THE UTILIZATION OF SEWAGE SLUDGE

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by mechanical action alone was not a success, and of all the various proportions of humus and ripe sludge mixtures made with the view of encouraging separation, the best result was obtained where the smallest quantity of the former was mixed with the largest proportion of the latter. This is understandable when one remembers that the "humus" contains 5% to 6% of nitrogen and the oxidized sewage effluent conveying it has in its composition a sufficient quantity of nitrates to arrest putrefactive tendencies. How long this humus emulsion will remain a jelly it is difficult to say, but there are samples on the works which still retain that jelly-like character after exposure to the atmosphere for six years.

The third is not the least important function of this lagoon. Water rises to the surface when fermentation is exhausted and frequently when it is quiescent, when it may be decanted direct to the filter-bed. When one remembers that by reducing a 90% to an 80% sludge, one gets rid of one-half its water-content, the importance of decanting as much liquid as possible is evident. It has also been proved that additional advantage is gained by providing deep lagoons, thus supporting A. J. Martin's theory that the deeper the tank, the denser the sludge obtained; at the same time the benefits in this respect must be measured by the degree of emulsification obtaining.

Drying Beds

The rotted sludge or residuum of the fermentation process is pumped direct to the drying-beds which are in the immediate vicinity. They consist of plots of engine ashes 150 ft. square and have a total area of 54 acres. All the plots are under-drained with 4-in. agricultural tile-pipes in herring-bone fashion (see Fig. 4) toward a main leader which conveys the drainage to a well, whence it is pumped with water decanted from the lagoons to a percolation filter made for the purpose.

Each drying-bed is formed by earthen banks about 2 ft. high. The area is provided with a system of permanent 2-ft. gauge tramways—laid to suit loco haulage, both steam and electric battery locos (see Fig. 7)—and provided with conveniently placed turnouts and crossings to allow temporary rails to be laid through the beds for the collection of dried sludge.

The time required for drying varies with the weather, but in dry weather it quickly cracks and admits air. Fig. 5 shows the appearance of the sludge three days, and Fig. 6 thirteen days, after it has been deposited. When it has become sufficiently dry to be lifted in lumps (see Fig. 8) it should be conveyed to the tip, as it is troublesome to the workmen when it gets into the dry-as-dust state; indeed, eye protectors have had to be provided in such cases. The embankments which are being formed of the dry sludge are about 15 ft. in height. When the lumps are tipped over the embankments, the drying is completed, and the estimations for calorific value dried at 212°F. give an average of 4,500 B.T.U., or something similar to the calorific value of ordinary house and shop refuse as burnt on a destructor.

Process Complete in Itself

It should be clearly understood that this process of sludge treatment is put forward as a complete process in itself, just as the Imhoff tank process was put forward by the German engineer, but without in this case any suggestion that the effluent from the sedimentation tank could be discharged into a stream. It effectually converts an exceedingly offensive colloidal mass of sewage into a dry substance, which might be kept in one's office for years without giving off more odor than would garden soil in similar circumstances. This conversion is accomplished without nuisance at any stage, and judging by pre-war costs the expense is similar to that incurred by London and Manchester. In a report which the author submitted to the Drainage Board in June, 1914, comparative costs were given as follows:—

	Pence per ton.
London	5.6
Birmingham	5.7
Manchester	6.9

The figures for cost given by the Royal Commission on Sewage Disposal are as follows:—

	Pence per ton (90% water).
Sea disposal	4.1 to 6.9
Trenching in soil	4.0 to 7.0
Pressing (for large towns)	7.7 to 12.6
Pressing and burning	18,0

Comparing sludge digestion at Birmingham with these figures, and assuming a wet sludge containing 90% water, it is approximately 5 pence per ton.

Cost figures are bound to vary, and in comparing sludge costs care should be taken to see that the percentage of water in the sludges coincides. Another statement showed the cost to be 6.3 pence per ton of sludge (86.6% water) made up as follows:—

Statement of Cost

1. Cost of tankage, digestion and pumping to drying beds:—

	£	s.	d.
Wages	1,622	10	0
Coal	710	5	0
Stores, etc.	90	9	0
Repairs, etc.	22	10	0
Water charges	75	5	0
	£2,520	19	0

The volume of sludge dealt with was 260,000 cu. yds. Approximate cost per cu. yd. of wet sludge, 2.25 pence.

2. Cost of drying sludge, lifting and carrying to tip:—

28,816 cu. yd. of dry sludge	£990 17 7
Cost of cu. yd. of dry sludge	8.3 pence
Cost of cu. yd. of wet sludge	2.5 pence

By adding (1) and (2), wet sludge 86.6% water = 4.7 pence per cu. yd., or 6.3 pence per ton.

That the scheme as illustrated at Birmingham is as perfect as it might be made, the writer does not claim. It has been an experiment, and has been extended from time to time always as an experiment. The great tanks and lagoons, with a total capacity of 28,000,000 gals., have been built in a temporary manner out of revenue as necessity has arisen, and the design or lay-out—apart from the biological side—if design it may be called, is obviously an improvization to meet current requirements and to obtain knowledge, rather than a consistent ideal based on some well-tested prototype. Indeed our calculations were so far out of truth originally that at one time we hoped that by an intensive fermentation at Saltley, the 20 brick-built tanks, which have a capacity of only 7,000,000 gals., would suffice for treatment of all the sludge arriving there.

Success Depends Upon Nitrogen

The adoption of the scheme which has been described was due to the impossibility of septicizing sewage and sludge together without nuisance. It has accomplished what it essayed to do, thanks chiefly to the consistent work of our chemist and superintendent of works, but its final success is dependent upon the profitable utilization of the nitrogen, which up till now has been lost sight of in the predominating desire to get rid of sludge with a minimum of nuisance.

With the object of recovering from the dry sludge nitrogen and other products of distillation, a boat-load of it has been sent to the Saltley Gas Works each week for some time. Absolutely trustworthy results will not be available until more producers are installed there, but the gas works engineer, Mr. Chaney, says that he is willing to give 3s. 6d. per ton for it delivered in boat at the Saltley Gas Works.

The fact that they are possessed of a plant capable of treating sludge for a moderate sum does not satisfy the Drainage Board that they have done all that they might to