MUNICIPAL DEPARTMENT

IMPROVED METHODS OF SEWAGE DISPOSAL.

By Charles G. Hobretzky, C.E.

The following paper on the most recent methods of sewage disposal now in operation in the United States, being to some extent the outcome of experiments made by the Massachusetts State Board of Health, with remarks upon their adaptability (in whole or in part) to cities in Canada, was read at the annual meeting of the Association of Executive Health Officers of Ontario, held at Ottawa on September 27th, 1898:

At your tenth annual meeting, held at Belleville, Ontario, in 1895, I read a paper upon methods of sewage disposal then used in some of the provincial institutions of Ontario.

In December, 1895, I was one of the consulting engineers with reference to the disposal of the sewage of the city of London, Ontario, and then recommended a system of land disposal or filtration, my recommendation being largely based upon the successful working of the Brockton, Mass., plant then in operation, and upon the very doubtful success of several chemical systems visited upon a tour of inspection through the United States in October of that year.

Since 1893 further, and most important discoveries in this direction have been made by the Massachusetts State Board of Health at their experimental station at Lawrence, Mass., where the last few years have been devoted to researches upon the capabilities of gravel and coke filters aided by forced aeration. A description of these experiments would be interesting, but out of place here, and can be seen in the different annual reports. It will suffice to say that the conclusions arrived at offer a great incentive to the practical ingenuity of all those interested in the construction and maintenance of sewage disposal plants.

It has been demonstrated that filters of gravel of an effective size of 5.40 M.M. can produce a most satisfactory effluent, and remove from 60 to 85% of the organic matter of strong city sewage, at the rate of 400,000 gallons daily per acre.

(Note: In a sample of sand or gravel, the effective size is the maximum diameter in millimeters of the finer ten per cent. of the sand grains, or gravel.)

Coke breeze (screenings from commercial coke) has also been found of immense value as a filtering and straining medium, and possesses the advantage of being fully as valuable for purposes of combustion after its use as a sewage strainer and sludge retainer as before. This will be discussed further on. As regards the forced aeration applied to these experimental filters, pipes were passed through, and within 6 inches of the bottom. A fan blower driven by electricity was attached, and, while the fan made 3,600 revolutions per minute, an air current capable of sustaining 3 inches of mercury was forced through the filters. By frictional loss the force of the current was reduced fully one-third. In the experiments with the coke filters up to January 1st, 1895, the average rate of filtration was 260,000 gallons per acre daily for six days in the week, while the average removal of organic matter (albuminoid ammonia) and bacteria was 95 and 98 per cent. respectively.

In 1894 Col. Waring instituted experiments upon sewage purification aided by forced aeration at Newport, R. I. These were continued during five months from May till October, and the results set forth in a pamphlet, which also contains a synopsis of the chemical work and investigation carried out simultaneously by Mr. George W. Ralfe, A.M. (Harvard).

The Willow Grove Park (15 miles from Philadelphia) sewage disposal plant was constructed by Col. Waring upon the principles evolved by the Newport experiments. It is simply composed of a set of "strainer" and "aerator" beds ⅛ acre in extent in all. The sewage applied daily is assumed to be from 60,000 to 100,000 gallons. The resulting effluent at date of my visit on 6th September was very good, clean and odorless, and the most of it was in daily use for sprinkling the lawns and roadways at *Willow Grove*. I found, however, that the receiving well was clogged with hard, compact sewage to the depth of 4 feet. This will have to be removed eventually by hand, as it cannot be pumped up. The man in charge informed me that the plant had been one year in operation, and that the "strainer" beds have to be overhauled every season (every six months), and the material washed and returned to its place. This, he says, occupies three men during a week.

As to the conclusions arrived at by the chemist in charge during Col. Waring's Newport experiments, they indicate that a "strainer" tank can remove 40% of the nitrogenous matter in ordinary sewage, if this sewage, roughly strained and free from mud, is applied continuously, at a minimum rate of 3,000,000 gallons daily per acre; and that an "aerator" bed one acre in extent, with nitrification properly established, and proper manipulation, will remove 95% of the organic nitrogen of a "strainer" effluent, applied at the rate of at least 800,000 gallons daily. It will do so for an indefinite period, under, of course, proper conditions of working. This means that ¼ acre of strainers, and 1 acre of aerators (1¼ acres in all) will suffice for the treatment of the sewage of 10,000 people at the rate of 80 gallons per capita.

I have been unable to obtain the cost of the Willow Grove plant, now about one year in operation, which includes the pump house, pump, blower, masonry and concrete work, filtering material, and all accessories; hence, it is difficult, nay, impossible, to compare it in the large and practical way with other methods which will be discussed further on; but, from my own actual observation, and the statements of the man in charge, I am of the opinion that the conclusions reached by the experimenters are quite in accordance with the actual working of this very valuable system of "Artificially Aerated Bacterial Filters," as claimed by the inventor.

Reverting to the Massachusetts State Board of Health experiments with coke, I now quote an exstract from page 480, report 1896, which sums up the immense value of this material as an aid to sewage purification, and especially as a sludge retainer:

"When coke breeze can be obtained, and the sewage given a preliminary treatment before sand filtration by being passed through this breeze at a high rate in gallons daily per acre, the organic matters can be removed from the entire body of the sewage as completely as chemical precipitation removes them from the main body of the sewage. There is *no resulting sludge liquor from this coke* straining process, and the clogged coke can be removed from time to time and burned, the sludge being of course held by, and burned with it. During some of the experiments, 13.8 cubic yards of coke per million gallons of sewage filtered were removed, dried, and could have been used as ordinary fuel. By straining through coke we have removed during 1895 54 per cent. of the sludge (albuminoid ammonia) of the sewage. The latter has been strained at an average rate of one million gallons per acre daily, and the coke strainer contained from 6 to 8 inches in depth of coke. The coke is known as breeze (screenings from ordinary coke). At the Lawrence Gas Works, where it is obtained, it is used under the boilers, and estimated to be worth one-fourth as much as the steam coal, or from $1 to $1.25 per ton; the amount used has been 10 cubic yards per million gallons of sewage strained, and, as a ton of coke occupies about 2.3 cubic yards, the sewage has been purified, to the extent given, at a cost for coke of $5.43 per million gallons of sewage strained, estimating the coke to be worth $1.25 per ton. By this method we remove the sludge from the entire body of liquid, and get rid of the concentrated sludge liquor which results from sedimentation, or any chemical precipitation process, and it seems that the coke is as valuable for combustion after use in the strainer as before."

I may add that in the coke filter experiments of 1895, the removal of organic matter and bacteria, at a rate of 260,000 gallons per acre daily, for 6 days in the week, was 95 and 98 per cent. respectively.

Now, sludge resulting from sedimentation or chemical precipitation contains 90 per cent. of water, the latter being separated from the solids by a most expensive and dirty method of pressing. Even then the resulting cake contains 50 per cent. of water, and, using the lime and alum precipitation process (probably the best), the pressed sludge will amount to 8 tons per million gallons treated, equal to 40 tons as *swept from the tanks. As one-half of the* pressed cake consists of water, the dry solids are equal to four tons per million gallons of sewage.

(To be Continued)