any navigable water."

THE DISINFECTION OF SEWAGE AND SEWAGE FILTER EFFLUENTS.*

By Earle Bernard Phelps.

Review by T. Aird Murray, C.E.

The previous chapters have dealt with experiments carried out at Boston in connection with effluents from percolating filters and with crude sewage, and also compared results with those of German conclusions.

CHAPTER III. (Concluded).

Disinfection of Septic Sewage.

Red Bank, a town of 6,800 inhabitants, situated on the Navesink River in Monmouth County, was chosen as the base for experimental work in disinfecting septic sewage.

The experiments are of great importance, especially in this particular case, where the partly purified effluent reaches shellfish areas. The question of the practicability of disinfecting an effluent which has only undergone septic action, is one of valuable consideration in connection with sewage discharges into tidal basins.

Phelps admits that it was at once recognized that more chloride of lime would be required than in treating non-putrescible effluents, or even crude sewage.

We reproduce a plate showing the disposal works at Red Bank. After passing through grit chambers the sewage enters a septic tank of a capacity equal to about an 8½ hour dry weather flow. The two tanks shown were formerly utilized as filters, and were converted in conjunction for disinfecting purposes, presenting a joint capacity of 14,000 gallons. Each tank held about forty-five minutes flow.

The receptacles c and d provided a capacity of 240 gallons each for the preparation of the chloride of lime solution. An automatic dozing tank supplied the disinfectant to the sewage before it entered the sterilizing tanks. The arrangement kept the flow of chlorine solution proportional to the flow of sewage.

During the investigation free chlorine was never found in the effluent. This is important in view of the well known effect that chlorine has in destruction of fish life. One of the chief objections to disinfecting sewage discharging into tidal water, has been the fear that chlorine would kill the fish in the neighborhood.

Results are given of weekly average tests from July 20 to September 28th, 1907. The average amount of available chlorine used was 11.5 parts per 1,000,000. The average per cent. removal of total bacteria was 99.7 at the end of 45 minutes, and the corresponding B. coli removal 99.96. In 90 minutes the average per cent. removals were 99.8 and 99.97 respectively.

During the period August 19 to August 31, the available chlorine was reduced to about 7.5 parts per million. The results, which are not included in the above averages, show a total bacterial removal of 95 per cent., and 94.3 per cent. in B. coli after 45 minutes. It is thus apparent that much of the chlorine is absorbed by the septic sewage without any great disinfecting efficiencies.

Eighty-four per cent. of the tests showed bacteria in the effluents of from 100 to 1,000 per c.c.; while in 6 per cent. of the tests the numbers were not less than 5,000. The average initial number of bacteria to the sewage was 900,000 per c.c.

Phelps states that "the disinfection of septic sewage evidently requires so much chlorine that the expense will be considerable. It will probably be found to take twice as much chlorine for septic sewage as for crude sewage."

The above experiments appear to point to the advisability of either simple straining or ordinary sedimentation, when a non-putrescible effluent is not demanded. Nothing is gained by allowing septic action to take place prior to disinfection, in fact the cost is doubled. If septic action is insisted upon, then the sewage must be disinfected previous to the treatment in the septic tanks. No experiments were made, however, as to the results of septic action with a sewage which has previously undergone disinfection.

In view of Phelps conclusions, the engineer in providing disinfection for sewer effluents discharging into tidal basins or large bodies of water will probaly choose for removal of solids some such form of tank as the Dortmund allowing a rate capacity of from 1½ to two hours with an upward velocity flow of about 1/10th of inch per second, thus avoiding septic action as much as possible. It is, however, not quite apparent whether, when disinfection is demanded, it will not prove both more efficient and less costly to provide a non-putrescible effluent prior to disinfection in such cases.

We still feel that a great deal more information and comparative cost data are required to allow of exact determination in connection with the advisability of disinfecting either settled or crude sewage, rather than expending so much more capital in obtaining a non-putrescible effluent first, and so saving the constant and permanent cost for the extra amount of chlorine required.

Disinfection of Trickling-Filter Effluent at Baltimore.

A brief report is given of the work done at the Walbrook testing plant, in connection with the new sewage disposal plant at Black River. The sewage disposal plant is to consist of—screening, sedimentation, percolating filters, and final sedimentation.

About 50,000 gallons of sewage per day was collected at the testing station, and treated in a grit chamber, septic tank, percolating filters, and sedimentation tanks.

Less chlorine was used at Baltimore than at Boston, the available amount being 2.2 parts per million as compared with 3.4. The effluent from the Baltimore filters was in a better condition than that at Boston. The average disinfection results practically agree with those at Boston, although Phelps is of opinion that even better results could have been obtained by the use of three parts per 1,000,000 of available chlorine. The B. coli results showed less efficiency per cent. removal than the total bacteria. An attempt is made to explain this by assuming the presence of another organism which fermented the bile medium. However, a review of the results, generally, point to the entire feasability of practical disinfection.

Phelps concludes as follows: "The application of three parts per million of available chlorine in the form of bleaching powder to a trickling filter effluent, similar to those in which experiments were made, effects satisfactory disinfection. The removal of bacteria from the effluent averages 95 per cent., making the removal for the whole purification process 98 to 99 per cent. of the number in the crude sewage. The cost of disinfection ranges from $1 to $1.50 per million gallons of sewage, depending chiefly on the size of the plant. Effluents of higher degrees of purity can be disinfected at

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