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# Edible oil refinery waste water treatment by using effluent treatment plant

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The information and data thus generated by detail study was used for preparing material and energy balances and further pin point the waste stream and problem areas already identified. Therefore, this paper reviews the processing, purification of soya bean oil and the different methods of treatment applied to the soybean oil refinery effluent that is being generated. Effect of aeration and sludge concentrations are studied.

***Keyword:*** Oil refinery wastewater, lime, Polyelectrolyte, BOD, COD, oil and grease.

## 1. Introduction

Edible refined oil processing industry is a major issue of environmental concern in developing countries for the last three decades. The waste streams come out from oil refinery create serious environmental problem such as great threat to aquatic life due to its high organic content. Hence its treatment is essential prior to its disposal. The choice of effluent treatment method depends on the organic content present in the effluent and its discharge conditions. (Rupani *et al.*, 2010)

Edible oil industry wastewaters mainly come from the degumming, deacidification, deodorization and neutralization steps. In the neutralization step sodium salts of free fatty acid soap stocks are produced whose splitting through the use of sulfuric acid generates highly acidic and oily wastewaters. Its characteristics depend largely on the type of oil processed and on the process implemented that are high in COD, oil and grease, sulphate and phosphate content, resulting in both high inorganic as well as organic loading of the relevant wastewater treatment. (Olafadehan *et al.*, 2012).

Effluent from the vegetable oil industry used to be discharged directly into soil or groundwater. But due to the emergence of environmental consciousness the Pollution Control Boards have become stricter and imposed stringent norms. The studies have shown that fatty materials within waste streams from oil industries are readily biodegradable and it therefore follows that these effluents are amenable to biological treatment. 95% of BOD in wastewaters from a soya bean oil refining plant is removed by using an activated sludge process [2].

During these processes by-products and wastes are formed. The operating conditions and processes carried out influence the amount and characteristics of the by-products and wastes formed. The wastewater varies both in quantity and characteristics from one oil industry to another. The composition of wastewater from the same industry also varies widely from day to day discussed types of physical, chemical and biological methods used for the oily wastewater treatment. Use of these methods, disposal and waste treatment still remain major challenges in the fats and oils industries [3].

## 2. Material and Methods

After acquiring understanding of the production processes and utilities, a detail investigative method was carried out. The method comprised of in-depth study of unit operations, monitoring, measurement, and analysis of parameters affecting environment, and performance evaluation of utilities and pollution control devices was undertaken to identify the problems and causes. The samples were analyses according to the procedures given in standard methods. The experiments were carried out using jar test apparatus. Six beakers of 1 liter capacity were used in which one liter neutralized effluent was taken for detail studies. Coagulant stock solutions were prepared and used for the complete set of each test. While using jar test apparatus, initially the samples were flash mixed for one minute at high rpm of 100 and later at 40 RPM for half an hour. After half an hour of mixing, the samples were settled for half an hour. Supernatant liquid was drawn and subjected to various parameters and sludge volume settled. (Saatci Hasar *et al*., 2001)

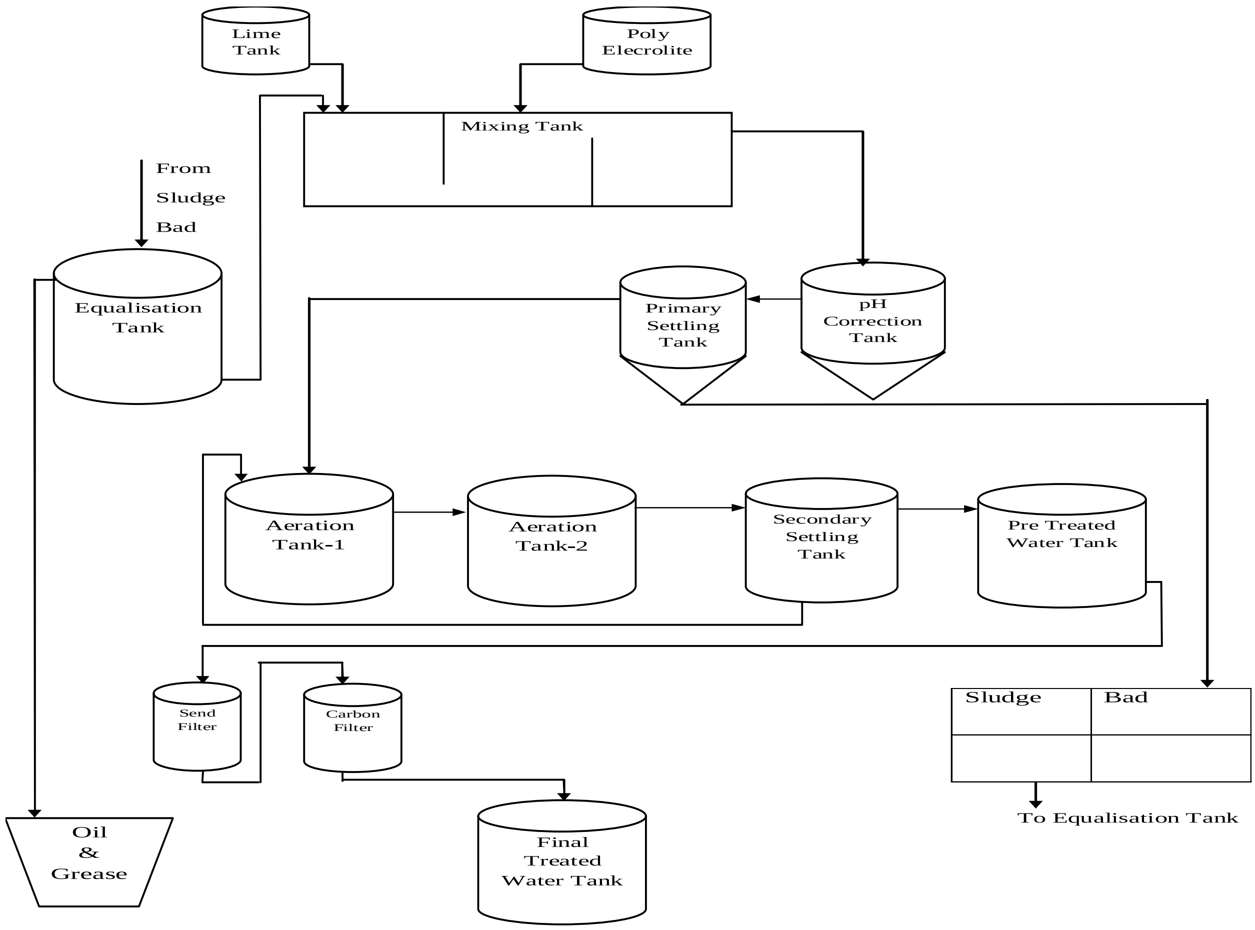


**Fig 1:** Effluent Treatment Plant

The characteristics and treatment of edible oil industry wastewaters by different advanced oxidation processes were considered. Typically, the amount and composition of the effluent varies considerably. The high organic matter content is a basic problem in edible industry wastewaters but the organic compounds are usually easily biodegradable and the effluents can be treated by conventional aerobic biological methods.

**Table 1:** Characteristic of the influent edible oil wastewater

| Parameter | Range |
|---|---|
| BOD (mg/L) | 20-40 |
| COD(mg/L) | 100-250 |
| TDS (ppm) | 2000-5000 |
| TS(mg/L) | 0-100 |
| Hardness (ppm) | 100-400 |
| Temperature(◦C) | 25-35 |
| pH | 6.0-7.5 |
| Oil & grease(mg/lit) | 10 |

The overall material balance were prepared for the production units/sections to assess the quantity of raw material, chemicals, and other additives used and products & byproducts produced along with waste discharged to environment. Unit wise overall material balances are given below.

### 2.1 Refinery Effluent Treatment Plant

Wastewater from the refinery and acid oil recovery plant is treated in the existing Effluent Treatment Plant. The operation of various components of ETP is described briefly here under: The combined wastewater from refinery passes through Slop Oil tank followed by a four-stage Oil & Grease trap. The free-floating fatty matters are taken back into the refining process. The wastewater after four -stage Oil & Grease trap flow in a rectangular open channel in which acidic wastewater generated from Acid Oil Recovery Plant. It is observed that the addition of acidic wastewater to the refinery wastewater takes place from many points. The acidic wastewater split the emulsified oil present in the refinery wastewater. The splitted oil containing wastewater passes through two-stage and three-stage O/G traps before reaching to the Equalization Tank. The wastewater after three -stage Oil & Grease trap is subjected to Primary chemical treatment. The wastewater is pumped into either of the two Equalisation cum neutralisation tanks. Lime slurry, prepared in the lime-preparation tank, and alum solutions are used for the Neutralisation of wastewater to maintain the pH up to 7.5. Mixing of chemicals in Equalisation-cum-neutralisation tank is carried out through mechanical mixer; it is carried out through return flow of transfer pump. After mixing, suspended particles are allowed for settling for few minutes so that supernatant can be easily pumped to primary settling tank. No sludge-handling pump is present to transfer entire mass from Equalisation tanks. The settled sludge in the tanks is cleaned manually.

The mixing tank is used as a holding tank, which allows wastewater to flow by gravity. Wastewater flows by gravity through pH-correction tank, settling tank and corrugated plate separator to the Aeration Tank. All three tanks act like settling tanks. The settled sludge is discharged to the Sludge Drying Beds (SDB). The supernatant flow under gravity to the Aeration Tank. Air diffuser is used for aeration. The wastewater then flows by gravity to the Secondary Clarifier. The settled sludge in the Secondary Clarifier is either returned to the Aeration Tank to maintain the MLSS or the excess sludge is sent to the SDBs for de-watering. The filtrate from SDB goes to the Aeration Tank.

### 2.2 Basics of biological aeration process

The liquid discharged from the tank is transferred to a sedimentation tank. The supernatant liquid from this tank overflows to the aeration lagoon. The concentrated digested liquid is re-circulated into the digestion tank to maintain a constant level of suspended solids in the digestion tank. When solids level exceeds the desired concentration, some of it is taken off into the sludge storage tank and sent to the decanter for dewatering. The sludge cake produced is mixed with fiber until a moisture content of about 60% is obtained. This mixture is then placed in the composting tank. For a 20 ton fresh fruit Bunch per hour oil mill an aerobic lagoon with 20 days retention at 0.1 kg BOD: kg mixed liquid suspended solid (MLSS), a minimum of two diffuser aerators can be used. An extended aeration process is advantageous in the following ways. Operation is simple and the problem of solid generation and handling are reduced. Nitrogen destruction efficiencies are high Power requirement is not critical Construction costs are low Land usage is reasonable after sedimentation the discharge from the digester is dumped in the aeration lagoon at the start. Twin aerators operate continuously to provide mixing and oxygen transfers. The lagoon discharge is passed through a sedimentation tank and the settled suspended sludge is at present recycled to the acidification pond but can be used as fertilizer because of its high nitrogen content. (Muro *et al*., 2005)

Aerobic Mechanism Organic matter + microorganisms + $O_2$ $\rightarrow$ $5CO_2 + 2H_2O + NH_3$ + energy Ammonia is further oxidized to nitrate and nitrite.

### 2.3 Sludge Treatment

The sludge fraction discharge from the tanks usually contains oil > 15%. The edible oil refinery effluent ex-sludge is made up of mainly two other Components in addition to the oil, which are water 93-94% and solids 3-4%, but the composition may very widely. If the oil is not recovered somewhat loses will be incurred in the form of effluent waste. The sludge fraction is therefore subjected to further treatment to recover the oil before discarding to the effluent pit.

**Fig 2:** Sludge granules from filter press plate

The sludge fraction from the settling tank is routed to a holding tank (sludge tank), from where it is pumped to plate frame filter. The plate frame filter separates the sludge from the stream which will cause severe wear on downstream equipment.

## 3. Result and Discussion

The wastewater flow in an open channel where acidic wastewater from settling tanks of Acid Oil Recovery Plant joins. Composite wastewater samples were collected from various stage of treatment and analyzed for relevant pollution parameters.

### 3.1 Variation of pH and removal efficiency of different parameter in each stage

The quantity of acid wastewater is relatively low, the extent of its pollution load is larger than that of technological wastewater as indicated by particular each component pH, Total Suspended Solids, Oil & Grease, COD, and BOD respectively. All that result showed graphically as follows.

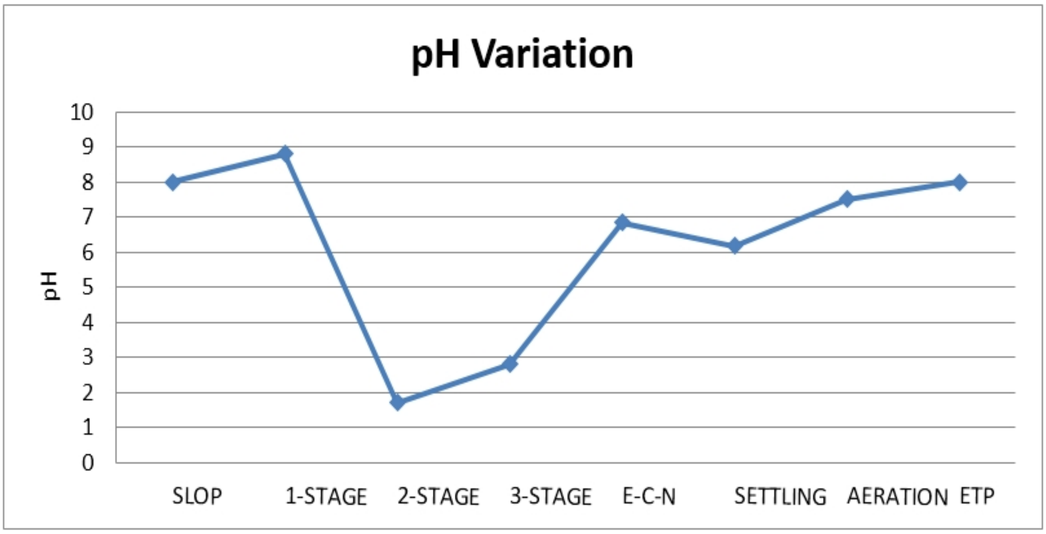


**Fig 3:** pH Variation.

### 3.2 Variation of pH

Figure-3 Shows that the variation of waste water pH from edible oil refinery to ETP in different at slope oil Composite alkali waste water are come then 1-stage refinery wastewater after oil and grease trap so it was highly alkali, on 2-stage refinery & acid oil recovery Plant mixed wastewater so it was acidic nature, 3-stage refinery & acid oil recovery Plant mixed wastewater with removal of some oil, chemical treatment provided in E-C-N tank Inadequate mixing of acidic wastewater in alkaline wastewater tank so pH fluctuated as lime mixing then settled on settling tank so pH is normal, biological treatment given in aeration here pH as required condition, after filtration ETP overall performance obtain as treated water quality with 8.0 pH.

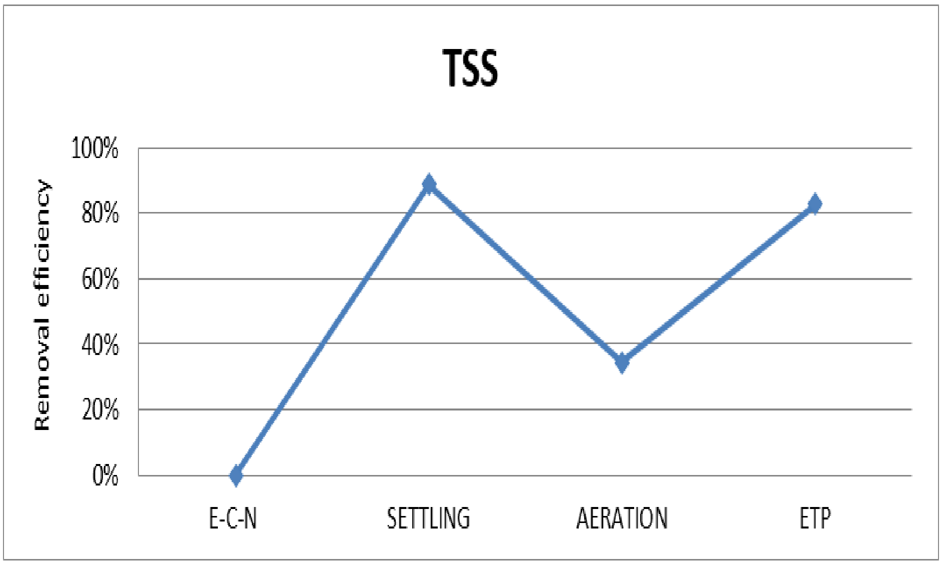


**Fig 4:** Effect of various stages on TSS removal efficiency.

**3.3 Removal Efficiency of Total Suspended Solids**
Figure-4 Shows that the removal efficiency of waste water total suspended solid from edible oil refinery to ETP, in E-C-N tank Inadequate mixing of acidic wastewater in alkaline wastewater tank so suspended solid are not removed after lime mixing TSS percentage increases, biological treatment given in aeration due to removal efficiency of TSS decreases, the overall removal efficiency of total suspended solid on ETP is 82.6%.

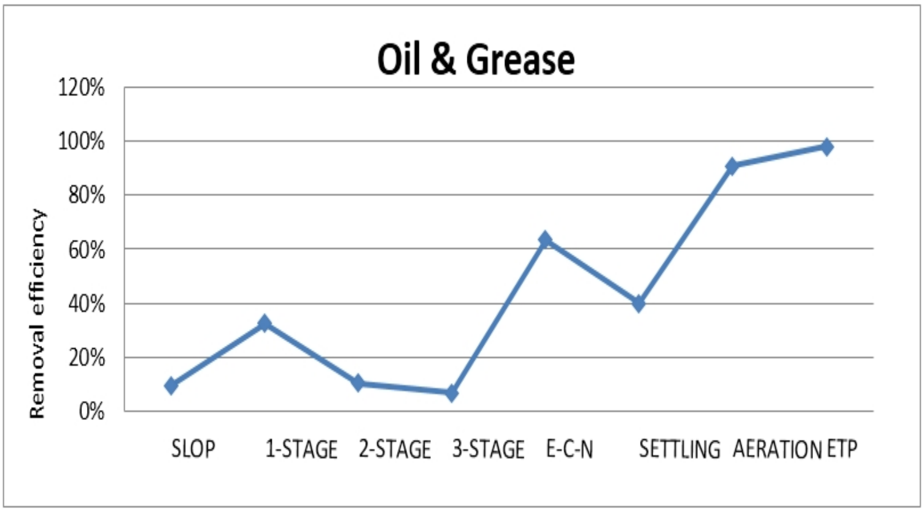


**Fig 5:** Effect of various stages on Oil & Grease removal efficiency.

**3.4 Removal Efficiency of Oil & Grease**
Figure-5 Shows that the removal efficiency of Oil & Grease in waste water from edible oil refinery to ETP, at slope oil Composite alkali waste water is come so some amount of Oil & Grease are recovered on 1-stage after that 2 &3 stage small amount of Oil & Grease is recovered, in E-C-N tank maximum amount of Oil & Grease removed due proper retention time, in settling tank removal percent are decreases then aeration maximum removal of Oil & Grease due to diffuser and frothing on water. The overall removal efficiency of Oil & Grease on ETP is 97.9%.

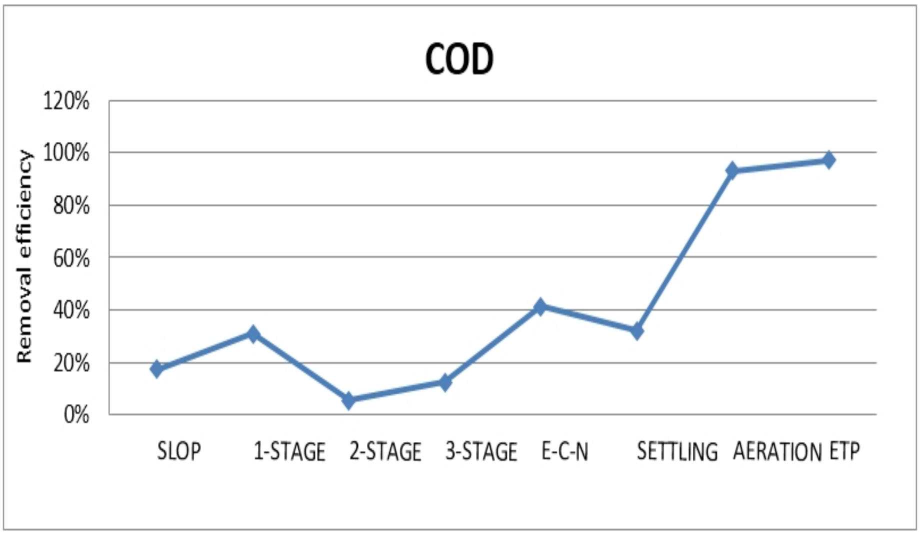


**Fig 6:** Effect of various stages on COD removal efficiency.

### 3.5 Removal Efficiency of COD

Figure-6 Shows that the removal efficiency of COD in waste water from edible oil refinery to ETP, at slope oil minor removal efficiency then 1, 2 and 3-stage slightly fluctuated then E-C-N tank chemical treatment provided so get high COD removal efficiency then settling decreases and aeration maximum removal efficiency achieved. The overall removal efficiency of COD on ETP is 97.3%.

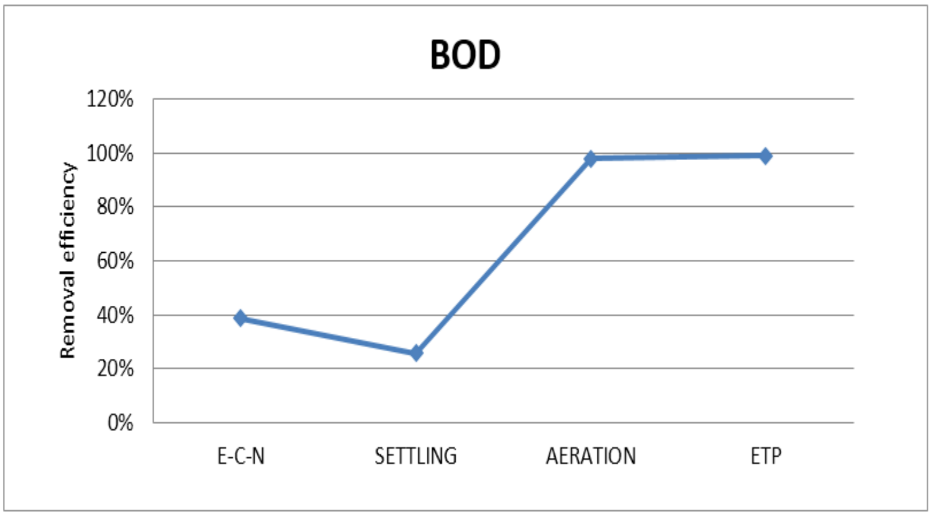


**Fig 7:** Effect of various stages on BOD removal efficiency

### 3.6 Removal Efficiency of BOD

Figure-7 Shows that the removal efficiency of BOD in waste water from edible oil refinery to ETP, in E-C-N tank Inadequate mixing of acidic wastewater in alkaline wastewater tank so BOD removal efficiency is medium, after lime mixing then settling tank BOD removal efficiency decreases, in aeration organic bacteria maximum that increase the BOD removal efficiency, the overall removal efficiency of total suspended solid on ETP is 99.4%.

## 4. Conclusion
The studies concluded that the oil refining wastewater is easily amenable to chemical and biological treatment. The effectiveness of the treatment process was different for each parameter monitored (pH, Total suspended solids, Oil & Grease, COD, BOD). COD load could be importantly decreased with a decrease in oil & grease concentration. Hence, for effective treatment of edible oil refinery wastewater, in addition to chemical and biological methods, a biological treatment process would probably improve the quality of the final effluent and ensure the reduction in biodegradable organic matter content.

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