IV EXPERIMENTAL INVESTIGATION

Design of Experimental Filters

The experiments were conducted on a 7.5 x 7.5 cm^2 column, 2.00 m. height of 0.3 cm. thick perspex sheet. This single column was designed to be able to function as a slow, or rapid gravity filter. A constant-head tank was used to maintain a constant flow to the filter. Sampling taps and manometer tubes of 0.6350 cm. (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. Filter piping were 3/4 in. P.V.C. pipe with manual flow control valves. A 1/3 Hp. pilot plant size centrifugal pump was used to pump the water from a 25 x 40 x 25 cm^3 dosing and mixing tank to the top of the filter. The details and dimensions of the experimental set-up filter unit are illustrated in Fig V, VI, VII.

A 3/4 cu.m. tank was used for mixing synthetic water (by adding $FeSO_4.7H_2O$ into the ground water to meet the required iron concentration). Influent water was pumped from the storage tank to the constant head tank by a pilot plant size centrifugal pump. A manometer board, about 2.50 meters high attached with 10 glass tubes, 0.635 cm. (1/4 in) diameter is used to measure head losses as shown in Fig (3).

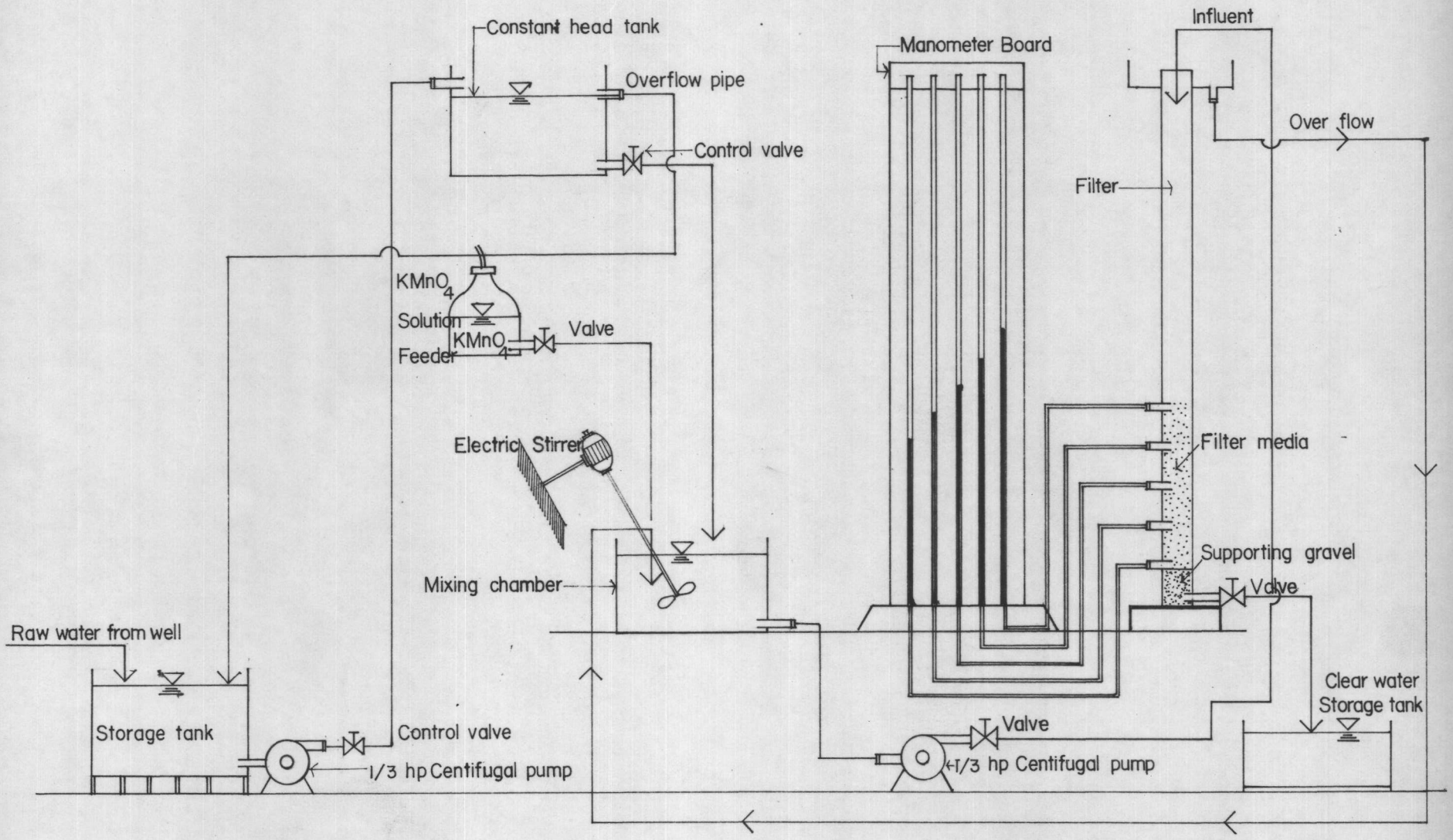


Fig. V Schematic Flow Diagram of the Pilot Plant.

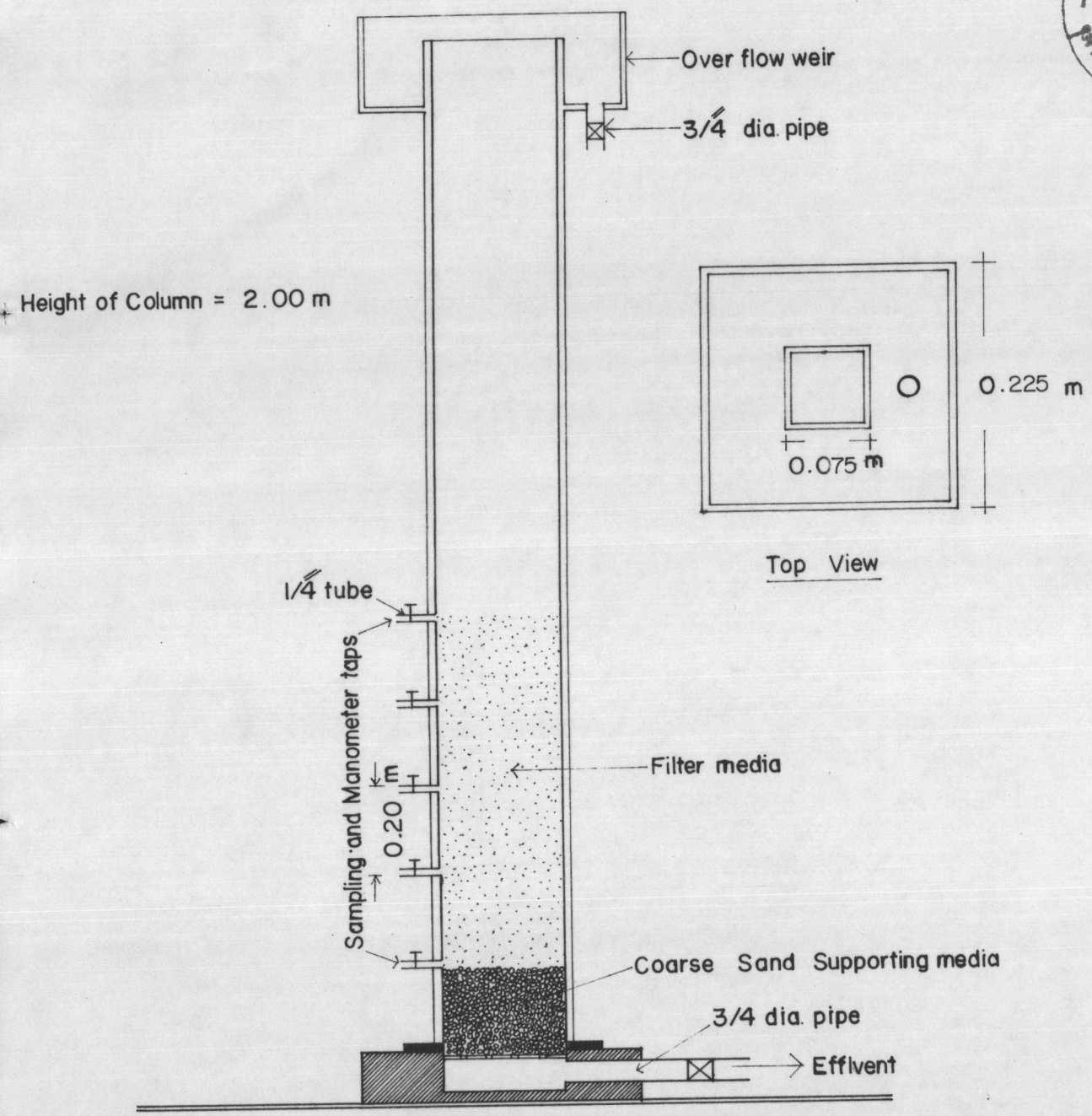


Fig VI Detail of Experimental Filter.

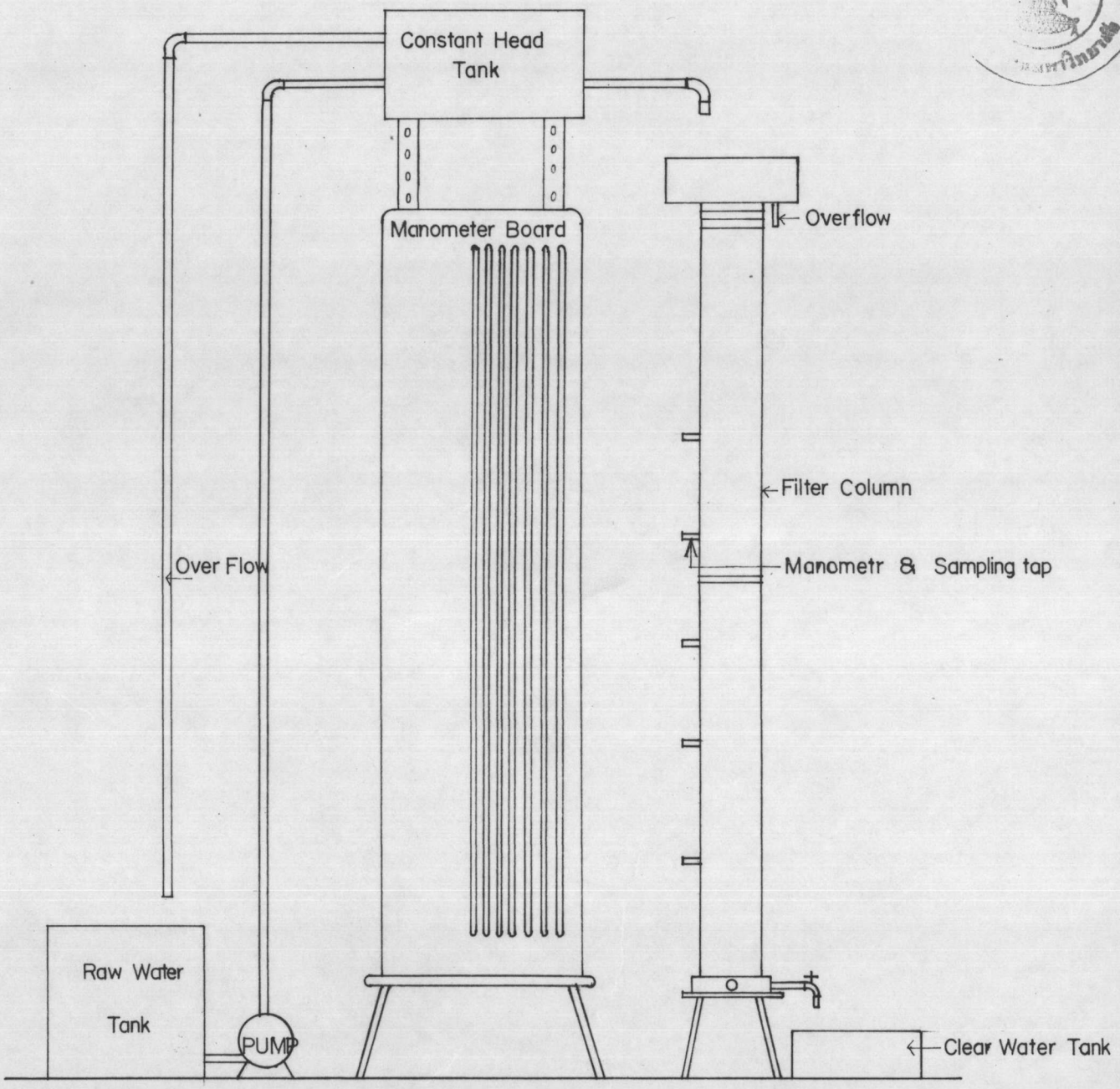


Fig. VII Experimental Set up of Filter Unit.

Conventional Jar Test Experiments.The ground water from wells in Bangkok and the synthetic iron-content water was taken for performing jar tests at the Sanitary Engineering Department laboratory to determine the optimum potassium permanganate demand for iron removal. The raw water was first analysed for pH, alkalinity, total hardness, and total iron content. For the conventional jar test each of the six one-litre beakers was filled with the raw water and stirred at a paddle speed of about 100 rpm. Potassium permanganate was added to the water in each beaker simultaneously. The solution was then violently agitated for 1 minute at a paddle speed of about 100 rpm to ensure uniform distribution of the chemicals throughout the body of the water. The speed of the paddle was then slowed down to 40 rpm for 3 minutes. After this period, the solutions in the six beakers were allowed to stand for 20 minutes settling time before the clear upper portion of the supernatant was taken to analyse immediately for pH, alkalinity, total hardness, and total iron.

In this conventional jar test study, the concentration of $KMnO_4$ was 5000 mg/l. The chemical dosage range were depent on the iron concentration in the raw water. Five sets of jar tests were made to determine the optimum $KMnO_4$ demand (for various iron concentration) needed for iron removal. The results obtained served as a guide to the optimum $KMnO_4$ demands in the Pilot plant treatment.

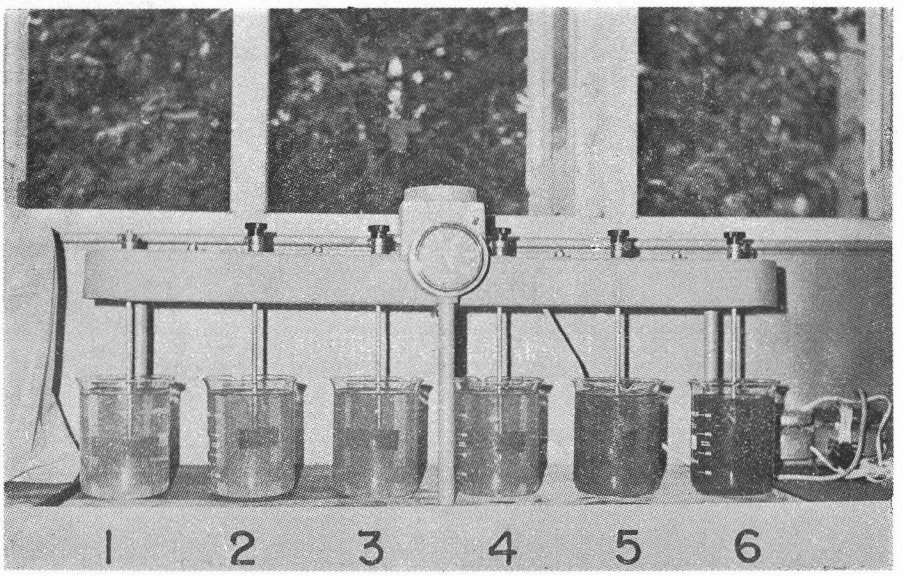


Fig. 1 Conventional Jar Test Apparatus.

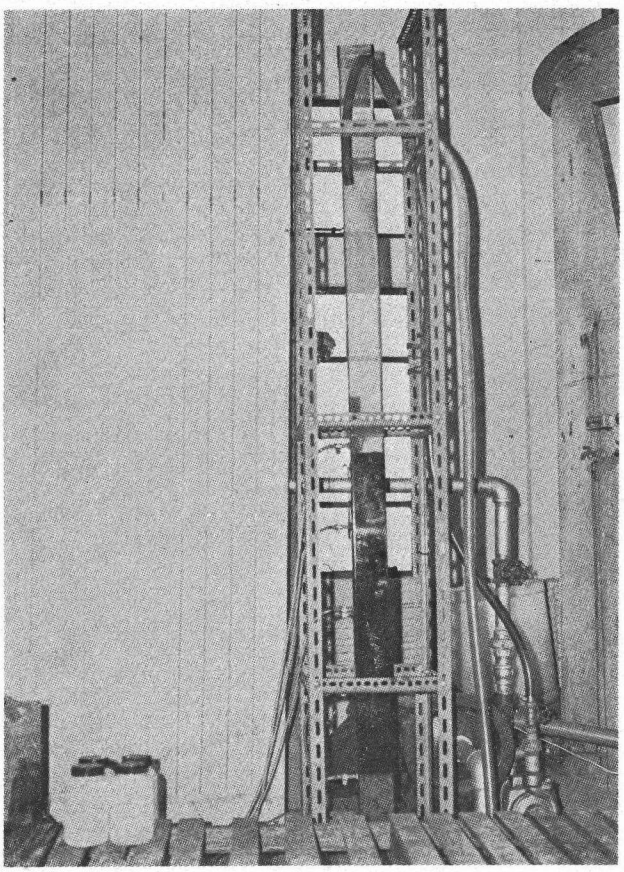


Fig. 2 Experimental Set-up of Filter Unit.

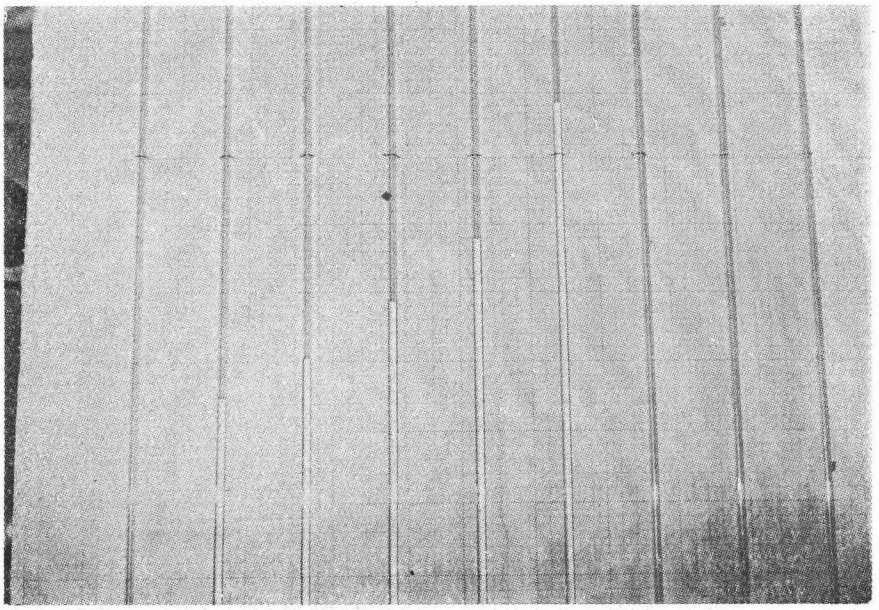


Fig. 3 Manometer Boord.

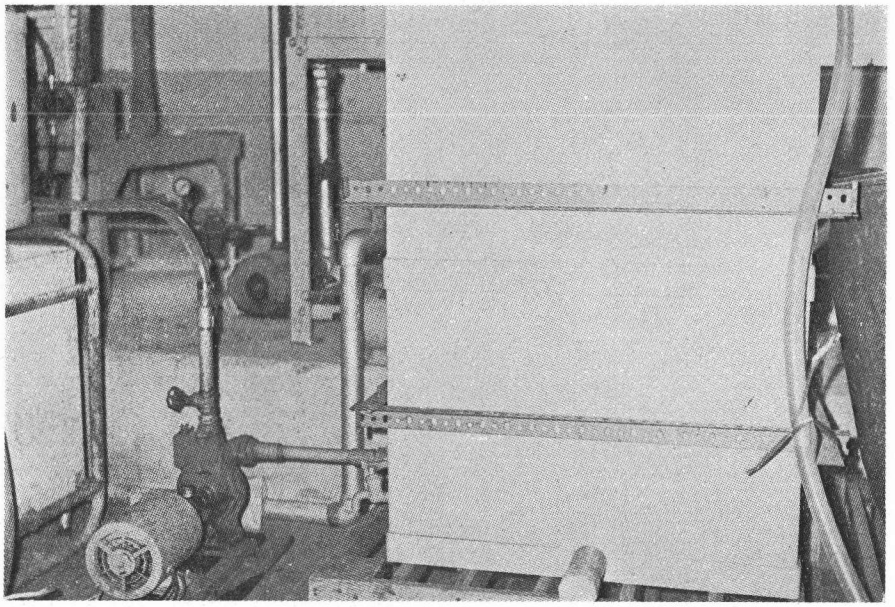


Fig. 4 Raw Water Storage Tank.

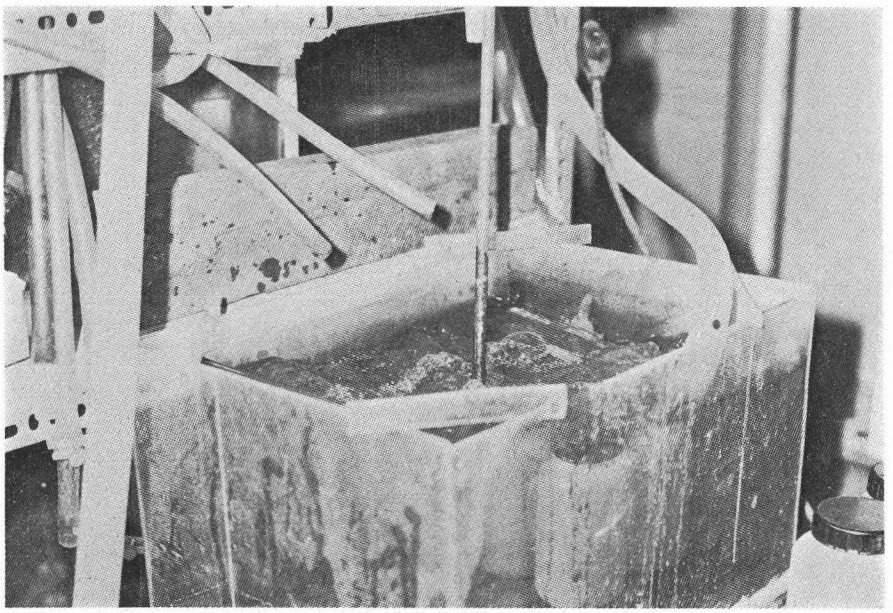


Fig. 5 Mixing Tank with Electric Stirrer.

Materials and Equipment Utilized

Experimental studies on synthetic water and high iron-content ground water from various water wells in Bangkok: For synthetic water, Fe SO_4.7 H_2O. was added to the municipal tap water to obtain the desired level of iron concentration.

The cost of commercial grade potassium permanganate used for the experiments was about 30 baht per kg.

"Anthrafilt" (granular anthracite coal) which had an effective size of 0.40 - 0.45 mm and a uniformity co-efficient of 1.4, the density of about 1.5 gm/cm^3. was avialable in the Bangkok chemical store. The costs for the anthrafilt were about 27 Bahts per kg.

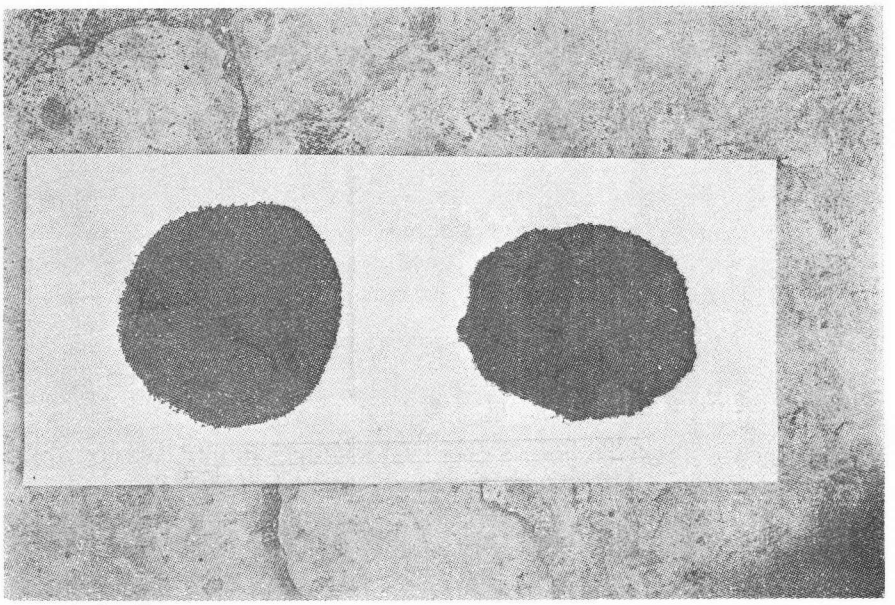
Burnt rice husk size was the same as taken from a local rice mill. The burnt rice husk was obtained free of charge except for transportation costs to and from the mill.

Influent turbidity and effluent turbidity were measured by a Hach Turbidimeter. Head loss throughout the bed will be measured by air-manometer tubes attached to a manometer board. Filter column description was stated in the previous section. Ordinary valves were used to control water flow measured by a volumetric cylinder and a stop watch. Two small plant size pumps of maximum head 6m. were used to pump water from the storage tank to a constant head tank and from dosing tank to the filter column.

Preliminary studies were conducted on a conventional Jar test equipment to determine the potassium permanganate demand of the raw water at various iron concentration that will give the optimum $KMnO_4$ residual in the water.

Procedure and Analytical Methods

The following analyses were performed to characterize



Anthracite Burnt Rice Husk

Fig. 6 Comparison of Anthracite Grain and Burnt Rice Husk.

the water at any stage of treatment.

a) Total Alkalinity
b) Total hardness
c) Total iron
d) Ferrous Iron
e) pH measurement
f) Temperature
g) Turbidity
h) Coliform bacteria

All chemical analyses were performed according to the procedures given in STANDARD METHODS (1971), 13 th Edition, except for total iron, Ferrous iron which were analysed by using a DELTA SCIENTIFIC MODEL 260 WATER ANALYZER. Turbidity was measured by a Hech Turbidimeter, pH was determined by a Richmond Analytical Pocket pH meter, and Temperature by a mercury in glass thermometer. Coliform count was determined at the SAM SEN WATER TREATMENT PLANT LABORATORY.

Summary of Analytical Methods

Determination	Std. Method 13 th Ed.	Method Used	Commence Remarks
Alkalinity	Yes	Titration	
Free CO_2	"	"	
Total hardness	"		
Ferrous Iron	No	Phenanthroline Method	By DELTA SCIENTIFIC METHOD
Total Iron	"	"	"
pH	Yes	pH meter	
Temperature	"	Mercury Thermometer	
Coliform Count	"	Fermentation tube Method	

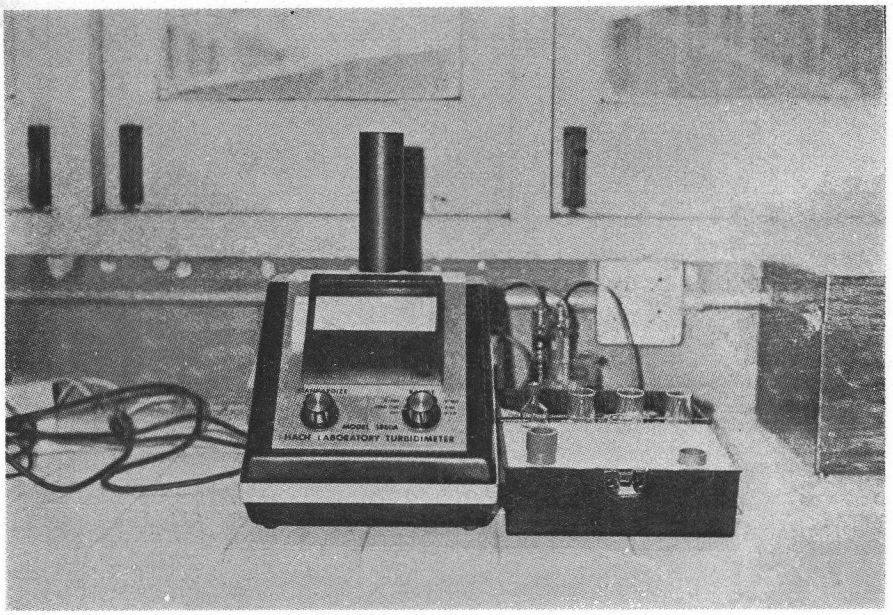


Fig. 7 Hach Turbidimeter.

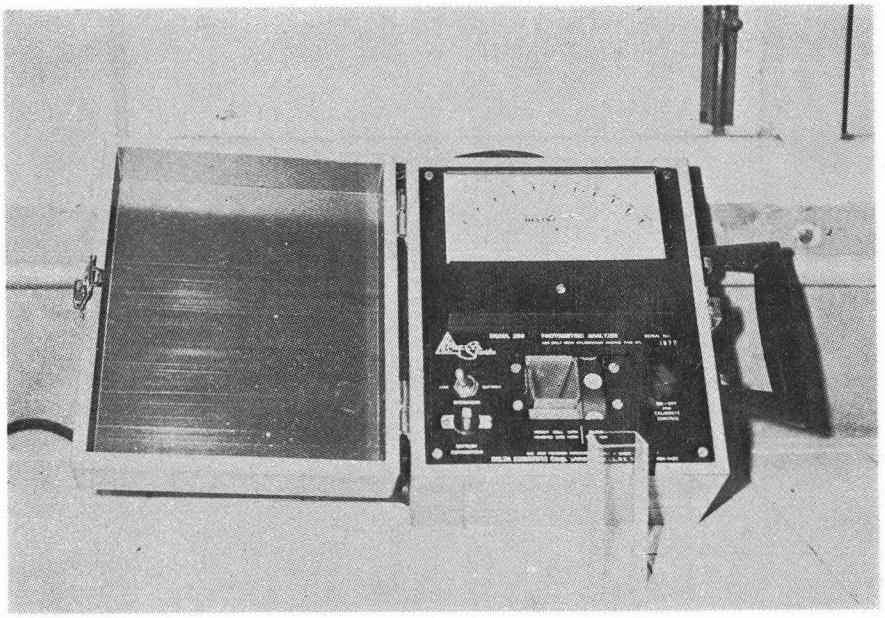


Fig. 8 DELTA SCIENTIFIC Photometric Analyzer.