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(WASTE MANAGEMENT TECHNIQUE FOR EDIBLE OIL INDUSTRY)

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Abstract :- Industry manufacturing refined edible oil with a capacity of 18000 tones/annum generated wastewaters and solid waste (chemical and biological sludges). During production of edible oil , different types of oilseeds are processed and that generate huge amount of different waste including wastewater , organic solid waste (i.e. seeds and hucks) and inorganic residues .mainly in edible oil industry waste and by products are hulls , miscella , wastewater , sludge , soapstock , waxes , in process of wastewater in edible oil industry depends on ETP (Effluent treatment plant)

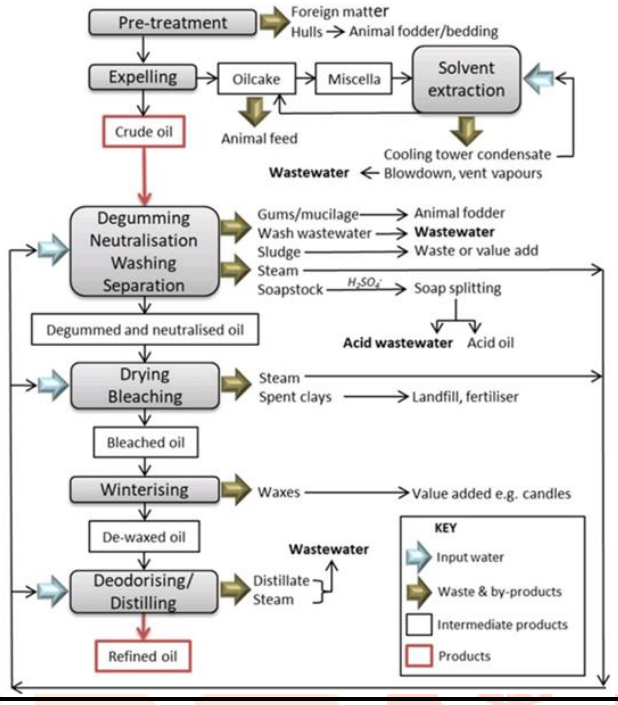
index terms :- Edible oil industry , wastewater , Effluent treatment , plant operation

INTRODUCTION

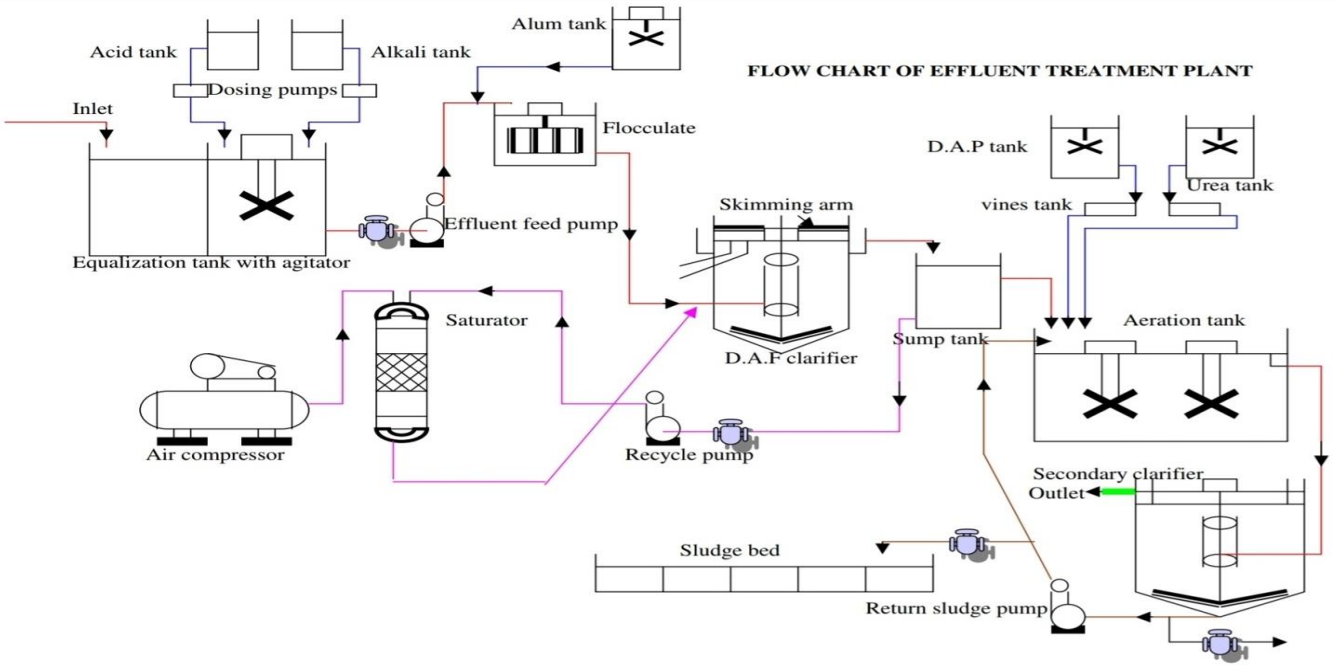
THE REFINING OF CRUDE EDIBLE OILS GENERATES LARGE AMOUNTS OF WASTEWATER. THE neutralization step, in particular, produces sodium salts of free fatty acids ("soap stocks") whose splitting through the use of H_2SO_4 generates highly acidic and oily wastewater. Its characteristics depend largely on the type of oil processed and on the process implemented. Oil and grease in oily wastewater may take various forms:
free, dispersed and emulsified. Decantation and skimming are adequate in removing free oil. For decades, aerobic and anaerobic treatment has been used to remove biodegradable organic pollutants present in the wastewater generated during several industrial processes. India has around 550 units of edible oil refineries located in different States. The sources of edible oil manufacture are soyabean, groundnut, rapeseed, sunflower, safflower, cotton, sesame, coconut, palm, mustard, rice bran, watermelon, neem, mahua etc. The refined edible oil manufacturing units generate **solid waste (spent earth) and wastewater** which are of environmental concern and need proper treatment prior to their disposal. In a

vegetable oil industry, the effluent mainly comes from the degumming, deacidification and deodorisation steps

EMISSION AND WASTE GENERATION FROM EDIBLE OIL INDUSTRY



EFFLUENT TREATMENT PLANT FOR TREATING THE INDUSTRIAL WASTE WATER

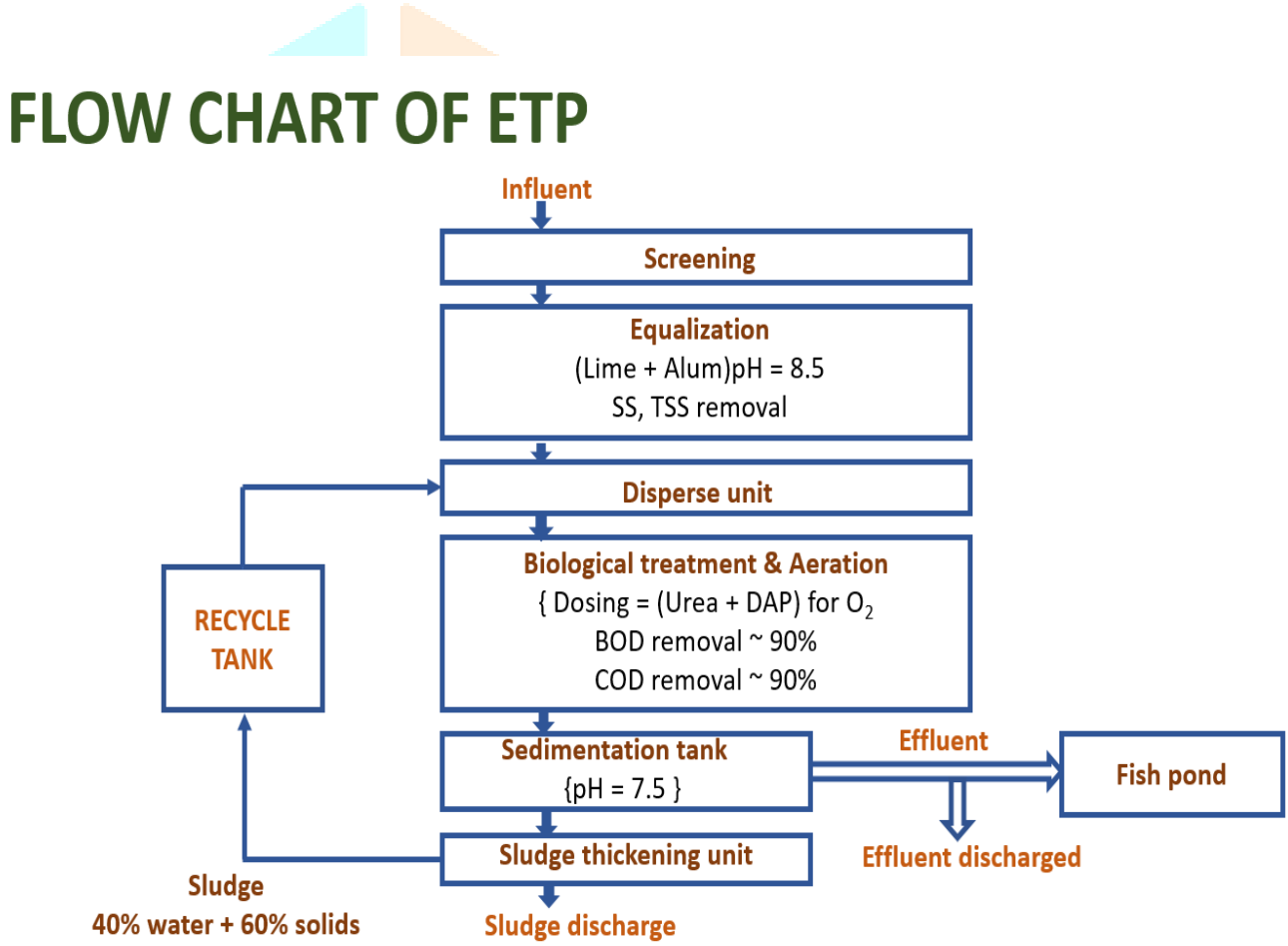


During these processes by-products and wastes are formed. The operating conditions and processes carried out influence the amount and characteristics of the by-products and wastes formed. The wastewater varies both in quantity and characteristics from one oil industry to another. The composition of wastewater 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. The salient findings of the investigations are presented in this paper

Problem statement :-

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 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

Structure Detail :-



IMPORTNANT CHARACTERISTICS OF WASTEWATER FROM EDIBLE OIL INDUSTRY

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

RESOURCE CONSUMPTION

INPUTS PER UNIT OF PRODUCTS	UNIT	BENCHMARK
Water Use		
Crude oil production - wastewater	m3/t raw material	0.2 – 0.5
Crude oil production – cooling water	m3/t raw material	2 – 14
Chemical neutralization	m3/t product	1 – 1.5
Deodorization	m3/t product	10 – 30
Hardening	m3/t product	2.2 – 7
Chemical Consumption		
Caustic soda	Kg/t crude oil	1 – 6
Phosphoric acid	Kg/t crude oil	0.1 – 2.0
Citric acid	Kg/t crude oil	0.1 – 1.0
Sulfuric acid	Kg/t soap	100 - 250

WATER CONSUMPTION IN EDIBLE OIL INDUSTRIES

Process	Average monthly oil production (t)		Average monthly water intake (m^3)		Specific water intake (m^3/t)	
	Range	Mean	Range	Mean	Range	Mean
Milling	1000-3600	2080	2070-11070	5390	2,1-3,1	2.6
Refining	1000-3600	2520	3100-9650	9650	3,2-4,6	3.8

	Mill (%)	Refinery (including hydrogenation) %	Total(%0)
Process	2	13	15
Boilers	10	30	40
Cooling	25	10	35
Washdown	1	7	8
Domestic	1	1	2

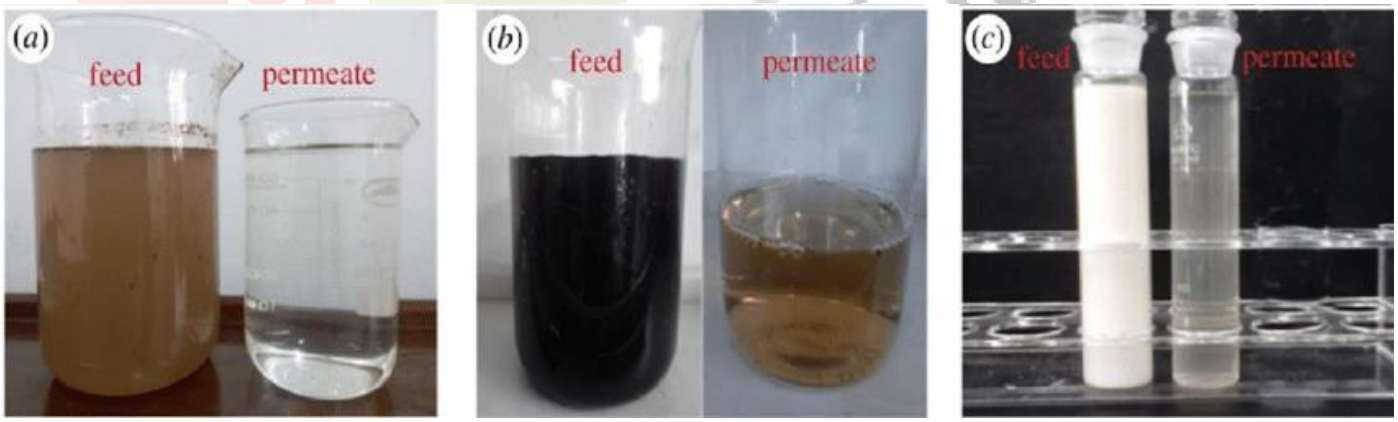
- **Population and Sample**

Visual comparison of the feed and permeate of different oily wastewater samples.

(a) Simulated oilfield wastewater

(b) palm oil wastewater

(c) mechanical cutting oil wastewater.



(waste water from different types of feed and treated waste water camparison)

I. RESEARCH METHODOLOGY

(Edible oil processing)

The objective of food oil processing is to separate the food oils from constituents that cause odour, colour or objectionable taste. The fats and oils obtained from translation or from the extraction of the oil seeds are termed "crude" fats and oils. Crude fats and oils contain changing but relatively small amounts of other naturally occur-ring materials that are removed through a series of subsequent processing steps. The specific raw material requirement and process details with respect to manufacture of refined edible oil is presented in Table 1 and Table 2, respectively. In short, edible oils are individually pre-refined with caustic soda to remove free fatty acid (FFA) and with citric acid or phosphoric acid to remove gummy matters. The oils are then bleached with bleaching earth and activated carbon to remove the colour and residual matter .

Ingredients	Magnitude for the production of refined Edible oils (tones/month)
Edible oil	1899.74
Bleaching earth	68.92
Sulphuric acid	43.42
Caustic	11.00
Phosphoric acid	2.08
Total products (tones/month)	2025.16

(TABLE :-1 SPECIFIC RAW MATERIAL REQUIRED IN EDIBLE OIL REFINERY)

(TABLE :-2 DETAILS OF UNIT OPERATION AND UNIT PROCESS IN EDIBLE OIL REFINERY)

Unit operations/ process	Process details
Degumming	Removal of phospholipids, suspended matters, sugars and metals by dehydration followed by separation through gravity settling or centrifugation
Water degumming	Water degumming process removes hydrated phospholipids and recovers gum as lecithin
Gum-conditioning degumming	Gum conditioning removes both hydrated and non-hydrated phospholipids using phosphoric or citric acid
Acid degumming	Acid degumming removes anhydrous phospholipids
Pre-neutralization	Pre-neutralization involves the removal of FFAs from the oil
Pre-neutralization	Pre-neutralized oil is bleached with bleaching earth and carbon to remove colour and residual matter
Soap splitting	The soap splitting is a process in which soap solution/ water waste oil from pre-neutralization unit is drawn and split up to get free oil using sulphuric acid. This helps in recovery for trapped oil
Pre-deodorization (only for mustard and rape seed oil)	Pre-neutralized mustard/rape seed oil is stripped with 4 m^3 steam/ kg oil at 160.8 ^{0}C. This removes the sulphur compounds causing odour from the oil
Blending and post- neutralization	The hydrogenated (hardened oils) oils are blended together and final blend is neutralized to free the hardened oils from FFAs and catalyst
Post-bleaching and post- deodorization	The hardened oils after FFA removal along with sesam oil is bleached and deodorized using suitable agents for removal of odiferous and other volatile compounds to below the taste threshold

Process of effluent treatment plant

Effluent treatment plant are used to purify water and remove toxic and nontoxic materials, organic matter as well as chemicals from it. In edible oil industries these plant can be used for environment protection.

Treatment Levels
• Preliminary
• Primary
• Secondary
• Tertiary

Treatment mechanisms
• Physical
• Chemical
• Biological

- **Recovery of by-products, recycle and reuse of the wastes after proper treatment in order to achieve zero discharge**

Generally, the hydrogenated edible oil manufacturing units practice recovery of lecithin, soap stock, spent nickel catalyst and deodorizer distillates as by-products for reuse.

- **Lecithin**

Lecithin is derived from the degummed edible oil and it is one of the important ingredients of phosphatides. The gums from the centrifuge are processed by treating with H2O2 and then dried. After reduction of moisture, the product is cooled. Thus, six common grades of lecithin are obtained and are used in foods and other industrial processes. However, the industry was not selling the degummed waste material generated during the process to another industry as a raw material for production of lecithin. The investigation identified one of the industries and arranged for the selling of degummed waste material for production of lecithin.

- **Soap stock**

Soap stock is defined as a by-product, which results from the alkali-refining of the edible oil, otherwise treated as waste. The basic reaction in alkali-refining is given here under:

C3H5(O2CR)3 + 3NaOH ~> 3RCO2Na + C3H5(OH)3
Fat Alkali Sodium soap Glycerol

In the industry under investigation, the soap stock is produced during the refining of edible oil. The soap stock contains 50% total fatty matter and, therefore, it has a commercial value. The soap stock produced in the industry is sold directly to the soap manufacturers.

- **Spent earth**

Bleaching material like active earth produced as waste from the filter press was having 30- 50% oil content. The organic carbon content of the produced spent earth in the industry was found to be in the range of 33.54-39.34%, while remaining is inorganic material. The spent earth generated at the industry is about 657-tones/ year (coal equivalent to 2366 tones/year), and was suggested to be used as boiler feed to generate steam for the process. The spent earth has also got a potential market to be used in laundry soap manufacture, and essence sticks manufacture. Occasionally, the fat adsorbed on filter cake of spent earth is defatted with hexane and reused in the process. However, the industry was suggested to reuse spent earth as substitute of coal in the boiler. It can be converted into clay carbon adsorbent for potential reuse in the adsorptive cleansing of vegetable oils, also suggested to be used as boiler feed for steam generation process.

- **Wastewater**

It was suggested, and also practiced to reuse and recycle the acidic wastewater from soap splitting tank for soap splitting. Recycling of the filter press cleaning water through Thompsoning tank was adopted for reusing in the manufacturing process. The recycling of process cooling water was adopted in bleaching, deodorizer, and dehydroxylation units.

- **Lime sludge**

Lime sludge generated in the process after dewatering and drying was stored in gunny bags for disposal. It can be tried as the constituent of masonry cement, burning of lime sludge to make building lime, as raw material for making flooring tiles and compounding of burn lime waste with surkhi/fly ash to make lime pozzolana composites mortars.

- **Biological sludge from aeration basins**

Sludge generated from biological ASP units along with garbage was suggested to be composted and reused for vegetation. The suggestions were adopted by the industry and produced composted sludge is now being taken up from the pit and distributed to the farmers for agricultural usage. Sludge is a useful source of nitrogen, phosphorous and organic matter and after further processing can be used as a liming material.

IV. RESULTS AND DISCUSSION

The waste from edible oil refinery included solid wastes viz. spent earth, chemical and biological sludge and wastewater from soap splitting unit, floor washing, and cooling and boiler sections. The combined wastewater from soap splitting and floor washing had high concentration of oil and COD. The industry under investigation recycled and reused most of the solid wastes, while wastewater from cooling and boiler section was recycled in the process. The remaining wastewater could be treated in the existing ETP and the treated effluent met the prescribed limits of discharge into inland surface water.

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