

Sewage Disposal in Colombo.

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COLOMBO, Ceylon. Population 250,000. Rainfall, 80 inches. Mean temperature 80°F. Mean humidity 80 per cent. Area 8,617 acres. 3,485 Acres fully provided with sewers, 1,623 acres with arterial sewer system, 617 acres no sewer system, and 2,892 acres of lake, swamp or not habitable.

The first instalment of the disposal works, opened in 1910, consisted of four septic tanks 240 ft. \times 13 ft. \times 10 ft. deep (12 hours' flow thorough capacity), with a 26 ft. detritus tank at the head of each. Eight circular aerobic beds and two storm water settling tanks and two percolating filters. The instalment was designed to serve an ultimate population of 60,000 with a dry weather flow of 1,500,000 galls. Storm flow up to twice this amount was dealt with by the septic tanks and aerobic beds and the remainder up to six times the dry weather flow by the storm tanks and filters.

The septic tanks were originally covered with a corrugated iron roof but this was removed to prevent mosquito breeding. The mean temperature of the sewage in the tanks is 85°F.

The early sewage was weak, but gasification and intense ebullition caused masses of sludge to be disorged with the tank effluents. The aerobic beds quickly ponded and were put out of use. The material in the storm filters was removed and they were converted into additional storm tanks.

As the result of extended experiments it was determined to convert the septic tanks into two-storey sedimentation tanks.

In No. 1 tank, this was effected by longitudinal concrete slab divisions sloping from a continuous slot at each side wall to a continuous vent or scum opening in the centre (Fig. 1).

In No. 2 tank, separation between sedimentation and sludge chambers was effected by pre-cast concrete Λ shaped divisions placed laterally across the tank and forming a series of ridges and valleys through its length. The settling solids pass through slots in the valleys (the edges of adjoining slabs overlap) and the lateral divisions are divided at the centre of the tank by a continuous vent and scum chamber with which the underside of each ridge communicates (Fig. 2).

This second type was adopted because it gave greater sludge capacity below slot level, greater sectional area, and consequently less velocity of flow in the sedimentation chamber, and on the theory that as soon as the settling solids fell below ridge level (2 ft. 6 in. below sewage level), they would be less affected by the flow through the tank.

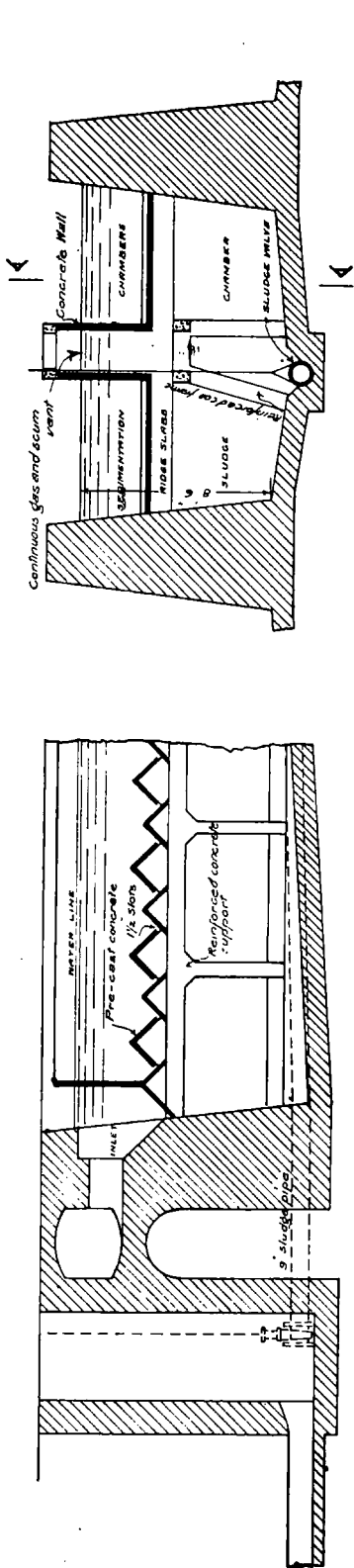
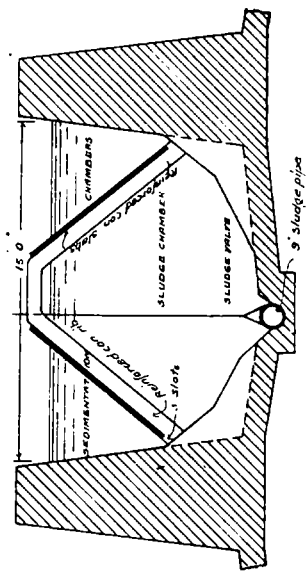


FIG 2

CROSS SECTION OF NO 2 TANK



CROSS SECTION OF NO 1 TANK

COLOMBO MUNICIPALITY
MADAMPITIYA TREATMENT WORKS

SCALE 1/4" IN = FOOT



Later experiments appear to support this theory. It was found that whilst retaining constant volume of flow the sewage level could be reduced and the velocity of flow thereby increased as much as five times the normal, without materially affecting the percentage of solids removed.

The slope of the slabs was 51° in No. 1 tank and 45° in No. 2 tank. The steeper slope gave no advantage.

Sedimentation in both tanks is extremely effective, No. 2 giving slightly but consistently better results than No. 1.

Table A.—Details of altered tanks.

	No. 1.	No. 2.
Dry weather flow, gallons per day ...	375,000	375,000
Sectional area of sedimentation chamber,		
cu. ft.	27.6	31.4
Normal velocity of flow, ft. per min. ...	1.5	1.3
Sludge capacity to level of slots, cu. ft. ...	7,750	15,800
Length of slots per foot of tank, ft. ...	2.0	6.0
Flow through period, hours	2.7	3.0

9 in. diam. stoneware sludge pipes with valves about every 19 ft. were laid in the old longitudinal sludge chamber at the bottom of each tank.

Table B.—Typical results from altered tanks with an ordinary dry weather sewage flow.

SUSPENDED SOLIDS. PARTS PER 100,000.

	<i>Volatile.</i>	<i>Non-Volatile.</i>
Sewage	30	17
Inlet to Sedimentation Tanks	17	8
Combined effluent from sedimentation		
tanks	5	1.5

Considerable reduction of suspended solids occurs before entry into the tanks. This is due partly to settlement but chiefly to scum formation in the detritus tanks and inlet channels, which require clearing at frequent intervals.

Aerobic Beds.—100 ft. diam., 5 ft. 3 in. of 2 in. stone, 12 in., $\frac{1}{2}$ in. top layer; revolving sprinklers, normal rate 1,000,000 gallons per acre per day.

In a full size experimental bed, a section of 3 in. broken stone, 6 ft. 3 in. deep gave best results.

The formation under a hot sun of a leathery top coating was overcome by replacing part of the finer top layer by 4 in. of a $2\frac{1}{2}$ in. material. The free passage through the coarser material and absence of sun-light from the finer layer was the apparent reason.

Imhoff Tanks.—The second instalment (for a further 60,000 population) consists of five circular radial flow Imhoff tanks, 36 ft. diam., 29 ft. deep.

The effluent contains about 2 parts per 100,000 of suspended solids more than that from the altered septic tanks.

Rectangular Tanks.—The third instalment consists of two detritus tanks and three rectangular longitudinal flow, two storey sedimentation tanks, each 81 ft. long by 36 in. wide.

When first opened the normal capacity of these tanks was overtaxed. Scum accumulated in the vent chambers rapidly and was so buoyant as to force out and dislodge the top rows of the sloping slab divisions.

As an experiment these were replaced in one tank in a vertical position, thereby increasing the surface area of the vent or scum chamber by about 60 per cent. Originally designed to deal with 335,000 gallons of dry weather sewage (velocity of flow 0.17 ft. per minute) and up to 2,000,000 galls. of storm sewage per tank per day, the altered tanks deal with 1,000,000 galls. (velocity 0.51 ft. per min.) of dry weather sewage without scum trouble.

Sewage Flow.—Although complete house drainage is ultimately intended, the present sewage is a composite sewage made up of the flow from 1,300 connected premises with 4,300 water closets, from 37 public latrines and bathing places (very largely used), considerable quantities of very foul sullage diverted from the old drain system to the new sewers and the discharge from tipping depôts at which nearly the whole of the remaining night soil is tipped into the sewers.

Considerable difficulty is experienced in obtaining representative samples of the sewage entering the works and entering the tanks owing to the heavy scum formation, and to variation in the amount of suspended solids (particularly the more resistant volatile solids) dependent on conditions of pumping, conditions in the channels and tanks and the state of the weather. The outfall discharges into the Kelani River, $2\frac{3}{4}$ miles from its mouth. The outfall is at the bank, the river is about 480 ft. wide at this point and is slightly subject to tidal influence.

It was originally intended to treat up to twice the whole dry weather flow on aerobic beds but as the minimum river discharge is estimated at 200 times, and the daily average discharge at 450 times, the ultimate dry weather flow of 8,000,000 galls., the municipality was subsequently advised to abandon or postpone the provision of further beds.

The present effluent is invisible 50 yards below the outfall, no nuisance is caused, and it is practically untraceable chemically a quarter of a mile away.

The high temperature reduces the possible oxygen content of the water, but investigations by the authors (unfortunately interfered with by the War) appear to show that sun and heat materially assist surface absorption and regeneration.

Sludge.—Sludge from the Imhoff and new sedimentation tanks amounts to about 125 cu. ft. (exclusive of scum) per 1,000,000 galls. and the moisture content varies from 88 per cent. to 93 per cent. The dry material is about one half volatile and contains 2·25 per cent. nitrogen.

The sludge is inodorous, oily in appearance and flows freely to the low drying ground where it dries quickly and without nuisance.

It is less easy to discharge undiluted sludge through the valves of the altered septic tanks and the moisture content of the sludge is considerably higher than the above mentioned figures. Attempts to utilise the partially dried sludge as manure have been temporarily abandoned pending investigation of an outbreak of hookworm amongst the coolies coming in contact with it, and the apparent survival of anchylostomiasis larvæ in sludge of all ages.

A second drainage area discharging to a sea outfall has recently been brought into operation. The first instalment provides two rectangular two storey tanks capable of dealing with the dry weather sewage from a population of 28,000.