Vegetable Oil Processing

Industry Description and Practices

The vegetable oil processing industry involves the extraction and processing of oils and fats from vegetable sources. Vegetable oils and fats are principally used for human consumption but are also used in animal feed, for medicinal purposes, and for certain technical applications. The oils and fats are extracted from a variety of fruits, seeds, and nuts. The preparation of raw materials includes husking, cleaning, crushing, and conditioning. The extraction processes are generally mechanical (boiling for fruits, pressing for seeds and nuts) or involve the use of solvent such as hexane. After boiling, the liquid oil is skimmed; after pressing, the oil is filtered; and after solvent extraction, the crude oil is separated and the solvent is evaporated and recovered. Residues are conditioned (for example, dried) and are reprocessed to yield by-products such as animal feed. Crude oil refining includes degumming, neutralization, bleaching, deodorization, and further refining.

Waste Characteristics

Dust is generated in materials handling and in the processing of raw materials, including in the cleaning, screening, and crushing operations. For palm fruit, about 2–3 cubic meters of wastewater is generated per metric ton of crude oil (m^3/t). The wastewater is high in organic content, resulting in a biochemical oxygen demand (BOD) of 20,000–35,000 milligrams per liter (mg/l) and a chemical oxygen demand (COD) of 30,000–60,000 mg/l. In addition, the wastewaters are high in dissolved solids (10,000 mg/l), oil and fat residues (5,000–10,000 mg/l), organic nitrogen (500–800 mg/l), and ash residues (4,000–to 5,000 mg/l). Seed dressing and edible fat and oil processing generate approximately 10–25 m^3 of wastewater per metric ton (t) of product. Most of the solid wastes (0.7–0.8 t/t of raw material), which are mainly of vegetable origin, can be processed into by-products or used as fuel. Molds may be found on peanut kernels, and aflatoxins may be present.

Pollution Prevention and Control

Good pollution prevention practices in the industry focus on the following main areas:

- Prevent the formation of molds on edible materials by controlling and monitoring air humidity.
- Use citric acid instead of phosphoric acid, where feasible, in degumming operations.
- Where appropriate, give preference to physical refining rather than chemical refining of crude oil, as active clay has a lower environmental impact than the chemicals generally used.
- Reduce product losses through better production control.
- Maintain volatile organic compounds (VOCs) well below explosive limits. Hexane should be below 150 mg/m^3 of air (its explosive limit is 42,000 mg/m^3).
- Provide dust extractors to maintain a clean workplace, recover product, and control air emissions.
- Recover solvent vapors to minimize losses.
- Optimize the use of water and cleaning chemicals.
- Recirculate cooling waters.
- Collect waste product for use in by-products such as animal feed, where feasible without exceeding cattle-feed quality limits.

Continuous sampling and measuring of key production parameters allow production losses to be identified and reduced, thus reducing the waste load.

Odor problems can usually be prevented through good hygiene and storage practices. Chlorinated fluorocarbons should not be used in the refrigeration system.

Pollution Reduction Targets

Since the pollutants generated by the industry are very largely losses in production, improvements in production efficiency, as described above, are recommended to reduce pollutant loads.

Wastewater loads are typically 3–5 m^3/t of feedstock; plant operators should aim to achieve lower rates at the intake of the effluent treatment system. Hexane, if used, should be below 50 mg/l in wastewater. The BOD level should be less than 2.5 kg/t of product, with a target of 1–1.5 kg/t.

Treatment Technologies

Pretreatment of effluents comprises screening and air flotation to remove fats and solids; it is normally followed by biological treatment. If space is available, land treatment or pond systems are potential treatment methods. Other possible biological treatment systems include trickling filters, rotating biological contactors, and activated sludge treatment.

Pretreated effluents can be discharged to a municipal sewerage system, if capacity exists, with the approval of the relevant authority. Proper circulation of air, using an extractive and cleaning system, is normally required to maintain dust at acceptable levels. Dust control is provided by fabric filters. Odor control is by ventilation, but scrubbing may also be required.

Emissions Guidelines

Emissions levels for the design and operation of each project must be established through the environmental assessment (EA) process on the basis of country legislation and the *Pollution Prevention and Abatement Handbook,* as applied to local conditions. The emissions levels selected must be justified in the EA and acceptable to the World Bank Group.

The guidelines given below present emissions levels normally acceptable to the World Bank Group in making decisions regarding provision of World Bank Group assistance. Any deviations from these levels must be described in the World Bank Group project documentation. The emissions levels given here can be consistently achieved by well-designed, well-operated, and well-maintained pollution control systems.

The guidelines are expressed as concentrations to facilitate monitoring. Dilution of air emissions or effluents to achieve these guidelines is unacceptable.

All of the maximum levels should be achieved for at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.

Air Emissions

Odor controls should be implemented where necessary to achieve acceptable odor quality for nearby residents. Fabric filters should be used to control dust from production units to below 50 milligrams per normal cubic meter (mg/Nm^3).

Liquid Effluents

The effluent levels presented in Table 1 should be achieved.

Table 1. Effluents from Vegetable Oil Processing

(milligrams per liter, except for pH and temperature)

Parameter	*Maximum value*
pH	6–9
BOD	50
COD	250
TSS	50
Oil and grease	10
Total nitrogen	10
Temperature increase	≤ 3°C[a]

a. The effluent should result in a temperature increase of no more than 3° C at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters from the point of discharge.

Ambient Noise

Noise abatement measures should achieve either the levels given below or a maximum increase in background levels of 3 decibels (measured on the A scale) [dB(A)]. Measurements are to be taken at noise receptors located outside the project property boundary.

	Maximum allowable log equivalent (hourly measurements), in dB(A)	
Receptor	*Day (07:00–22:00)*	*Night (22:00–07:00)*
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Monitoring and Reporting

Monitoring of the final effluent for the parameters listed in this document should be carried out at least weekly, or more frequently, if the flows vary significantly.

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be kept in an acceptable format. The results should be reported to the responsible authorities and relevant parties, as required.

Key Issues

The key production and control practices that will lead to compliance with emissions requirements can be summarized as follows:

- Monitor key production parameters to reduce product losses.
- Prefer citric acid to phosphoric acid in degumming operations.
- Give preference to physical refining over chemical refining of crude oil, where appropriate.
- Hold levels of hexane, if used, below 150 mg / m^3.
- Design and operate the production system to achieve recommended wastewater loads.
- Recirculate cooling waters.
- Collect wastes for use in by-products or as fuel.

Source

German Federal Ministry for Economic Cooperation and Development (BMZ). 1995. *Environmental Handbook, Documentation on Monitoring and Evaluating Environmental Impacts.* Vol. 2. Bonn.