VI DISCUSSION OF RESULTS

Coagulation by Potassium Permanganate

Before the determination of factors affecting potassium permanganate coagulation, the conditions of mixing and total settling time were selected based on preliminary laboratory test.

The fast mixing speed of 100 rpm for 1 minute, the slow mixing speed of 40 rpm for 3 minutes and the total settling time of 20 minutes were selected as the optimum speeds and settling time.

Effect of Potassium Permanganate Dosage on Iron Removal

From Fig 9. The addition of 0.5 mg/l $KMnO_4$ rapidly decreased the 3 mg/l iron concentration of raw water. A further increase of $KMnO_4$ resulted in a rapid change in the slope of the curve.

The maximum decrease of the iron concentration was obtained by the addition of <u>1.5</u> mg/l $KMnO_4$. A continuous addition of $KMnO_4$ resulted in slightly change of the iron concentration. Therefore the dosage that provided maximum reduction of the iron concentration was considered as the optimum $KMnO_4$ dosage. Plots graph of optimum $KMnO_4$ dosages required for oxidation of various iron concentration are shown in Fig 10,11,12 and 13.

It was observed that theoretically, 1 mg/l of potassium permanganate would oxidize 1.06 mg/l of ferrous iron as can be seen from the reaction.

$$3Fe^{++} + KMnO_4 + H_2O \quad = \quad 3Fe\,(OH)_3 + MnO_2 + K^+ + 5H^+$$

In practice, however, less $KMnO_4$ was required than that of the theoretical amount. It was believed that this was due to the formation of MnO_2 which catalyzed a secondary reaction:

$$2\,Fe^{++} + 2MnO_2 + H_2O \quad = \quad 2Fe\,(OH)_3 + Mn_2O_3 + 4H^+$$

According to Fig 14, the actual amount of $KMnO_4$ required to oxidize ferrous iron Fe^{++} was less than the theoretical amount as determined by conventional jar tests.

Effect of $KMnO_4$ Dosage on pH, Alkalinity and Total Hardness Removal of Raw Waters

According to conventional jar test, pH, total alkalinity and total hardness of a treated water were slightly changed and did not affect by the increase or decrease of $KMnO_4$ dosage.

Effect of pH on $KMnO_4$ Reactions

Potassium permanganate is a very strong oxidizing agent and is effective over a broad pH range and not pH dependent. However, $KMnO_4$ generally reacts more rapidly, though possibly not more completely, as the pH increases.

Very rarely is pH adjustment required when using it to treat for iron and/or manganese since the reaction between $KMnO_4$ and the contaminants is very rapid.

Due to the well supply at Wat Prasertsuthavas contained average 4.5 ppm of iron concentration. The well water could not be introduced into the town's water system unless the high iron-manganese content was reduced.

Many types of treatment were considered. After making preliminary laboratory tests, it was decided to install a gravity-type system in which local burnt rice husk or anthracite was used as filter medium and gravel as supporting media. Potassium permanganate was applied to the mixing unit(flocculation unit) and reacted with composited ground water containing high iron concentration. After coagulation of the colloidal MnO_2, the treated water leaved the mixing basin and entered the filtration unit.

Run Series I:

Study of the Performance of Anthracite

Filter medium for this run (I) was anthracite. The influent water entering the filtration unit was ground water that had previously been treated with $KMnO_4$,the turbidity of this influent ranged from 5 - 15 FTU

For anthracite, the total depth of 80 cm. bed was considered to ensure turbidity removal but five levels of filtration rate 2.5, 5.0, 6.0, 7.0 and 10 $m^3/m^2/hr$ were conducted. Effective size of anthracite was 0.40 - 0.45 mm with uniformity coeficient of 1.4.

According to the experiment the behavior of turbidity removals for various rates were nearly the same. It could be observed from the experimental graph that the curve shows the initial breakthrough, a transitory in effluent turbidity, and a terminal breakthrough. During filtration the turbidity increased especially at the end of the run, occuring as floc penetration approaches the full bed depth, was typical of the terminal breakthrough caused by a condition of weak flocculation. Breakthrough could be corrected by termination of filter runs at head losses lower than 1.2 m, and reduction of filtration rate. Backwashing would have called when the loss reached a little more than this level.

The duration of filter run increased when reduced filter rates and concentration of influent turbidity as seen from the figures. The duration of filter run of run No.2 was shorten than run No.1 because of higher turbidity level of influent of run No. 2.

However the turbidity of the effluent at the end of filtration run was not exceeded WHO's standard.

It was visualised from the plot and experimental data that total alkalinity, hardness and pH slightly fluctuated.

Efficiency of Coliform organisums removal was low at the start because it took time to build up the biological layer, percent removal efficiency of coliform organisum was high as 99.9%,only 5 MPN/100 ml was counted from the effluent at the end of runs.

RUN SERIES II

Study of the Performance of Burnt Rice Husk:

The burnt rice husk was filled into the filtration column at a depth of 80 cm and operation conditionswere same as run in series I.

The behavior of turbidity, Coliform organisms, total alkalinity, hardness removals and pH were similar in running series I. Head losses rose at the end of the filtration run.

However, burnt rice husk filter medium provided effluent turbidity and longer duration of run at the same filtration rate and range of influent turbidity. Burnt rice husk seemed to be disadvantage because it is not convenient to be back washed. From the experiment burnt rice husk can remove turbidity and soluble iron more than anthracite and both media showed the maximum turbidity removed and amount of water filtered at filtration rates of 5 to 6 $m^3/m^2/hr$.

Comparison of duration of runs versus filtration rates, as shown in Fig 31, indicates that burnt rice husk will have a longer duration than anthracite at any filtration rates. For coliform removal efficiency, anthracite can remove percentage of coliform organism than burnt rice husk.

Due to low specific gravily and greater percentage of bed expansion while backwashing, burnt rice husk must be removed off for every filter run whilst anthracite can be backwashed more conveniently.