# Oil Seed and Pulse Processing

## Level II

## Based on October 2019, Occupational standards (OS) Version 2

**Module Title: Operating Mechanical Extraction Process**

**LG Code: IND OSP2 M13 LO (1-3) LG (41- 43)**

**TTLM Code: IND OSP2 TTLM 1020v1**

**October 2020**

United Nations
Educational, Scientific and
Cultural Organization

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**Instruction sheet**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Preparing Materials for mechanical extraction process
- Identifying Workplace documentation
- Confirming different services
- Requiring facilities and equipment for mechanical extraction
- Occupational Health and Safety (OHS)
- Following policies and procedures to control the risk
- Loading material into mechanical press

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Prepare Materials for mechanical extraction process
- Identify Workplace documentation
- Confirm different services
- Require facilities and equipment for mechanical extraction
- Occupational Health and Safety (OHS)
- Follow policies and procedures to control the risk
- Load material into mechanical press

| **Learning Instructions:** |
| --- |
| 1. Read the specific objectives of this Learning Guide.<br>2. Follow the instructions described below.<br>3. Read the information written in the information Sheets<br>4. Accomplish the Self-checks |

**Information Sheet# 1 - Preparing Materials for mechanical extraction process**

## 1.1 Introduction

This module aims to provide the skills and knowledge required to operate, adjust and shut down processes used to extract crude oil from oil seed using mechanical extraction methods. Lever and wedge presses were the early mechanical oil expression equipment used for oil seed processing. The first cottonseed oil mill constructed in the United States in the 1920s utilized a hydraulic press. Seeds in filter bags were manually loaded into perforated, horizontal boxes between the head block and the ram of the press. Boxes were pressed together by applying hydraulic pressure on the ram. Oil was pressed out through the filter bag. Then the filter bag containing spent cake was manually removed from the hydraulic press. Later versions of the hydraulic presses used cages instead of filter bags. Hydraulic presses were in use until the 1950s. They are replaced with continuous screw presses and continuous solvent extraction plants, which are less labor intensive. The olive oil industry still utilizes hydraulic press today.

The mechanical screw press consists of a vertical feeder and a horizontal screw with increasing body diameter to exert pressure on the oilseeds as it advances along the length of the press. The barrel surrounding the screw has slots along its length, allowing the increasing internal pressure to first expel air and then drain the oil through the barrel. Oil is collected in a trough under the screw and the de-oiled cake is discharged at the end of the screw. The main advantage of the screw press is that large quantities of oilseeds can be processed with minimal labor, and it allows continuous oil extraction. The maintenance of screw presses is challenging. The moving parts and high pressure and temperature generated in the press increase wear. The primary improvement in mechanical screw press design has been developing materials of construction that extend life of the parts that wear the most. Equipment parts that used to last three months before requiring replacement may now last up to two years. Today, much larger screw presses have been built. Former capacities of 5 tons per day are now more than 100 tons per day for full pressing and

more than 800 tons per day for pre-pressing applications. A growing number of mini crushing mills, which employ extruding-expelling (E-E) technology have been built as farmer-owned cooperatives or as on-farm operations to process locally produced soybeans or other oilseeds (http://www.insta-pro.com/products_services.htm) (Figure 1). E-E uses a dry extruder in which heat is generated by friction prior to screw pressing, replacing more capital intensive use of steam-heated dryers and cookers and associated steam generation equipment. The partially defatted meal, typically with 6-7 percent residual oil content, is used in livestock rations.

Expanders can be used to form oilseeds into porous pellets, which are commonly known as collets. Conversion of flaked seeds into extruded collets improves solvent extraction efficiency. Collets are larger and stronger and have larger bulk density than flakes. Better solvent flow and micelle (oil + solvent) drainage are achieved in the solvent extractor when collects are used for solvent extraction. Because of the larger bulk density of collets, less space is required for the same weight oilseed in the extractor. Production capacity in a plant is increased when collets, rather than flaked seeds, are used for solvent extraction. High oil content seeds such as sunflower, safflower, peanut canola and rapeseed have too much oil to produce good flakes and collets. Hence, they are pre-pressed to reduce meal oil content to 16-18 percent before solvent extraction. Soybean does not require pre-pressing because of its relatively lower oil content, 18-20 percent. A new screw press design, Hivex, combines pre-pressing and extruded collets formation into a single processing unit (http://www.andersonintl.net/VO%20Expander%20Page.htm). A drainage cage and a pressing screw are included into the barrel of an expander, so there is no need for purchasing a separate extruder and pre-press.

## 1.2 Preparing Materials for mechanical extraction process

Before processing the oilseeds and nuts should be properly dried before storage, and cleaned to remove sand, dust, leaves and other contaminants. All raw materials should be sorted to remove stones and moldy nuts. Some molds, especially in the case of groundnuts, can cause aflatoxin poisoning. When storage is necessary, this should be

in weatherproof, ventilated rooms which are protected against birds, insects and rodents. Some raw materials (for example groundnuts, sunflower seeds) need de-husking (or decorticating). Figure 1 shows a simple manually-operated groundnut decorticating machine.

Decortication is important to give high yields of oil and reduce the bulk of material to be processed. However, expellers normally require a proportion of fibrous material in order to work and, particularly with groundnuts, some husk is normally added to allow oil to escape more freely from the press. Coconut is de-husked and split manually by skilled operators. Most oilseeds (e.g. copra, palm kernels and groundnuts) need grinding in mills before oil extraction to increase the yield of oil.

Some seeds (especially groundnuts for example) are conditioned by heating to 80-90$^{o}$C using a seed scorcher (Figure 2 shows a typical small-scale example – a separate heat source is necessary beneath the scorcher). All oil-bearing materials need to have the correct moisture content to maximize the oil yield. Using small-scale expellers, oilseeds and nuts are usually processed “cold” (i.e. without additional heating).

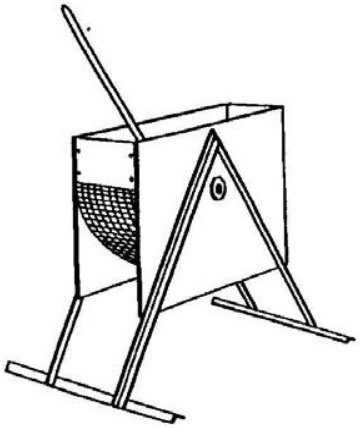

**Figure 1: A groundnut decorticating machine**

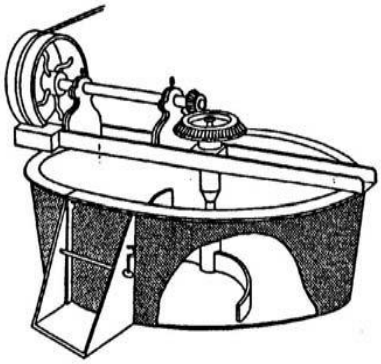

**Figure 2: A seed scorcher**

| Self-Check # 1 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Explain in detail about mechanical screw press (5pts )
2. What we have to do du preparing oil seeds to extract oils? (6pts )
3. Write the equipment that helps to maximize the oil yield (5pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers

**Information Sheet#2- Confirming different ingredients**

## 2.1 Confirming different ingredients

In oil seed processing you can use different ingredients which provides different functions to the oils. During using these ingredients you have to confirm that all the ingredients meet the specified condition, quality, and availability. Different ingredients that must be confirmed in oil seed processing may include but not limited to:

- Water
- Salt
- white sugar
- Aerated sugar
- Emulsifier
- Flavors /citric acid

## 2.2 Emulsifier

An emulsifier acts in the following ways

- It adsorbs at the interface between two immiscible liquids such as oil and water.
- It reduces the interfacial tension between two liquids, enabling one liquid to spread more easily around the other.
- It forms a stable, coherent, viscoelastic interfacial film, which prevents or delays coalescence of the dispersed emulsion droplets.

Molecules that can act as emulsifiers contain both a polar, hydrophilic (water loving) section, which is attracted to water, and a hydrophobic (or water-hating) section, which is attracted to hydrophobic solvents such as oil. Good emulsifiers are able to interact at the interface to form a coherent film that does not break easily. The best emulsifiers are proteins, such as egg yolk (lipoproteins) or milk proteins, because they are able to interact at the interface to form stable films, and hence to form stable emulsions. However, many other types of molecules are used as emulsifiers. In some cases, finely divided powders such as dry mustard or spices are used to act as emulsifiers in oil-in-water mixture. The mustard and spices adsorb at the interface and reduce interfacial tension.

A temporary emulsion separates upon standing. The emulsion is not permanent because the hydrophobic oil and hydrophilic water components separate upon standing. A permanent emulsion is formed when two ordinarily non miscible phases, such as water and oil, are combined with an emulsifier.

Thus, the time of separation of oil and water is dependent upon the effectiveness of an emulsifier and the degree of agitation.

Factors Affecting Emulsion Stability

- Type of emulsifier
- Concentration of emulsifier
- Droplet size
- Changing pH or ionic strength
- Viscosity
- Addition of stabilizers
- Heating, cooling, freezing, and/or shaking

### 2.3 Citric acid

Citric or lemon juice may be used to increase foam stability. Addition of acid reduces the pH, which reduces the charge on the protein molecules and usually brings them closer to their isoelectric point. This generally results in a stronger, more stable interfacial film

Foams make a vital contribution to the volume and texture of many common food products. They give volume and a distinctive mouth feel to products such as whipped cream and ice cream and they give a light, airy texture to baked goods.

### 2.4 Sugar and salts

Sugar and salts acts as preservative which improve shelf life of an oils.

### 2.5 Water

Water facilities the extraction of oil from oil seeds. It makes some fatty compounds soluble.

| Self-Check # 2 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List some ingredients that must be confirmed in oil seed processing (5pts )
2. Explain ingredients that used in oil seed processing process (6pts )
3. What are the factors that affects emulsion stability (5pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers

## Information Sheet 3 - Identifying Workplace documentation

**3.1** Identifying Workplace documentation

Workplace documentation may include but not limited to:

- Specifications
- manufacturing formulae
- processing instructions
- continuous production records
- Standard Operating Procedures (SOPs)
- OHS information, including Material Safety Data Sheets (MSDS)

### 3.2 Standard Operating Procedure (SOP)

What is a Standard Operating Procedure (SOP)?

SOP is a set of written instructions that document a routine or repetitive activity followed by an organization.

The development and use of SOPs are an integral part of a successful quality system as it provides individuals with the information to perform a job properly, and facilitates consistency in the quality and integrity of a product or end-result.

An SOP is a procedure specific to your operation that describes the activities necessary to complete tasks in accordance with industry regulations, provincial laws or even just your own standards for running your business. Any document that is a “how to” falls into the category of procedures. In a manufacturing environment, the most obvious example of an SOP is the step by step production line procedures used to make products as well train staff. An SOP, in fact, defines expected practices in all businesses where quality standards exist. SOPs play an important role in your small business. SOPs are policies, procedures and standards you need in the operations, marketing and administration disciplines within your business to ensure success.

These can create:

- efficiencies, and therefore profitability
- consistency and reliability in production and service
- fewer errors in all areas
- a way to resolve conflicts between partners
- a healthy and safe environment
- protection of employers in areas of potential liability and personnel matters
- a roadmap for how to resolve issues – and the removal of emotion from troubleshooting – allowing needed focus on solving the problem
- a first line of defense in any inspection, whether it be by a regulatory body, a partner or potential partner, a client, or a firm conducting due diligence for a possible purchase
- value added to your business should you ever wish to sell it

**Benefits of SOP**

The development and use of SOPs minimizes variation and promotes quality through consistent implementation of a process or procedure within the organization, even if there are temporary or permanent personnel changes. SOPs can indicate compliance with organizational and governmental requirements and can be used as a part of a personnel training program, since they should provide detailed work instructions. It minimizes opportunities for miscommunication and can address safety concerns. When historical data are being evaluated for current use, SOPs can also be valuable for reconstructing project activities when no other references are available.

In addition, SOPs are frequently used as checklists by inspectors when auditing procedures. Ultimately, the benefits of a valid SOP are reduced work effort, along with improved comparability, credibility, and legal defensibility.

### 3.3 Materials Safety Data Sheets (MSDS)

A material safety data sheet is a technical document which provides detailed and comprehensive information on a controlled product related to:

- Health effects of exposure to the product
- Hazard evaluation related to the product's handling, storage or use
- Measure to protect workers at risk of exposure
- Emergency procedures.

The data sheet may be written, printed or otherwise expressed, and must meet the availability, design and content requirements of WHMIS legislation. The legislation provides for flexibility of design and wording but requires that a minimum number of categories of information be completed and that all hazardous ingredients meeting certain criteria be listed subject to exemptions granted under the Hazardous Materials Information Review Act.

| Self-Check 3 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write and explain what SOP mean in detail (4pts )
2. Write the benefits of SOP (4pts )
3. Define MSDS (2pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 4 - Requiring facilities and equipment for mechanical extraction

### 4.1 Requiring facilities and equipment for mechanical extraction

During extracting oil by mechanical extraction process, you may use or need to have different facilities and equipment which enables us easily extract oil.

Equipment used in mechanical extraction of oil from oil seed may include but not limited to:

- collection vessels
- cooker
- Hydraulic press
- Screw conveyor ,screener and filter press
- Cake crushes
- Exchangers
- Conveyors(belt, chain)
- Screw press

### 4.2 Screw conveyor

Screw conveyors are a cost effective and reliable method of conveying bulk materials.

Thousands of bulk materials are conveyed and processed daily utilizing screw conveyors.

Primary considerations for the selection of a screw conveyor are:

- Type and condition of the bulk material to be conveyed including maximum particle size and specific bulk density.
- Capacity or feed rate of bulk material to be conveyed expressed in pounds per hour, tons per hour, or cubic feet per hour.
- Required distance and incline the bulk material is to be conveyed.
- Design conditions such as materials of construction, inlet feed conditions and operating temperature.

The inlet of a screw conveyor is always control fed by another device such as:

- Screw Conveyor
- Screw Feeder
- Belt Conveyor
- Rotary Airlock
- Volumetric or Gravimetric Feeder

**Advantages of Using Screw Conveyors**

- Idea lf or conveying dry to semi-fluid bulk materials–free flowing to sluggish
- Cost effective when compared to other conveying devices such as belt, pneumatic or aero-mechanical
- Efficientlydistributesbulkmaterialstovariouslocationsusingmultipleinletanddischargepoins
- Totally enclosed for dusty, corrosive or hazardous environments

**Figure 3: Typical screw conveyor**

### 4.3 Hydraulic oil press

A hydraulic press is a machine press using a hydraulic cylinder to generate a compressive force. The application of compressive load causes the seeds to force the air out of the macro pores. This process continues until a critical point that occurs when the seeds respond to pressure through their points of contact. This causes the change

in volume and starts the output of oil (initial stage). When the first drop of oil leaks out of the mass, it begins the second stage (dynamic stage), where the air is displaced by the liquid and an air/fluid mixture is extracted. The oil flow increases rapidly to its maximum, which is when the second stage ends. The last stage (final stage) begins when the maximum instantaneous flow rate, i.e. the volume is completely filled with fluid, is reached. At the beginning of the twentieth century the vegetable oil industry worked basically with the hydraulic presses but even making use of a hydraulic cylinder, work with this type of equipment was considered labor intensive. With the emergence of the continuous screw- press, the only application that still requires the hydraulic press is the one that requires gentle handling, such as processing and production of cocoa butter.

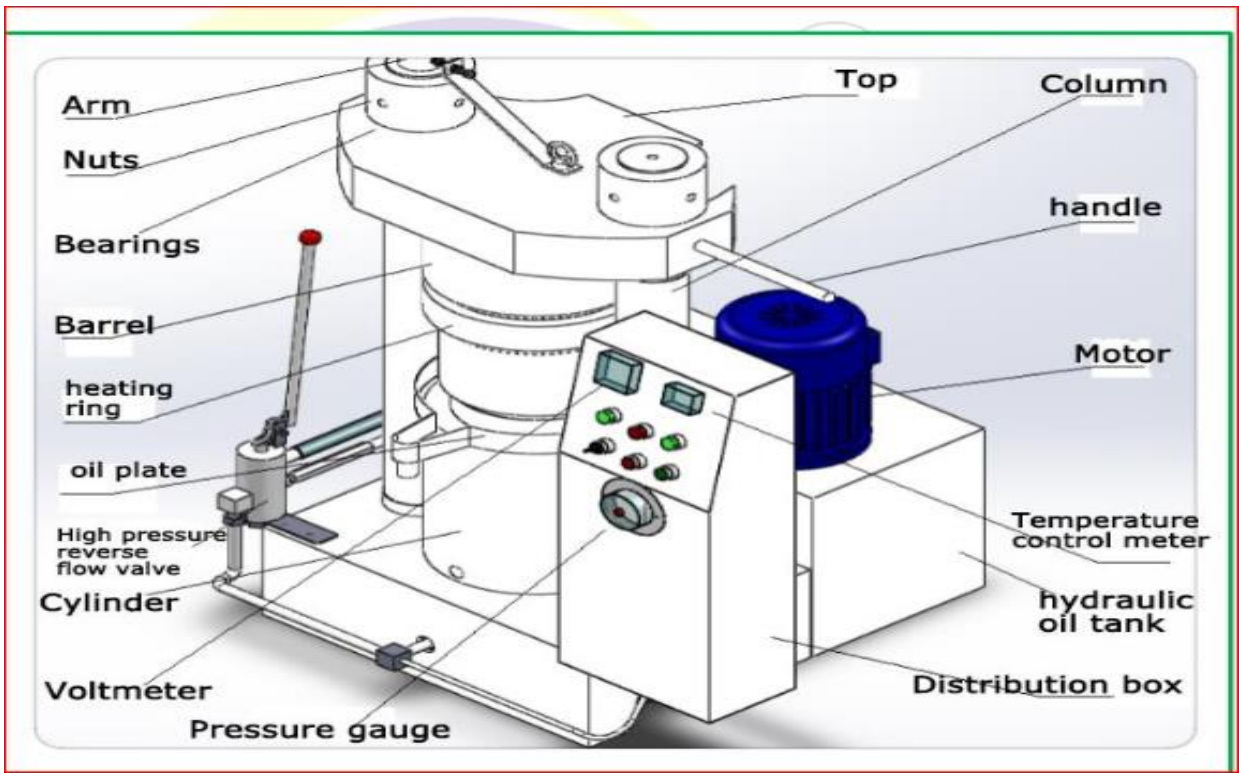


**Figure 4: Parts of Hydraulic oil press**

| Self-Check 4 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write the advantages of screw conveyors (4pts )
2. Define and explain hydraulic oil press (6pts )
3. Write at list five equipment which are used in mechanical oil pressing process (5pts)

***Note:*** **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers

## Information Sheet 5 - Occupational Health and Safety (OHS)

### 5.1 Occupational Health and Safety (OHS)

Occupational health and safety (OHS) is one of the oldest and most advanced social policy areas of the work. OHS is an integral part of everyday work. Occupational safety and health (OSH) is generally defined as the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment. This domain is necessarily vast, encompassing a large number of disciplines and numerous workplace and environmental hazards. A wide range of structures, skills, knowledge and analytical capacities are needed to coordinate and implement all of the "building blocks" that make up national. OSH systems so that protection is extended to both workers and the environment It is every Public service employee's responsibility to cooperate in practicing sound OHS principles in all work activities established minimum occupational safety and health requirements and stated that "particularly sensitive risk groups must be protected against the dangers which specifically affect them". It includes Information about key health and safety policies, standards of conduct, and associated issues.

### 5.2 Core OSH principles

Occupational safety and health is an extensive multidisciplinary field, invariably touching on issues related to scientific areas such as medicine – including physiology and toxicology ergonomics, physics and chemistry, as well as technology, economics, law and other areas specific to various industries and activities.

Despite this variety of concerns and interests, certain basic principles can be identified, including the following:

- All workers have rights. Workers, as well as employers and governments, must ensure that these rights are protected and must strive to establish and maintain decent working conditions and a decent working environment.

More specifically:

- ✓ work should take place in a safe and healthy working environment;
- ✓ conditions of work should be consistent with workers' well-being and human dignity;
- ✓ Work should offer real possibilities for personal achievement, self fulfilment and service to society (ILO, 1984).

- Occupational safety and health policies must be established. Such policies must be implemented at both the national (governmental) and enterprise levels. They must be effectively communicated to all parties concerned.
- A national system for occupational safety and health must be established.
- Such a system must include all the mechanisms and elements necessary to build and maintain a preventive safety and health culture. The national system must be maintained, progressively developed and periodically reviewed.
- A national programs on occupational safety and health must be formulated. Once formulated, it must be implemented, monitored, evaluated and periodically reviewed.
- Social partners (that is, employers and workers) and other stakeholders must be consulted. This should be done during formulation, implementation and review of all policies, systems and programs.
- Occupational safety and health programs and policies must aim at both prevention and protection. Efforts must be focused above all on primary prevention at the workplace level. Workplaces and working environments should be planned and designed to be safe and healthy.
- Continuous improvement of occupational safety and health must be promoted.

This is necessary to ensure that national laws, regulations and technical standards to prevent occupational injuries, diseases and deaths are adapted periodically to social, technical and scientific progress and other changes in the world of work. It is best done by the development and implementation of a national policy, national system and national programs.

## 5.3 Rights and duties

The responsibilities of governments, employers and workers should be seen as complementary and mutually reinforcing in the common task of promoting occupational safety and health to the greatest extent possible within the constraints of national conditions and practice.

- **Workers' rights**

It is increasingly recognized that the protection of life and health at work is a fundamental workers' right (see box 8); in other words, decent work implies safe work. Furthermore, workers have a duty to take care of their own safety, as well as the safety of anyone who might be affected by what they do or fail to do. This implies a right to adequate knowledge, and a right to stop work in the case of imminent danger to safety or health. In order to take care of their own safety and health, workers need to understand occupational risks and dangers. They should therefore be properly informed of hazards and adequately trained to carry out their tasks safely. To make progress in occupational safety and health within enterprises, workers and their representatives have to cooperate with employers, for example by participating in elaborating and implementing preventive programs.

- **Employers' responsibilities**

Because occupational hazards arise at the workplace, it is the responsibility of employers to ensure that the working environment is safe and healthy. This means that they must prevent, and protect workers from, occupational risks. But employers' responsibility goes further, entailing knowledge of occupational hazards and a commitment to ensure that management processes promote safety and health at work. For example, an awareness of safety and health implications should guide decisions on the choice of technology and on how work is organized. Training is one of the most important tasks to be carried out by employers. Need to know not only how to do their jobs, but also how to protect their lives and health and those of their co-workers while working. Within enterprises, managers and supervisors are responsible for ensuring that workers are adequately trained for the work that they are expected to undertake.

Such training should include information on the safety and health aspects of the work, and on ways to prevent or minimize exposure to hazards. On a larger scale, employers' organizations should instigate training and information programs on the prevention and control of hazards, and protection against risks. Where necessary, employers must be in a position to deal with accidents and emergencies, including providing first-aid facilities. Adequate arrangements should also be made for compensation of work-related injuries and diseases, as well as for rehabilitation and to facilitate a prompt return to work. In short, the objective of preventive programs should be to provide a safe and healthy environment that protects and promotes workers' health and their working capacity.

- **Governments' duties**

Governments are responsible for drawing up occupational safety and health policies and making sure that they are implemented. Policies will be reflected in legislation, and legislation must be enforced. But legislation cannot cover all workplace risks, and it may also be advisable to address occupational safety and health issues by means of collective agreements reached between the social partners. Policies are more likely to be supported and implemented if employers and workers, through their respective organizations, have had a hand in drawing them up. This is regardless of whether they are in the form of laws, regulations, codes or collective agreements. The competent authority should issue and periodically review regulations or codes of practice; instigate research to identify hazards and to find ways of overcoming them; provide information and advice to employers and workers; and take specific measures to avoid catastrophes where potential risks are high.

The occupational safety and health policy should include provisions for the establishment, operation and progressive extension of occupational health services. The competent authority should supervise and advise on the implementation of a workers' health surveillance system, which should be linked with programs to prevent accident and disease and to protect and promote workers' health at both enterprise and national levels. The information provided by surveillance will show whether

occupational safety and health standards are being implemented, and where more needs to be done to safeguard workers.

### 5.4 Classifications of occupational health and safety hazards

The various hazards which give rise to occupational injuries, diseases, disabilities or death through work may be classified as: -

- Physical Hazards
- Mechanical Hazards
- Chemical Hazards
- Biological Hazards
- Ergonomic Hazards
- Psychosocial Hazards

#### 5.4.1 Physical Hazards

Physical hazards, which can adversely affect health, include noise, vibration, ionizing and non-ionizing radiation, heat and other unhealthy microclimatic conditions. Between 10 and 30% of the workforce in industrialized countries and up to 80% in developing and newly industrialized countries are exposed to a variety of these potential hazards.

Physical hazard has possible cumulative or immediate effects on the health of employees. Therefore, employers and inspectors should be alert to protect the workers from adverse physical hazards.

**A. Extremes of Temperature**

The work environment is either comfortable or extremely cold or hot and uncomfortable. The common physical hazard in most industries is heat. Extreme hot temperature prevails on those who are working in foundries or in those industries where they use open fire for energy. Examples of these include soap factories in large industries and in the informal sectors that use extreme heat to mold iron or process other materials

**Effects of hot temperature in work place include**:

- **Heat Stress**

Heat stress is a common problem in workplace because people in general function only in a very narrow temperature range as seen from core temperature measured deep inside the body. Fluctuation in core temperature about 2 $^{0}$ C below or 3 $^{0}$ C above the normal core temperature of 37.6 0 C impairs performance markedly and a health hazard exists. When this happens the body attempt to counteract by:

- ✓ Increasing the heart rate
- ✓ The capillaries in the skin dilate to bring more blood to the surface so that the rate of cooling is increased.
- ✓ Sweating to cool the body

- **Heat stroke**

Heat stroke is caused when the body temperature rises rapidly in a worker who is exposed to a work environment in which the body is unable to cool itself sufficiently. Predisposing factors for heat stroke is excessive physical exertion in extreme heat condition. The method of control is therefore, to reduce the temperature of the surrounding or to increase the ability of the body to cool itself.

- **Heat Cramp**

Heat cramp may result from exposure to high temperature for a relatively long time particularly if accompanied by heavy exertion or sweating with excessive loss of salt and moisture from the body.

- **Heat Exhaustion**

This also results from physical exertion in hot environment. Signs of the problem include:

- ✓ Mildly elevated temperature
- ✓ Weak pulse
- ✓ Dizziness
- ✓ Profuse sweating

- ✓ Cool, moist skin, heat rash

**B. Vibration Motion Conditions**

Vibration causes vascular disorders of the arms and bony changes in the small bones of the wrist. Vascular changes can be detected by

X-ray examination of the wrist. The most common findings is rarefaction of the lunate bone. Exposure to increased atmospheric pressure (under water) leads to aseptic bone necrosis around the knee, hip and shoulder that can be detected by X-ray examination.

### 5.4.2 Mechanical Hazards

Mechanical factors include unshielded machinery, unsafe structures at the workplace and dangerous unprotected tools are among the most prevalent hazards in both industrialized and developing countries. They affect the health of a high proportion of the workforce. Most accidents could be prevented by applying relatively simple measures in the work environment, working practices, and safety systems and ensuring appropriate behavioral and management practices. This would significantly reduce accident rates within a relatively short period of time. Accident prevention programs are shown to have high cost-effectiveness and yield rapid results. However, ignorance of such precautions, particularly in sectors where production has grown rapidly, has led to increasing rates of occupational accidents.

### 5.4.3 Chemical Hazards

Average annual world production of chemicals amounts to an estimated 400 million tones. There are between 5 to 7 million known chemicals, however, only 70,000 to 80,000 are on the market, with 1,000 or so being produced in substantial quantities. In North America around 1,000 to 1,200 are produced annually (50 % are polymers).In Western Europe, some 150 to 200 new substances are registered each year. Of the 70,000 to 80,000 chemicals only 5 to 10 %( i.e., 500 to 7,000 should be considered hazardous; 150 to 200 of these are carcinogenic.

Chemical hazards are dependent on their:-

- Amount
- Concentration
- Time of exposure
- Mode of entry to the body
- Age
- Sex
- Health status
- Resistance of the exposed workers

The effects of chemical agents are as follows:

- Asphyxiation
- Systemic intoxication
- Pneumoconiosis
- Carcinogens
- Irritation
- Mutagencity
- Teratogenicity

Among all chemical agents in work place the most notorious and most in contact with the skin or respiratory system that deserve attention is solvent

**Solvent**

In most occupational settings or industries a potential threat to the health, productivity and efficiency of workers is their exposure to organic solvents. Exposure to solvents occurs throughout life. Example, organic solvent vapor inhaled by a mother could reach the fetus.

**Classification of Solvents**

The term solvent means materials used to dissolve another material and it includes aqueous or non-aqueous system. Aqueous solutions include those based in water. Example:

- Aqueous solution of acids
- Aqueous solution of alkalis
- Aqueous solution of detergents

Aqueous solutions have low vapor pressure thus the potential hazard by inhalation and subsequent systemic toxicity is not great.

Examples of non-aqueous solutions

- Aliphatic hydrocarbons.
- Aromatic hydrocarbons
- Halogenated hydrocarbons.
- Cyclic hydrocarbons.

The solvent we are concerned in occupational health and safety will include any organic liquid commonly used to dissolve other organic material.

These are:

- Naphtha
- Mineral spirits
- Alcohol, etc.

**Effects of Solvents**

The severity of a hazard in the use of solvents and other chemicals depends on the following factors.

- How the chemical is used.
- Type of job operation, which determines how the workers are exposed.
- Work pattern.
- Duration of exposure.
- Operating temperature.
- Exposed body surface.
- Ventilation rates.
- Pattern of airflow.
- Concentrations of vapors in workroom air.

- House keeping

**Health Effect**

The effect of solvents varies considerably with the number and type of halogen atoms (fluorine and chlorine) present in the molecules. Carbon tetrachloride, which is a highly toxic solvent act acutely on the kidney, the liver, gastro intestinal tract (GIT). Chronic exposure to carbon tetrachloride also, damages and cause liver cancer. This solvent should never be used for open cleaning processes where there is skin contact or where the concentration in the breathing zone may exceed recommended level.

**Chemical Hazards: - Exposure Monitoring**

- Special instruments - infrared absorption, photoionization, gas Chromatography
- Detector tubes
- Air sampling and lab analysis
- Professional judgment

**Chemical Hazards**: **Engineering Controls**

- Substitution (use lower toxicity materials)
- Enclose processes and otherwise engineer for low emission / low risk
- Provide local exhaust to remove airborne agents
- Local exhaust ventilation
  - ✓ Need to have even air flow for hoods
  - ✓ Need to design for adequate capture velocity - usually about 100 feet/minute
  - ✓ Need sufficient make up air
  - ✓ Use ACGIH Ventilation Manual for design
- Reduce exposure time
- Better procedure
- Training

### 5.4.4 Biological Hazards

Many biological agents such as viruses, bacteria, parasites, fungi, moulds and organic dusts have been found to occur in occupational exposures. In the industrialized countries around 15 % of workers may be at risk of viral or bacterial infection, allergies and respiratory diseases. In many developing countries the number one exposure is biological agents.

HIV/AIDS, Hepatitis B and C viruses and other blood borne pathogens, tuberculosis infections (particularly among health care workers), asthmas (among persons exposed to organic dust) and chronic parasitic infections (particularly among agricultural and forestry workers), are the most common occupational diseases that result from such exposures. Exposure to biological hazards in workplace results in a significant amount of occupationally associated diseases. Biological hazards include viruses, bacteria, fungus, parasites, or any living organism that can cause disease to human beings.

Biological hazards can be transmitted to a person through:

- Inhalation
- Injection
- Ingestion
- Contact with the skin

### 5.4.5 Ergonomic Hazards

Ergonomics, also known as human engineering or human factors engineering, the science of designing machines, products, and systems to maximize the safety, comfort, and efficiency of the people who use them. Ergonomists draw on the principles of industrial engineering, psychology, anthropometry (the science of human measurement), and biomechanics (the study of muscular activity) to adapt the design of products and workplaces to people's sizes and shapes and their physical strengths and limitation. Ergonomics or the proper designing of work systems based on human factors has the following advantages:

- There will be more efficient operations
- There will be fewer accidents

- There will be reduced training time
- There will be fewer costs of operations
- There will be more effective use of workers or personnel.

The goal of "ERGONOMICS" or human factors ranges from making work safe to humans, and increasing human efficiency and wellbeing. To ensure a continuous high level performance, work system must be tailored to human capacities and limitations measured by anthropometry and bio-mechanics.

**Ergonomic Hazards**

Between 10% and 30% of the workforce in industrial countries and between 50% and 70% in developing countries may be exposed to heavy physical workload or to un ergonomic working conditions such as lifting and moving of heavy items or repetitive manual tasks. Repetitive tasks and static muscular load are found in many industrial and service occupations. In many industrial countries musculoskeletal disorders are the main cause of both short-term and permanent work disability, which can cause economic losses that may amount to 5% of the GNP.

### 5.4.6 Psychosocial hazards

Up to 50% of all workers in industrial countries judge their work to be “mentally heavy”. Psychological stress caused by time pressure, hectic work, and risk of unemployment has become more prevalent during the past decade. Other factors that may have adverse psychological effects include jobs with heavy responsibility for human or economic concerns, monotonous work or work that requires constant concentration.

Within the work environment emotional stress may arise from a variety of psychosocial factors, which the worker finds unsatisfactory, frustrating, or demoralizing.

| Self-Check 5 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define and explain in detail about Occupational health and safety (OHS) (6pts )
2. What are the core OHS principles (6pts )
3. Write at list four classifications of occupational health and safety hazards (4pts )
4. Explain at list three classifications of occupational health and safety hazards in detail. (9pts )

***Note:*** **Satisfactory rating - 20 points** **Unsatisfactory - below 20 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 6 - Following policies and procedures to control the risk

### 6.1 Introduction

Workplace policies are statements of principles and practices dealing with the ongoing management and administration of the organization. Policies act as a guiding frame of reference for how the organization deals with everything from its day- to-day operational problems or how to respond to requirements to comply with legislation, regulation and codes of practice. It is important that policies are reasonable, that employees are aware and clearly understand what the policy is trying to achieve. Policies are a statement of purpose, which highlight broad guidelines on action to be taken to achieve that purpose. The statement of purpose should not be more than one page in length, but this will vary depending on the policy. Procedures explain how to perform tasks and duties. A procedure may specify who in the organization is responsible for particular tasks and activities, or how they should carry out their duties.

To be effective, policies need to be publicized and provided to all existing and new employees. This includes casual, part-time and full-time employees and those on maternity leave or career breaks

### 6.2 Following policies and procedures to control the risk

Policies and procedures followed to control the risk may include but not limited to:

- company policies and procedures,
- regulatory and licensing requirements,
- legislative requirements, and
- industrial awards and agreements

#### 6.2.1 Company policies and procedures

Benefits of Company policies and procedures

Well-written Company policies

- Are consistent with the values of the organization and employment legislation
- Demonstrate that the organization is being operated in an efficient and businesslike manner
- Ensure uniformity and consistency in decision- making and operational procedures
- Save time when a new problem can be handled quickly and effectively through an existing policy
- Foster stability and continuity
- Maintain the direction of the organization even during periods of change
- Provide the framework for business planning
- Assist in assessing performance and establishing accountability
- Clarify functions and responsibilities.

### 6.2.2 Policy checklist

A policy should:

- set out the aim of the policy
- explain why the policy was developed
- list who the policy applies to
- set out what is acceptable or unacceptable behavior
- set out the consequences of not complying with the policy
- Provide a date when the policy was developed or updated.

Policies also need to be reviewed on a regular basis and updated where necessary. For example, if there is a change in equipment or workplace procedures you may need to amend your current policy or develop a new one.

### 6.2.3 Types of workplace policies

Here are some examples of common workplace policies that could assist your workplace:

- Code of conduct
- Recruitment policy
- Internet and email policy
- Mobile phone policy

- Non-smoking policy
- Drug and alcohol policy
- Health and safety policy
- Grievance handling policy
- Using social media.
- Anti-discrimination and harassment policy
- Discipline and termination policy

✓ **Code of conduct**

A code of conduct sets standards of behavior or appearance in the workplace. These standards will vary depending on the industry, the role of the employee and work undertaken by staff. A code of conduct may include dress standards at work or email and internet use.

✓ **Internet and email usage**

Determining what is or is not acceptable usage of the internet during working hours is of concern to many employers. Companies have valid reasons for wanting to manage the use of personal email, interactive gaming and social media sites.

In developing a policy on the use of the internet and email at work it is important to ensure that all terms such as 'offensive' and 'inappropriate' are clearly explained and understood by all staff.

Any email and Internet policy should cover:

- requirements for storing email where it relates to the core business of the organization
- whether back-up copies are stored on the server and who has access to them
- whether the company monitors logs of Internet usage which may reveal information such as which servers (including websites) have been accessed by the employee and email addresses used
- level of privacy employees can generally expect for their email
- circumstances in which management reserves a right to read and take action on employee email

- confirmation that email can be subject to production in litigation or other investigations
- That it is unacceptable to use email to abuse or harass other employees.

- ✓ **Smoking in the workplace**

As an employer, there are legislative requirements for the employer to provide a healthy and safe workplace for employees. The employer has the right to designate the workplace as smoke free and can indicate that in job advertisements. There is no legal requirement for an employer to provide smoke breaks. While an employer may be prepared to recognize the needs of a smoker, they also need to avoid the problem caused by an employee disappearing on a regular basis for a 'smoke break'. Setting guidelines (morning, afternoon tea and lunch breaks) makes it clear to staff about what is acceptable and also overcomes the antagonism that may come from non-smoking employees when a smoker takes excessive breaks.

| Self-Check 6 | Written Test |
|---|---|

I. Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define company policies (2pts)
2. Define company procedures (2pts)
3. Explain Workplace policies (3pts)
4. What are the importance of policies and procedures in controlling and minimizing hazards that may happen in a workplace or an industry? (3pts)

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

**Information Sheet 7- Loading material into mechanical press**

## 7.1 Loading material into mechanical press

Loading a materials in to mechanical oil press (or any processing machine) is the primary point in mechanical oil pressing process. During loading materials, you have to load appropriate amount of raw materials in an oil press. If there was excess or over loading of materials may cause partial or complete damage to the machine. So during loading materials in to a pressing mechanical press you have to add appropriate or recommended amounts.

Material which are used to extract oils mechanically may include but not limited to:

- Conditioned seed and cake of Niger seed
- Conditioned seed and cake of Rape seed
- Conditioned seed and cake of Lin seed
- Conditioned seed and cake of Cotton seed
- Conditioned seed and cake of Ground nut
- Conditioned seed and cake of Soya bean
- Conditioned seed and cake of sunflower seed
- Conditioned seed and cake of sesame seed.

http://www.bestoilpressmachine.com/hydraulic-oil-press/6yz-320-hydraulic-oil-press.html


**Figure 5: Material feeding or loading in hydraulic press**

| Self-Check 7 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What happen if you load un appropriate amount of materials in to mechanical oil press?(4pts )
2. What are the material which are used in mechanical oil press to extract oils ?(6pts)

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

| LG #42 | LO#2 Operate and monitor the mechanical Extraction process |
|---|---|

**Instruction sheet**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Monitoring the mechanical extraction process
- Identifying out-of-specification of product
- Maintaining the work area
- Monitoring operation of equipment and processes
- Identifying variation in equipment operation
- Separating by-product from oil seed
- Conducting work legislative requirement
- Conducting pre-start checks

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Monitor the mechanical extraction process
- Identify out-of-specification of product
- Maintain the work area
- Monitor operation of equipment and processes
- Identify variation in equipment operation
- Separate by-product from oil seed
- Conduct work legislative requirement
- Conduct pre-start checks

| Learning Instructions: |
| --- |
| 1. Read the specific objectives of this Learning Guide.<br>2. Follow the instructions described below.<br>3. Read the information written in the information Sheets<br>4. Accomplish the Self-checks<br>5. Perform Operation Sheets<br>6. Do the “LAP test” |

**Information Sheet #1- Monitoring the mechanical extraction process**

## 1.1 Introduction

The mechanical process is the original technique used to extract oil from seeds by applying pressure and heat to disrupt oleosome structure. In the early 1940s, hydraulic pressing and continuous screw pressing were the main techniques for oil extraction used in the U.S. This typical process is now mainly used to produce oil for food and industrial applications. Also, the cake collected from the mechanical process is the main resource for animal feeds.

To improve oil recovery, higher cooking temperatures are required; which results in over-heating, darkening, and deterioration of oil. Nelson and his colleagues (1987) introduced an extruding-expelling approach to reduce the disadvantages caused from excessive heating and increased the oil recovery rate to over 70%.

Oil seed processing and oil extraction processes are designed to obtain high quality oil with minimal undesirable components, achieve high extraction yields and produce high value meal. There are several techniques for extracting oil from oilseeds. Two common oilseed extraction processes are solvent extraction and mechanical extraction using a screw press. Today in the United States, mechanical oil expression is not widely used due to low oil recovery. However, the use of screw press is preferred by small processors because of its low capital cost. Solvent extraction with hexane is the standard practice in today's modern oilseed-processing facilities. Solvent-extraction plant capacities range from 100 to 9000 metric tons per day. Supercritical fluid, water and enzyme-aided water extraction processes are of interest for specialty and gourmet oils production.

In a typical edible oil processing plant oil is extracted from the seed first using mechanical extraction (expeller press) followed by chemical extraction (hexane

extraction). By using both methods less than 1% of the oil is left in the meal that is produced.

## 1.2 Monitoring the mechanical extraction process

The majority of this meal is sold for use in animal feed rations.

The mechanical extraction process of oil from oil seed are

- Batch or continuous, and
- apply to single or different product types

✓ **In batch processes,**

- A certain quantity of flakes is contacted with a certain volume of fresh solvent.
- The miscella is drained off, distilled and the solvent is recirculated through the extractor until the residual oil content in the batch of flakes is reduced to the desired level

✓ **In continuous extraction**

- Both the oilseeds and the solvent are fed into the extractor continuously.
- The different available types are characterized by their geometrical configuration and the method by which solids and solvents are moved one in relation to the other, in counter-current fashion.

Mechanical oil extraction (expression) is a solid-liquid phase seperation method which is applied to cooked seed flakes.

✓ It can be executed by batch, mainly hydraulically, and by continous, mainly mechanically, working presses.

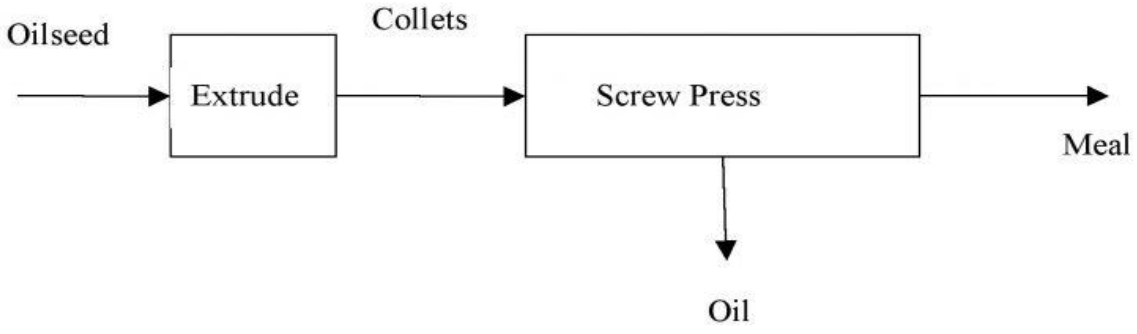

**Figure 6: Flow diagram of an Extrusion-Expelling (E-E) process**

## 1.3 General oil seed processing

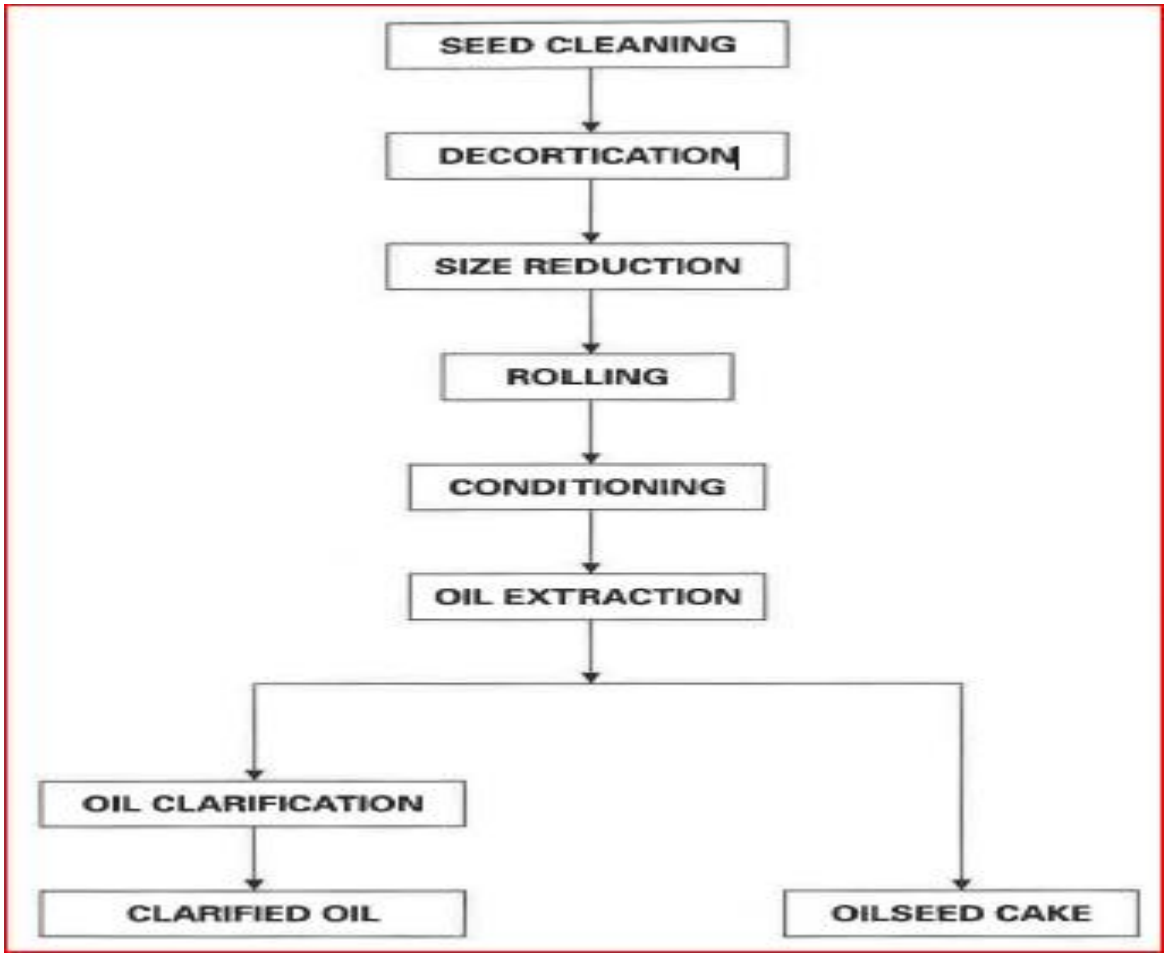


**Figure 7: General flow diagram oilseed extraction**

The general unit operations which are involved in oil seed extraction process are described below.

- **Seed Cleaning**

  It is essential to winnow and sieve oilseeds, prior to expelling, to remove as much dirt, dust, sand and small stones as possible. The presence of sand results in high wear on critical components of expellers such as cages, worm shafts and chokes. Incoming oil seeds are passed over magnets to remove any trace of metal before being de-hulled. The de-hulled seeds are then ground into coarse meal to provide more surface area to

be pressed. Using clean oilseed for expelling will greatly increase the time that the expeller can be used before replacement parts are needed.

- **Decortication/De-hulling**

  Some oilseeds have a hard outer shell which must be removed before processing. This process is called decortication. Palm kernel is an example of a seed that must be decorticated prior to processing. The extraction of oil from other oilseeds which can be processed without decorticating them fir t, such as sunflower, may be aided by removing a proportion, of the hull before processing.

- **Size Reduction**

  Generally, small oilseeds (sudle as sesame or rapeseed) can be processed directly, while larger seeds (such as copra or shea nuts) need to be ground before processing. At the domestic level, grinding is usually carried out with a pestle and mortar (Plate 1) while larger quantities may be ground in a village maize mill. Hand operated meat mincing machines can also be used in certain circumstances. The most common type of powered mill used for small-scale operations is the hammer mill. Mechanized grooved rollers or hammer mills crush the material to the proper consistency.

- **ROLLING**

  Rolling a seed generally results in an improvement in oil extraction by increasing the surface area of the seed while at the same time retaining channels for the flow of oil. The flakes should be very fine and preferably thinner than 0.1 mm. Rolling before processing in a bridge press is said to increase oil yields by 10% for palm kernel, groundnut and sunflower (UNATA information sheet).

- **CONDITIONING**

  Conditioning or 'cooking' oilseeds involves heating the oilseed in the presence of water. The water may be that which is naturally present in the seed, or it may be added. The changes brought about by conditioning are complex but include the coalescence of the small droplets of oil, present in the seed, into drops large enough to flow easily from

the seed. In addition, higher process sing temperatures improve oil flow by reducing the viscosity of the oil.

Oils seeds are nearly always conditioned before large-scale expelling. Small scale expellers minimize the need for pre-treatment by using a relatively fast warm shaft speed which shears the oilseed as it passes through the expeller and produces frictional heating within the expeller barrel. This assists oil expulsion by raising the temperature of the oilseed. However, even when using a small-scale expeller, oil extraction will be assisted by heating and/ or steaming the oilseed before expelling. Heat treatment is essential for some seeds with a low fiber content such as groundnuts; they must be heated and moisturized before expelling or the machine will produce an oily paste instead of oil and cake. The meal is then heated to facilitate the extraction of the oil. While this procedure allows more oil to be pressed out, more impurities are also released with the oil, and these must be removed before the oil can be deemed edible.

- **OIL EXTRACTION**
  - ✓ **Wet extraction methods**

In wet extraction methods water is used to extract oil from oilseeds. The distinction should be made between wet methods and water-assisted methods of oil extraction.

Wet extraction methods involve the use of a relatively large amount of water so that the oilseed is suspended in the water and the extracted oil floats on the surface.

Water-assisted methods involve the addition of a small quantity of water to the oilseed before the oil is extracted by manual kneading. The hot water flotation (HWF) method of edible oil extraction is traditionally used in the rural areas of many developing countries. Usually, decorticated oilseed is used. The oilseed kernels are heated and ground by pounding in a pestle and mortar. The ground seed is then suspended in boiling water and boiled for at least 30 min. Liberated oil floats to the surface. Further quantities of water are sometimes added after boiling to replace that lost by evaporation, and to encourage the oil to float to the surface. The oil is carefully scooped from the surface of the water using a shallow dish and is then heated over a fire to remove residual moisture. The advantage of the HWF method over other small-

scale oilseed processing techniques, such as those using expellers or ghanis, is its simplicity. The equipment required (pestle and mortar boiling pans, etc.) is readily available.

However, oil yields tend to be low and the process can be time consuming and arduous. This is especially true ii traditional pestle and mortar methods are used to grind the oilseed kernel. If long boiling times are used, fuel consumption will also be high.

✓ **Manual methods using kneading**

In common with the water flotation process, only simple domestic utensils are needed to extract oil by kneading. This method is used to process groundnuts traditionally in West African villages. Water is added to groundnut paste and the mixture is stirred and kneaded by hand until the oil separates. The water plays a vital but obscure role in the extraction process. It is believed that the water displaces oil from hydrophilic, or 'water loving', surfaces in the ground seed.

- Manual presses

A selection of the many different types of manual press employed in oilseed processing. To get the best oil yields, pressure on the prepared oilseed should be applied slowly and increased gradually.

- **Oil clarification methods**

Freshly extracted vegetable oil may contain suspended seed debris which gives the oil a cloudy appearance. TI1e quantity of solid material in the crude oil depends on the method used to process the oil seed and the type of seed processed. Oil produced from expellers contains substantial quantities of seed debris. Oil from manual presses and traditional processes contains smaller quantities of debris. To produce a clarified oil, the solids must be removed from the crude oil. Oil clarification methods are described below.

✓ **Clarification by settlement**

Freshly extracted oils are left to stand in a small oil drum or bucket for several days to allow solids to settle. After settlement, the clear supernatant oil can be poured or siphoned off, leaving the plant debris at the bottom of the container. These settled solids are called foots.

**Recovery of oil from foots**

Oil can be recovered from the settled foots by:

- Filtering through finely-woven material into a container;
- Heating the foots with a small quantity of water in a metal basin. This coagulates the solid material. The mixture is boiled to remove water, leaving a mixture of partially-separated oil and coagulated solids.

This is then filtered through muslin to produce clarified oil. The solids retained on the muslin can be squeezed by hand in a cloth to remove any residual oil.

✓ **Oil clarification by boiling with water**

A mixture of freshly-extracted oil is heated strongly with water (10% by weight of oil). Frothing of the oil will occur when most of the water has been driven off. When this takes place, oil can be poured off, leaving the coagulated solids at the bottom of the container. A skilled operator will leave a solid 38 residue which contains only a small amount of residual oil. However, if the residue appears particularly oily, it can be squeezed in a cloth to recover further quantities of oil. Oil recovered by the boiling method will sometimes contain a small quantity of fine plant debris which can be removed by filtration through a piece of cloth spread over a bucket.

- **Oil clarification and expeller operation**

Crude oil from an expeller tends to contain high levels of sediment usually about 10-15%. A convenient oil collection vessel (sl1own in Figure 3) is constructed from a 200 1 oil (45 gal) drum. The coarse foots which separate in the primary collection vessel may be added in small amounts to the fresh seed for reprocessing, but the fine sediment, when isolated (normally either by standing or in a filter press), is best used as a fertilizer or admixed with the cake. The provision of a filter press in any small-scale expeller plant is worth considering.

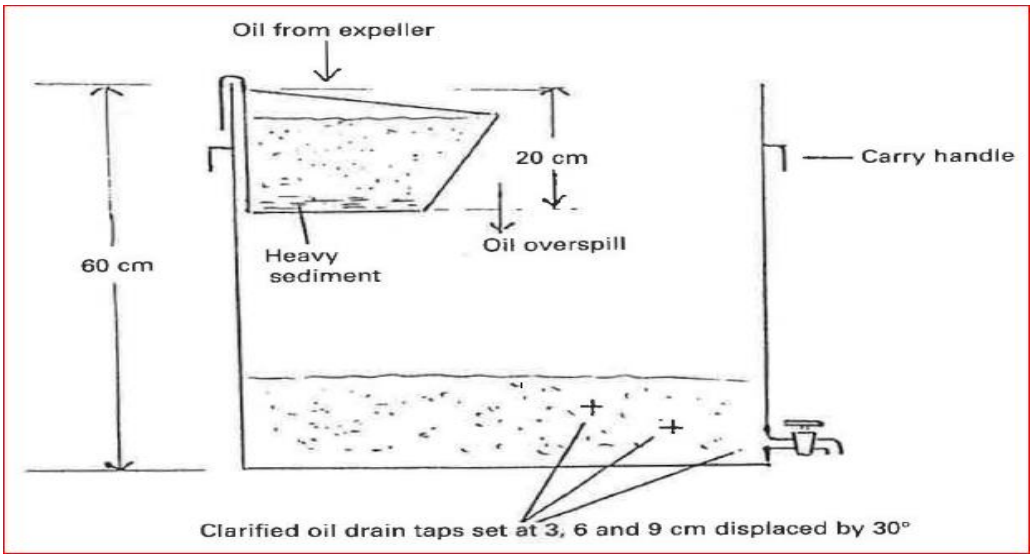


**Figure 8: Oil collection and sedimentation vessel**

## 1.4 Different types of oil

- **Groundnut Oil/ Peanut Oil**

This is one of the most commonly consumed oils India, particularly in the rural areas. It contains Heart-friendly MUFA that lowers the level of bad cholesterol in our body without lowering the Levels of good cholesterol. In the market, it is available in refined form as well as filtered form. Although the filtered oils are nutritionally superior, they often contain toxic compounds or other Adulterants. The oil is suitable for all types of cooking – frying, grilling seasoning, etc.

- **Olive oil**

Olive oil is good for salad dressing. Although more expensive than other oils, olive oil has many Health benefits. Studies have found that consumption of olive oil can lower the risk of coronary Heart diseases. When buying olive oil, it is best to select the extra virgin variety. In order to get Maximum benefits. Olive oil should be used to prepare salad dressings, as a seasoning for soups, or for sautéing vegetables. It is generally not advisable to use this oil for frying and heating since it has a low smoke point. It is not suited for Indian frying conditions because we mostly oils for frying and not as dressing.

- **Rice Bran Oil**

It is relatively new oil that is extracted from rice-bran, the most nutritious part of rice. Rice bran oil is gaining popularity across the world. Rice bran oil is unique edible oil with many nutritional benefits, as compared to other edible oils. It has magical cholesterol-lowering properties due to the presence of a component called Oryzanol. It also contains squalene, which is good for the skin. It is probably the only oil that reduces bad Cholesterol, at the same time increasing the much required good cholesterol. It is the ideal cooking oil since it has good stability (it does not decompose at high temperatures to form toxic compounds) and is suitable for deep-frying. Studies have shown that snacks prepared in rice bran oil absorb 12-25 per cent less oil than those prepared in groundnut oil. It is the best oil for deep-frying and everyday cooking.

- **Mustard Oil**

This oil is traditionally used in West Bengal and is prized for its characteristic flavor (Pungent and sharp). Mustard oil has a higher proportion of MUFA and is also a rich source of the PUFA. However, it also contains erucic acid, a fatty acid that has undesirable effects on health when consumed in large amounts. Mustard oil should be used along with other cooking oils to reduce the erucic, acid content. Mustard oil is sometimes adulterated with argemone oil, which is toxic.

- **Sunflower Oil**

It is popular cooking oil available under many brand names. Extracted from the seeds of the Sunflower, sunflower oil is good all-purpose oil. This oil is rich in PUFA, particularly linoleic acid that lowers the levels of both good and bad cholesterol. Hence, this oil cannot be used as the only Cooking oil.

- **Safflower/ Kordi Oil**

This is light all- purpose oil extracted from the seeds of the safflower. It has a more oily texture and a nuttier flavor than sunflower oil. It is suitable for deep-frying. It also

contains PUFA in the form of linoleic acid. Like sunflower oil, this oil too should be used in combination with other oils.

- **Soya Bean Oil**

Extracted from soybeans, soybeans oil contains PUFA, particularly linoleic acid and alpha-linoleic acid and alpha-linolenic acid (ALA) in the right balance, which are essential for human health. Soya bean oil is suitable for all types of cooking methods except trying. PUFA gets oxidized at frying Temperatures to form toxic compounds. It is not recommended for salad dressings because of its slightly fishy flavor.

- **Palm Oil**

Bright orange waxy oil, it is used in the manufacture of vegetable oils and fats. It has a nutty flavor and is high in saturated fats. It contains MUFA and is low in linoleic acid, hence it is healthy to use in combination with other oils.

- **Coconut Oil**

Solid at room temperature, coconut oil is white and buttery in texture; it has a distinctive coconut flavor and is widely used in South India. It is high in saturated fats. However it contains saturated Fats that are different from those present in animal fats. It can be safely consumed as part of a balanced diet, in combination with other cooking oils.

- **Butter**

It is made from milk fat and contains a high proportion of saturated fats and increases cholesterol when consumed, both of which are risk factors for developing heart disease.

Hence, it is wise to Consume less amount of butter.

- **Ghee**

Prepared from milk fat, ghee or clarified butter is an essential item in Indian cuisine.

According to Indian medical systems, ghee contains several medicinal properties. Nutritionally, like butter, it also contains saturated fats and cholesterol which, when consumed in excess, leads to heart diseases. Using small amount of ghee to season foods is not harmful. Just avoid sweets and other dishes Prepared with large quantities of ghee.

- **Vanaspati**

It is nothing buta mixture of vegetable oils that have been converted to solid form by the addition of Hydrogen. Hydrogenated fat is used as a ghee substitute in cooking as well in the production of bakery products, sweets and snack items. When Vanaspati is made, Trans fatty acids are also produced; these increase the risk of heart disease when consumed in excess and are best avoided.

- **Rice Bran Oil**

Rice Bran Oil (RBO) is obtained from the most nutritious part of rice – the golden brown layer which covers the white rice? It forms about 5% of the paddy and is enriched in oil to the extent of 10-25%. Bran from parboiled paddy yields more oil than the bran from fresh paddy. Rice Bran Oil offers several unique properties that make it special. With a very neutral taste, it is very stable at higher temperature and has prolonged shelf life.

However, its most notable feature is its high level of components with nutraceutical value such as Gamma-oryzanol, tacopherol and tocotrienol. It also contains vitamins, antioxidants, nutrients and is trans-fat free. Perhaps the only oil that helps lower cholesterol LDL (bad cholesterol) and increase HDL (good cholesterol), RBO helps the body fight diseases, enhance the immune system and fight free radicals.

- **Micro Nutrient profile of Rice Bran Oil**

Among the many nutrients present in the unsaponifiable fraction of rice bran oil, Oryzanol and tocotrienol are two distinctly different component groups that have been intensively studied for their health benefits.

- ✓ **Oryzanol**

Oryzanol is a nutraceutical present only in Rice Bran Oil. It is known to reduce bad cholesterol (LDL), improve good cholesterol (HDL) and bring down the total cholesterol. Crude rice bran oil contains about 4 to 5% or more gamma-oryzanol. Physically refined rice bran oil has higher oryzanol content than the chemically refined rice bran oil.

- ✓ **Health Benefits of Rice Bran Oil**

Rice Bran Oil exerts hypocholesterolemic activity in relation to more commonly used vegetable oils and is characterized by a relatively high content of non-fatty acid components known to have beneficial health effects.

Some of its key benefits are mentioned below:-

- Rice Bran Oil is the only oil that contains Oryzanol. A powerful antioxidant, it is most effective in reducing bad cholesterol (LDL). No just that, it also maintains the good cholesterol (HDL) Levels in the body. This makes it the healthiest cooking oil to use.
- Rice Bran Oil has one of the highest smoke points amongst oils, even higher than Olive oil. This makes RBO much better oil for deep-frying and everyday cooking.
- Naturally rich in vitamin E (Tocopherols and Tocotrienols) it protects the human body from ailments and maintains the balance of nervous system. Tocotrienols are known to have anti-cancer, anti-thrombotic and anti-ageing properties.
- Interestingly, RBO absorbs 15%-20% less into food hence making the food less oily. Lesser oil means reduced calorie intake and better heart. It also means lesser oil consumption.
- RBO is Tran's fatty acid free when cosmpared to any other oil. This reduces the chances of Coronary Heart Diseases.

## 1.5 Sunflower oil seed processing

Sunflower seeds are four-sided and flat, and are generally 0.6 cm long and 0.3 cm wide. They have a black seed coat with dark or grey stripes. The coat, or hull, surrounds a small kernel that is composed of about 20% protein and 30% lipids. Additionally, the seed contains a high level of iron and dietary fiber. The high linoleic acid content of the kernel makes it prone to rancidity, thus giving it a limited shelf life. Sunflowers are used to make oil, meal and confectionary products. Oil and meal are processed from the same sunflower seed varieties. The seed variety used foe confectionary products has a lower percentage of oil. The seed is usually black with white stripes and is larger than the seed cultivated for oil extraction; the hull is heavier and less firmly attached to the kernel, and its oil content rarely exceeds 35%.
Sunflower oil is extracted mainly from oil-type sunflower seed varieties and hybrids.

Meal, a by-product of the oil extraction process, is used primarily as an ingredient in livestock feed rations. Compared with soybean meal, sunflower meal has a lower percentage of protein (28%). However, more than 80 % of a sunflower's value comes from oil. Oil-type sunflower seeds contain 38–50% oil and about 20% protein. The crushing process removes the hulls from the seeds, and the hulls can be used to generate steam to power the crushing plant. For every 100 kg of seed, about 40 kg of oil, 35 kg of high-protein meal and 20-25 kg of by-products are produced. More than 90% of the sunflower seeds produced are processed into edible oil. Sunflower oils are cold-pressed. This method, which entails minimal processing, produces a light, flavorful oil suitable for some cooking needs.

Sunflower oil manufacture involves cleaning the seeds, grinding them, pressing and extracting the crude oil from them, and further refining. In extracting the oil, a volatile hydrocarbon such as hexane is used as a solvent to extract the oil.

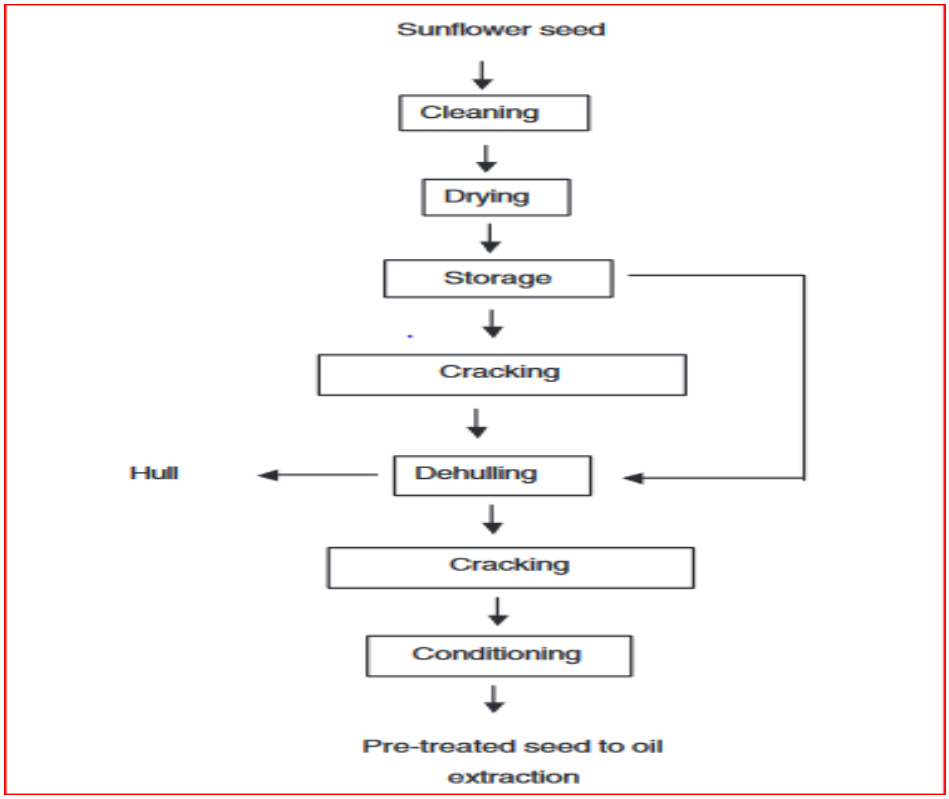


**Figure 9: Sunflower oil seed processing flow diagram**

## 1.6 Oil composition and physical properties

Sunflower oil contains predominantly linoleic (48–7%), oleic (14–40%), palmitic (4–9%) and stearitic (1–7%). There are several types of sunflower oils produced, such as high linoleic, high oleic and mid oleic. High linoleic sunflower oil typically has at least 69% linoleic acid. High oleic sunflower oil has at least 82% oleic acid. The variation in the unsaturated fatty acids profile is strongly influenced by both genetics and climate. In the last decade, high stearic lines of sunflower oil have been developed in Spain to avoid the use of hydrogenated vegetable oils in the food industry. The conventional sunflower oil (high linoleic) is used for home cooking oil and margarine and for industrial use (paint, etc.) The high oleic sunflower oil is used for cosmetics, gasoline blend and other purposes. Sunflower oil also contains lecithin, tocopherols, carotenoids and waxes. Sunflower oil's properties are typical of a vegetable triglyceride oil. It is light in taste and appearance and has a high vitamin E content. The refined oil is clear and slightly amber-colored with a slightly fatty odors.

Sunflower oil is liquid at room temperature and has the following characteristics:

- smoke point (refined): 232 °C
- smoke point (unrefined): 227 °C
- density (25 °C): 917 kg/m3
- refractive index (25 °C): ≈1.473
- viscosity (25 °C, unrefined): 0.04914 kg/(M*S)

## 1.7 Screw press (Expeller)

In oil industry, screw presses (expellers) are mostly utilized for expression.

The main parts of continuous-screw press are;

- Seed feeder,
- Cone-shaped cage
- Adjustable cone for press-cake outlet
- Worm (pressure and feed)

**Figure 10: Screw oil press**

### 1.7.1 Working steps or principles of screw presser

- The seeds enter the barrel and falls on the helical pressure worm.
- During movement in the barrel, between worm and cage (barrel) is gradually reduced and the seed flakes are subjected to increasing pressure.

- The cage (barrel) is made of a number of special steel bars which let liquids pass through.
- The oil passes between the bars and flows out of the cage.
- The cone moves along the shaft of the expeller and the space between the worm and cone can be regulated.
- This permits easy control of the thicknesses' of cakes and of the degree of pressure to which the cooked flakes are subjected.

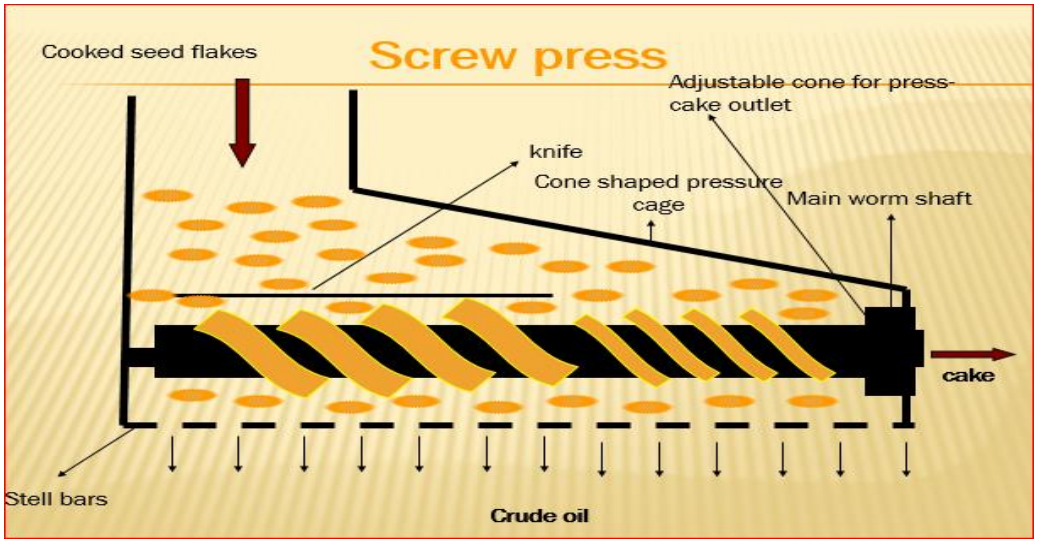


**Figure 11: Flow diagram of screw press**

### 1.7.2 Operation principles of screw presser

Continuous pressing by means of expellers (also known as screw presses) is a widely applied process for the extraction of oil from oilseeds and nuts. It replaces the historical method for the batch-wise extraction of oil by mechanical or hydraulic pressing. The expeller (Fig. 10) consists of a screw (or worm), rotating inside a cylindrical cage (barrel). The material to be pressed is fed between the screw and the barrel and propelled by the rotating screw in a direction parallel to the axis. The configuration of the screw and its shaft is such that the material is progressively compressed as it moves on, towards the discharge end of the cylinder. The compression effect can be achieved, for example, by decreasing the clearance between the screw shaft and the cage ( progressive or step-wise increase of the shaft diameter ) or by reducing the length of the screw flight in the direction of the axial movement The gradually

increasing pressure releases the oil which flows out of the press through the slots provided on the periphery of the barrel, while the press-cake continues to move in the direction of the shaft, towards a discharge gate installed at the other extremity of the machine. Before entering the expeller, the oilseeds must be cleaned, de-hulled (optional), flaked, cooked and dried. Flaking facilitates oil release in the press by decreasing the distance that the oil will have to travel to reach the particle surface. Cooking in the presence of moisture is essential for the denaturation of the proteins and, to some degree, for the coalescence of the oil droplets. Cooking plasticizes the flakes, renders them less brittle and thus reduces the extent of flake disintegration as a result of shear in the press. Extensive flake disintegration would reduce oil yield and produce a crude oil with a high content of fine solid particles (foots). After cooking, excess moisture is removed in order to avoid the formation of muddy emulsions in the press. Cooking is usually achieved by mixing the flakes with live steam. Additional heat may be provided by indirect steam, while thoroughly mixing the mass.

### 1.7.3 Basic steps involved in processing oilseeds by expeller

The basic steps involved in processing oilseeds by expeller are shown in the flow diagram below.

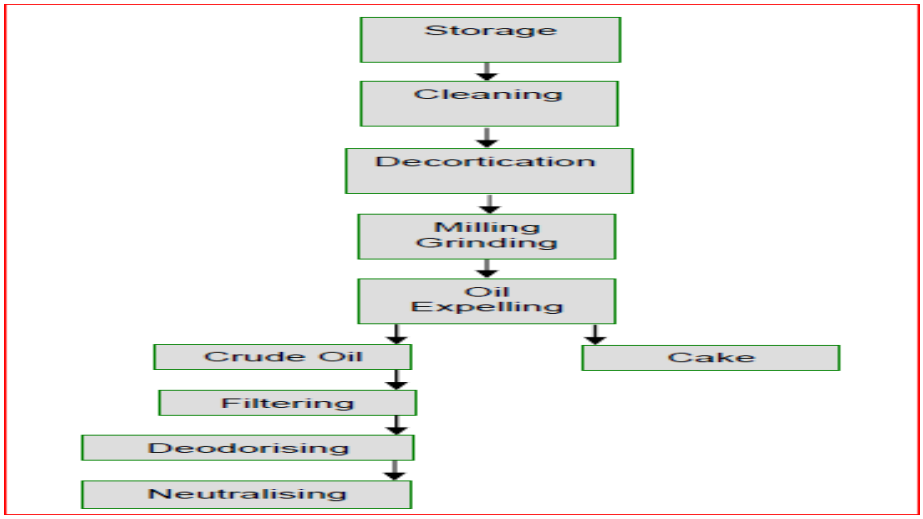


**Figure 12: Flow diagram of oil expeller**

An illustrated description of the working of an expeller is available at: http://www.rosedowns.co.uk/press_basics/Press_Parts.htm

### 1.7.4 Advantages and disadvantages of the expeller process

Expellers can be used with almost any kind of oilseeds and nuts. Therefore, in a multi-purpose plant built to process different types of raw materials and not only soybeans, the expeller process may prove advantageous. The process is relatively simple and not capital-intensive. While the smallest solvent extraction plant would have a processing capacity of 100-200 tons per day, expellers are available for much smaller capacities, from a few tons per day and up. The main disadvantage of the screw-press process is its relatively low yield of oil recovery. Even the most powerful presses cannot reduce the level of residual oil in the press-cake below 3 to 5%. In the case of oil-rich seeds such as sesame or peanuts this may still be acceptable. Furthermore, most of the oil left in the cake can be recovered by a stage of solvent extraction. Such two stage processes (pre-press/solvent extraction) are now widely applied. In the case of soybeans, however, a 5% residual oil level in the cake represents an oil loss of about 25%. Solvent extraction of the cake would not be economical, because of the bulk of material which must be processed. Pre-press/solvent extraction processes are, therefore, not applied to soybeans. In the case of soybeans, the commercial value of the meal is usually higher than the income from sales of the corresponding quantity of oil. The quality of the meal is therefore a factor of particular importance in the selection of a processing method for soybeans. In this respect, the expeller process has several disadvantages. The first is the poor storage stability of the press-cake, due to its high oil content. Furthermore, the extreme temperatures prevailing in the expeller may impair the nutritive value of the meal protein, mainly by reducing the biological availability of the amino acid lysine. At any rate, expeller press-cake is not suitable for applications requiring a meal with high protein solubility.

Advantage of electric motor driven oil press over manually operated one

- High efficiency
- High processing capability
- High oil press rate
- Easy to operate
- Save time

| Self-Check 1 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define and explain mechanical oil extraction process in detail. (5pts )
2. Write and explain each unit operations in an oil seed extraction process (15pts )
3. Write main parts of continuous-screw presser(4pts)
4. Write Working principles of screw presser (5pts)
5. Write advantages and disadvantages of screw presser (5pts)

***Note:*** **Satisfactory rating – 30 points** **Unsatisfactory - below 30 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 2 - Identifying out-of-specification of product

### 2.1 Identifying out-of-specification of product

Out-of specification of a product means a condition in which the product did not fall in a specified condition, like chemical composition, physical appearance, recommended quality and so on.

There are many factors that leads a product in to out-of specification are:

- Quality of raw material,
- Processing temperature and pressure
- Processing conditions.
- Packaging materials used
- Efficiency of a machine

In any food processing industry, out-of specification can be happen due to many factors. Several general factors affect the oxidative stability of sunflower oil as well as most vegetable oils during storage. One of these factors is the degree of unsaturation, i.e., the relative content of oleic and linoleic acids. Product shelf-life is affected by manufacturing conditions such as the type of extraction process (pressing , with solvent, with super critical fluids), degree of purification (crude, refined, deodorized, etc.), addition of antioxidants, and type of packaging (container material , incorporation of inert atmosphere, etc.). Other major factors influencing the oxidative stability are the particular storage conditions: time, temperature, and light, among others.

| Self-Check 2 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define out-of-specification of product means (4pts )
2. What are factors that leads a product in to out-of specification (6pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 3 - Maintaining the work area

### 3.1 Introduction

Having a safe and healthy physical work environment, including amenities and facilities, is critical to eliminating and controlling risk in the workplace. This includes ensuring the work environment, facilities and amenities are compliant with legislative and other identified requirements.

### 3.2 Maintaining the work area

A safe work environment Including facilities, Amenities and accommodation. Facilities refer to toilets, washrooms, showers, lockers, dining areas, drinking water, etc. These facilities must be in good working order, clean, safe and accessible. When considering how to provide and maintain facilities that are adequate and accessible, a person conducting a business or undertaking must consider all relevant matters including:

- The nature of the work being carried out at the workplace
- The nature of the hazards at the workplace
- The size, location and nature of the workplace
- The number and composition of the workers at the workplace.

During Conducting work in accordance with workplace guideline a person should ensure the following requirements.

#### 3.2.1 Legislative Requirements

A person conducting a business or undertaking at a workplace must ensure so far as is reasonably practicable, the following:

- The layout of the workplace allows, and the workplace is maintained so as to allow, for persons to enter and exit and to move about without risk to health and safety, both under normal working conditions and in an emergency,

- Work areas have space for work to be carried out without risk to health and safety,
- Floors and other surfaces are designed, installed and maintained to allow work to be carried out without risk to health and safety,
- Lighting enables:
  - ✓ Each worker to carry out work without risk to health and safety, and
  - ✓ Persons to move within the workplace without risk to health and safety, and Safe evacuation in an emergency,
- Ventilation enables workers to carry out work without risk to health and safety,
- Workers carrying out work in extremes of heat or cold are able to carry out work without risk to health and safety,
- Work in relation to or near essential services does not give rise to a risk to the health and safety of persons at the workplace.

### 3.2.2 Responsibilities

- Facilities Management Division (or Equivalent)

The Facilities Management Division (FMD) are responsible for ensuring that workplace amenities and facilities:

- ✓ Are designed and installed according to company legislative and requirements
- ✓ Are inspected and maintained to ensure a safe level of hygiene.

- Company Management and Supervisors

Management and supervisors of faculties, divisions and units are to ensure that amenities and facilities in the workplace do not expose workers, or visitors to health and safety risks.

This includes:

- ✓ Ensure, so far as is reasonably practicable, that the layout of the workplace, lighting and ventilation enables workers to carry out work without risks to health and safety

- ✓ Ensure, so far as is reasonably practicable, the provision of adequate facilities for workers, including toilets, drinking water, washing and eating facilities
- ✓ Manage risks associated with remote and isolated work
- ✓ Prepare local area emergency response procedures
- ✓ Implement risk control measures for any unsafe facilities or amenities within their responsibility to ensure the workplace is safe
- ✓ Consult with workers on health and safety issues pertaining to facilities and amenities

- Employees

Employees are responsible for reporting any identified hazard in the work environment, facilities or amenities that they become aware of in accordance with factory or company guidelines.

### 3.2.3 Needs Assessment

The work environment, facilities and amenities are provided for basic health and welfare of employees, contractors and visitors. These include items such as:

- Toilets
- Rest rooms
- Shelter sheds
- Dining rooms
- Drinking water
- washing facilities
- Accommodation
- Waste receptacles
- First aid facilities/rooms (refer to first aid guidelines).

This also includes factors such as workspace, temperature and air quality, lighting and flooring.

### 3.2.4 Work Environment

Work environment includes/consider: work layout, work access, floors and other surfaces, work station, lighting, air quality, and heat and cold.

- **Work Layout**

The layout of the workplace is required to allow persons to enter and exit the workplace and move within safely, both under normal work conditions and in an emergency.

- **Entry and Exit**

Entries and exits are required to be safe to allow impeded access and egress for all workers, students and visitors including those with special needs.

In particular:

- ✓ Entries and exits should be slip resistant under wet and dry conditions
- ✓ Any walkways, boundaries or pathways shall be marked with 50mm wide with a contrasting color e.g. white or yellow
- ✓ Open sides of staircases should be guarded with an upper rail at 900mm or higher and a lower rail
- ✓ Handrail should be provided on or at least one side of every staircase
- ✓ Separate entry and exits for mobile equipment e.g. forklifts or trucks, and pedestrians are to be provided
- ✓ Power operated doors and gates should have safety features to prevent people from being stuck or trapped.
- ✓ Location of exits should be clearly marked and signs posted to show direction of exit doors to aid emergency evacuation.

- **Housekeeping**

Untidy workplaces may lead to injuries e.g. slips and trips, therefore good housekeeping practices are essential for all workplaces.

For example:

- ✓ Spills on floors should be cleaned up immediately
- ✓ Walkways should be kept clear of obstructions
- ✓ Work materials should be neatly stored
- ✓ Any waste should be regularly removed
- ✓ Suitable containers for waste should be conveniently located and regularly emptied.

- **Work Areas**

The layout of the work area should be designed to provide sufficient clear space between machines, fixtures and fittings so workers can move freely without strain or injury also evacuate quickly in case of an emergency.

In determining how much space is required, the following should be considered:

- ✓ The physical actions needed to perform the task
- ✓ The need to move around while working
- ✓ Whether the task is to be performed from a sitting or standing position
- ✓ Access to workstations
- ✓ The equipment to be handled and the personal protective equipment that may be worn to perform the work.
- ✓ Environmental factors including heat or noise may require an increase to the space, as will work activities that involve manual tasks or the use of equipment.

- **Floors and Other Surfaces**

Floor surfaces shall be suitable for the work area and be chosen based on the type of work being carried out at the workplace, as well as the materials used during the work process, the likelihood of spills and other contaminants, including dust, chemicals, and the need for cleaning.

In general:

- ✓ Floors shall be free from slip or trip hazards e.g. cables, uneven edges, broken surfaces
- ✓ Floor surfaces shall have sufficient grip to prevent slipping, especially in areas that may become wet or contaminated
- ✓ Anti-fatigue matting, carpet, shock absorbent underlay, cushion backed vinyl shall be provided for workers where static standing occurs
- ✓ Carpet shall be properly laid without loose edges or ripples and should be well maintained
- ✓ Floors should be strong enough to support loads placed on them.

- **Workstations**

Workstations should be designed so workers are comfortable undertaking their task and allow for a combination of sit and standing tasks.

For tasks undertaken in a seated position, workers should be provided with seating that:

- ✓ Provides good body support, especially for the lower back
- ✓ Provides foot support, preferable with both feet flat on the floor, otherwise a footrest shall be provided
- ✓ Allows adequate space for leg clearance and freedom of movement
- ✓ Is fully adjustable to accommodate different size workers (e.g. seat height, back rest height and back rest tilt adjustments) and should not tip or slip utilizing a five-point-base
- ✓ Chairs shall be fitted with castors for carpeted surfaces and glides or braked castors on hard surfaces.

Workstations shall be designed and procured according to FMD (Facilities Management Division) Design Standards and Australian

- **Lighting**

Sufficient lighting is required to allow safe movement around the workplace and to allow workers to perform their job without having to adopt awkward postures or strain their eyes to see.

Emergency lighting is to be provided for the safe evacuation of people in the event of an emergency.

The following factors are to be taken into account:

- ✓ The nature of the work activity
- ✓ The nature of hazards and risks in the workplace
- ✓ The work environment
- ✓ Illumination levels, including both natural and artificial light
- ✓ The transition of natural light over the day
- ✓ Glare Workplace Environment Guidelines
- ✓ Contrast

- ✓ Reflections.

Measures to prevent low or excessive levels of lighting, glare or reflection include:

- Providing additional lighting, such as a lamp on a movable arm
- Changing the position of existing lights
- Changing the location of the workstation
- Increasing or decreasing the number of lights
- Changing the type of lighting used e.g. from white light to blue light
- Changing the diffusers or reflectors on existing lights
- Using screens, visors, shields, hoods, curtains, blinds or external louvers to reduce reflections, shadows and glare.

- **Air Quality**

Workplace are to be adequately ventilated which includes provision of fresh, clean air drawn from outside the workplace, uncontaminated from flues or other outlets and be circulated through the workplace.

Workplace inside buildings may have natural ventilation, mechanical ventilation or air conditioning.

An air-conditioning system should:

- ✓ Provide a comfortable environment in relation to air temperature, humidity and air movement
- ✓ Prevent the excessive accumulation of odors.
- ✓ Reduce the levels of respiratory by-products, especially carbon dioxide, and other indoor contaminants that may arise from work activities
- ✓ Supply an amount of fresh air to the workplace, exhaust some of the stale air as well as filter and recirculate some of the indoor air.

- **Heat and Cold**

Refer to the Thermal Comfort Guidelines for further information on managing health and safety risks associated to hot and cold environments.

### 3.2.5 Welfare Facilities

- **Access**

Workers, including those who have particular needs or disabilities, must have access to the facilities provided.

Workers are to be provided with:

- ✓ Adequate breaks to use the facilities
- ✓ Facilities which are within a reasonable distance from the work area
- ✓ Shift workers have similar access to those who work during the day
- ✓ A means of access which is safe.

- **Drinking Water**

Free potable drinking water which is cool, clean and palatable is required at each place of work.

The supply of drinking water should be:

- ✓ Positioned where it can be easily accessed by workers
- ✓ Close to where hot or strenuous work is being undertaken to reduce the likelihood of dehydration or heat stress
- ✓ Separate from toilet or washing facilities to avoid contamination of the drinking water
- ✓ Below 24 degrees Celsius
- ✓ Supplied in a hygienic manner e.g. upward jet fountain, via disposable or washable drinking containers.
- ✓ Non-drinking water should be marked accordingly.

- **Toilets**

Access to clean toilets must be provided for all workers while they are at work.

- **Hand Washing**

Hand washing facilities are to be provided to enable workers to maintain good standards of personal hygiene. As a guide hand washing basins should be provided in a ratio of 1 per every 30 workers or part thereof.

Paper towels, continuous roll towel or hot air dryers are to be supplied with hand washing facilities, as well as appropriate soap, cleaning agents and waste receptacles.

- **Dining Facilities**

Where work processes may cause risk to health, a separate eating area protected from dust, fumes or noise arising out of the work process is to be available. The area should be suitable for dining, have access to a refrigerator, enable easy cleaning and kept free of tool, materials, and vehicles and be protected from the weather.

- **Personal Storage**

Accessible and secure storage should be provided at the workplace for personal items belonging to workers. This storage should be separate from that provided for personal protective equipment in cases where contamination is possible.

- **Change Rooms**

Persons required to change clothes before and after work should be able to access a change room.

This includes workers who need to:

- ✓ Wear personal protective clothing or uniforms while they are working
- ✓ Leave their work clothing at the workplace.

It should be private and contain lockers for storage of personal belongings. The door should also be capable of being locked.

Separate change rooms for males and females must be provided. The changing room space should allow a clear space of at least 0.5m2for each worker.

- **Shower Facilities**

Where dirty, hot or hazardous work is undertaken showering facilities should be provided. Showers should have:

- ✓ Floor area of not less than 1.8m2
- ✓ A Slip resistant surface that is capable of being sanitized

- ✓ A Partitions between each shower that are at least 1650mm high and no more 300cm above the floor
- ✓ An adjacent dressing area for each shower containing a seat and hooks
- ✓ A Lockable door enclosing the shower and dressing cubicle

Where the substances or materials handled are contaminants, decontamination facilities e.g. safety showers are to be available.

- **Shelter Facilities**

Where persons are required to be performing tasks offsite and can be exposed to environment elements appropriate shelter is to be provided.

### 3.2.6 Inspection and Monitoring

The work environment, facilities and amenities need to be periodically inspected to ensure they conform to relevant legislation, standards and codes of practice and are maintained and serviced appropriately. Any non-conformances identified throughout the inspection require a risk control assigned to an appropriate person.

Review of the work environment, facilities and amenities are required when:

- Work practices, equipment or workplaces are modified
- Employees numbers increase
- New work processes are introduced
- An incident impacting on the health, safety or welfare of employees occurs.

Where it is identified that the workplace environment, facilities or amenities pose a health and safety risk, the issue should be reported to the supervisor and recorded.

Corrective actions may include a review of the area in relation to the information contained in guideline, WHS Regulation, Code of Practice or other information.

| Self-Check 3 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the all relevant matters that a person conducting a business or undertaking must consider include (4pts )
2. What are the requirements a person should ensure during conducting work in accordance with workplace guideline(6pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 4 - Monitoring operation of equipment and processes

### 4.1 Introduction

In any processing industry there must equipment and process monitoring and controlling system. So in oil processing industry there is equipment that needs monitoring and control of its processing parameters like temperature, pressure, and flow meters and different sensors. Monitoring equipment and process in an industry helps to obtain expected out puts. Without monitoring and controlling the equipment and process it is impossible to get quality products. Basic equipment which is controlled and monitored in oil extraction are explained below.

### 4.2 Monitoring operation of equipment and processes

During extraction of oil using mechanical extraction process you can use many types of equipment. In these process we have monitor equipment operation and process weather the equipment or process are going under specified conditions. So, when you extract seed oils using hydraulic oil press you have to monitor and control the temperature and pressure gauges are working under setting point or not.

**Hydraulic oil press**

Preheat before each pressing, preheat temperature, summer and autumn is 50 degrees 70 degrees, winter Spring is 70 degrees-90 degrees. Preheat automatic control without turning off the temperature switch.

**A. Temperature controller**

- Temperature controller can set the fixed temperature which can heat temperature automatically. Adjustment mode: As shown in the figure, according to the needs of the loop below the upper and lower buttons, you can set the heating temperature.

- Temperature controller is automatic control, after reaching the set temperature, it will stop working. Temperature drop will automatically start heating, no need to turn off the temperature switch.
- If the temperature controller appears heating digital abnormalities, it is recommended to check the Temperature controller line connection, check whether there is a loose line.


**Figure 13: Temperature controller**

Grip on the top roof handle completely open: top roof and work position into 180 degrees, to the bottom of the barrel cushion, the piston down in place, standby.

Each oil before the empty machine to run 1-2 times, such as winter, spring hydraulic oil thickening, should be empty machine running for 5-10 minutes, so that oily thinning, easy to operate. Put the fried raw material loaded into the barrel, exhaust fumes.


**Figure 14: Operation Diagram of Hydraulic oil press machine**

**Pressing Process:**

- First point heating starts, to heat the main machine.

  At this time the heating indicator light, the machine will be automatically heated to set the temperature.
- After the barrel has been put raw material, pointing the main engine starts, the machine begin to press.
- No oil leakage in the oil line, oil has been press out totally, hydraulic valve pressure relief, so that the barrel down to below the top 10mm.
- Open the top roof plate.
- Point main engine starts, let the defatted cake up. The top of the piston is flat with the upper end of the pressing barrel. Take out the defatted cake.

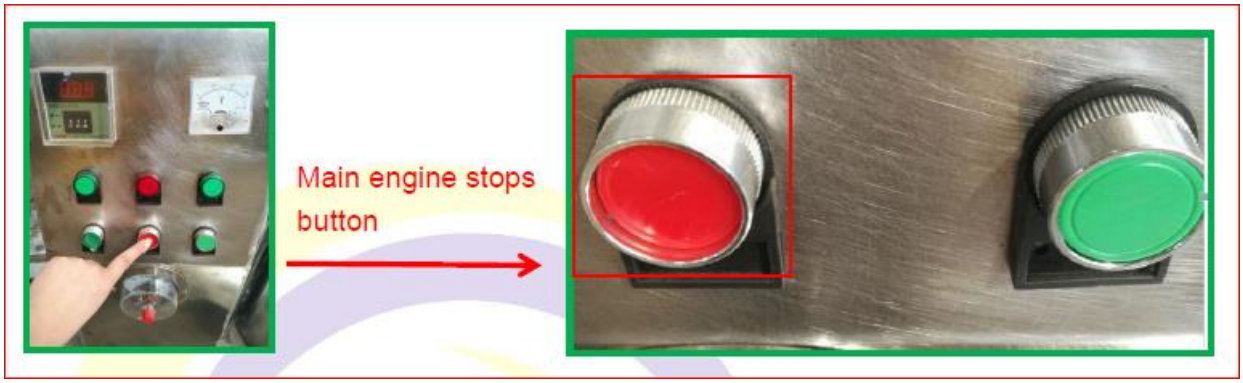


**Figure 15: stops button self-locking switch**

### B. Pressure Gauge

This hydraulic press must have the special operation, the main engine in the working process is not allowed to leave people, the pressure reached 50 MPa when the main motor stop, or should immediately turn off the power supply, check whether the pressure gauge damage, failure, AC contactor is bad, if there is damage should be replaced immediately, check and reboot for use. When the pressure gauge raises to 55 MPA, the electrical control system automatically stops, when the pressure drops to 45 MPA, the electrical control system opens automatically, the pressure gauge pressure again picks up. When there is no oil in oil line, it means oil pressed out totally.

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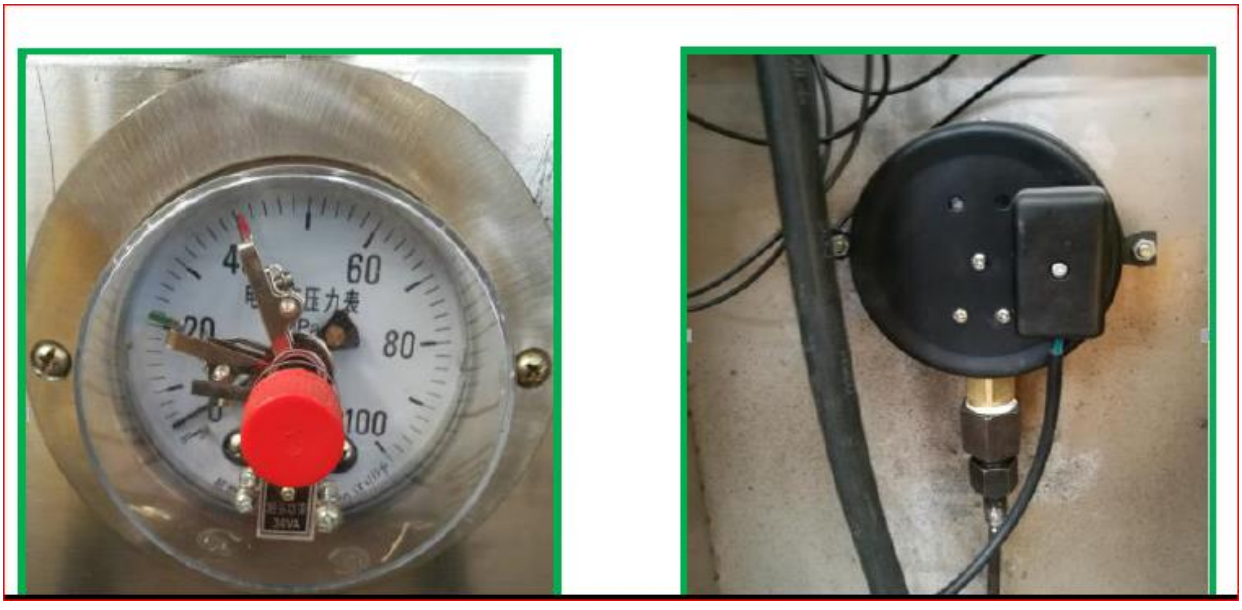


**Figure 16: Pressure Gauge**

| Self-Check 4 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the processing parameters to be monitoring and controlled in an industries (4pts )
2. How can we monitor and control temperature controller in hydraulic oil press machine (10pts )

***Note:*** **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 5- Identifying variation in equipment operation

### 5.1 Identifying variation in equipment operation

Variations in equipment operations can be happen due to many factors. Such as lack of maintenance or poor maintenance, sensor defects, equipment component problem, difference in applied pressure, and power shortages. These variation may causes different damages to a machine, process, products, and environments. To minimize these variation we have to conduct pre-start checks on all components of equipment, sensors, and perform maintenance before we are going to operate equipment.

Variables to be monitored to minimize variations in equipment operations may include:

- Equipment performance (e.g. speed, output, variations)
- equipment component performance
- sequences and timing of operation
- materials changes (desired and not desired)

| Self-Check 5 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the factors that bring variation in equipment operations? (4pts )
2. Write the measures used to minimize variation in equipment operations (5pts )
3. What are the variables to be monitored to minimize variations in equipment operations (6pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 6 - Separating by-product from oil seed

### 6.1 Separating by-product from oil seed

After extracting oils from oil seeds, oil passes between the bars and flows out of the cage. The oil cake (as a by-product) was separated from oil extracting machines through worm shaft pipes.

- **Sunflower meal**

The remaining material from the pressing stage (expeller) of sunflower seed usually contains 10–12% of oil. Sunflower meal is obtained as a byproduct of solvent extraction from this material. In order to facilitate handling and transportation, the meal is often compacted through pressure and temperature treatment, into the shape of sunflower pellets. Sunflower pellets are the fourth important oleaginous raw material used in animal feeds. Sunflower meal (blended with wheat flour) can be used for human nutrition. The process yields a concentrate of 71% protein (dry basis), rich in glutamic and aspartic acids. The supernatant liquid, rich in potassium and phosphorous, can be used as agricultural fertilizer. Two products are originated in the sunflower-seed oil extraction process are meal and hulls. Sodium soap stock is obtained as a byproduct of alkali refining of the oil, and it may contain phosphatides, depending on process type. Sunflower lecithin is obtained by treatment of the oil. Less important byproducts are waxes, tocopherols, and so on.

- **Hulls**

Hulls are obtained as a byproduct of sunflower seed processing for oil extraction.

The amount of hull represents around 22–28% of seed weight. Hulls may be separated either prior to or upon extraction of the oil. They may also remain in the meal, making a whole meal product. Hulls contain around 4% of crude protein, 5% of lipidic matter (including waxes, hydrocarbons, fatty acids, sterols, and triterpenic acid),

50% carbohydrates (mainly cellulose and lignin), 26% reducing sugars (mainly xylose), and 2% ash. Hulls may be used as ruminant feed when finely milled and blended with other ingredients, composing the non-digestible part of the meal in view of the high content in cellulose and lignin.

| Self-Check 6 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the by-product Separated from oil seed (4pts )
2. Explain and write the uses of sunflower meal and hull (10pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 7- Conducting work legislative requirement

### 7.1 Conducting work legislative requirement

Legislative requirements may include but not limited to

- Ethiopian food standard code
  - ✓ Mandatory oil seed and edible oil standard
  - ✓ Mandatory packaging and labeling standard
  - ✓ weights and measures legislation
  - ✓ EFDA (Ethiopian Food and Drug Authority) legislation
  - ✓ Environmental management (Ethiopian Environmental Protection Authority)

### 7.2 Mandatory oil seed and edible oil standard

#### 7.2.1 Mandatory oil seed and edible oil standard

Ethiopian legislative requirements for different products are listed below in the table.

**Table 1:** Mandatory oil seed and edible oil standard

| No | Product | Ethiopian Standard Number | Ethiopian Standard Title |
|---|---|---|---|
| 1. | Oil seeds | CES 05-2013 | Oil Seeds-Specification |
| 2. | Oil seeds | CES 06-2013 | Oil Seeds Method Of Packaging |
| 3. | Edible oil additives | CES 12-2013 | Edible Oils-Specification For Additives |
| 4. | Edible Vegetable oil | CES 21-2013 | Edible Vegetable Oils-Packing |
| 5. | Edible groundnut oil | CES 16-2013 | Groundnut (Peanut) Oil-Specification |
| 6. | Sunflower seed oil | CES 17-2013 | Sunflower Seed Oil- Specification |

| | | | |
|---|---|---|---|
| 7. | Edible cottonseed | CES 19-2013 | oil Cottonseed Oil-Specification |
| 8. | Edible linseed oil | CES 18-2013 | Linseed Oil-Specification |
| 9. | CES15-2013 | Edible sesame seed oil | Sesame Seed Oil– Specification |

### 7.2.2 Mandatory packaging and labeling standard

In accordance with the Ethiopian Food, Medicine and Healthcare Administration and Control Authority Proclamation No. 661/2009, “packaging material shall be made out of substances, which are safe and suitable for their intended use, and the product shall be packed in container which will safeguard its hygienic, safety, quality and food grade.” Further, the Proclamation states that “no…packaging material shall be put into use unless it complies with the international and national safety and quality standards.” Individual product standards may also contain additional guidance and/or requirements as it relates to packaging and container requirements.

As an example, the standard for canned peaches indicates packing requirements, including lacquer usage inside the can as well as can thickness.

- Name of the food
- Nutrition content
- List of ingredients (except for single ingredient foods) in descending order of weight
- List of minerals or vitamin supplements added to fortify foods (if needed)
- List of ingredients that may cause an allergic reaction
- Net weight or volume of contents
- Name and address of the manufacturer, packer, distributor, importer, exporter or vendor
- Country of origin
- Production and expiration dates (Note: Food products must have at least 50 percent of their shelf life remaining when they arrive at customs. Expired food cannot enter the country not can it be sold in the marketplace. Certain foods are exempt from carrying expiry dates, including fresh fruits and vegetables, wines, beverages with 10 percent alcohol by volume, vinegar and chewing gum.)

- Code identifying producing factory and lot
- Instructions for use (if needed)
- For beverages containing more than 1.2 percent alcohol, the alcohol proof is required on the label.
- GM foods must carry the label with the following statement: ‘genetically modified food’.

Required Labeling Elements for Raw Foods:

- Name
- Ingredient list
- Net content
- Name and address of the producer and/or importer
- Country of origin
- Lot identification
- Expiry date or minimum useful life
- Conditions for product storage

| Self-Check 7 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write legislative requirements needed in oilseed processing (4pts )
2. List and write five oil products with its Ethiopian standard number and Ethiopian Standard Title. (5pts )
3. What are the required labeling elements for pre-packaged foods(6pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 8 Conducting pre-start checks

### 8.1 Introduction

In an industry, there are many types of works to be operated using different machine and equipment. So before we are going to operate machine/lab equipment we have to inspect /check whether it was in a good operating condition or not.

Before allowing someone to start using any machine you need to think about what risks there are and how these can be managed. So, you should:

- Check that it is complete, with all safeguards fitted, and free from defects.
  The term 'safeguard' includes guards, interlocks, two-hand controls, light guards, pressure-sensitive mats etc. By law, the supplier must provide the right safeguards and inform buyers of any risks ('residual risks') that users need to be aware of and manage because they could not be designed out.
- Produce a safe system of work for using and maintaining the machine.
  Maintenance may require the inspection of critical features where deterioration would cause a risk. Also look at the residual risks identified by the manufacturer in the information/instructions provided with the machine and make sure they are included in the safe system of work.
- Ensure every static machine has been installed properly and is stable (usually fixed down) and is not in a location where other workers, customers or visitors may be exposed to risk.
- Choose the right machine for the job.
- safe for any work that has to be done when setting up, during normal use, when clearing blockages, when carrying out repairs for breakdowns, and during planned maintenance;
- Properly switched off, isolated or locked-off before taking any action to remove blockages, clean or adjust the machine.

**Conducting pre-start checks may include but not limited to**:

- Inspecting equipment condition to identify any signs of wear
- Confirming that equipment is clean and correctly configured
- Positioning sensors and controls correctly,
- Ensure any scheduled maintenance has been carried out,
- Place sand filters/scourers in base of percolators

**Pre-operational checks of equipment may include**

- Pre-start and safety checks including the service and maintenance system.
- Checking size of sieve, type machine with respective oil seed type, fuel, and lubricants needed, fan belts, lines, connections and transmission.
- Inspection of safety guards
- Checking and confirming equipment calibration settings and operating methods
- Observing and monitoring noise levels for correct operation.
- Preparation of independently powered tools may include cleaning, priming, tightening, basic repairs and adjustments.
- Identify and segregate unsafe or faulty equipment for repair or replacement.

| Self-Check 8 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. what are pre-start check we have to do before start operating equipment (6pts )
2. List pre-start checks we perform before going to operate equipment (4pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

## Operation Sheet #1- Operation procedures of mechanical screw oil presser

Operation procedures or techniques of screw oil presser

1. Wear personal protective equipment (PPE)
2. Adjust pressing cone
3. Tied the main worm(screw) shaft
4. Weigh raw materials
5. Clean raw materials
6. Sort and grade raw materials
7. Fed or load raw material between the screw and the barrel
8. Rotate the screw in a direction parallel to the axis.
9. Roll or rotate pressing cone slowly and increase rotation speed step by step.
10. Regulate the space between the worm and cone.
11. Continue rotating the screw until the oil extracted from the oil seeds.
12. Collect the extracted crude oil using oil collection tank or vessels.
13. Collect by-products (cake) using cake collection tank.
14. Shutdown process
15. Record data
16. Clean screw presser

| LAP TEST #1 | Performance Test |
|---|---|

Name……. ID……. Date……..

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour. The project is expected from each student to do it. During your work: You can ask all the necessary tools and equipment

**Task- 1**: Operate mechanical screw oil presser

| LG # 43 | LO #3 - Shut down the mechanical extraction process |
|---|---|

**Instruction sheet**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Shutting down the mechanical extraction process
- Identifying and reporting maintenance requirements

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Shutdown the mechanical extraction process
- Identify and report maintenance requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

## Information Sheet 1- Shutting down the mechanical extraction process

### 1.1 Shutting down the mechanical extraction process

In mechanical oil extraction process, oil extraction equipment such as screw press, screw conveyor, cooker, hydraulic press, screener, filter press, and cake crushes are shut down after finishing product manufacturing.

Shutdown procedure may include but not limited to:

- The appropriate shutdown procedure is identified.
- The process is shut down according to shutdown procedures.
- Maintenance requirements are identified and reported according to workplace reporting requirements.

During hydraulic press operation, after extracting the oil and separating the by-product (cake or meal) you have to shut down the extraction process. This process are;

- First switch off power
- Un-plug power socket
- Clean external parts
- Clean internal parts like, screw or barrel
- If maintenance are needed, check all parts, tied bolts.

| Self-Check 1 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write shutdown mechanical oil procedure (4pts )
2. Write shutdown process for hydraulic press (6pts )

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

## Information Sheet 2- Identifying and reporting maintenance requirements

### 2.1 Introduction

Maintenance is a general upkeep and repair of equipment, buildings and grounds, heating and air-conditioning; removing toxic wastes; parking; and perhaps security

Food premises and equipment that are not kept in good repair and condition are a potential source of microbiological and physical contamination of food. Poorly maintained premises and equipment cannot be cleaned effectively. Poor maintenance may allow the entry of other sources of physical, microbiological and chemical contaminants such as water, pests and dust. Poor maintenance can have health and safety implications for workers.

### 2.2 Identifying and reporting maintenance requirements

To minimize the hazards that might be happen during equipment operation, you have to check that the equipment was in a god operating condition or not. If there is a defects on it, report and undertake maintenance before starting operate equipment.

The maintenance that needed may be adjusting thermocouple, pressure sensors, some components of a machine or equipment and etc.

### 2.3 Maintenance activities

Maintenance of equipment was the basic and mandatory activities in an industry. Many hazards that might be happen was due to lack of maintenance activities before, during and after operating a machine or an equipment. The following are the maintenance activities that will be done in a food processing industries. Such as:

- Operational maintenance (e.g. connection-disconnection of hoses, greasing, lubrication and lubricant systems, adjusting sealing glands, cleaning and changing filters, 'nipping up' flanges)
- General cleaning

- Removal and replacement (e.g. gland packing, changing blades or cutters, replacing gaskets, replacing /maintaining seals, changing filter elements, servicing strainers).

### 2.4 Routine maintenance

Routine maintenance tasks refer to on-going, scheduled tasks that are performed in order to keep hand tools and basic equipment functioning properly. It could include tasks such as unblocking pipes and nozzles, sharpening blunt tools, cleaning nozzles on sprayers, checking water and oil levels in machinery, cables and plugs.

#### 2.4.1 Some tips on routine maintenance, we have to follows

- Use the correct tool for the job
- Keep tools in good condition
- Handles should be tight and free from defect
- Cutting tools should be kept sharp
- Use and maintain power tools according to their operator instructions
- Make sure power tools are properly grounded or are double insulated
- Switch off and unplug power tools before changing blades or servicing and repairing
- Wear appropriate personal protective equipment (PPE), such as glasses, goggles, dust masks, face shields, hearing protection, etc.
- Keep all guards and shields in place
- Unplug and store tools after use

#### 2.4.2 Routine maintenance tasks

**Table 2: Routine maintenance tasks check list**

| Tool | YES | NO |
|---|---|---|
| 1. Are tools in safe condition? | | |
| 2. Are instruction manuals available? | | |
| 3. Are power tools properly grounded? | | |
| 4. Are guards and shields in place? | | |
| 5. Is Personal Protective Equipment available? | | |

| | | |
|---|---|---|
| 6. Are tools properly stored? | | |

During Routine maintenance tasks we perform the following tasks.

- Tighten nuts and bolts.
- Smooth off splinters and sharp points.
- Tighten shafts.
- Oil exposed steel e.g. spades, shovels and forks.
- Unblock pipes and nozzles.
- Sharpen blunt tools.
- Clean nozzles on sprayers.
- Check water and oil levels in machinery.
- Check and maintain cables and plugs.

### 2.4.3 Scheduling routine maintenance

Some tools may require daily checks and maintenance after use. Other tools, such as power tools, usually must be checked once in 6 months or so. More complicated power tools would need to be serviced on a regular interval

A maintenance schedule assigns a specific date to specific maintenance tasks.

It states what has to be checked and will require that the assigned person signs off the document assuring that the checks were done.

If faults are found, the tool must be sent for maintenance and the assigned person that fixes the tool has to report on exactly what was done and when it was completed.

- An example of a checklist used for maintenance request was given below:

**Table 3: Routine maintenance checklist**

| Date | Tool | Maintenance check points | Signature | Maintenance required | Signature |
|---|---|---|---|---|---|
| 14-10 /2011 | Spades | Handle | Mr. A | None | |
| | | Shaft | Mr. A | Splinters shaved | Mr. B |

| | | | | | |
|---|---|---|---|---|---|
| | | | | off | |
| | | Blade | Mr. A | None | |

- Maintenance performed were reported using a checklist below.

**Table 3: maintenance report checklist**

| Maintenance Performed | Date | Signature |
|---|---|---|
| Splinters shaved off | 16-10/2011 | Mr. B |

| Self-Check 2 | Written Test |
|---|---|

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define maintenance (4pts )
2. Write maintenance activities that will be done in a food processing industries (6pts)
3. What are routine maintenance tasks you perform in an industry? (5pts)

***Note:*** **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

**List of Reference Material**


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- Essentials of Food Science, third edition Elizabeth W. Christian; Department of Nutrition and Food Sciences
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**AKNOWLEDGEMENT**

We wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

We would like also to express our appreciation to the TVET Instructors and respective industry experts of Regional TVET Beau rues, TVET College/ Institutes, BEAR II Project, UNESCO and Federal Technical and Vocational Education and Training Agency (FTVET) who made the development of this Teaching, Training and Learning Materials (TTLM) with required standards and quality possible.

This Teaching, Training and Learning Materials (TTLM) were developed on October 2020 at Bishoftu Management Institute Center.

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