Chapter V

DISCUSSIONS

The results of the experiment are shown in the following tables and figures.

Figure 6 shows relationship between BOD and COD of the hospital sewage , BOD : COD is about 1 : 1.8

Figure 7 shows flow diagram of Tak Hospital waste flow in the follows;-

Average daily flow	=	49.45	m^3/day
Maximum flow	=	16.90	gpm
Minimum flow	=	2.44	gpm

Figure 9 shows flow velocity at various immersion depth. it is found that, if the immersion depth is less, the velocity is low,and if the immersion depth is high, the velocity is fast too. The velocity that optimal for oxidation ditch is about 1 fps. From the study at the immersion depth of 9 cm, the velocity at the centre of the ditch is about 1 foot per second.

Hospital waste water characteristics

In the study of the characteristics of hospital waste water in 10 hospital it is found that the BOD values vary from 41.5 mg/l to 445 mg/l with an average of 152.5 mg/l which is amenable to oxidation ditch system. Balton and Klein reccomended BOD loading for the oxidation ditch system not exceed 210 mg/l or 14 lbs / 1000 ft^3 of ditch capacity.

In general, the characteristics of hospital sewage are similar to those of domestic sewage. Domestic sewage contains 40.50 % of protein in organic compounds. In the study it is found that most of sources

of the waste water are also similar to domestic waste. The average BOD of the hospital sewage is almost the same as that of domestic waste is about 240 mg/l(Mc Kinney 1962).

The differents in the characteristics of the hospital waste from different sources depend upond the sources of it. It is found that the BOD value of the laundry house sewage of Chulalongkorn hospital is as high as 445 mg/l, and that of Nakorn--phathom Hospital is about 219 mg/l. After the sewage flow from all sources is combined, the BOD value decrease quite a bit less than that of fresh sewage since BOD is change in the time and distance.

As a sewage flow along, biological is progressing at ever increasing rate. The longer, the sewage remains in the sewage system the biological will be greater. If the sewer is very long and the load of flow is low, the biological action will become so extensive that the sewage can be considered as recieving patial biological treatment(Mc. Kinney 1962).

Considering others characteristics of the hospital sewage, it is found that suspended solid is about 89 mg/l. The BOD : N :P is adequate for the system. So there is no need to add any nutreint into the system. However, the oxidation ditch system usually requires less nutrient than the conventional activated sludge system(BOD : N : P = 100 : 5 : 1). The treatment of organic matter in the oxidation ditch system is very similar to that which takes place in the conventional activated sludge process. The oxidation ditch system has a low food and microorganism ratio(lower organics loading) and is design to operate at or near the point of maximum active microbiological population substrate BOD is rapidly removed by oxidation and synthesis and at the

same time, secondary sludge is returned continuously to the oxidation ditch serve the duel purpose of substrate BOD and synthesis sludge treatment, At the oxidation ditch system are design to produce a minimum quality of the biological sludge, the nitrogen requirement will be only that which is synthesized into inert organic solid and will be much less than the conventional activated sludge process. This can results appliciable saving when treating nitrogen deficient wastewater. Sawyer proposed a BOD : N ratio for optimum treatment of activatedsludge is 17 : 1 , but in the oxidation ditch system it is suggested that this ratio will be about 90 : 1.

Waste water flow

At the pilot plant, the study of wastes flow from hospital must be studied in oder that the flow can be used in the design of treatment plant. In principal, one of the design criteria that must be consider in waste water flow volume. At Tak Hospital which is a rural hospital, the sewage quantity was measured by allowing the wastewater flow into the pump sump manhole which has a capacity of 7.5 cub.metr The measurement was done per unit time, the record were kept from Monday to Sunday for 7 days. It was found that the peak flow occured between 4.00 to 6.00 p.m , the lowest flow bew st flow between 0.00 to 03.00 p.m., the average daily flow was 49.45 m^3/ day or about 50 m^3/ day, the maximum flow on Sunday was 60.53 m^3/day and the minimum flow is on Tuesday was 39.56 m^3/day . The study was made in December 1974 . In the January and Febuary 1975, the flow was roughly measured and the result were found to be about the same as those previously made. In addition, it was found that the number of out-patients has very little

effect upon the waste consumption in the hospital and most of wastewater was from in-patients and staff or hospital personels.

The statistics of water consumption of the hospital from May through October 1974 were found that, in May it was as high as 5000 m^3 but it was less in rainy season(August - September) which was about of 2000 m^3/month. Averagely, during the 6 months period, the water consumption was about 3,600 m^3/month or 120 m^3/ day. In the winter during the study, so the water consumption was less. That was the one reason of the low sewage flow. According to the design criteria of the Environmental Health Division, Health Department, the waste flow from the hospital is roughly estimated from the water used of the patients and hospital personels.

	Number of person	Water used	
In-patient	1	200	litr/day
Visistor	3	150	litr/day
Staff	1	250	litr/day
Out-patient	3	150	litr/day

When using the criteria for estimating the waste water flow of Tak Hospital with 250 beds, 203 personels and average 100 out-patient / day, the daily flow of sewage will be 218 m^3/ day, which it much different from that obtained from the study. That is the reason why the Tak Hospital waste treatment is relatively large and has the detention time greater than that estimated from the design criteria, normally 1 to 3 day.In the study , its found that the sewage flow equal 200 litr per bed per day or BOD loading is 30 gm per bed per day(BOD average of 152.5 mg/l).

Variation of pH

The average pH value of the hospital sewage was 6.3, that it was slighly acidic which was due to the biochemical change in the waste, especialy protein waste. When there was no aeration, anaerobic - bacteria would digest organic matter and cause an anaerobic condition from acid in the sewage.

Acid represents the highest oxidation state that an organic compound can attain. Futher oxidation results is the formation of CO_2 and H_2O, which are organic compounds and considered completly destroyed.

$$CH_4 \longrightarrow CH_3OH \longrightarrow H_2C \longrightarrow HCOOH \longrightarrow H_2O + CO_2$$

Hydrocarbon Alcohol Methane Acid Product of complete oxidation

All organic acids containing $-C^{O}_{\diagup}-OH$ group, this is called the carboxyl group, are known as monocarboxylic acid. The acid may be saturated and unsaturated. Some contains hydroxyl group in the molecule (Sawyer and Mc Carty 1967).

In the study, the pH value in the ditch varies from 6.7 to 7.3 , so pH adjustment in the system is not required.

Temperature effected

Temperature is also a very important in the oxidation reaction , when the temperature increase, the quantity of oxygen in the water is decrease, on the contrary the biological reaction will increase.

Most critical condition related to disolved oxygen efficiency in sanitary engineering practice occures during the summer

months when the temperature is high and solubility of oxygen is at the minimum(Sawyer & Mc Carty 1967).

At Tak Hospital, the temperature during the study is about 25 $^{\circ}$ C in winter, the temperature is not effected on the oxidation ditch system. The low temperature is not effected on the oxidation ditch system,the oxidation ditch system had been used in the cold climate. In the winter the oxidation ditch functions is very well(Stanley K Smith.)

Microorganism

The study of microorganism in the system was not caried out. According to the study made by the Division of Environmental Health, it was found that:-

(Women Hospital)

Presumptive bacteria	1,400,000	MPN/100 ml
Confirmed coliform org.	1,400,000	MPN/100 ml
Total plate count 20°C	483,000	Colonies/ml
Total plate count 37°C	574,000	Colonies/ml

The efficiency of the oxidation ditch system

The effluent quality of the oxidation ditch system was determined during December 1974 to Febuary 1975 for a period of three months in oder to test for disolved oxygen , biochemical oxygen demand,chemical oxygen demand, suspended solid, nitrate and phosphase.

The samples for determination BOD was taken as the last sample since the samples had to be taken to the laboratory in Bangkok and the time for preservation BOD is very short. From the results found that the BOD reduction was about 90 % on the average,and COD was 82 % on average. So it was regarded as suitable and efficient. The average

value of the influent BOD was 59.8 mg/l at pump sump manhole and effluent BOD of 6.3 mg/l which was less than the effluent standard.

The suspended solid in the effluent varied from 15 to 43 mg/l which an average of 29 mg/l .

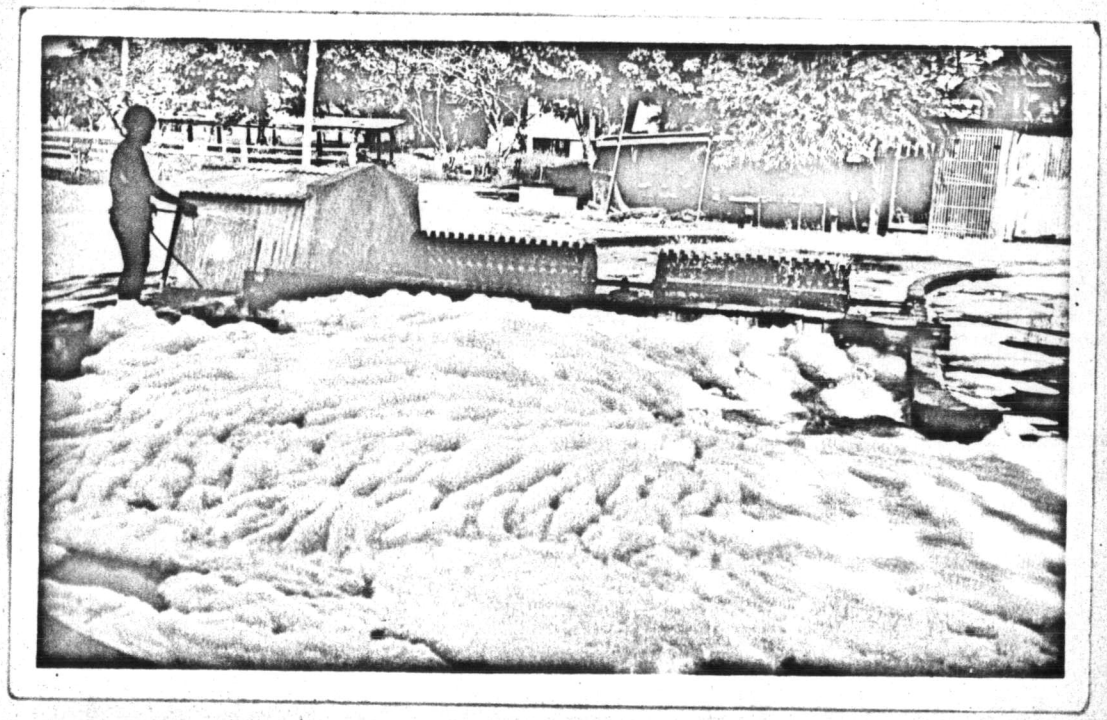
The amount of nitrate in the effluent was averagely 3.8 mg/L and phosphate was 1.7 mg/l. In the case , the effluent which discharge to the recieving stream has effected on algal bloom. At Tak Hospital the effluent was discharge to the pond near the hospital,it was recreation - area . So, the nitrate and phosphate which contained in the effluent was not effected althourgh it higher than this. Because its was a nutrient of algea in the pond, and last it was as similar as oxidation pond for purified water in the pond.

Foam problem

In the hospital sewage treatment by the oxidation ditch system the problem in the operation usually occures is foam. Foam is formed by the attraction of hydraulic end of molecule carying water in the liquid phase (Eckenfelder). The waste discharge from the laundry house contained a good deal of detergent and antiseptic. On bar screen of the plant there was quite a lot of foam.

The way to treat foam , as shown in figure 10 . At Tak Hospital waste treatment, the foaming are occured on 4.00 p.m going on, this time , waste were from the laundry house. Spraying water over foam can be destroyed foam in the pilot plant. So,in the new design criteria suggest that it will be treating foam in the system. The way to be treat foam is spraying water over the foam.

FIGURE 10



SHOWS FOAM ON THE OXIDATION DITCH SYSTEM AT TAK HOSPITAL