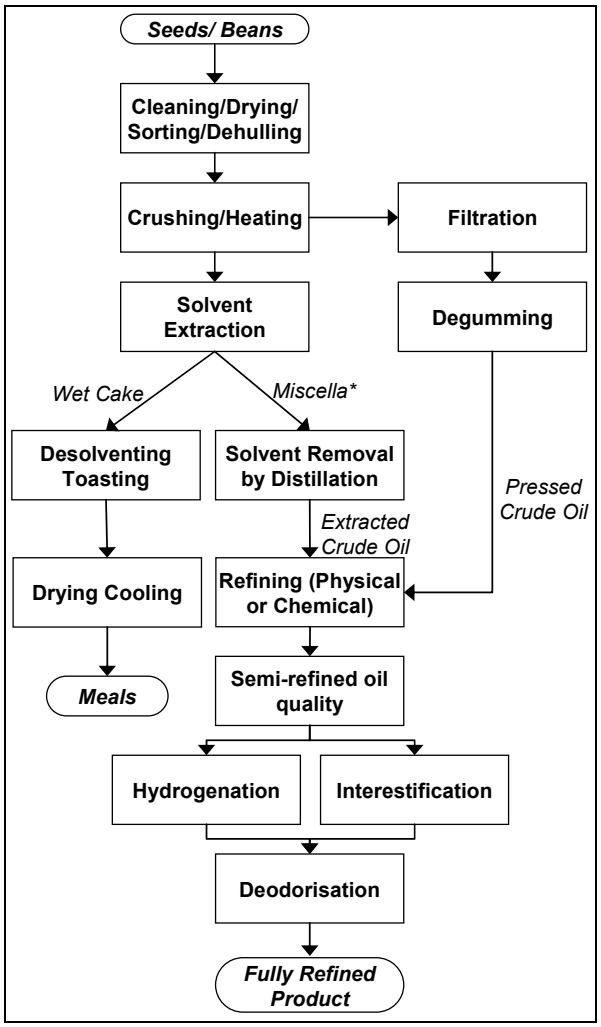
European Bank
for Reconstruction and Development

# Sub-sectoral Environmental and Social Guidelines: Vegetable Oil Processing

## *PROCESS DESCRIPTION*

Vegetable oils are extracted from seeds, beans, fruits and nuts. The basic steps in the process are shown in the figure below.




*Miscella is a mixture of oil and solvent

The extracted crude oil will be refined either by chemical/alkali refining or by physical means. The primary purpose is to separate the free fatty acids and remove other unwanted substances.

Vegetable oils and fats are an important ingredient in a vast number of products providing flavour, texture and structure. They are used in food applications, animal feed, cosmetics, detergents, paints, plastics, candles, pharmaceuticals, biofuels and many other technical applications.

## *SUMMARY OF KEY ENVIRONMENTAL, HEALTH AND SAFETY RISK/LIABILITY ISSUES*

### *Solid Waste*

Vegetable oil processing can generate significant quantities of organic solid waste such as empty fruit stalks and waste palm kernels. The waste products can normally be used for animal feed.

Other solid wastes may include:

- Spent bleaching earth: activated clay, silica and carbon are used in the bleaching process and will contain pigments and residues of other undesirable substances such as gums and metals;
- Soap stock and spent acids from chemical refining;
- Deodoriser distillate;
- Mucilage[1] from degumming;
- Spent catalysts and filtering aid from hardening;
- Sludge arising from the wastewater treatment plant which may be contaminated with hazardous chemicals or have a high pH and therefore require careful disposal.

[1] Gelatinous substances secreted by plants

Solid wastes should be stored in adequate containers and segregated where possible to encourage recycling. Solid wastes will need to be disposed of regularly to avoid odour, litter, fly and rodent problems.

***Volatile Organic Compounds (VOCs)***

Solvent is used to separate oil from the vegetable matter. Solvent emissions arise from several steps in the process such as the solvent recovery plant, volatisation during refining and leaks in piping and vents.

The most common solvent used is hexane, which is a colourless volatile liquid, soluble in water and highly flammable and may cause explosions due to the volatisation of the solvent dissolved in the oil. Exposure to hexane may cause impaired fertility. Acute inhalation of high levels of hexane can cause mild central nervous system (CNS) depression and irritation of the skin and mucous membrane. Prolonged exposure may cause serious health damage. Hexane is also harmful in low concentrations to aquatic organisms. Strict controls are required to prevent a build-up in working areas and discharges to the environment.

Processors within the EU must comply with the Council Directive 88/344/EEC on extraction solvents in foodstuffs and the solvents emissions directive 1999/13/EC.

***Exposure to Other Hazardous Substances***

In addition to solvents, a range of other potentially hazardous materials may be used during processing and cleaning, including:

- Caustic soda – used to convert free fatty acids into soap stock;
- Sulphuric acid – used to subsequently free the fatty acids from the soap stock;
- Phosphoric acid – used in degumming;
- Spent bleaching earth – this material presents a fire risk;
- Hydrogen;
- Other solvents;
- Cleaning agents such as detergents.

The transport, storage and handling of such materials provide opportunities for spills and other releases to the environment and present a risk of fire and explosion.

***Water Supply***

Edible oil extraction can use a relatively large quantity of water throughout the process primarily for:

- Raw ingredient cleaning;
- Cooling water in crude oil production;
- Chemical neutralisation;
- Washing and deodorisation;
- Cleaning process areas;
- Steam production.

Water can be wasted when much of it can be treated and reused in the process. It is typical for abstraction or water use permits to detail volumes of water abstraction allowed as over abstraction can impact local communities. Whenever

changes take place in product volumes this should be reflected in the permit.

***Wastewater Treatment***

Large volumes of wastewater containing high organic loads, organic nitrogen, oils and fats, cleansing agents, solvents and suspended solids may be produced. The wastewater may also be contaminated with pesticide residues.

The main production processes producing wastewater are the refinery, deodorisers and boilers. The wastewater will require treatment before it can be discharged to a municipal wastewater treatment system or to the environment. Many facilities have on site wastewater treatment plants which may utilise mechanical and chemical means of treatment. A permit with specific discharge parameters from the regulatory authorities will normally be required.

***Energy***

Large quantities of energy are consumed in oil processing in two ways:

- Thermal energy in the form of steam and hot water used for distillation, cleaning, and sterilising. Frequently an auxiliary boiler is used to generate steam;
- Electricity for machinery operation, refrigeration, lighting and production of compressed air. Minimum refrigeration requirements are normally determined by regulation.

Energy usage has a direct correlation to the operating costs of the company and energy generation and consumption may be regulated or taxes/levies applied to reduce energy use and associated emissions of gases such as carbon dioxide.

***Dust and Aerosols***

Dust may arise from storage, handling and drying activities; aerosols typically arise from the use of compressed air and high-pressure water for cleaning.

- Workers may inhale or ingest the dust and aerosols exposing them to biological hazards which present a risk of occupational lung disease. When combined with high levels of humidity they may give rise to skin irritation or allergic reactions;
- A dust cloud of any flammable material will explode where:
  - The concentration of dust in air falls within the explosive limits;
  - A source of ignition.

Dust emissions can be controlled by enclosing processing and transport equipment, which also reduced product losses and the installation of extraction equipment.

## *OTHER ENVIRONMENTAL , HEALTH AND SAFETY RISK/LIABILITY ISSUES*

***Packaging***

Extracted oil is typically packaged in plastic, cans and glass. Where possible companies should attempt to recover packaging or should ensure that the packaging is easy to recycle. Solid waste will arise from the packaging process in the form of discarded packaging offcuts. Waste oils should be recovered and reprocessed, e.g. into biofuels.

Companies operating with the European Union (either as a manufacturer or as a supplier into European Union countries will be subject to the European Union Packaging and Packaging Waste Directive (94/62/EC), which aims to reduce the amount of packing that is being introduced into waste streams.

***Permitting***

Operations within the EU with a finished food product production capacity greater than 300 tonnes per day will be subject to national regulations under the Integrated Pollution Prevention and Control Directive (2008/1/EC), which requires the use of the best available techniques and a programme of continuous environmental improvement. Other smaller facilities within the EU and operations outside the EU will still be subject to local regulation but this will generally set less stringent requirements on the techniques to be adopted.

***Storage Issues***

Bulk storage facilities will be used for the storage of oil seeds and beans, gas and liquid chemicals used in the production process and for cleansing and disinfection, and fuel oils for energy production. These storage facilities should be provided with satisfactory containment (concrete walls/bunds, recessed drainage gullies connected to effluent treatment areas to prevent spills reaching the wider environment. Alarms may be fitted to detect leakages. Gas storage tanks should be regularly tested for integrity and may require licensing under local regulatory regimes.

***Noise***

- The noise generated by equipment such as steam, condensers, ventilation, canning and bottling lines and pressurised air equipment as well as manoeuvring trucks can be a nuisance if the site is located close to residential areas and other sensitive receptors.
- Noise induced hearing loss can occur from working in noisy areas, e.g. internal transport, conveyors, boilers, pumps, fans, and steam and air leaks;

***Machinery & Sharp Edges***

All equipment should have safety guarding and workers should be issued with appropriate personal protective equipment to protect against unavoidable sharp items and edges. Particular attention should be paid to conveyors, mills and packaging machinery;

***Manual Handling & Repetitive Work***

Lifting, repetitive work and posture injuries occur as a result of lifting and carrying heavy or awkward shaped items and solid wastes. Repetitive tasks can lead to musculoskeletal injuries;

***Slips, Trips & Falls***

Slippery floors and surfaces caused by oil and fat deposits present a high risk of slips, trips and falls where spills have not been cleared up or effective cleaning has not taken place;

***Collision***

In a busy manufacturing environment it is common to have injuries where people are struck by moving or falling objects such as crates, boxes, equipment, conveyors and forklift trucks;

***Temperature***

High temperatures can lead to collapse through heat exhaustion and contact burns.

## *KEY SOCIAL, LABOUR AND COMMUNITY RISKS/LIABILITY ISSUES*

***Product Contamination***

Contamination of product could result in ill health in the general public and may result in product recall. Vegetable oils can become contaminated as a result of contamination of the raw materials, during processing, packaging and transport. Screening of raw materials will identify any incoming contaminated raw product and food hygiene standards such as Hazard Analysis Critical Control Points (HACCP)[2] and Codex Alimentarius[3] will need to be considered in order to reduce the risk of contamination.

A system of product quality testing and traceability should be considered to enable product recall if required

***Deforestation***

The demand for vegetable oil has increased significantly which in some cases has led to the destruction of tropical rain forest and removal of indigenous peoples from their land. Some of this has been blamed on palm oil and soya producers and therefore could reflect on purchasers and processors of these crops.

[2] ISO 2005

[3] FAO and WHO (1962–2009).

## *OTHER SOCIAL, LABOUR AND COMMUNITY RISKS/LIABILITY ISSUES*

***Odour***

Unpleasant odours may be generated during operation which heat the oil and involve solvents. Controls should be in place to control gaseous emissions which could cause a nuisance to the surrounding areas.

## *FINANCIAL IMPLICATIONS*

- Product recall can have a significant impact, e.g. compensation claims, loss of reputation, loss of contracts and in terms of export markets. Significant upgrades in hygiene standards may be required at the production facility in order to reduce the risk of contamination during processing and to satisfy national and European food hygiene standards;

- If oil and solvents are allowed to enter the effluent stream, the cost of treatment increases and this represents the loss of valuable by-products;

- Where large quantities of energy are used then this can result in high operating costs to the business;

- Many countries are signatories to the Kyoto Protocol and have adopted targets for the reduction of $CO_2$ emissions. Where Governments have set up carbon emission reduction programmes industrial processes have been required to reduce their $CO_2$ emissions through the setting of targets. This can result in a need for substantial investment in new/clean technologies to achieve the emission targets. These targets may be reflected in environmental permits;

- Injures may lead to increased payroll costs to replace skilled workers and lost production time;
- Fines, penalties and third party claims may be incurred for non-compliance with environment, health and safety regulations.

## *ENVIRONMENTAL, HEALTH AND SAFETY IMPROVEMENTS*

### *Environmental, Health and Safety Improvements*

- Reduce dust emissions by:
  - Ensuring proper maintenance of all cleaning, screening and crushing equipment to prevent fugitive emissions
  - Enclose and seal plant and equipment to prevent escape and accumulation of dust;
  - Use of doors/plastic strip curtains on building access points;
  - Redesigning processes to reduce free-fall distances and speed of movement for dry products;
  - Replace any external bulk storage areas with silos, fitted with alarms to prevent overfilling;
  - Install a centralised piped vacuum cleaning systems;
  - Installation of dust extractors e.g. cyclones and fabric filters
  - Improving ventilation within buildings;
  - Maintaining a slight negative pressure within storage vessels such as bins and silos;
- Install dust and solvent emissions monitoring equipment at most sensitive points;
- Reduce odour emissions from soap splitting, extraction cookers, vacuum and pressurised systems by using caustic, alkaline or ozone scrubber systems or by incinerating the gas.
- Minimise solvent use by switching to physical (rather than chemical) refining where free fatty acid content >2%;
- Improve process design to increase solvent recovery, e.g. Distillation, reuse of vapours, gravity separators
- Where feasible use citric acid in conjunction with phosphoric acid in degumming to reduce phosphorous loading in effluent;
- Use appropriate cleaning chemicals in the right dosage for the equipment to be cleaned, e.g. caustics for polymerised fat and acids for lime deposits. Use hot water rather than solvents to facilitate cleaning where possible;
- Regular inspection should be carried out of all bulk containment facilities on site and effluent holding tanks and treatment facilities;
- Separate cooling water from process water and recycle condensates and cooling waters;
- Explore waste recovery measures such as:
  - Use of waste vegetable matter as a soil improver;

  - Use of waste vegetable matter and free fatty acids as fuel for steam and power generation at refineries or for animal feed;
  - Use of free fatty acids as feedstock for chemical industry;
  - Use of uncontaminated wastewater treatment sludge in agricultural applications;
  - Use of spent bleaching earth in brick/block/cement manufacture, fertiliser, anaerobic digestion;
- Ensure contaminated sludge is disposed of by incineration or landfill at permitted facilities;
- Install grids to reduce or avoid introduction of solid materials into the wastewater drainage system;
- Treat wastewater prior to discharge to separate oils and fatty acids from the water and discharge through a fat trap;
- Installation (or upgrade) of wastewater treatment plant;
- Use heat recovery to heat incoming oil with the outgoing oil thereby reducing energy demand and water demand for steam;
- Reduce the risk of fire and explosion by:
  - Reducing dust emissions as above;
  - Minimising fugitive solvent emissions;
  - Use of closed system ventilation;
  - Use of explosion proof electrical equipment and lighting;
- Provision of personal protective equipment (PPE) that is fit for the task to prevent injury and maintain hygiene standards. Staff should be trained in the correct selection, use and maintenance of PPE; the training should include the reasons for its use and the dangers of not using it. PPE should be inspected regularly and maintained or replaced as necessary;
- Train workers in correct use of machinery, safety devices and chemical handling;
- Implement preventative maintenance to reduce the risk of burns from steam pipes and hot surfaces;
- Separation of people from moving equipment:
  - Ensure that the process layout reduces opportunities for process activities to cross paths;
  - Install correct guarding to reduce risk of entrapment of employees;
  - Install walkways to separate people from vehicle movements to reduce risk of collision;
- Walking and working surfaces should be kept clean and dry. Restrict access to areas being cleaned or where spillages have occurred. Floor cleaning should be scheduled for a time when work is not in progress or has finished for the day and the floor should be dried as much as possible;
- To reduce the risk of noise exposure rotate tasks to minimise time spent in a noisy area over an eight hour period and provide personal protective equipment where people have to enter noisy areas;

- Restrict times for people being in very hot areas.

***Social, Labour and Community Improvements***

- Implement product traceability systems that facilitate tracing of products once released for sale.

***GUIDE TO INITIAL DUE DILIGENCE SITE VISITS***

During the initial site visit, the issues will vary according to the type of vegetable product being produced and depending on the level of environment, health and safety management already introduced. While visiting the site it is important to discuss and review the following:

- Check the condition and efficiency of any wastewater treatment plant and location of discharge points for wastewater from the market. Note the colour and appearance of adjacent watercourses;
- Note whether the wastewater treatment plant discharges to a local watercourse or the municipal wastewater treatment works. Higher environmental risks will be associated with facilities discharging to water courses;
- Check the source of raw materials and screening for contamination, in particular, which contamination parameters are analysed (e.g. pesticides, herbicides, radioactivity, heavy metals, industrial pollutants);
- What is the standard of "housekeeping" on site? Do areas look clean and tidy? Look for build up of fat and oil on floors and surfaces, evidence of any recent spills or releases of raw materials/product. Look for evidence that the walking and working surfaces are kept clean and dry;
- Observe food hygiene standards at the facility and the results of previous food hygiene inspections, e.g. Separate welfare areas for workers; Are staff wearing PPE?; Does the organisation have systems for food traceability;
- Check signage around the site:
  - Does it convey the health and safety risks?
  - Are fire exits clearly marked?
  - Are there demarcated routes for pedestrians and vehicles painted on floor?
- Is fire fighting and first aid equipment available?
- Check the age and condition of equipment, look for signs of wear and tear, degradation, leaks and breaks;
- Check that solid waste storage and disposal (storage equipment) is in a good condition;
- Check that waste disposal takes place on a regular basis;
- Check that waste storage areas are clean of debris and that are skips covered to prevent waste escaping, for example, check that waste containers have lids or are stored in an area with a roof;
- Review measures of controlling the odour coming out from the plant;
- Does the organisation have insurance in place to cover the recall of contaminated products?

Have there been any recent product recall incidents?

- Have there been any recent (within the last three years) incidents on site such as fatalities, fires/explosions, spills? Are there insurances in place to cover such incidents?
- Have the premises been inspected recently (within the last 2 years) by the regulatory authorities for health, hygiene and environment? What were their findings?
- Is the facility subject to any audits by customers? What was the outcome of these audits?
- Does the business plan have line items for Environment, Health and Safety improvements?
- Check the conditions and duration of validity for all permits.

***Social, Labour and Community Improvements***

- Check that labour standards, contracting and remuneration are in line with national law and are consistent with the average for the sector
- Check that hours worked, including overtime, are recorded and staff should receive written details of hours worked and payment received;
- Check that wages and working hours are consistent with the average for the sector and national standards;
- Has the Company received inspections from the local labour inspectorate in the previous three years? Have these resulted in any penalties, fines, major recommendations or corrective action plans?
- Does the organisation have a grievance mechanism which allows employees to raise workplace concerns?
- Are employees free to form, or join, a worker's organisation of their choosing?
- Consider installing product traceability systems that facilitate tracing and recall of products once released for sale.
- Does the organisation have insurance in place to cover the recall of contaminated products? Have there been any recent product recall incidents? What other insurances does the company have in place?

Take note/ask questions relating to any activities that address the improvements listed in the improvements section of this document.

## *ACTION PLANS*

Dependent on the individual business, select appropriate improvements from the list above to include in the action plan. As a minimum, any business should be required to have the following in place:

- Operational procedures to manage environmental, health and safety risks;
- Monitoring programmes;
- Improvement objectives, targets and project plans;
- Training for personnel;

- Regular inspections, checks and audits with records to demonstrate achievement of the required level of performance against legal requirements and improvement action;

- Emergency plans for environment, health and safety accidents;

- Management review/demonstrated involvement in environment, health and safety management.

## *REFERENCES AND ADDITIONAL SOURCES*

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