Chapter VI

DISCUSSION

The results of BOD, COD, DO and S.S. are expressed as graphs in fifure 7,8,9, & 10 respectively.

The graph in Figure 7, shows the BOD on the 1st day and the 7th day. The results of BOD from 2 to 6 days have not been obtained because experiments have not been made.

Figure 8 shows COD curve from 1 to 7 days.

Figure 9 shows the variation of residual dissolved oxygen of the samples. As mentioned before, dissolved oxygen of the waste was zero. After being aerated for sometimes, D.O was gradually recovered until reaching its maximum at 7 days and D.O. was about 5

Figure 10 shows the variation of S.S. of the sample. In a day or two, the growth starts as soon as the microorganisms come into contact with the substrate in the waste. The mass of cells increases before numerical division occurs. In this phase, there is always an excess of food around the microorganisms. The rate of metabolism and growth is limited only by the microorganisms ability to process the substrate. At the end of this phase, the microorganisms are growing at their maximum rate so suspended solids will reach its maximum on the third day as can be seen from the curve. At the same time they are removing organic matter from solution at their maximum rate. After 3 days, the curve declines because of the limitation of food. As the microorganisms lower the food concentration, the rate of growth becomes less and less. Then growth ceases.

The decrease in microbial mass causes that of the rate of metabolism and food is insufficient for growth. during 5,6,& 7 days, microorganisms are very weak so they lose their zeta potential. At this time, Van der Waals forces overtake zeta potential so weak microorganisms will coalesce, then suspended solid will drop as we can see from the curve from the 4^{th} to 7^{th} day.

Figure 11 shows the relationship between BOD & COD reducing rate. As mentioned before that BOD results have been obtained only on the 1^{st} and the 7^{th} day so the true picture of BOD Curve is not represented. However, we can see some relationship between the reducing rate of these two.

Figure 12 shows the percentage reduction of COD which is about 90% on the 7^{th} day.

In the study of the problem and the method of reducing high concentration of sugar factory wash water to the level that can be discharged into the river without causing any problems. Following topics will be discussed.

Characteristics of sugar factory wash water

It is rather difficult to determine the amount of nitrogen of raw waste as owing to the fact that the contents of each washing are different. Generally there will be washing every day, to wash off spilled sugar cane juice and sugar together with factory filth. When the factory begins operation for a period of 21 days, it will stop an operation in order to clean mill rollers, sugar spinning tank etc. Then resumes operation. After having been used, the waste water will be gathered in a waste reservoir and let it

fermented there until the end of the milling season. Samples which has been taken out of such fermentation have thevalue of pH in the range of 3.8 - 4.6 However, generally before the fermentation reaches its stable level, there will be additional waste water flows into it, which will keep the COD of the waste increased. Therefore it is rather impossible to find organic - N, but rather find value of NO_3 instead. For value of phosphorus, it is also impossible to calculate as the waste has low pH so it was adjusted by adding K_2HPO_4 to obtain a suitable range of pH and in the same time K_2HPO_4 can be the nutrients for bacteria. The samples are of carbohydrate waste which will be lack of nitrogen and phosphorus but nitrogen is needed for bacteria so it is added in the form of urea, while phosphorus obtained from K_2HPO_4 Nutrients will be added at roughly in the ratio of BOD:N:P = 100:5:1

A typical sugar cane mill might discharge 4,000 gpm. of condenser water containing 200 mg/L of BOD_5 but devoid of the essential nutrients, nitrogen and phosphorus. The most economical form in which those nutrients can be supplied are anhydrous ammonia (NH_3) 24 lb/hr and phosphoric acid (H_3PO_4) 12 lb/hr (The Sugar Journal 1970)

Variation of pH

The value of pH decreases through out aeration. After aeration, sucrose will form acids.

Acids represents the highest oxidation state that an organic compound can attain. Further oxidation results in the formation of carbon dioxide and water, which are classed as inorganic compounds, and the organic compound is considered

completely destroyed

$$CH_4 \text{----} CH_3OH \text{ ----} H_2C = O \text{ ----} HCOOH \text{ ----} H_2O + CO_2$$

Hydrocarbon	Alcohol	Aldehyde	Acid	Productsof complete oxidation

All organic acids contain the $-C^{O}-OH$ group. This is called the carboxyl group and is commonly written - COOH. Acids with one carboxyl group are known as monocarboxylic acids and those with more than one are polycarboxylic acids the acids may be saturated or unsaturated. Some contain hydroxy groups within the molecule (SAWYER & Mc CARTY, 1967)

Therefore we will have to control and adjust the pH within the range of 7 - 7.2 so that the aerobic bacteria which is the most active digester of organic matter can be alive. With out adjusting the pH, aerobic bacteria cannot work properly.

In controlling and adjusting pH, K_2HPO_4 will be applied and at the same time phosphorus from K_2HPO_4 will be used as nutrient for bacteria. If pH drops to lower than 6.8, bulking will be likely to occur. In case, bulking is likely to occur aeration must be increased by using air diffusers and the waste should be diluted, also adjust pH to the range of 7 - 7.2 by using K_2HPO_4 sothat the bacteria will become active again and bulking will gradually disappear. All change of the properties and characterictics of them shown in the appendix A - 1, A - 2

The overall oxygen transfer rate

The quantity of oxygen transfer to the waste water is very essential in the aeration. In the begining,

bacteria are not fully grown and the quantity is still small only little oxygen will be consumed, until a few days after, bacteria will need more oxygen in digesting organic matters in the waste water. Therefore the amount of residual dissolve oxygen in the waste water from the first to the forth day the quantity will be increased as shown in Figure 9. As owing to the fact that the bacteria do not consumed much oxygen in order to acclimatize with the environment of the waste water but during the stage of digesting organic matters, more oxygen will be required until organic matters are decomposed. A portion of the bacteria will be dead since lack of food therefore there will be more oxygen left over as shown in the curve in Figure 9.

Temperature effect

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

Most critical conditions related to dissolved oxygen deficiency in sanitary engineering practice occur during the summer months when temperature are high and solubility of oxygen is at minimum (SAWYER & Mc CARTY, 1967)

As for Thailand, temperature does not fluctuate very much, since average temperature is not too high.

Microorganisms

There were many kinds of bacteria found in the stabilization of sugar waste but the predominate one was E. coli. The culture and identifications are as follows:

1. gram-stain is negative staining
2. TSI agar reaction are
   a yellow slant
   b yellow butt + gas

posible organisms

   a E. coli
   b Klebsiella - Enterobacteriaceae

3. Desoxycholate agar
   positivetest indicates that - lactose fermenting gram - negative bacilli
4. EMB. agar; have metalic sheen on EMB.

This shows that the colony that grows all the test may be E. Coli

From microscopic determine

1. rod shape
2. gram negative
3. 2 - 3 .u in length
   0.4 - 0.6 .u in width

The results of these tests have obtained from Mahidol University Laboratory.

From this study, the populations of each kind of organisms have not been counted so only predominate bacteria, E.coli, can be noted as predominance. For bacteria which digest sucrose still has not get used to with the environment of the waste before, so they will take time to acclimatize first, then begins to digest the wastes. Therefore in solving this problem bacteria should be fed with sucrose wastes so that they will be acclimatized first then seed into the wastes

water inorder that they can digest the wastes right away.

Nutrient Addition

As sugar wastes are of carbohydrate which lack of nitrogen and phosphorus, as earlier stated, If we do not add nitrogen and phosphorus the process will run very slow, since BOD : N : P will not be in a suitable proportion and in this research we add nitrogen at the ratio of 1 : 20 of BOD.