AERATION METHOD OF PURIFYING SLUDGE.

PURIFICATION of sewage by aeration, although not new in a sense, has been a subject of great attention and study of late and the past year or so has brought forth some valuable literature regarding experiments and their application to sewage disposal works. In *The Canadian Engineer* last week we referred editorially to the activated sludge treatment and to the importance to Canadian municipalities of the results now being attained by those who are studying the problem. It is likely that the near future will see more attention given to activated sludge experiments by Canadian sanitary and municipal engineers.

Mr. J. P. Wakeford, M.Inst.C.E., city engineer of Wakefield, Eng., deals in an interesting way with some past experiments, in a paper read before the Institution of Municipal and County Engineers last June. He refers first to the Manchester and Salford investigations of Dr. Gilbert Fowler and Messrs. Ardern, Lockett and Melling, mentioned in these columns last week, and then proceeds to describe the experiments made by himself. His description of the system, and of his experiments is as follows:—

Sludge which has been brought into an activated state by thorough aeration is added to raw sewage and the admixture is kept in a state of agitation by forcing air through it for a certain period. The air supply is then cut off and when the solid matters in suspension are deposited, the supernatant liquor is in such a state of purification that it can be discharged direct to the river.

In a biological filter the period necessary for the filter to become "mature" is that period during which sewage sludge is deposited as a slimy film on the surface of the filter material to act as a nidus for the purifying organisms. During this period the slimy film is being converted into "activated sludge," which is the seat of the purification process.

The new process seeks to dispense with the filter material by converting sewage sludge directly into "activated sludge" by means of forced aeration. It is indeed a speeding-up of the processes which have been known for some time as biological methods of sewage purification, for it has been shown by Ardern and Lockett, and confirmed by the author, that the process is biological in that it cannot be carried out with sterile sewage and sterile sludge.

The experiments at the Wakefield works were first conducted in a forty-gallon cask in which a quantity of humus sludge was placed, together with a quantity of ordinary sewage, and aeration was carried on for a few days. The sludge was allowed to settle for two hours and the effluent was drawn off. The barrel was again filled with crude sewage and aerated for twenty-four hours, the sludge allowed to settle for two hours, and the effluent drawn off. This was repeated four times, retaining the sludge in each case. It was noticed that the time required for each succeeding oxidation gradually diminished until eventually it was possible to obtain a well-clarified effluent in two hours.

The table at the foot of this page gives the results of the analyses of the four fillings.

It will be noticed that when the sludge had become thoroughly activated as in case (*d*), it was possible to completely oxidize the ammonia present after two hours aeration.

On the average, aeration for a period of two hours under the conditions of experiments, was sufficient to obtain a percentage purification as measured by the four hours' oxygen absorption and albuminoid ammonia tests, quite equal to that yielded by chemical precipitation and bacterial filters. The aeration was effected by means of a porous tile diffuser set in a light cast-iron box, an air chamber being formed between the underside of the tile and the floor of the box. This diffuser was placed on the bottom of the barrel to introduce the air in the finest possible state of division. The difference between aeration effected by air admitted in large bubbles and that in a fine state of diffusion is clearly seen in the following table, taken from Part 2 of Messrs. Ardern and Lockett's researches on the "Oxidation of Sewage Without the Aid of Filters" (Journal Society of Chemical Industry, Volume XXXIII.):—

Rate of Oxygenation of Raw Sewage, Results Expressed in Parts per 100,000.

Dilute Sewage.

Time	Dissolved Oxygen Content when Aeration effected by:— Plain Tube	Diffuser
At commencement	.24	.24
After 15 minutes	.42	.73
" 30 "	.49	.74
" 45 "	.56	.76
" 60 "	.57	.77
" 90 "	.63	.79

Messrs. Ardern and Lockett have also proved that temperature influences the oxidation process, the sewage

DESCRIPTION	Oxygen absorbed in 4 hours at Lab Temperature	Percentage Purification on Oxygen Absorbed Figure	Ammonia (as N) Free and Saline	Ammonia (as N) Albuminoid	Nitrites (as N)	Nitrates (as N)
(*a*) Crude sewage, average	9.88	—	3.750	.780	—	—
After 6 hours' aeration	1.86	81.2	.480	.192	Nil	1.20
" 24 " "	1.10	88.9	.060	.156	Nil	1.60
(*b*) Crude sewage	12.48	—	4.250	.800	—	—
After 4 hours' aeration	2.92	76.6	1.800	.328	Nil	.40
" 6 " "	2.64	78.9	1.200	.248	Nil	.86
" 12 " "	2.08	83.3	.300	.180	Nil	1.40
(*c*) Crude sewage	13.96	—	3.500	.750	—	—
After 2 hours' aeration	1.47	89.5	.700	.132	—	.50
" 4 " "	1.28	90.8	Nil	.080	—	.90
(*d*) Crude sewage	16.44	—	2.750	1.140	—	—
After 1 hour's aeration	1.57	90.5	.100	.096	.10	.50
" 2 hours' "	1.22	92.6	Nil	.076	Trace	.90
" 3 " "	.94	94.3	—	—	—	—