CHAPTER III

MATERIALS AND METHODS

A pilot-plant scale multiple tray aerator in conjunction with an oxidation ditch located near the Sanitary Engineering department, was designed for the study of mechanism and overall rate of oxygen transfer coefficient. A schematic flow diagram of the experimental set-up of the aeration unit was shown in Fig. 5.

To start up the experiment tap water was fed into the oxidation ditch and was afterwards pumped 3.1 m high from the centre of the suction pipe into the constant head tank. The pump used was a submersible pump type "JUNG" U3E, 0.25 Kw, 220 V, 50 Hz, 1.25 in. inside diameter of suction and discharge pipes. To facilitate the designed orifice, dissharge pipe connection was reduced from 1.25 in. to 0.5 in. I.D. The head-discharge performance was initially calibrated and the curve was plotted in Fig. 8 in order to control the flow during operation.

Details of the water constant had tank were shown in Fig. 2. This tank was used to minimize flow and pressure pulsations. The dimension of the tank are 90 cm. high and 58 cm. inside diameter and its capacity is 237 litres. An overflow pipe of 3.12 cm. I.D. was connected at 10 cm. below the top. The surface of the water in tank was always kept at about the upper rim of the overflow hole, making the actual volume of water in the tank during operation equal to 203 l. An outlet cast iron pipe 3/4 in. inside diameter 20 cm long followed by ½ in. I.D. 10 cm long pipe were connected with an orifice and a control valve. The arrangement was shown in Fig. 3. The desired flow rate could be easily obtained by adjusting the control valve until the head drop corresponds to the determined flow rate on the calibration curve. Five different flow rates of 9.6, 12.0, 14.7, 19.6 and 23.0 l/min were used in this study.

Multiple Tray Aerator Trays trapezoidal in shape were made of pieces of wood 1.25 cm thick. The upper and lower surface areas were 35 x 35 and 25 x 25 cm^2 respectively and its height is 16.5 cm. The opening of the tray is 1 cm x 5 cm and it is formed by using wooden slats. The system of multiple tray aerator consisted of six trays. Each tray was filled with gravel 1.3 in. size forming a layer of 10 cm high. All trays were supported on four 1.25 in x 1.25 in. steel angle with holes for adjusting tray spacing in order to study their appropriate spacing which gives the optimum overall oxygen transfer coefficient. The details of tray arrangement at several rates of flow were shown in Fig. 4 tried through each layer of trays in an attemp to obtain the most efficient rate. Tray spacings were varied from 15, 20, 25, 30 and 35 cm.

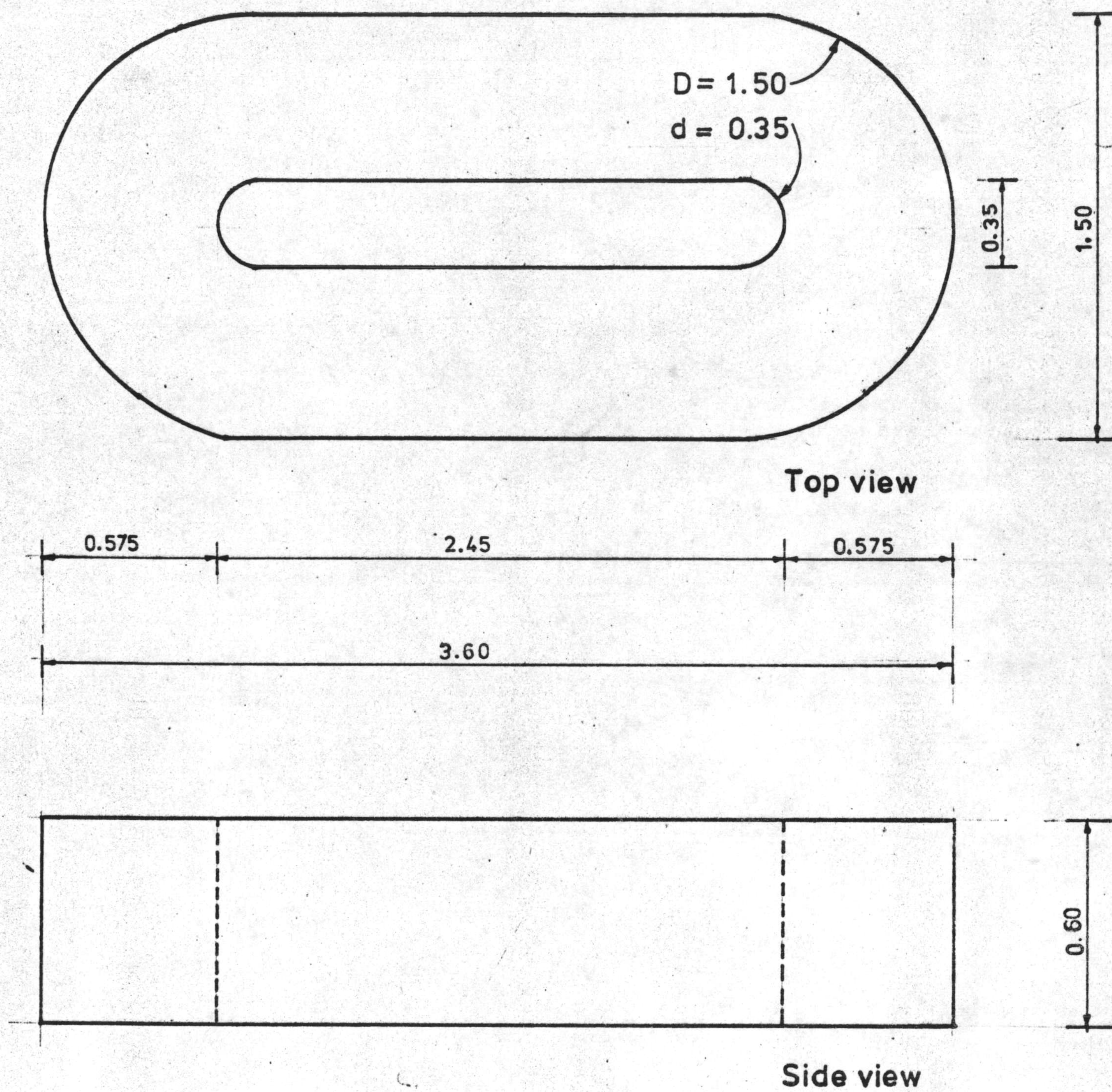

FIG 1 OXIDATION DITCH

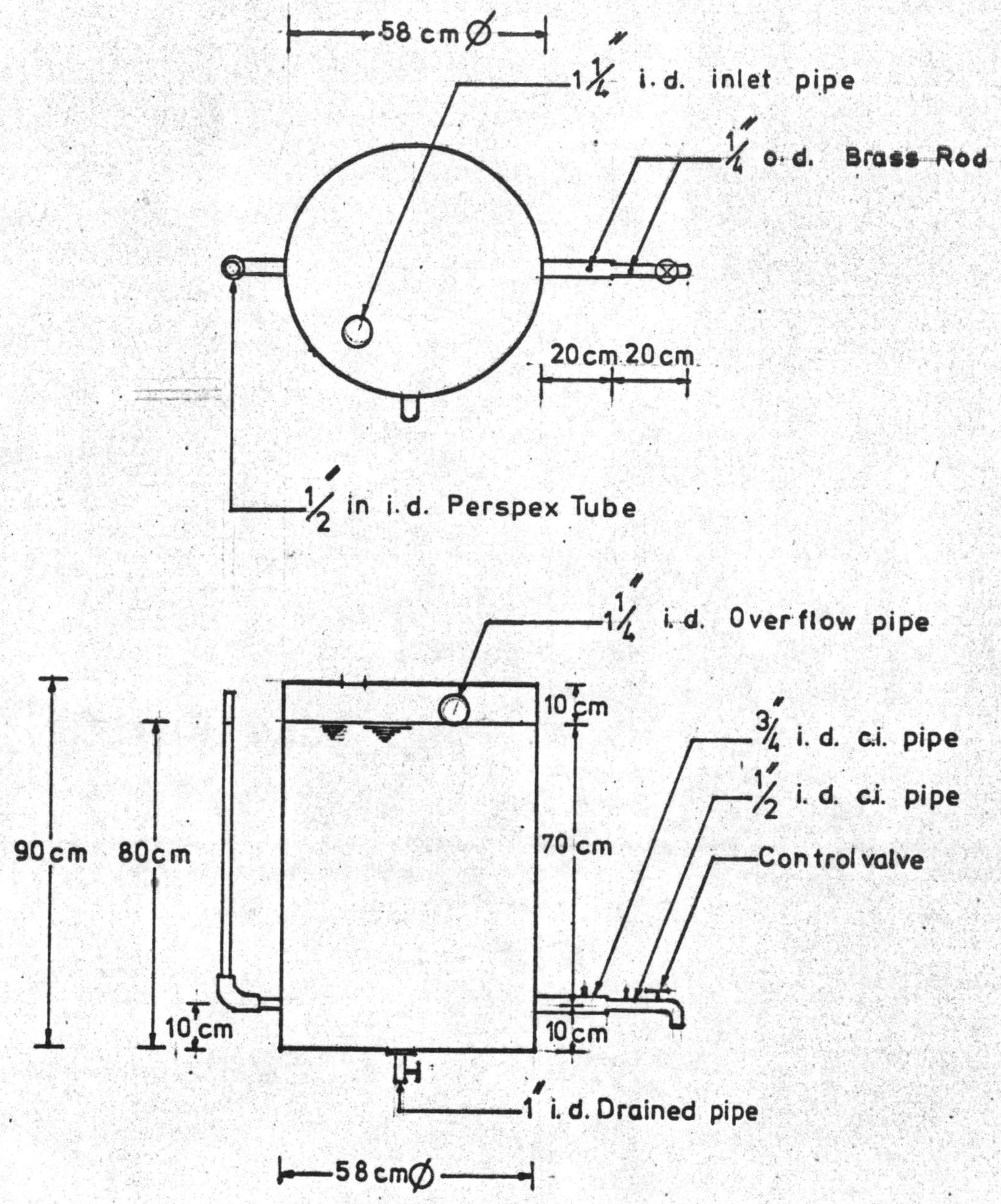

FIG. 2 ARRANGEMENT AND DETAILS OF WATER CONSTANT HEAD DOSER

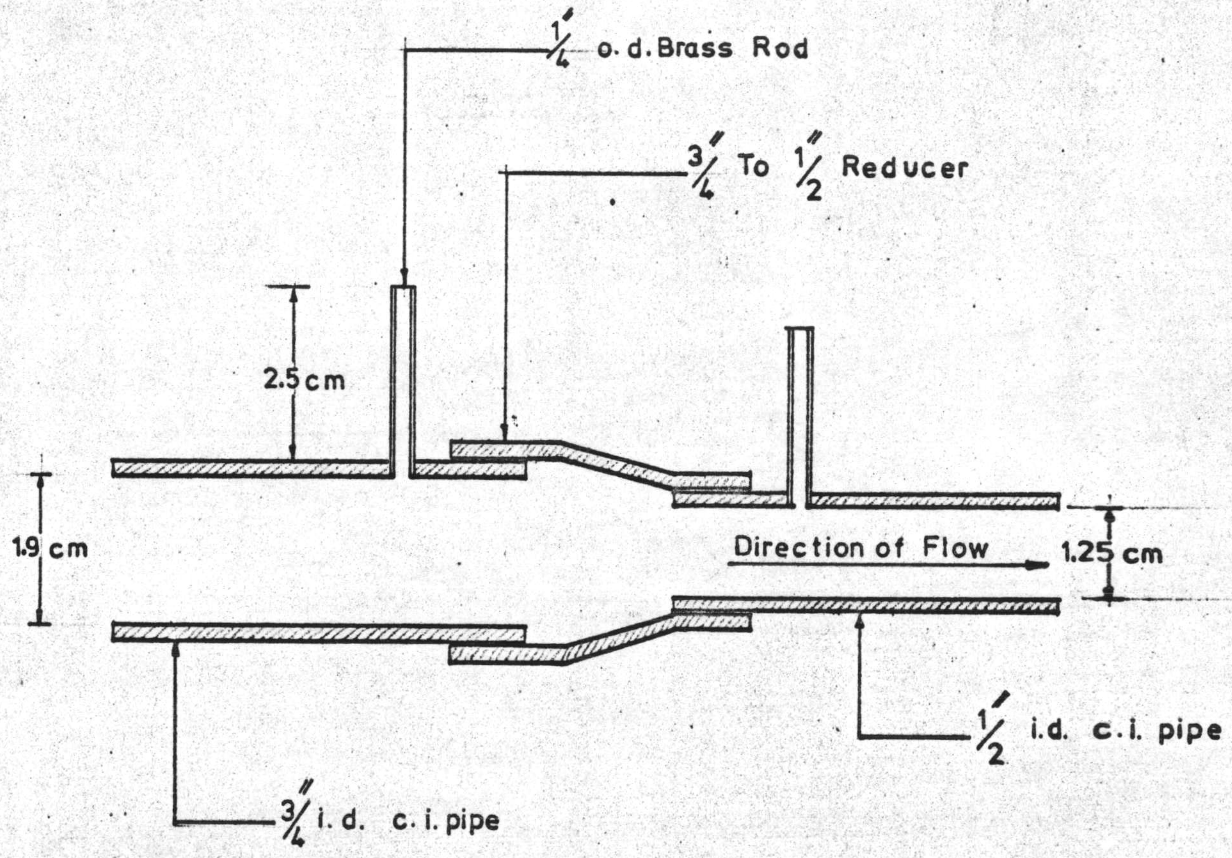

FIG. 3 DETAILS OF 1.25 CM. ORIFICE

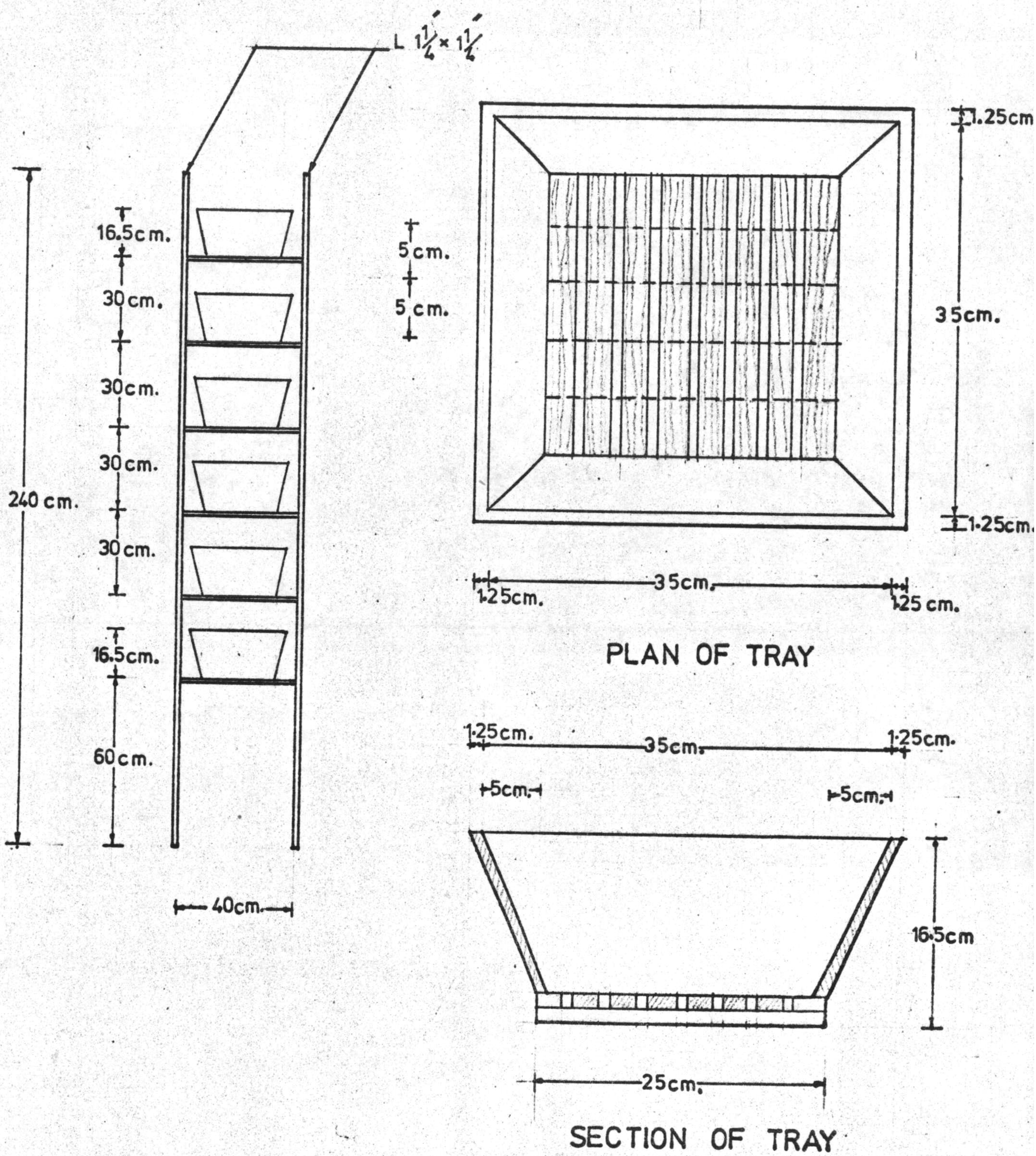

FIG. 4 DETAILS OF TRAY ARRANGEMENT

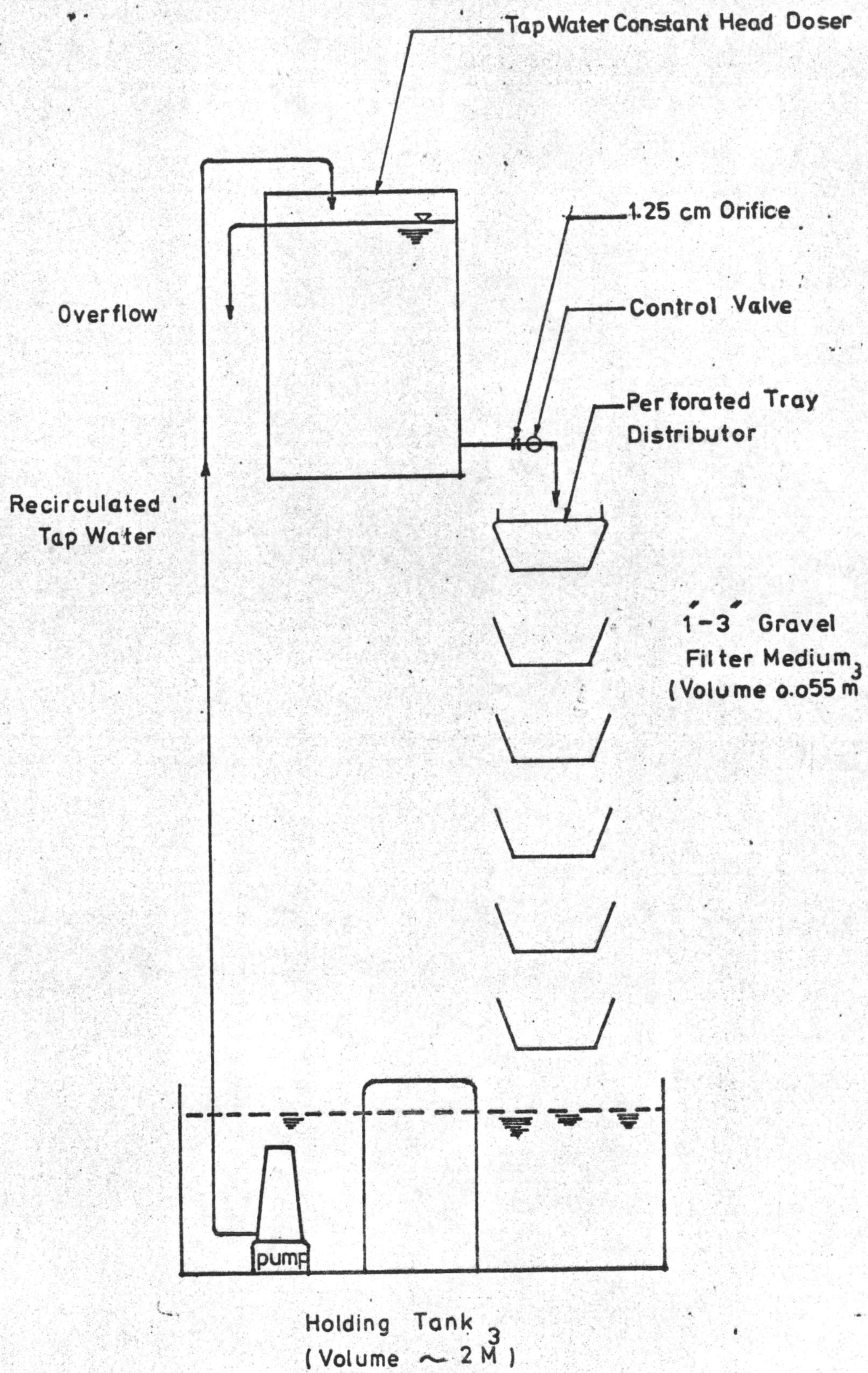

FIG. 5 SCHEMATIC FLOW DIAGRAM OF THE PILOT PLANT

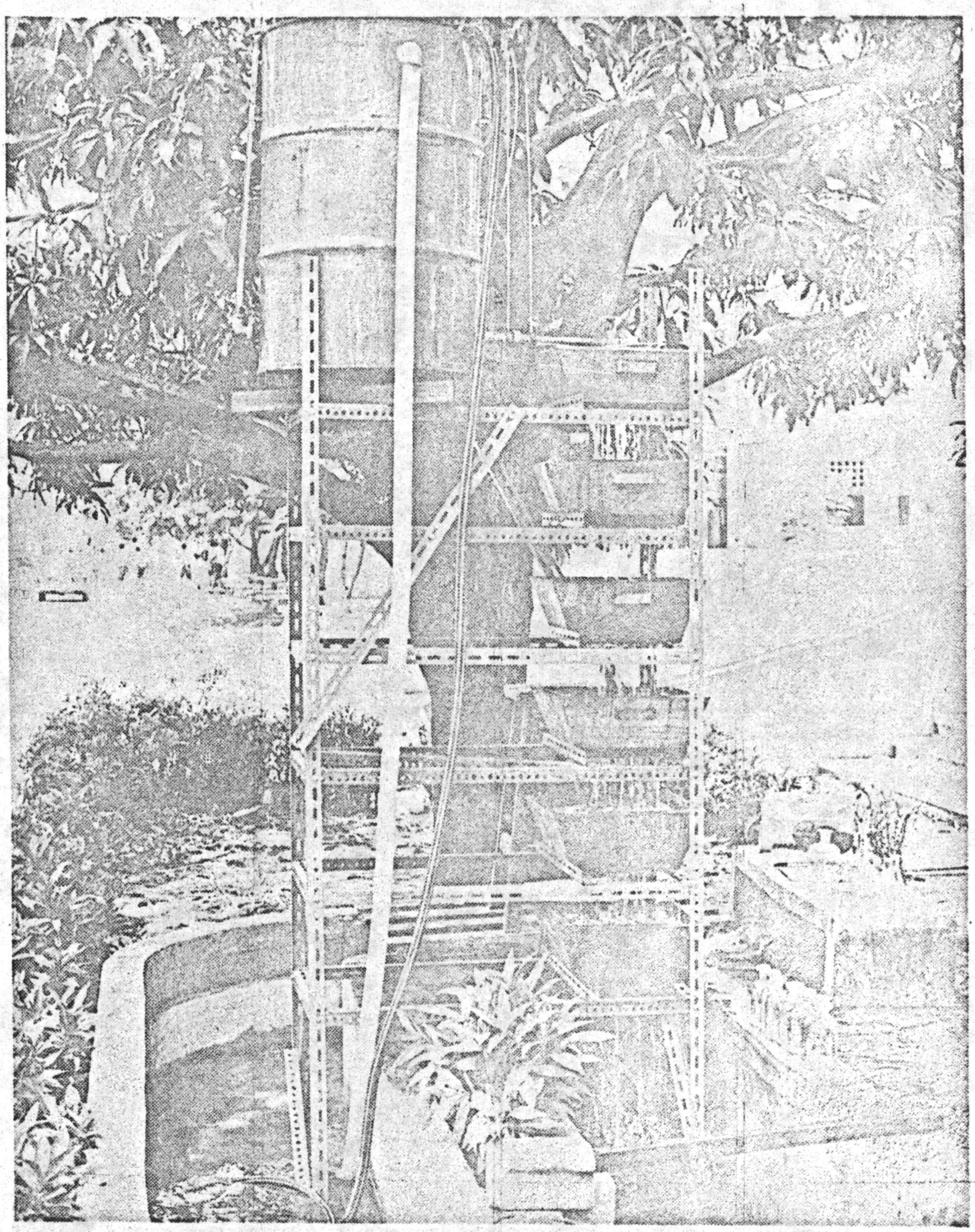

Fig. 6 The aeration system at operational flow rate of 19.7 litre per minute.

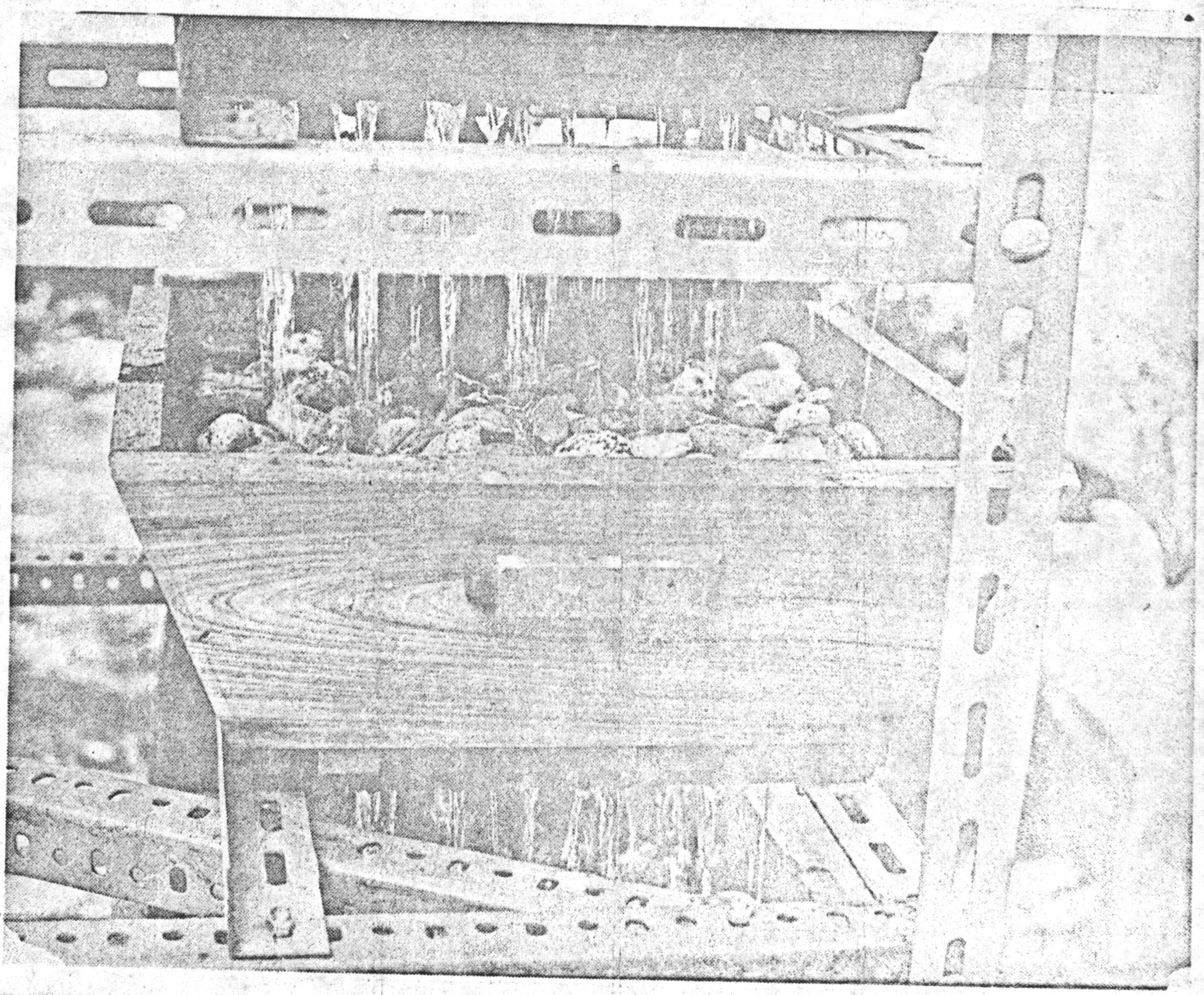

Fig. 7 1"-3"-gravel in tray layer at operational flow rate of 19.7 litre per minute.

Tap water was used as an absorbing substance in this experimeht under the non-steady state aeration of a deoxygenated water as suggested by Eckenfelder and Ford (1968).

The procedure for determination of overall oxygen transfer coefficient for each experimental run was as follows:

1. The control valve was closed and the required volume of water was prepared according to the operational conditions.

2. The initial dissolved oxygen in the water was removed by adding sodium sulphite of about 7.88 mg/l per 1 mg/l of dissolved oxygen and only 0.10 mg/l of cobolt chloride as a catalyst as suggested by Jones, Day and Converse (1969).

3. The ditch was thoroughly mixed by using a paddle in order to ensure the dissolved oxygen approximately zero at any point.

4. The submersible pump was turned on in order to pass experimental water into the elevated dosing tank as shown in figure 2 until the water approched the upper rim of overflow pipe.

5. Adjust the control valve to the desired flow rate by using the head-discharge per formance curve as shown in Fig. 5.

6. The flow rate, temperature and determined dissolve oxygen of water at different time intervals were recorded. At least five

samples were tested before 90 % oxygen saturation of the water was reached (Eckenfelder, 1966).

7. All the dissolved oxygen in water were determined by Azide Alsterberg modification of Winkler method. The oxygen saturation value, C_s at a specified temperature was taken from the Table of Solubility of Oxygen in Water Exposed to Water - Saturated Air, STANDARD METHODS (1965).