CHAPTER IV

EXPERIMENTAL INVESTIGATION

Determination of Water Quality Used for Automobile-wash Business

Samples of Water, both before and after use for car-wash, were collected from 20 service stations located in 8 Amphurs of Bangkok Metropolis, namely, A.Bangkoknoi, A.Bangrak, A.Dusit, A.Pathumwan, A. PraKanong, A. Pranakorn, A.Pomprab and A. Payathai. The collection was made on 4 different days in January 1975, and a total number of 160 samples were obtained. All samples of wash-water before use were collected from washing hoses, whereas the after-use samples were taken from the concrete troughs just behind the grease traps. Every sample then underwent tests for turbidity in the laboratory.

Determination of Automobile Washwater Consumption of Service Stations

Five sets of meters of $\phi\ 1\frac{1}{2}$" in size as shown in Fig.1, obtained on loan from the Metropolitan Water Works Authority, were installed at 4 service stations located in 4 different Amphurs, namely, A.Dusit, A.Pathumwan, A.Payathai and A.Pranakorn. The selection of the places was made by taking into account the wide range of water consumption discovered in the preliminary survey. The meters were made to start registering the total consumption of wash-water from 8 February 1975 to 9 April 1975. The details are shown below.

1. The Dao Rachawat Service Station in A.Dusit, which renders a 24-hour service of car-wash, was equipped with one $\phi\ 1\frac{1}{2}$ in.meter to record the consumption at 3 - hour intervals for 59 consecutive days. The detail of the installation is shown in Fig.2 and Fig.3.

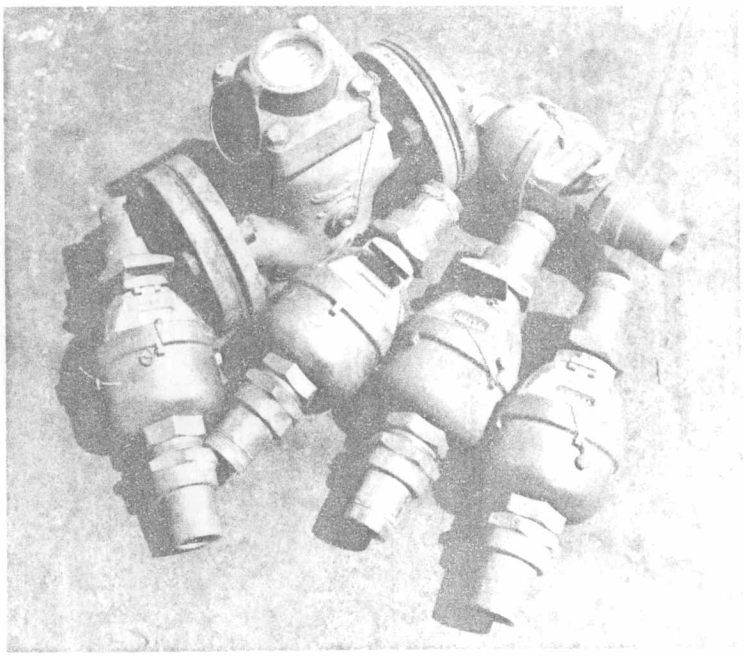


Fig. 1 Sets of Meters, on Loan from the Metropolitan Water Works Authority

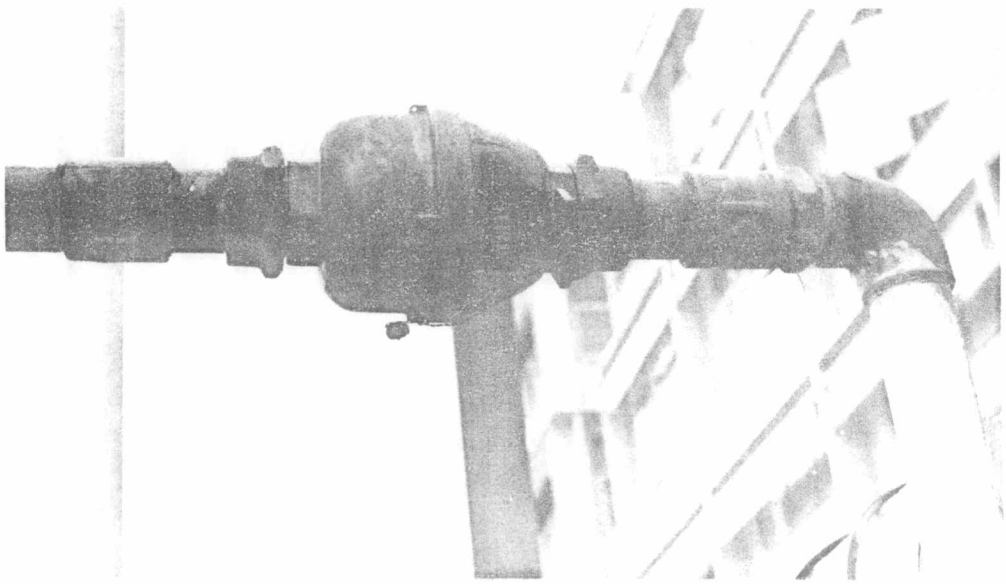


Fig.2 Meter Set-up at DAO RACHAWAT

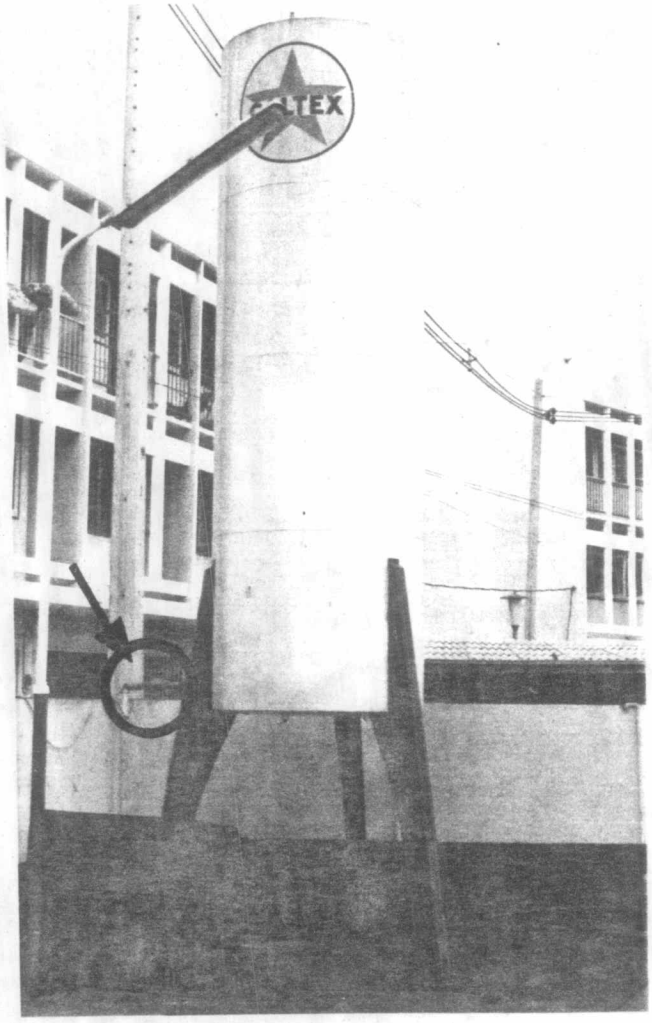


Fig. 3 Position of Meter at the Tank

2. The P.Sapan Lueng Service Station in A.Pathumwan, which renders a 24 - hour service of car-wash, was equipped with two ϕ $1\frac{1}{2}$ in. meters to record the consumption at 6 - hour intervals for 60 consecutive days.

3. The Ruam Charoen Borikarn Service Station in A.Payathai, which also renders a 24 - hour car-wash service, was equipped with one ϕ $1\frac{1}{2}$ in. meter. The consumption was recorded at 12 - hour intervals for 59 consecutive days.

4. The Mahachai Service Station in A.Pranakorn, which renders a 12 - hour service of car-wash, was equipped with one ϕ $1\frac{1}{2}$ in. meter to record the consumption at 24 - hour intervals for 60 days consecutively.

Design of Experimental Filter

The experiments were performed at the P.Sapan Lueng Service Station during 20 May 1975 to 3 August 1975 and were conducted on a 7.5 $\times$ 7.5 cm^2 column of 2.00m height built of 0.3 cm ($\frac{1}{8}$ in.) thick perspex sheet. This column was so designed as to be able to function either as a slow or as a rapid gravity filter. Sampling taps and manometer tubes, built of 0.635 cm ($\frac{1}{4}$ in.) diameter plastic tubes, were placed along the height of the column at an interval of 20 cm , starting from the bottom of the filter bed. Influent weir box was also built of 0.3 cm thick perspex sheet. Filter and influent weir box pipings were of $\frac{3}{4}$ in. PVC pipes. The details and dimensions of the experimental filter are illustrated in Fig.4. Steel feeding tank with float switch control was provided to control the operation of the pump. Steel constant head tank was used to maintain a constant flow to the filter. Effluent weir box, on which an inlet pipe was installed at a level just above the top of the filter media, was used in order to prevent accidental dewatering of the filter bed and also ensure a

balance of pressure so as to keep the rate of out flow equal to the rate of inflow at all times.

The details with dimensions of the feeding tank, constant head tank and effluent weir box are illustrated in Figs. 5 and 6. Figs. 7 and 8 show schematically the set-up and lay-out of the experimental filter respectively. A Photograph of the actual set-up at the P.Sapan Lueng Service Station is shown in Fig.9

Raw water was pumped from the effluent compartment of the grease trap to the feeding tank with a $\frac{1}{3}$ - HP, pilot plant size centrifugal pump, as shown schematically in Fig.10. An air-water manometer board, about 2.50 m high attached with 10 glass tubes, 0.635 cm ($\frac{1}{4}$ in.) diameter, was provided to measure the head losses through the bed and is shown on the right hand side of Fig.9.

Design of Experiments

The experiments were conducted in two series. The first series of test runs were conducted in order to determine the optimum filtration rate for burnt rice husk at constant depth of the media. Table 3 shows the schedule of the test runs in Run Series I. The second series of test runs were conducted so as to determine the optimum depth of the media at the constant, optimum rate obtained priorly from Run Series I. Table 4 shows the schedule of the test runs in Run Series II.

Throughout all the runs, the independent variables considered in this study were :

1. influent water quality, such as turbidity and pH;
2. loading or filtration rate; and
3 depth of media.

The dependent variables considered were :

1. effluent water quality, such as turbidity and pH;

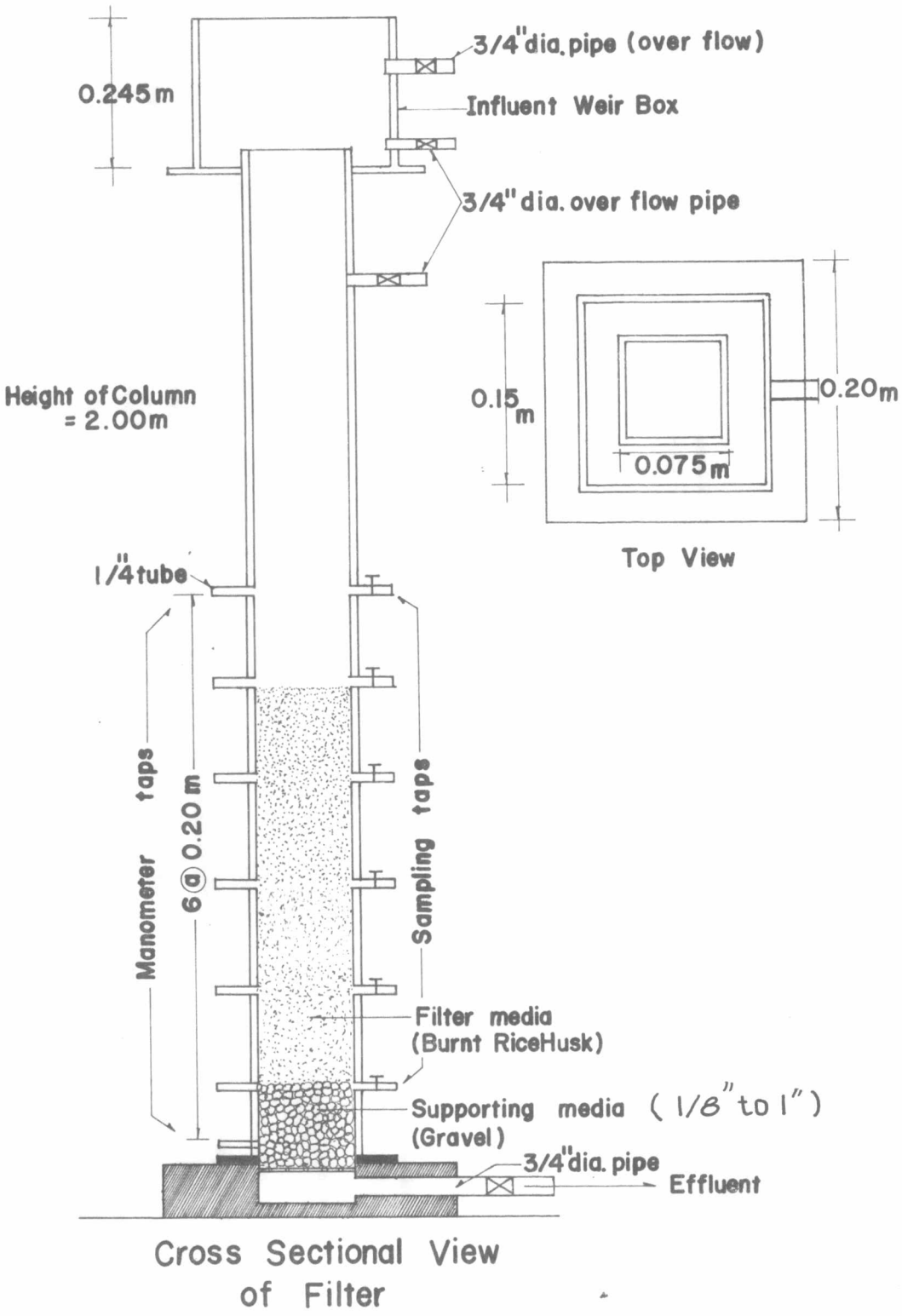


Fig. 4 Detail of Experimental Filter.

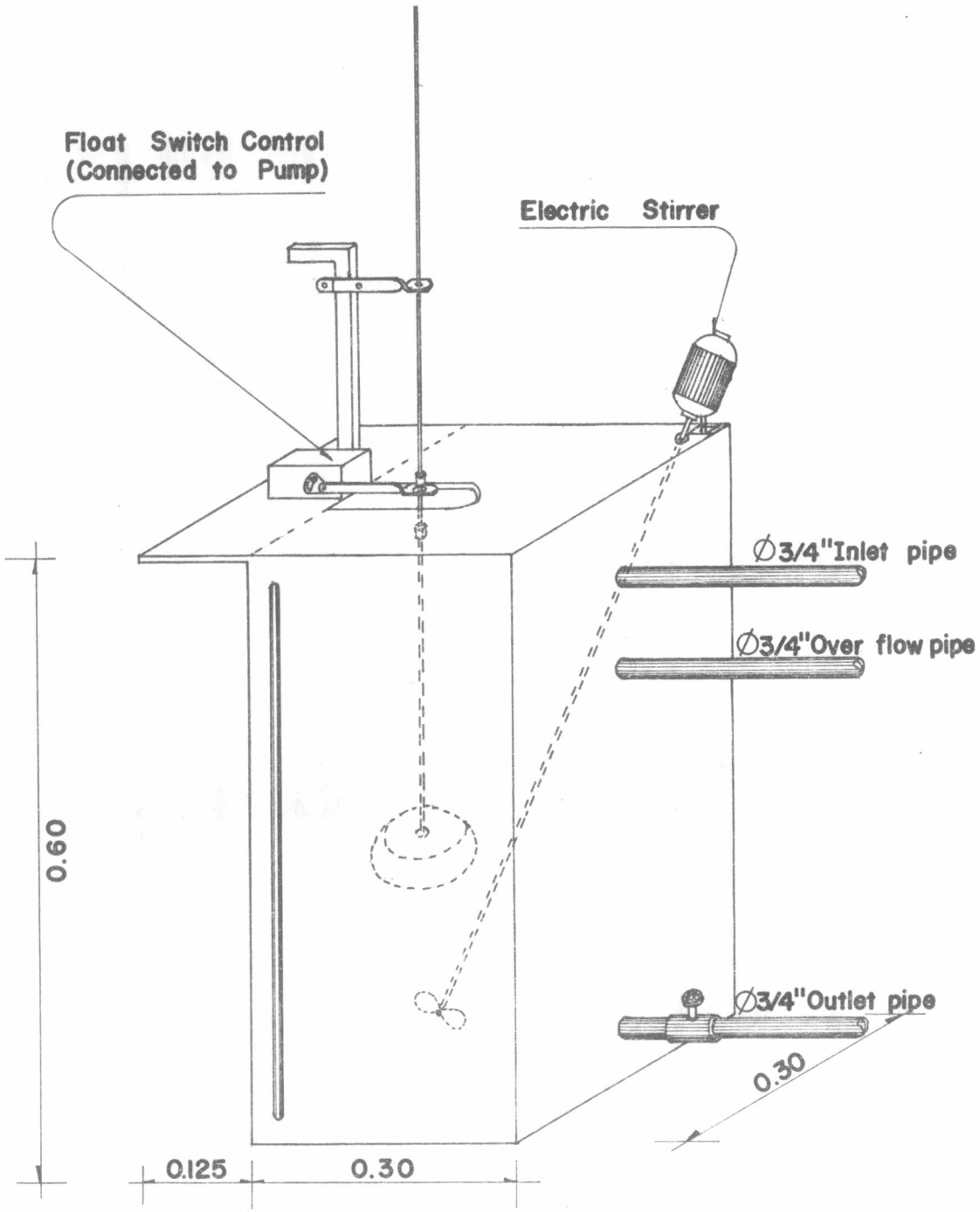
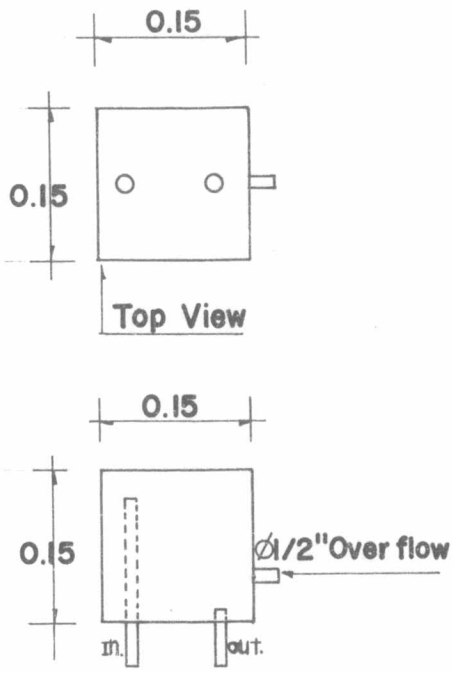
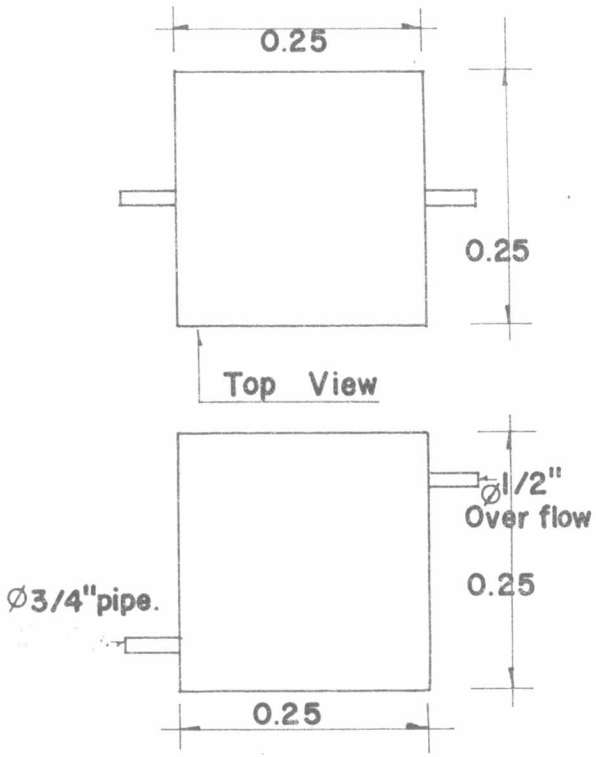


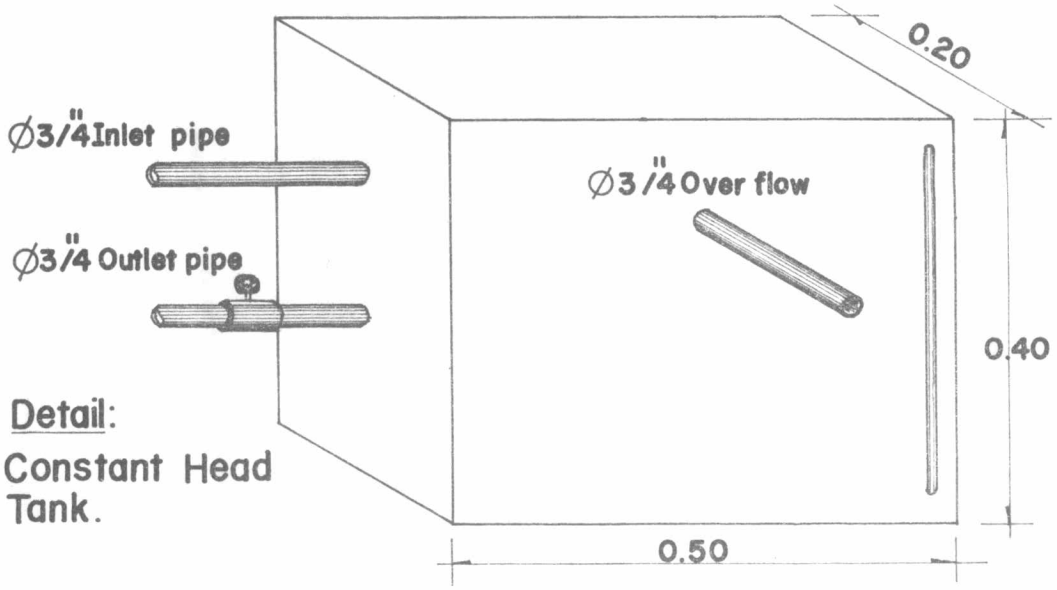
Fig. 5 Detail of Feeding Tank.



Detail: Effluent Weir Box

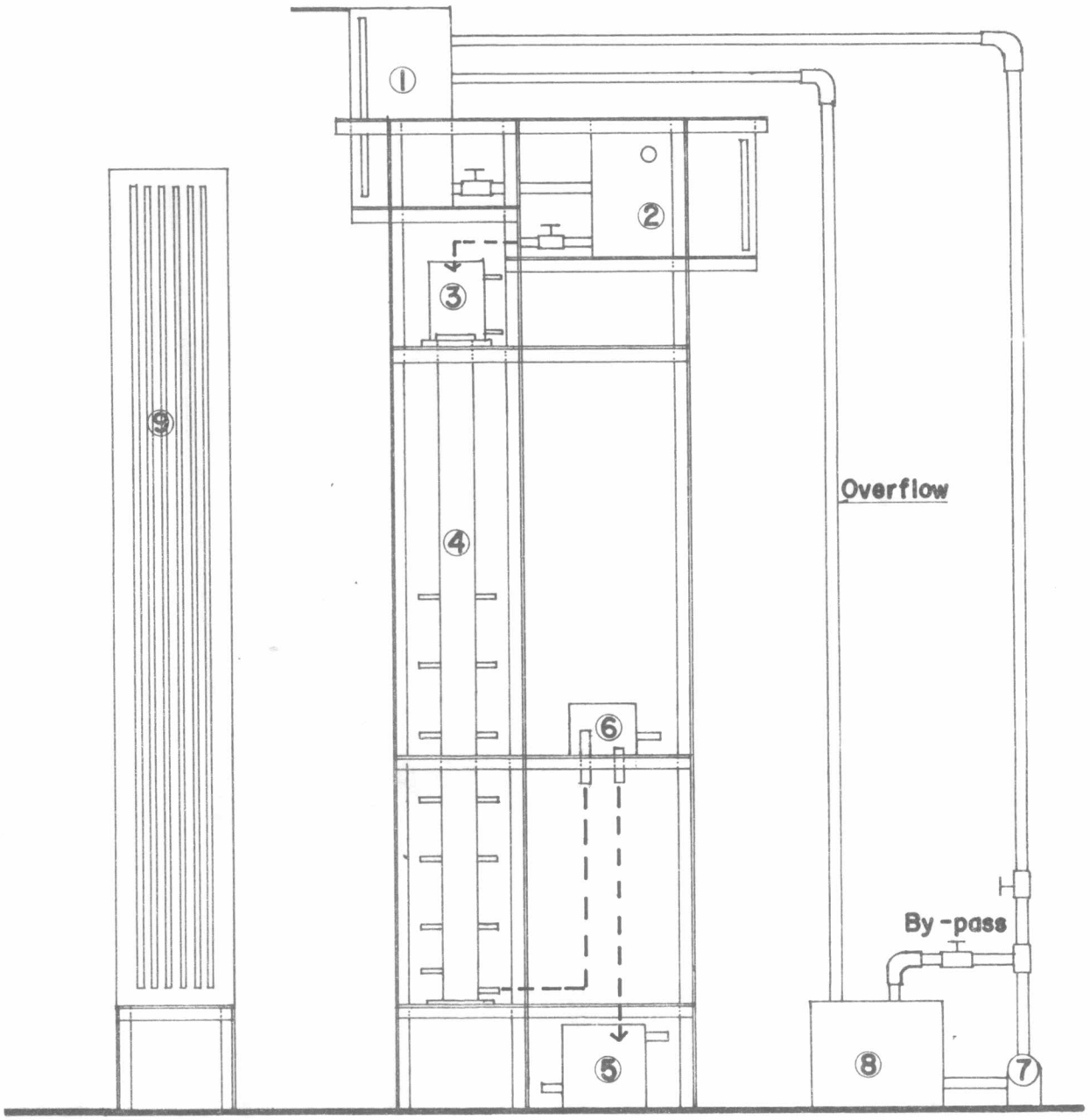


Detail: Clear Water Tank



Detail:
Constant Head
Tank.

Fig. 6 Detail of Constant Head Tank ; Effluent Weir Box & Clear Water Tank.



1. Feeding Tank
2. Constant Head Tank
3. Influent Weir Box
4. Filter Column
5. Clear Water Tank
6. Effluent Weir Box
7. Pump
8. Raw Water Tank
9. Manometer Board

Fig. 7 Experimental Set up of Filter Unit.

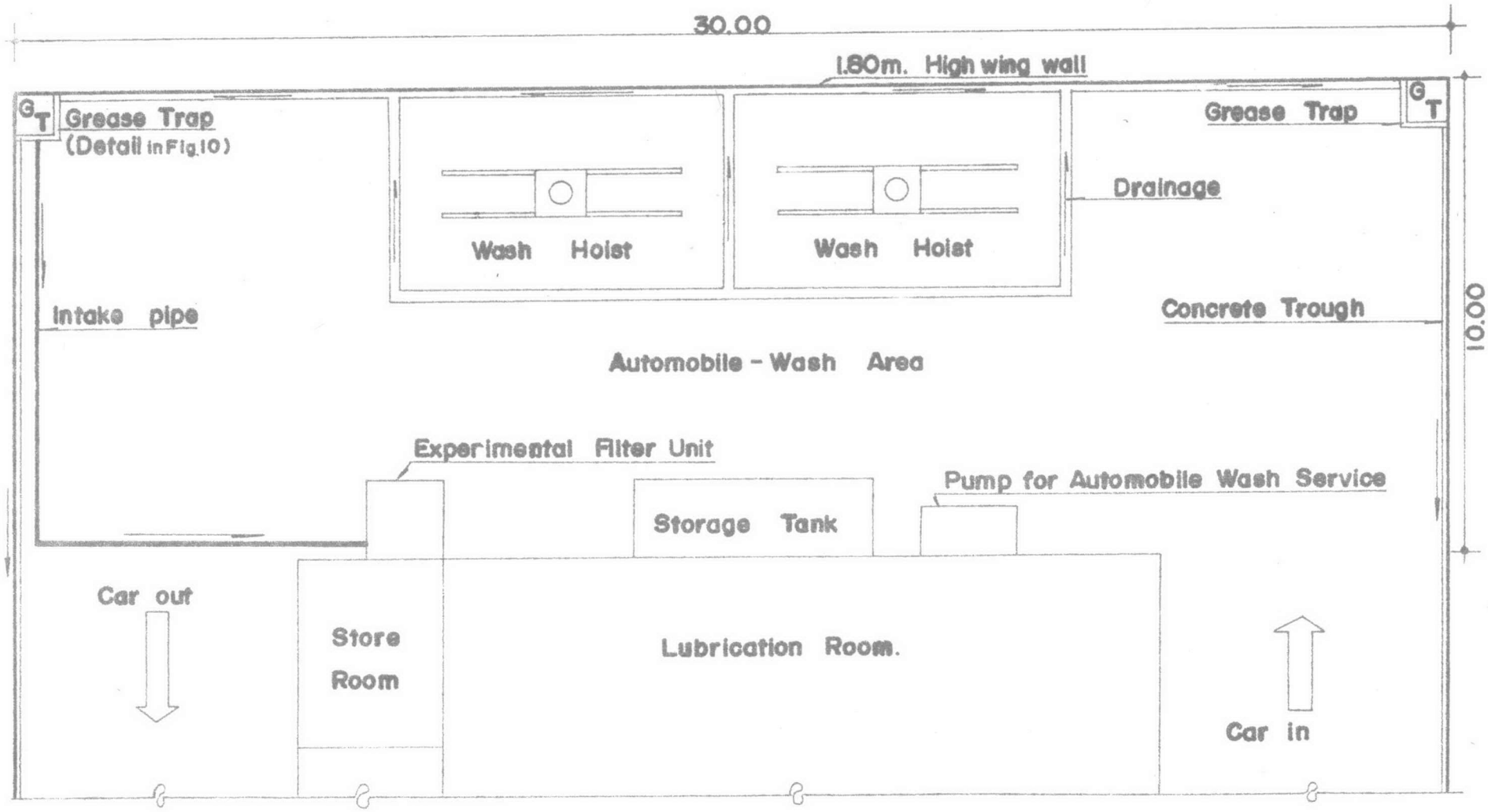


Fig. 8 Lay - out of the Experimental Filtration.

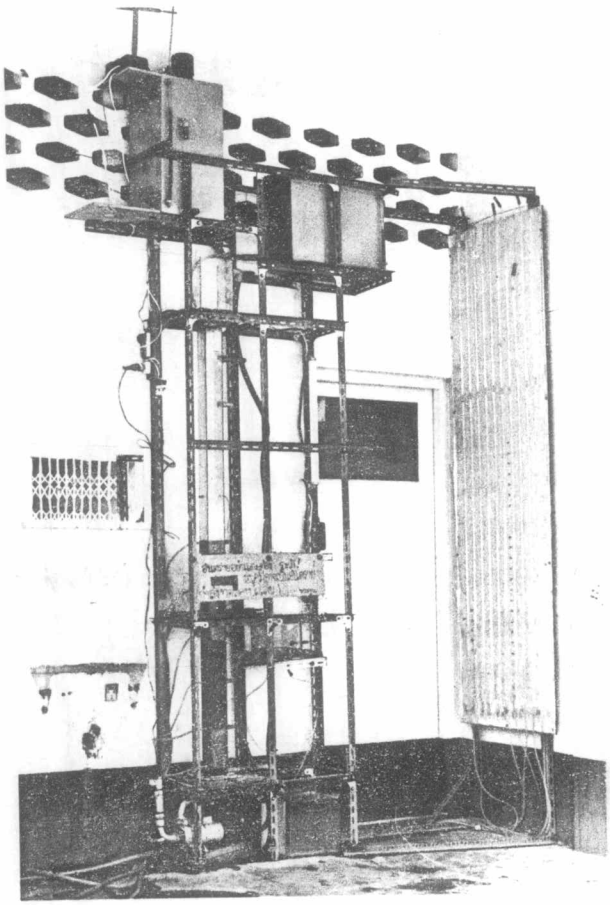


Fig. 9 Experimental Filter Set-up at the Service Station (P. SAPAN LUENG)

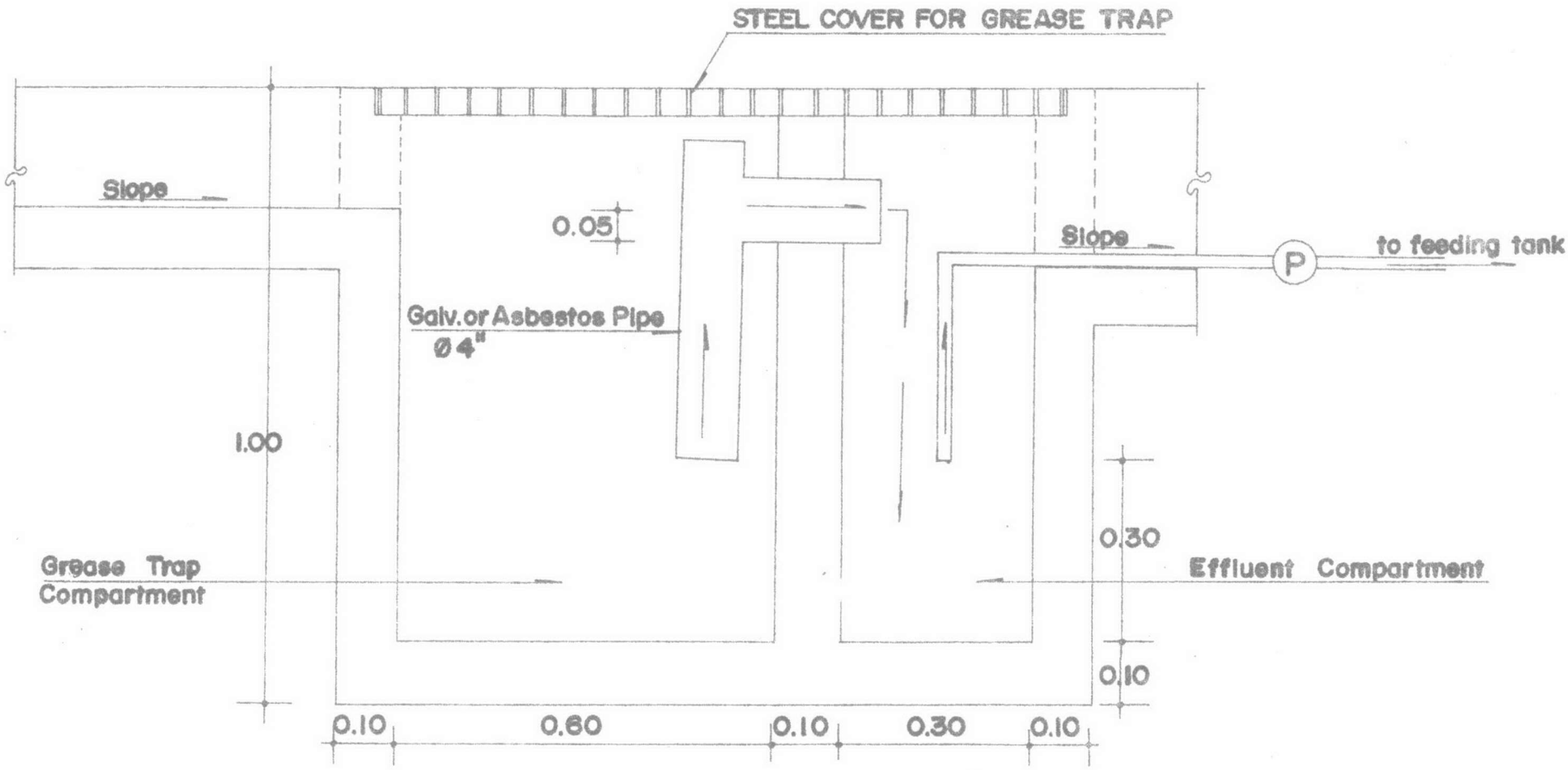


Fig. 10 Schematic Detail of Raw Water Flow from The Grease Trap

Table 3 Schedule of Test Runs in Run Series I

Fix 1. Range of Turbidity
2. Depth of Media
Vary Filtration rate
} Select: Filtration rate.

Run No.	Media	Depth of Media (cm)	Filtration Rate ($m^3/m^2/hr$)	Remark
1.	BRH*	80	2.5	
2.	BRH	80	1.25	
3.	BRH	80	0.25	

BRH* = Burnt Rice Husk

Table 4 Schedule of Test Runs in Run Series II

Fix 1. Range of Turbidity
2. Filtration Rate
Vary Depth of Media
} Select: Depth of Media

Run No.	Media	Depth of Media (cm)	Filtration Rate ($m^3/m^2/hr$)
1.*	BRH	80	Optimum Rate from Series I
2.	BRH	60	Optimum Rate from Series I
3.	BRH	40	Optimum Rate from Series I

1* = Result from Series I

2. head loss through the filter media; and
3. duration of filter run before head loss builds up to 1.2 m.

In these experiments, the filtration rates were studied at three levels : 2.5, 1.25 and 0.25 $m^3/m^2/hr$. The depth of the filter bed was varied among 80, 60 and 40 cm and was supported by 20 cm of graded - gravel. The results obtained from these test runs were used to determine the design parameters and duration of the filter system.

Materials and Equipment Utilized

In the determination of washwater consumption for automabile of the service stations, KENT water meters of ϕ $1\frac{1}{2}$" - size were installed at the selected service stations.

In the experimental filter studied, filtering media used for the investigation was burnt rice husk of the same size as that taken from a local rice mill. The burnt rice husk was given free of charge except for transportation costs to and from the mill.

Hach Laboratory Turbidimeter of Model 1860 A, as shown in Fig.11, was used for turbidity measurement. Orion Research Digital pH Meter of Model 701, as shown in Fig.12, was used for pH measurement. An air - water manometer was provided to measure the head loss throughout the filter bed. In measuring the flow rate, a volumetric cylinder and a stop watch were used. Ordinary valve was used to control the flow. The descriptions of the filter column, influent weir box, feeding tank, constant head tank and effluent weir box were given in the previous section. An electric stirrer was installed on the feeding tank to prevent some portion of the solids from depositing in the feeding tank and to ensure uniform distribution of the solids. A small - size centrifugal pump of capacity $\frac{1}{5}$ HP was used to pump raw water from the effluent compartment of the grease

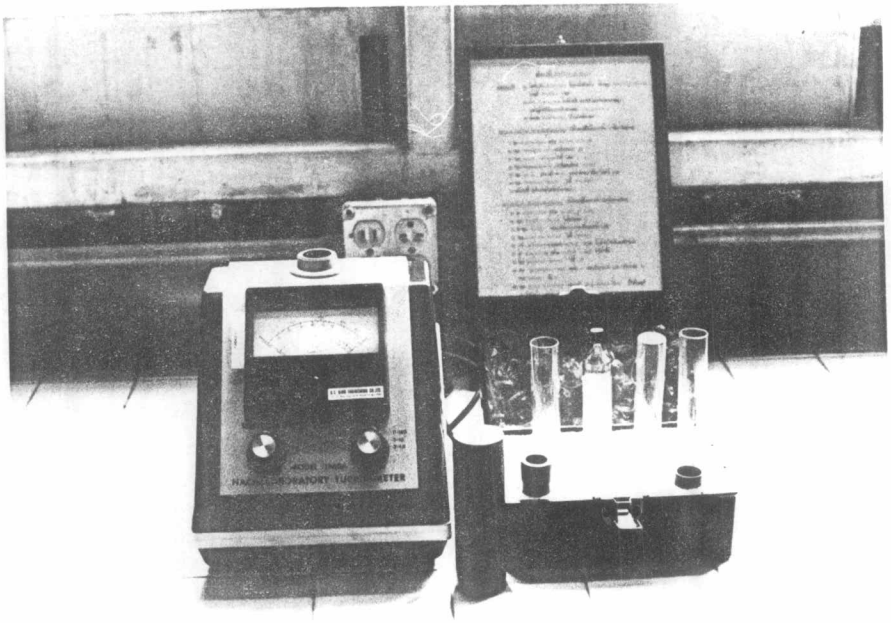


Fig.11 Hach Laboratory Turbidimeter Model 1860A

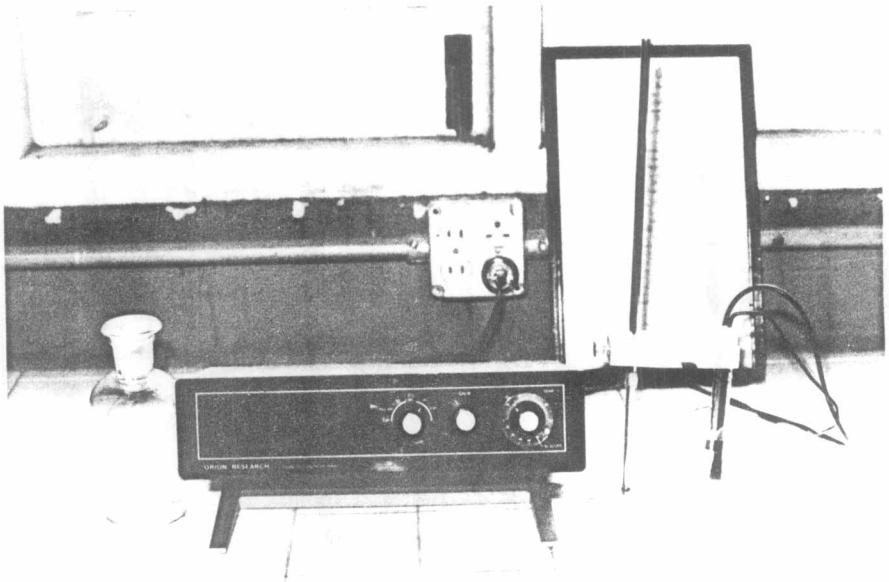


Fig.12 Orion Research Model 701/ Digital pH Meter

trap to the feeding tank.

Procedure and Analytical Methods.

Procedure for analyzing turbidity was as described by the manufacturer of Hach Turbidimeter and turbidity was measured in Jackson Turbidity Units (JTU). Orion Research Digital pH meter was used to measure pH and the procedure for the analysis of pH is given in detail by the manufacturer. Head loss was measured with the manometers attached at the filter surface and different depths of the bed. Head loss measurement was done every 6 hours and turbidity was analyzed every 12 hours until the head loss builds up to 1.2 m. Oil, filter bed performance and particle penetration were observed and analyzed visually. A photograph shown in Fig.13 was taken to show the extent of bed penetration.

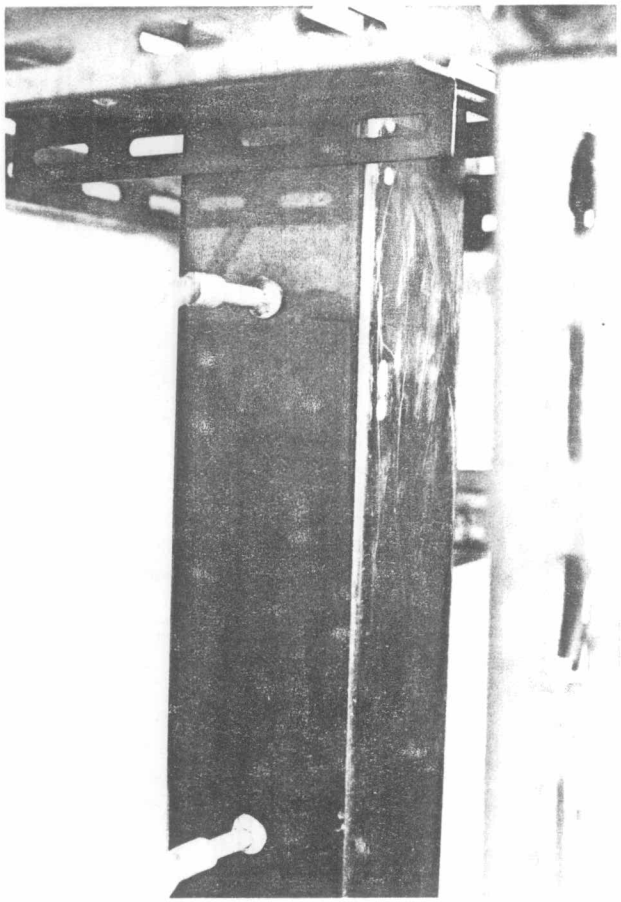


Fig. 13 Bed Penetration in Burnt Rice Husk