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Clean Production in Edible Oil (Olympic Edible Oil Factory)

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ABSTRACT: Edible oil industry is one of the most important food industries in Sudan. It has wide effects on surrounding environment like high emission of CO_2, solid waste and contaminated water. It is necessary that the Edible oil industry requires to implementing clean production opportunities to reduce the risk to human and environment, optimum utilities of raw materials and energy and reduction of water usage as well as to reduce the cost of disposed wastewater. Olympic Edible Oil Factory was taken as case study. It is found that this factory uses fuel oil and electricity as source of power, it is advisable that fuel leaks and spills to be avoided and the operation is to be continuous. The factory use excessive water this increases contaminated water and also adds to the cost of disposing and treatment of contaminated water. In edible oil industry the air is contaminated by carbon dioxide (CO2) from fuel oil combustion. The emission of CO2 is too high as being determined and calculated. The contaminated water is to be tested COD, BOD, TSS, TDS, soap, oil and grease and gums. The factory only testes for BOD and COD. As conclusion the implementation of the clean production methodology will solve all such problems.

INTRODUCTION

UNEP DTIE (United Nations Environment Programme, Division of Technology, Industry and Environment) coined the term "Cleaner Production" (CP) in 1989 as "...the continuous application of an integrated preventive environmental strategy applied to processes, products, and services to increase overall efficiency and reduce risks to humans and the environment" (UNEP 2011). Cleaner Production principles, which are also practiced as waste minimization, pollution prevention, and eco- efficiency, are founded on the four Rs: Reduce, Recycle, Reuse, and Reformulate. Pollution control is an after–the-event, "react and treat" approach, whereas Cleaner Production reflects a proactive. "anticipate and prevent" philosophy. Prevention is as is always better than cure. When minimizing waste and pollution through cleaner production a reduction of consumption of raw material and energy is also achieved. Other concepts similar to cleaner production are:

- Waste minimization ;
- Pollution prevention ; and
- Green productivity.

Definition of Cleaner Production (UNEP)

The continuous application of an integrated preventive environmental strategy applied to process, products, and services in order to increase efficiency and reduce risk to humans and environment.

For production process: cleaner production includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes.

For products: cleaner production includes the reduction of negative impacts along the life cycle of a product, from raw material extraction to its ultimate disposal;

For service: cleaner production is to incorporate environmental concerns into designing and delivering services.

II. MATERIAL AND METHODS

Refining of Edible Oil in Olympic Factory

Edible oils obtained from coconut, corn, cottonseed, olive, palm, peanut, soybean and sunflower etc. contain gums and other impurities which are removed by alkalization, bleaching dewaxing and deodorization processes.

Olympic Oil Factory, processing steps:

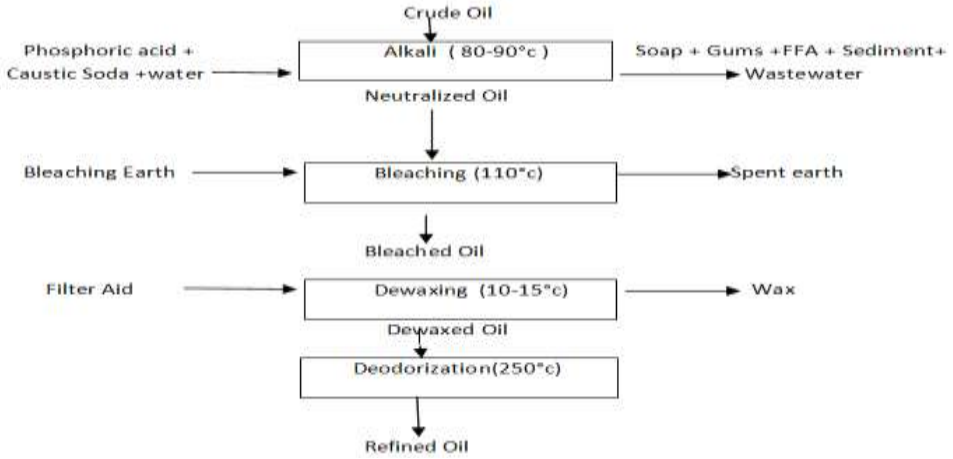

Fig (1): Olympic Oil Factory, processing steps

Inputs and Outputs for Alkalization Process:

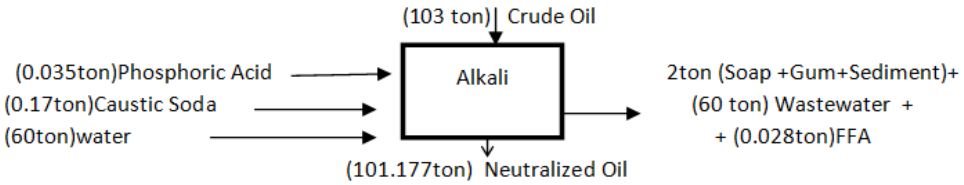

Fig (2) Inputs and Outputs for Alkalization Process

Table (1):- Amount of Inputs and outputs of the Alkalization Process:

Inputs	*Amounts*	*Outputs*	*Amounts*
Crude Oil	103 ton	Soap + Gum + Sediment	2 ton
Phosphoric Acid	0.035 ton	FFA	0.028 ton
Caustic Soda	0.17 ton	Neutralized Oil	101.177 ton
Water	60 ton	Wastewater	60 ton
Total	163.205 ton	Total	163.205 ton

Inputs and Outputs:- For Bleaching Process

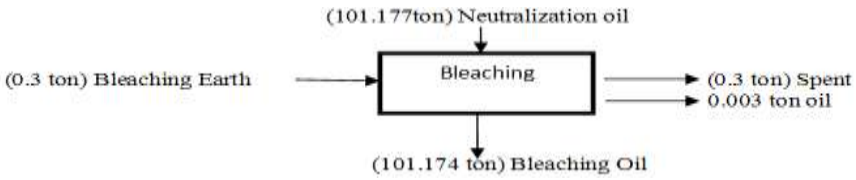

Fig (3) Inputs and Outputs for Bleaching Process

Table (2):- Amount of Inputs and outputs of the Bleaching Process:

Inputs	Amounts	Outputs	Amounts
Neutralization Oil	101.177 ton	Bleaching Oil	101.174 ton
Bleaching Earth	0.3 ton	Spent Earth + oil	0.303 ton
Total	101.477 ton	Total	101.477 ton

Inputs and Outputs:- For Dewaxing Process

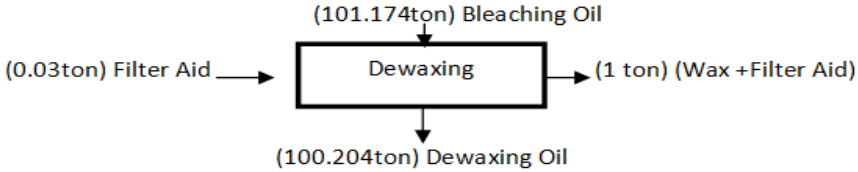

Fig (4) Inputs and Outputs for Dewaxing Process

Table (3):- Amount of Inputs and outputs of the Dewaxing Process:

Inputs	Amounts	Inputs	Amounts
Bleaching oil	101.174 ton	Bleaching oil	101.174 ton
Filter aid	0.03 ton	Filter aid	0.03 ton
Total	101.204 ton	Total	101.204 ton

Inputs and Outputs:- For Deodorization Process

Fig (5) Inputs and Outputs for Deodorization Process

Table (4):- Amount of Inputs and outputs of the Deodorization Process:

Inputs	Amounts	Outputs	Amounts
Dewaxing oil	100.204 ton	Refined oil	100.204 ton

Table (5): Olympic factory limits for direct discharges of treated wastewater

No	Parameter	Limits	Unit
1	pH	5.5 - 9	-
2	BOD	100	mg/L
3	COD	250	mg/L
4	TSS	?	-

Noticed: TSS test is not done.

Oil Quality Control Unit

Table (6): The laboratory of Olympic factory analysis:-

Step	Tests
Raw oil	FFA not exceed 1% , moisture not exceed 0.5% , wax 1000ppm , P.V not exceed 10 millimole/kg , sediment from 0.5% to 1%, gum=1%
Alkali	FFA = 0.1% ,sediment from 0% to o.o5% , gum
Bleaching	FFA =0.1%%
Dewaxing	FFA = 0.1% , wax < 100ppm

The calculation of the emission of co2 from gasoline burnings in factory:-

As in EPA emission facts gasoline carbon content per gallon =2,421 gram For all oil and oil product, the oxidation factor used is .0.99 To calculate CO2 emissions from a gallon of fuel, the carbon emissions are multiplied by the ratio of the molecular weight of Co2 (m.w.44) to the molecular weight of carbon (m.w.12): 44/12 Co2 emission from gallons of gasoline=2,421 grams * 0.99 *(44/12) = 8788 grams = 8.8 kg/gallon There are 31.75 gallons in 1 ton of gasoline.

The emission of 4 ton of gasoline = 8.8*31.75*4=1117.6 = 1117.6 kg/gallon.

III. RESULTS AND DISCUSSION

It is found that this factory uses gasoline and electricity as source of power, about 4 tons /day of gasoline and 1000 SDG is paid for electricity daily. Water is heated with gasoline to generate required steam. The boiler is controlled to avoid any explosion. It is advisable that fuel leaks and spills to be avoided. The operation is to be continuous as about 3 tons of fuel are needed for start up, shut down and restarting also has effect on factory equipment.

The factory use about 60 tons per day of water. This excessive water consumption increases contaminated water and also adds to the cost of disposing of contaminated water. Treatment of contaminated water, reduce the problems and cost of disposing. The factory uses a feed of 103 tons per day of crude oil this produces 100 tons of net oil. It is necessary to prevent leaks and spills during unloading and storage. The chemicals used are 0.035 tons of phosphoric acid and 0.17 tons of caustic soda –for the above operation- the optimal use of chemicals reduces of loss of raw materials.

In edible oil industry the air is contaminated by carbon dioxide (CO2) from gasoline combustion. The emission of CO2 is too high as being determined and calculated (1117.6 kg/gallon of fuel).

The contaminated water is to be tested for COD, BOD, TSS, TDS, soap, oil and grease and gums. The factory only testes for BOD and COD (BOD = 100 mg/l and COD =250 mg/l). Unfortunately the water treatment unit worked for two weeks only and stopped, hence the water is disposed without treatment.

The crude oil comes from Ukraine there is no problems for import it and the characteristics of it are shown in table (7). These specifications satisfy Sudanese standard except for the sediment.

Table: (7) characteristics of Ukrainian imported oil.

Test	Result	Standard Range	Unit
FFA	Not exceed 1	2.00max	%
Moisture	Not exceed o.5	o.5 max	%
Wax	1000	1400 max	ppm
P.V	Not exceed 10	15 max	Millimole/kg
Sediment	0.5 -1	0.1 max	%
Gums	1	1 max	%

The oil product is in the standard range as in table (8) and there are no problems in the final product.

Table: (8) characteristics of the Olympic oil product.

Test	Result	Standard Range	Unit
FFA	0.09	0.2	%
Colour	0.6 max in cell 1''	4 max in cell 1''	Unit
Peroxide Value	2.9	7 max	millimole/kg
Sediment	0.00	0.00	%
Soap content	Nil	Nil	-
Taste & Odour	Nil & Good	Good & Nil	-
Gums	0.05	0.1 max	%

The factory location is good and it has enough a workforce nearly 110 employees. It is noticed that services to employees is not satisfactory; they haven't supermarket, a clinic nor company transport. There are enough fire extinguishers in the factory and there is no shower for workers.

IV. CONCLUSIONS

- The factory does not used local raw crude oil but produces an edible oil of Sudanese standards imported from Ukraine.
- The imported raw material contains gums and other impurities which are removed by alkalization, bleaching, dewaxing and deodorization processes. These processing units are found to be working satisfactorily at Olympic Oil.
- From the calculation it is found that 97% of raw material is recovered an edible oil with the rest being gum, FFA, and entrained in bleaching earth.
- The water consumption is found to be too high- which leads to increase the effluent wastewater - and disposed untreated; for which cleaner production opportunities are not implemented.
- The soap stock produced during the edible oil manufacture is discharged outside the factory without being recovered as by-product.
- The emission of CO_2 is too high that increases environmental pollution problems.
- The factory has enough working force nearly 110 employees. It is noticed that services to employees is not satisfactory; they haven't supermarket, a clinic nor company transport.
- Safety wise there are enough fire extinguishers but there are no showers.

V. RECOMMENDATIONS

It is recommended:-

- To look for a local source of crude oil.
- Reduction of the water consumption and application of water conservation techniques, reuse and treatment of wastewater before disposal.
- Finding an economical way for soap stock recovery.
- Isolate spent bleaching earth from contact with air to avoid spontaneous combustion.

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