

## CHAPTER – IV

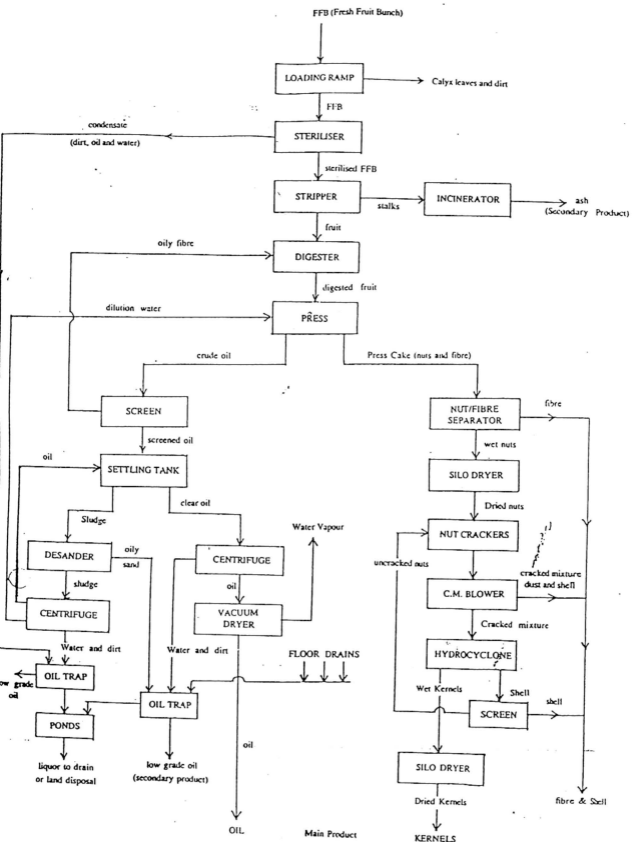
### CORROSION IN EFFLUENT TREATMENT SYSTEM

#### 1 PALM OIL MILL

The effluent emanating from a Palm oil mill contain heavily contaminated Water which results in damage of several critical parts in the waste treatment plants. There are over 350 oil palm mills in Malaysia. Approximately 7 million tons of crude oil is annually produced from over 40 million tons of FFB processed.

Open ponding system for effluent treatment being convenient and cost effective, was most preferred till recently and corrosion was not a major problem. However, in view of present stringent discharge conditions and also the mounting cost of real estate, mechanical systems with advanced technology for treatment is now greatly recommended. The advanced mechanical and biological treatment of effluent involves equipment and structures of mild steel and RCC which are highly prone to corrosion. Other areas of corrosion in this industry are marshalling yard rail tracks/ flooring, oil room floorings, cages etc. Typical characteristics of the effluent from a 40 ton FFB/hr oil palm mill is enclosed for reference. Chimneys of boilers and incinerators are also highly prone to corrosion due to high temperature and corrosive gases.

typical line diagram of the milling process is shown in page 74 and the General arrangement of the process is shown in page 75. The effluent generation and treatment is shown in Figure 25. Fresh water flows through three different sections of the process line viz sterilizer (as steam), clarifier and hydrocyclone. The contaminated water flows after each process into a sludge pit. The effluent from the sludge pit is passed through a series of treatment system (consisting of mechanical and biological processes) to achieve the required discharge standards. A typical process diagram of a oil palm processing is also enclosed for reference. Factors contributing for corrosion from this effluent are high temperature, dissolved solids, dissolved oxygen and pH. The low pH, high temperature, high BOD and high dissolved solids in the effluent are responsible for corrosion. Hence the quality of water has a major impact on metallic corrosion. Corrosion can occur when an electrical potential between dissimilar metal surfaces is created. The corrosion cell consists of an anode, where oxidation of one metal occurs, and a cathode cell, where reduction of another metal takes place. "Total dissolved solids" increases the electrical conductivity of the solution and there by accelerate the corrosion reaction.



Material Flow Chart



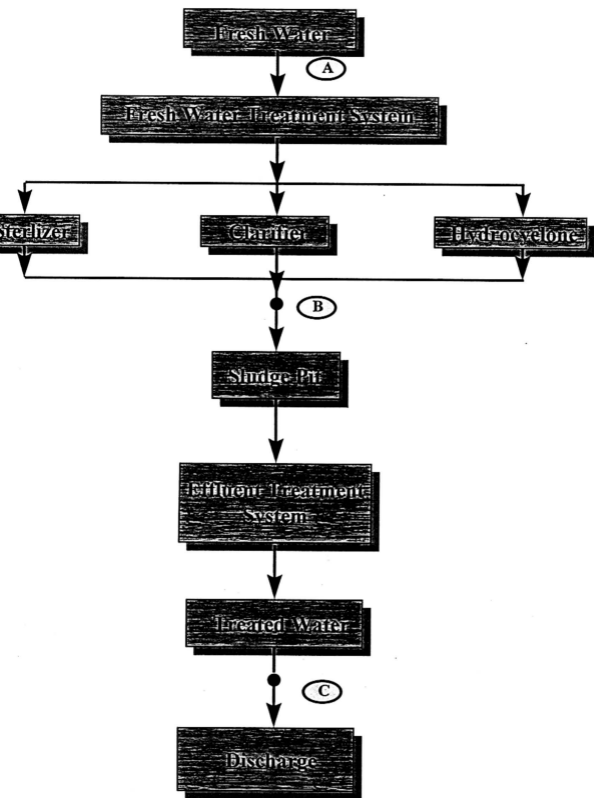


Figure 25 : Plant Waste Water Flow Diagram

“Dissolved oxygen” and presence of certain metals (magnesium, iron and aluminium) promote corrosion because of their relatively high oxidation potential. Warm and moist environment is effluent treatment system is ideal for promoting biological growth. This also leads for increased dissolved oxygen in the effluent leading to pronounced corrosion. Large amounts of liquid wastes are generated by this industry. Pollution associated with this industry has high biological oxygen demand imposed by organic effluents. Low pH, high temperature, excessive solids, oil and grease, high BOD and COD are the characteristics of this effluent. These parameters in isolation or together has a major impact on materials used in treatment system leading to corrosion. The photographs enclosed indicate the extend of corrosion from this industry by liquid and gaseous effluents. Large quantities of water is required in the milling process. It is estimated that 1 to 1.5 Ton of water is required to process 1 ton of FFB, of which 0.5 Ton is used as boiler feed water. The remaining water is used as process water like dilution water, wash water etc, about half of the water ends up as palm oil mill effluent. Fresh oil palm mill effluent is thick brownish colloidal slurry of water, oil and fine cellulosic fruit debris. Effluent analysis as shown in the table in page 78, indicates high temperature, low pH, high solids, high BOD and COD, and oil and grease.

## ANNEXURE "B"

Parameter Location	A	B	C
pH	6.57	4.0	6-9
Temperature	28° C	60-65° C	45° C
B.O.D. @ 3 days/30 °C (mg / ltr.)	2	33,196	20
C.O.D. (mg / ltr.)	48	99,590	100
Total Suspended Solids (mg / ltr.)	18	26,490	100
Oil & Grease (mg / ltr.)	ND	3,495	50
Ammoniacal Nitrogen (mg / ltr.)	ND	173.6	150
Total Nitrogen (mg / ltr.)	0.9	413.6	200

The sterilizer condensate released into effluent pit is very hot since it is the condensed steam from the tail end of the sterilizer. Steam is used for cooking the fruits in the sterilizer. Also, the condensate is oily since a portion of the oil from the fruits is released into the effluent along with the condensate. The solids in the effluent water is from various areas and operation of the milling process.

Analysis of the effluent parameters indicate that high temperature, low pH, high BOD and high solids are responsible for corrosion of steel and concrete in the treatment system. Photographs indicating the effect of these factors in a treatment system on steel and concrete is enclosed.

Temperature of the waste water is over  $60^{\circ}$  C, compared to the ambient temperature at the inlet to the process. Oil and Grease in the waste water is 3495 ppm compared to almost zero ppm in the inlet water. Presence of fats in the effluent reduces the pH of the water to as low as 4.0, which causes acidic corrosion in the treatment system. High levels of solids of over 26 000 ppm leads to erosion corrosion of materials in the system. The BOD of over 33 000 ppm is responsible for biological corrosion in the treatment process. It is observed that the corrosion causing parameters are all in the higher order compared to the values at the inlet to the system.

Each of these parameters in itself are capable of causing corrosion and in combination, effect will be complex. This is evident from the effluent analysis and also the photographs enclosed.

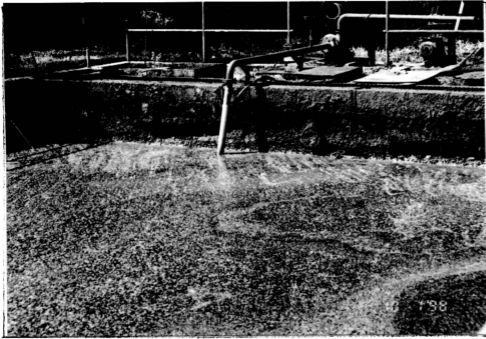
Another major area of environmental degradation from an oil palm mill is the Air Pollution resulting from Boilers and Incinerators. Corrosion of chimney, exhaust duct, induced draft fan, multi-cyclone etc is common in the oil palm mill. This is due to the environmental factors and also high temperature. The enclosed photographs clearly justifies this corrosion.



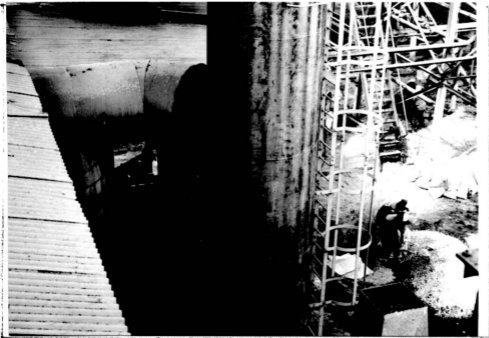
EFFLUENT TREATMENT POND WITH PUMPSET



CLOSE UP VIEW OF CORRODED PUMPSET AND BASE FRAME



CONCRETE CORROSION IN THE SLUDGE PIT



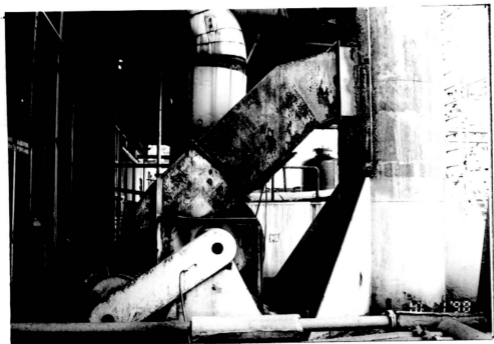
CORROSION OF BOILER STACK



CORROSION OF INCINERATOR STACK



CORROSION OF MULTICLONE AND ROTARY AIR LOCK



CORROSION OF EXHAUST FAN



CORROSION OF DUCTING