Volume 30. Toronto, May 25, 1916.

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The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

ACTIVATED SLUDGE EXPERIMENTS AT MILWAUKEE.

SOME FURTHER INTERESTING FACTS CONCERNING THE PROCESS BROUGHT OUT BY THE EXPERIMENTAL WORK CARRIED OUT AT MILWAUKEE.

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IN a previous article on this subject in the issue of April 27th attention was paid to the general results obtained at Milwaukee. There were, however, many additional interesting investigations made into different features of the process. These included the efficient diffusion of air, period of aeration, and volume of air required, effects of temperature, production and dehydration of sludge, inoculation of sewage with activated sludge, and so on, all of which are valuable studies and tend to render the process more efficient and economical. Most of these are confirmatory or enlargements of experiments made by Messrs. Ardern and Lockett in 1914.

Diffusion of the air in the sewage has been experimented upon by means of filtros plates, monel metal, and air jets. Filtros plates are made of quartz sand cemented together and baked, and are supposed to be made of any porosity desired. But, out of 530 plates, each 1 ft. square, only 60 per cent. complied with the specification that 2 cu. ft. of air per minute be passed through each dry plate 1½ ins. in thickness, under a pressure of 2 ins. of water, with a marginal allowance of 5 per cent. either way. When the plates are wet the pressure increases 10 to 12 times. For example, with 8 ft. of liquor the filtros plates required 4.6 lbs., that is, 1.12 lbs or 31 ins. in excess of the static head, or 15 times the pressure required when the plates are dry. Mr. Chalkley Hatton states that the bubbles were too large to produce the greatest efficiency. He expresses the opinion that the excess pressure might be reduced by making the plates thinner and reinforcing them like wired glass. He found that when the air bubbles were 1/16 in. or less in diameter they were in contact with the liquor in a 10-ft. deep tank from one to four minutes, but when the diameter of the bubbles exceeded the above dimension the contact was only but a few seconds. The economy in the use of air is to be attained by prolonging the contact until the oxygen has been absorbed, but the problem is to secure such prolonged contact. "Several mechanical devices have been designed and operated to break the air globes into smaller globes, but so far they have not been satisfactory."

Mr. Copeland states that filtros plates are very irregular in porosity. Some would pass 10 ft. and others less than 0.5 ft. of air, whereas 2 cu. ft. was stipulated. Dense plates gradually choke with sludge, and a mixture of dense and porous plates in a tank results in unequal aeration. "Bacterial growth on plates might require sterilization for their removal."

Fine-woven monel metal cloth has been tried and smaller bubbles issue from the surface of the cloth than from the filtros plates, although the former is more porous than the latter. There is also less frictional loss than through plates.

Open air jets reduce the pressure required but also reduce the efficiency because the bubbles are too large. An orifice 1/1000 of an inch in diameter under 5 lbs. pressure discharges air bubbles 1/32 inch in diameter. Dust, however, will tend to choke such a small orifice. Sludge enters into open jets and cakes within. This was the difficulty experienced at Salford, England, where open jets are largely used. Mr. Copeland suggests flushing such pipe with water under pressure.

Comparison Between Filtros, Air Jet and Monel Metal Diffusers.

Diffusers.	Period. 1915.	Pressure lbs.	Cub. ft. air per gallon.	% Bacteria removed.	Nitrate formed. p.p.m.	Stability of effluent. hours.
Filtros	June 1	4.3	2.5	91	3.4	78
Air jet	Aug. 12	3.5	2.3	91	2.2	52
Filtros	Nov. 18	4.6	2.1	90	0.3	113
Monel Metal	Dec. 7	3.0	2.1	80	0.2	63

Mr. Copeland states that "open air jets have given good service—almost as good, in fact, as the filtros plate, but they have one bad feature," namely, the sludging up of the orifice. This would indicate that a device similar to one used by the writer might obviate the trouble; that is, to hinge the pipes, and before the air is shut off, swing the pipes out of the tank. Where there are a number of such pipes it requires some ingenuity to arrange the air pipes to avoid complications.

Mr. Copeland mentions a pertinent statement with regard to increasing the depth of tanks so as to prolong the air contact. This matter has also been referred to by Messrs. Ardern and Lockett. The quantity of air per square foot of tank area or per acre will, in a given time, purify more sewage or purify a given quantity to a greater extent in deep tanks than in shallow ones. But deep tanks will require greater pressure and the supply of air will cost more. Whether the advantage will remain with the deep water tanks is not yet proven.

"Our supplementary experiments," according to Messrs. Chalkley Hatton and Copeland, "indicate that more efficiency of air can be obtained in deeper tanks (than 8 to 10 ft.) by reason of the longer contact period between air and sewage, and the tendency of the air, as it escapes from the diffuser, to break into smaller bubbles, because the pressure head is increased. Local conditions might, and probably would, largely control the depth of tank."

The period of aeration and volume of air required under different conditions are matters of importance. As all sanitary engineers know, the flow and strength of