Edible Oil and Fats Processing

Level-III

Based on October 2019, Version2 Occupational standards (OS) and March, 2021 v1 curriculum

Module Title: Operating a Winterization /de-waxing /Process

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LG # 38	LO #1 Prepare the Winterization Equipment for Processing

Instruction Sheet

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

- Confirming Materials to meet operating requirements
- Identifying and confirming Cleaning and maintenance requirements
- Confirming different services
- Fitting and adjusting machine components and related attachments
- Entering production parameters as required
- Checking and adjusting Winterization/de-waxing equipment performance
- Workplace information requirements
- Carrying out Pre-start checks as required

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:

- Confirm materials to meet operating requirements
- Identify and confirm cleaning and maintenance requirements
- Confirm different services
- Fit and adjust machine components and related attachments
- Enter production parameters as required
- Check and adjust Winterization/de-waxing equipment performance
- Workplace information requirements
- Carry out Pre-start checks as required

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
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet 1- Confirming Materials to Meet Operating Requirements

1.1 Introduction

A large portion of the high melting material can be removed from oils by a process known as "winterizing" in which the oils are carefully cooled to low temperatures for extended periods of time to permit precipitation of solid material. Solid material can then be removed by pressing or other separation procedures. However, not all of the high melting solid material is removed from oils by winterizing, and the oil still tends to cloud when stored for extended periods of time at low temperature. Moreover, the usual winterizing treatment undesirably tends to remove by entrainment a substantial portion of the olein fraction of the oil. This process is useful for processing oils which contain waxes such as sunflower, safflower, or corn oil. A number of oils such as those mentioned above contain small quantities of waxes which are derived from the seed coats during crude oil extraction. These waxes precipitate at room temperatures or lower, making the oils unsuitable for use in salad oils. In the past these waxes have been partially removed by expensive processes involving low temperature crystallization and filtration at very slow rates.

1.2 Confirming materials

confirm materials based on operation specifications and how many materials you have used to execute an operation.

1.3 Materials used for winterization/dewaxing

- Bleached oil
- Filter aid
- Filter cloths
- Papers and/or bags
- Freon gas/ammonia

- **Bleached oil**

The water washed oil is sent to bleach. The soap is sent to acidulation where it is split with sulfuric acid to recover the fatty acids. The bleached oil is sent to various processing steps, such as: winterization, hydrogenation, product formulation, deodorization

- **Filter aid**

Filter ides are materials used for filtration of crude oil. Filtration is very important that the crude oil coming into the refining process be filtered. It is done either in basket strainers or in disc-stack filters. The solid impurities, such as the meal, the hull, dirt, etc., are removed in this process. Without this step, the centrifuge bowl of the primary separator gets dirty soon and requires more frequent cleaning. This is true even for the self-cleaning centrifuge. Perlite and kieselguhr were used as filter aid materials in concentrations of 0.3 and 0.6%, respectively. The winterization process was carried out in three different periods of time (6 h, 12 h and 24 h) and in two replications. Also, a control winterization was performed without adding any filter aid materials.

1.4 Purpose of confirming materials availability

- To achieve the exact winterization processing goal/pure oil
- To ensure the performance of materials
- To maintain the materials if it is needed

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List materials used for winterization process? (5 points)
2. What are planed materials? (2 points)
3. Write the purpose of confirming materials? (3 points)

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

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

Information Sheet 2- Identifying and Confirming Cleaning and Maintenance Requirements

2.1 Introduction

All equipment requires periodic sanitation. Failure to practice proper sanitation or maintenance procedures as noted in the equipment manual can lead to unsafe conditions. Maintain optimum equipment sanitation to promote product quality and safe operating conditions.

2.2 Edible oil refinery equipment cleaning and maintenance rules

The maintenance of edible oil refinery equipment an essential step in the entire operation of the edible oil refinery plant. Regular cleaning and maintenance can extend the service life of the edible oil refinery equipment and can also prevent the leakage of the thermal oil. Now, for everybody, edible oil refinery equipment maintenance rules.

First, ensure the surface of edible oil refinery equipment is clean. The surface of the cylinder piston is most likely covered with dust. If it is not cleaned in time, it can easily cause mechanical wear. Regularly cleaning the dirt on the surface of the cylinder piston can reduce unnecessary mechanical wear and improve the operation efficiency of the edible oil refinery equipment.

Second, when used, the pressure of the oil pump should not be too fast, or the pressure equipment and its accessories will be damaged because the hydraulic system is impacted, which influences the service life of the cooking oil refining equipment and perhaps cause oil back into cylinder.

Third, if a small-scale edible oil refinery equipment needs a handle operation, do not lengthen the length of the handle on purpose, which may reduce the mechanical wear of other equipment parts.

Fourth, check the usage frequently, especially the parts that are easily damaged in cooking oil refining equipment.

2.3 Advantages of maintenance and cleaning equipment

- Increasing the cooking oil yield, reducing the oil loss in cakes.
- Improving the quality of refined oil, cake and meal.
- Adding processing capacity of cleaning equipment and oil pressing machine.
- Ensuring safe working and clean working environment.

2.4 Different type of maintenance and their importance

Proper maintenance is critical to personnel safety, smooth equipment operation and lasting performance. A production system or individual piece of equipment requires regular maintenance to help promote equipment safety, provide an optimum end product and to prevent costly down time. Failure to practice proper maintenance procedures lead to unsafe conditions and shorten the life of the equipment. A preventive maintenance program is imperative. Prior to any maintenance procedure, turn the equipment OFF and disconnect all power sources. Follow the lockout procedure. Failure to follow this warning could result in death or severe personal injury.

Production systems are dangerous during operation. Death or severe personal injury may result if warnings are disregarded. When working on or around all equipment, avoid the use of loose clothing, jewelry or any loose articles that may be caught in moving parts. Keep all extremities away from moving parts. Never operate any equipment while other persons are cleaning, servicing, or performing maintenance. Wear personal protective equipment (safety garments, safety glasses, gloves, etc.) appropriate for the maintenance process to be performed.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write advantages of maintenance and cleaning of equipment's? (5 points)
2. Describe the role of cleaning and maintenance? (5 points)

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

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

Information Sheet 3- Confirming different services

3.1 Services for winterization

All services or utilities that could impact on product quality and process should be qualified and appropriately monitored.

Oil processing processes require such utilities as:

- Energy in the form of steam, electricity and hot water.
- Water for cooling and cleaning.
- Compressed gases such as air and nitrogen for control purposes, oil protection and blowing.

3.1.1 Heating

During processing, oil needs to be heated at the following stages:

- At arrival: heating to storage temperature (for oils which are stored in heated tanks), in case of a temperature drop during transport.
- In the tank park: to compensate for heat losses during storage in heated tanks.
- From storage temperature to first process temperature (for neutralization, 95 ◦C; for bleaching, 70–120 ◦C): continuous processes may have heat recovery; the oil output has a temperature lower than the process temperature.
- In chemical refining: from neutralized oil storage temperature to bleaching temperature.
- In hydrogenation: oil needs to be heated to the temperature at which the reaction starts (120–150 ◦C); the reaction itself produces heat.
- In IEC: the oil must be heated to drying temperature (max. 110 ◦C); the IEE temperature is relatively low (70 ◦C) and no additional heating is required.
- In dewaxing after bleaching: the oil needs to be heated from dewaxing temperature to buffer temperature, or directly to deodorization temperature.

- From bleached oil buffer temperature to deodorization temperature: this is by far the largest temperature difference; heat recovery is normally applied.
- In fractionation: the stearin needs to be melted and heated to 15 ◦C above melting point.
- In refined oil storage: the temperature needs to be maintained at 15 ◦C above melting point.

3.1.2 Open steam and vacuum

In the refining process, vacuum is used for drying (after neutralization, during bleaching, before interesterification) and degassing (to evacuate hydrogen from a hydrogenation vessel and for deaeration before deodorization), and to enhance the stripping effect of open steam in deodorization.

3.1.3 Electrical energy

General electricity use is through consumption by pumps, stirrers, electrical tracing and heating, lighting and the process control system. Specific machines with relatively high electricity consumptions are:

- Centrifuges in deep degumming and neutralization.
- Cooling compressors in dewaxing, fractionation and dry condensing.
- Cooling water circulation pumps and cooling towers.
- Vacuum pumps.

3.1.4 Cooling water

In oil refining, the refined oil will leave the site at more or less the same temperature as that at which it entered the site. Hence the net effect of heating to process temperatures (after heat recovery) should be compensated for by cooling. Cooling to temperatures slightly above ambient can be achieved by circulating the cooling water that passes the process heat exchangers directly over a cooling tower. Cooling to temperatures slightly above the nearby open-water (river, lake or sea) temperature can be achieved by

circulation of open water directly through the process heat exchangers. To minimize the risk of pollution and corrosion of the process heat exchangers, it is preferable to cool indirectly. A closed loop that passes the process heat exchangers will exchange heat with open water in a secondary heat exchanger. In oil modification, the temperature of the product leaving the site may be different (in general higher) than that of the product entering the site.

3.1.5 Gases

Compressed air is mainly used for control purposes as a driving gas for controlling valves. Compressed air is sometimes used to blow filter cake at low temperature after dewaxing. It is not recommended to use air blowing at high temperatures after bleaching, because of the fire risk.

Compressed nitrogen has several applications:

- As a gas blanket in storage tanks of sensitive oils, to reduce oxidation.
- To blow filter cake after bleaching and catalyst filter cake after hydrogenation.
- As sparging gas in the outlet pipeline of a deodorizer, to reduce the risk of air entrainment.
- To blow pipelines.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Mention and explain utilities for dewaxing? (5 points)
2. Write the uses of steam? (5 points)

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

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

Information Sheet 4- Fitting and adjusting machine components and related attachments

4.1 Fitting and adjusting machine components

Fit is defined as a degree of tightness or looseness between two mating parts to perform definite function when they are assembled together. A fit may result either in a movable joint or a fixed joint. The three main categories are: Clearance fit. Transition fit. Interference fit.

Fitting - Make correct and proper the machine/equipment components for the pre-processing of oilseed cleaning.

Adjusting **-** Prepare**/** checking the cleanliness, power and operation of oilseed cleaning machines, equipment and containers.

Adjusting a machine tool demands to connect the active part of the tool with the machined surface. This work does not succeed at the first time because there are a lot of errors or uncertainties due to the adjustment operation and the machining process as well as the static or dynamic behavior of the machine tool, the tool or the work piece. In return, the dimension of machined quantity is more complicated, it assures the respect of the functional requirement. So, in practice, for adjustment correction, these requirements must be translating into a dimension compatible with a length (dimension of displayed quantity). Therefore, the aim of the measurement task is to evaluate the respect of the function and to give a measured quantity compatible with the adjustment parameters. The difference between displayed quantity and measured quantity gives the value of the correction of the adjustment parameter. Those uncertainties are the causes of manufacturing deviations.

To control the influence of some uncertainties machine-tool builder put some adjustment parameters into the numerical control unit or adjustable stops on conventional machine tool. The modification of these parameters allows to moving the uncertainty zone compared with its nominal position. The dimension of this displayed quantity

(adjustment parameter) is the length. Before allowing someone to start using any machine you need to think about what risks there are and how these can be managed and the operator should be checking the main parts of the equipment appropriately and identify faulty and unfit parts or components of the machine then adjust and fit all parts or components of the machine identified based on operation procedure standards.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Define the term fitting and adjusting? (5 points)
2. Write the function of fitting and adjusting machines? (5 points)

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

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

Information Sheet 5- Entering Production Parameters as Required

5.1 Entering Production Parameters

Production parameters

Any changes to operating parameters should be made gradually so that the effect of the changes can be monitored and corrective action taken if required. Operation parameters are:

- Voltage/power needed
- PH
- Pressure
- Temperature

- **Voltage/power needed**

Most motors at the plant are operated with 110 V/60 H power. Motors with high horse power are operated at 440 V 3 Phase AC power supply. The control circuit is operated at 24 V, reduced from 110 V supply line.

The process supervisor should be familiar with the following:

1. Horse power and the operating voltage for every motor in the area.
2. Location of the control panel (motor control center, MCC).
3. Location of the electrical switch and cut-off for every motor.
4. How to check whether a motor has tripped for some reason and how to restart it at the motor control panel.
5. When replacing a motor in an explosive environment, the new motor must be of explosion-proof type.

- **Temperature**

During processing, oil needs to be heated at the following stages:

At arrival: heating to storage temperature (for oils which are stored in heated tanks), in case of a temperature drop during transport.

In the tank park: to compensate for heat losses during storage in heated tanks.

From storage temperature to first process temperature (for neutralization, 95 °C; for bleaching, 70–120 ◦C): continuous processes may have heat recovery; the oil output has a temperature lower than the process temperature.

In dewaxing after bleaching: the oil needs to be heated from dewaxing temperature to buffer temperature, or directly to deodorization temperature.

In refined oil storage: the temperature needs to be maintained at 15 °C above melting point.

5.2 Condition monitoring

Condition monitoring is the process of monitoring a parameter of condition in machinery (pressure, speed, temperature etc.), in order to identify a significant change which is indicative of a developing fault. It is a major component of predictive maintenance. The use of condition monitoring allows maintenance to be scheduled, or other actions to be taken to prevent consequential damages and avoid its consequences. Condition monitoring has a unique benefit in that conditions that would shorten normal lifespan can be addressed before they develop into a major failure. Condition monitoring techniques are normally used on rotating equipment, auxiliary systems and other machinery (compressors, pumps, electric motors, internal combustion engines, presses), while periodic inspection using non-destructive testing (NDT) techniques and fit for service (FFS) evaluation are used for static plant equipment such as steam boilers, piping and heat exchangers.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write the main production parameters? (5 points)
2. What is condition monitoring? (5 points)

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

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

Information Sheet 6- Checking and Adjusting Winterization/De-Waxing Equipment Performance

6.1 Checking and adjusting equipment

The purpose of checking is to identify whether work equipment can be operated, adjusted and maintained safely with any deterioration detected and remedied before it results in a health and safety risk. Not all work equipment needs formal inspection to ensure safety and, in many cases, a quick visual check before use will be sufficient. However, inspection is necessary for any equipment where significant risks to health and safety may arise from incorrect installation, reinstallation, deterioration or any other circumstances. The need for checking and inspection frequencies should be determined through risk assessment.

- **Checking can vary in its extent, as the following**
  - ✓ Quick checks before use (e.g. electric cable condition on hand-held power tools, functional testing of brakes, lights)
  - ✓ Weekly checks (e.g. presence of guarding, function of safety devices, tire pressures, and the condition of windows, mirrors and on mobile plant)
  - ✓ More extensive examinations, undertaken every few months or longer (e.g. general condition of a ladder, close examination of a safety harness, portable appliance testing)

6.2 Equipment's for winterization process

- Tankers
- Pumps
- Chilling Unit (Quick Cooler, Crystallizer)
- Winterizing/De- Waxing Vessel
- Filtration Equipment

- Filter Aid Addition System

- **Tankers**

1. Crude oil storage tanks must have side entering mechanical agitators. Without agitation, the gum settles to the bottom of the tank causing hydrolysis the neutral oil. This increased refining loss and increases the potential flavor reversion (in soybean oil) as discussed earlier. Fig.1 shows the schematic diagram for crude oil storage.
2. The agitator must have a low-level cut-off switch to avoid whipping of the oil by the impeller.
3. The oil must be stored at ambient temperature of 68–95°F (20–35°C) for all seed oils and palm olein.

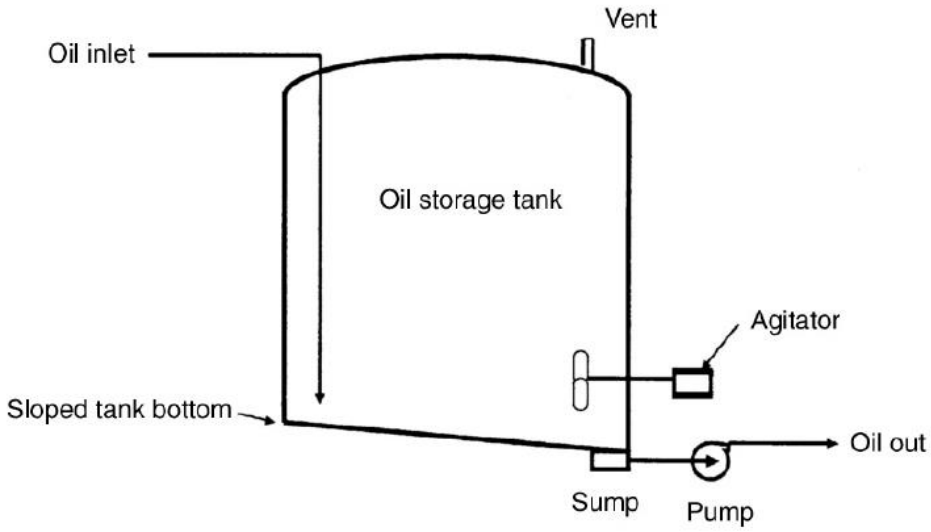

Figure 1 A typical oil storage tank

- **Pumps**

Pumps are one of the vital process accessories at the oil processing plant. These are used to transfer oils between tanks, pump oil through the process, unload and load trucks and rail cars, transfer oil out of various process unit operations for processing. There are two groups of pumps used in the oil processing plants, namely

1. Nonpositive displacement pumps
2. Positive displacement pumps

The nonpositive displacement pump generates the motive force through the centrifugal force created by an impeller, for example, centrifugal pump. A positive displacement pumps liquid with the help of the motive force generated by the rotating action of the gears or by the reciprocating motion of pistons in the pump. Examples of positive displacement pumps are:

1. gear pumps
2. piston pumps
3. diaphragm pumps

Fig. 2 shows the cut-away view of a centrifugal pump. The other brands will also have very similar internal construction. Table 2 lists some of the important differences between the two categories of pumps. The comparison will indicate the specific contrasts between the two types of pumps.

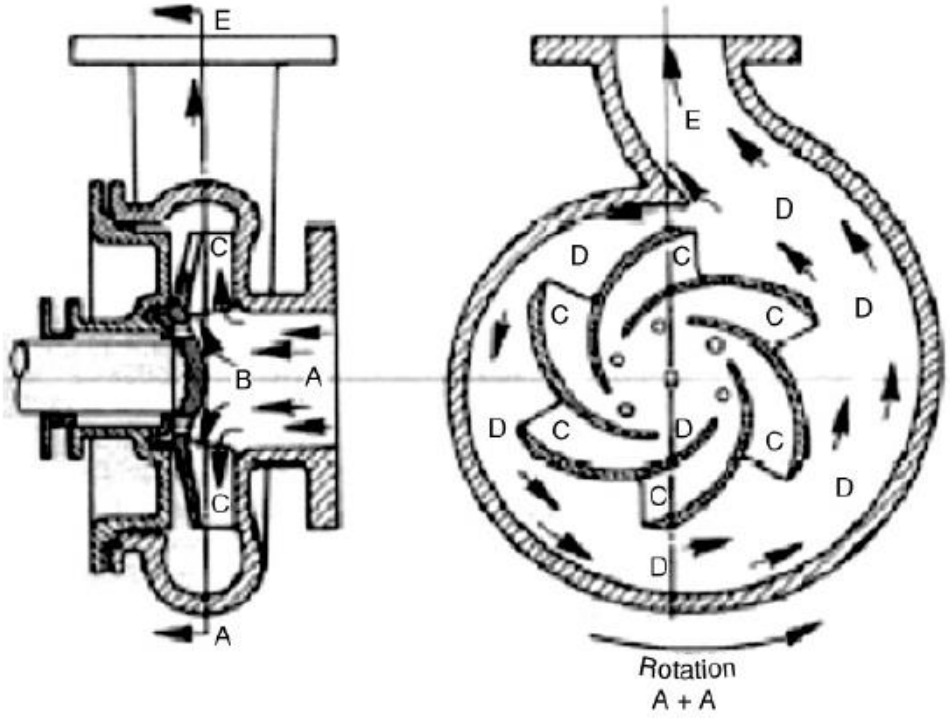

Figure 2 Centrifugal pump.

- **Filtration Equipment**

The oil industry uses three basic types of filters to remove the adsorbents from the bleached oil. They are:

- ✓ plate and frame filters;
- ✓ horizontal pressure leaf filters; and
- ✓ vertical pressure leaf filters.

The filter press has been in use in the vegetable oil industry for many years. These are rugged and dependable filters but the older versions have certain drawbacks in terms of oil quality.

- ✓ **Plate and Frame Filters**

Fig. 2 A–B show the typical filter press used in the oil processing industry.

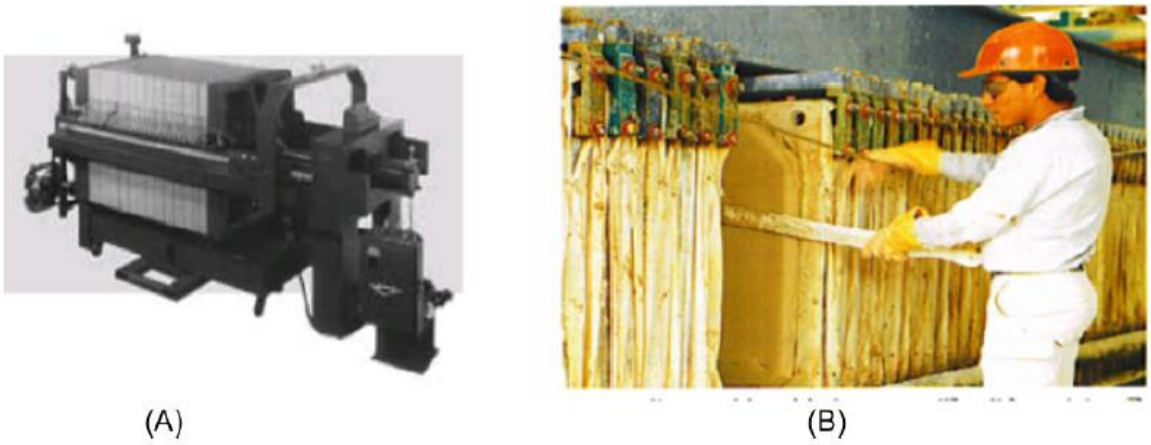

Figure 3 (A) Plate and (B) frame filters

- **Pressure Leaf Filters (Horizontal and Vertical Tanks)**

Fig. 3 shows the pressure leaf filters with horizontal as well as vertical tanks. The leaves are all in the vertical position, regardless of the type of the tank. Fig.3A shows the vertical tank vertical pressure leaf filter where the screens have to be lifted for inspecting or complete cleaning of the screens. Fig. 3B shows the horizontal tank vertical pressure leaf filter. Some filter manufacturers have the tank in the fixed position and the leaves are moved out by a hydraulic mechanism for cleaning and inspection of the screens. On

the other hand, some manufacturers have the filter screens remain stationary and the tank slides out. The end result is the same in either case. There are advantages and disadvantages in both designs (Vertical and Horizontal leaf filters). These are summarized in following sections.

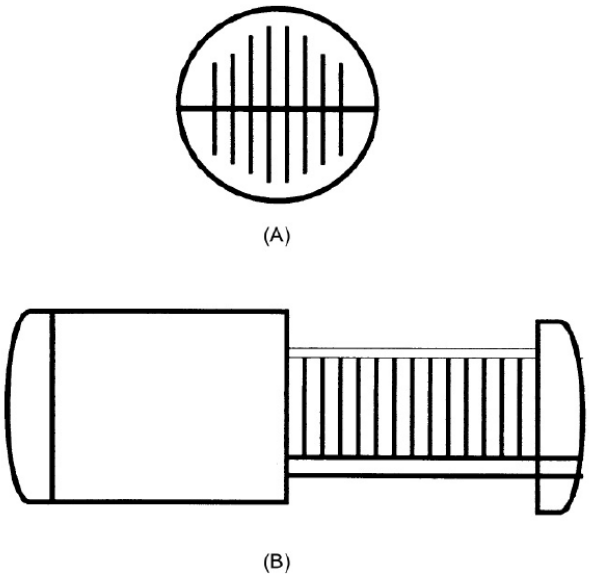

Figure 4 Filter screen arrangements in Vertical and Horizontal Tank Pressure Leaf

Figure 5 Edible oil refining equipment's

Figure 6 Winterization line for production of edible oil

Figure 7 Winterization/dewaxing equipment's

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write the purpose of checking equipment performance? (5 points)
2. Mention the types of checks performed? (5 points)
3. List at least 5 equipment's for winterization process? (5 points)

Note: Satisfactory rating - 15 points Unsatisfactory - below 15 points
You can ask you teacher for the copy of the correct answers.

Information Sheet 7- Workplace Information Requirements

7.1 Work place information

Each workplace relies on the exchange of information to carry out its daily business. Information is passed from employee to employee, customer to employee, supervisor to team member, supplier to customer, and so on. Dealing effectively with information and records is necessary and important for all organisations. The quantity and variety of information kept by an organisation can be huge. Information needs to be sorted into related groups so that it can be stored easily and found when needed. An organisation's success depends largely on how well it manages its information. Work place information includes the following:

- Standard Operating Procedures (SOPs)
- specifications
- production schedules and instructions
- manufacturers' advice
- standard forms and reports

7.1.1 Standard Operating Procedures (SOPs)

Standard operating procedures are 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. A standard operating procedure 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

standard operating procedure, in fact, defines expected practices in all businesseswhere quality standards exist. Standard operating procedures play an important role in your small business. Standard operating procedures are policies, procedures and standards you need in the operations, marketing and administration disciplines within the business to ensure success.

These can create:

- Efficiencies, and 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.

7.1.2 Specification

A specification is exact statement of the particular need to be satisfied, or essential characteristics that customer requires (in a good, material, methods, process, service, or work).

7.1.3 Production schedules and instructions

In production scheduling the products to be manufactured and their quantities are determined initially. The sequence of manufacturing processes required for the production of these items are also established. The manufacturing resources are then allocated to perform production processes to realize various items. This is spread over a

predetermined time. This function is known as production scheduling. The objectives of scheduling also include maximization of the resource utilization, minimization of the work-in-process inventory, reduction of manufacturing lead time, etc.

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Mention work place information's? (5 points)
2. What are standard operating procedures? (5 points)
3. Define specification? (5 points)

Note: Satisfactory rating - 15 points Unsatisfactory - below 15 points

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

Information Sheet 8- Carrying Out Pre-Start Checks as Required

8.1 Introduction

In oil winterization/ dewaxing process, before going to operate machine we have to inspect /check whether it was in a good operating condition or not. Checking conditions of operating equipment has a vital role for the operator"s safety, quality of a product and also for equipment safety. Undertaking a pre-start check on your machine before you start a day's work, happens in three stages.

Step1 visual inspection of important features prior to starting the machine

Step2 visual and function tests while the machine is turned on but stationary

Step3 testing the machines functions during a short drive.

8.2 Conduct checks on machine/equipment

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

- Check that it is complete, all equipment parts fitted correctly, and free from defects.
- 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.
- Choose the right machine for the job.

Make sure the machine/ equipment is:

- 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.

Self-Check – 8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write steps of undertaking prestart checks? (5 points)
2. What is prestart check mean? (5 points)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points
You can ask you teacher for the copy of the correct answers.

Operation Sheet –1 Conduct Pre-Start Checks

Sequence of conducting prestart checks

Objectives of pre-start checks:

- To inspect equipment condition
- To make safe for any work that has to be done
- To switch off, isolat or lock-off properly before taking any action to remove blockages, clean or adjust the machine.

1. Wear personal protective equipment's
2. Inspect equipment condition
3. Identify any signs of wear,
4. Confirm availability of tank storage space,
5. Select appropriate settings and/or related parameters,
6. Confirm the equipment is clean and correctly configured for winterization process requirements,
7. Position sensors and controls correctly,
8. Ensure any scheduled maintenance has been carried out,
9. Confirm that all safety guards are in place and operational
10. Record the task

Lap Test	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 **30** min. The project is expected from each student to do it.

Task-1 Conduct prestart checks

LG # 39	LO #2 Operate and Monitor the Winterization/De-Waxing Process

Instruction sheet

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

- Workplace policies and procedures for de-waxing process
- Basic operating principles of equipment
- Starting and operating winterization/de-waxing process
- Monitoring operation of equipment to identify variation
- Identifying variation in equipment operation and reporting maintenance requirements
- Monitoring winterization/de-waxing process to meet cold test specifications.
- Identifying, rectifying and reporting out-of-specification products
- Maintaining work area to housekeeping standards.
- Maintaining workplace records

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:

- Identify workplace policies and procedures for de-waxing process
- Identify basic operating principles of equipment
- Start and operate winterization/de-waxing process
- Monitor operation of equipment to identify variation
- Identify variation in equipment operation and reporting maintenance requirements

- Monitor winterization/de-waxing process to meet cold test specifications.
- Identify, rectify and report out-of-specification products
- Maintain work area to housekeeping standards.
- Maintain workplace records

Learning Instructions:

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

Information Sheet 1- Workplace Policies and Procedures

1.1 Introduction

Policy is a set of general guidelines that outline the organization's plan for tackling an issue. Policies communicate the connection between the organization's vision and values and its day-to-day operations. Procedure explains a specific action plan for carrying out a policy. Procedures tells employees how to deal with a situation and when. Using policies and procedures together gives employees a well-rounded view of their workplace. They know the type of culture that the organization is striving for, what behavior is expected of them and how to achieve both of these.

1.2 The importance of policies and procedures

Regardless of your organization's size, developing formal policies and procedures can make it run much more smoothly and efficiently. They communicate the values and vision of the organization, ensuring employees understand exactly what is expected of them in certain situations.

Well-written workplace 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.

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Implementing these documents also improves the way an organization looks from the outside. Formal policies and procedures help to ensure your company complies with relevant regulations. They also demonstrate that organizations are efficient, professional and stable. This can lead to stronger business relationships and a better public reputation.

Policies and procedures include:

- Work is carried out according to company policies and procedures, regulatory and licensing requirements, legislative requirements, and industrial awards and agreements.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Define policy and procedure? (5 points)
2. Write the importance of policies and procedures? (5 points)

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

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

Information Sheet 2- Basic Operating Principles of Equipment

2.1 Operating Principles of equipment

During starting and operating edible oil refining equipment, the basic operating principles followed include:

- Selection of appropriate materials and equipment used in case of oil seed cleaning
- Checking main equipment components,
- Checking status and purpose of guards,
- Maintaining equipment operating capacities and applications,
- Purpose and location of sensors and related feedback instrumentation
- The safe operation and maintenance of oil seed cleaning materials and equipment.
- Hazard and risk identification.
- Emergency operating and defensive operating procedures ensuring working loads are secure and within specifications.
- Appropriate use, maintenance and storage of personal protective equipment.
- Protection of people in the workplace.

2.2 Basic safety principles

The following list includes basic rules that apply to portable and fixed machinery:

- Follow the equipment manufacturer's recommendations
- Use equipment only for the purpose for which its design is intended
- Operate the tool at the speed and tension specified by the manufacturer
- Inspect the equipment visually before use
- Remove unadjusted, defective, cracked, or worn parts from service
- Maintain sharp and clean parts
- When provided, use equipment with an exhaust or dust-collection system

- Use the appropriate size and type of part for the material and cutting action
- Check to see that guards, guides, and counterweights are properly adjusted and operable
- Avoid overheating the equipment

2.3 Work practices

- Use only tools you can control easily
- Make sure hands are kept at a safe distance
- Follow safe procedures as outlined in the operator's manual
- Always wear eye and face protection and other appropriate personal protective equipment
- Do not wear loose clothing or long hair
- Check to see that power cords are kept away from the line of cut and other moving parts
- Follow proper lockout/tagout procedures during service and repair
- Never defeat the guard to expose the blade
- Never reach under the saw, work piece, or any place you can't see clearly
- Direct the operation away from your body

2.4 Work environment

- Practice good housekeeping avoid crowded, cluttered conditions
- Make sure combustible or flammable material is located away from spark-producing
- operations
- Provide adequate ventilation to reduce dust and other air contaminants
- Monitor noise levels and provide hearing protection when necessary

2.5 Precautions for edible oil dewaxing machine

- Before cooling, oil should be heated firstly to make the wax which has been precipitated at room temperature(wax precipitates when room temperature is lower than the crystallization temperature.) completely dissolved in oil liquid, which can enhance the following dewaxing effect.
- The oil cooling speed should be even which shouldn't be too fast.
- After cooling for 72 hours, the crystallized wax need be matured for 12~16 hours to make it grow big.
- When separating, you can use two plate filters for filtering to keep continuous working.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write the basic operating principles of equipment? (5 points)
2. Write basic safety principles? (5 points)

Note: **Satisfactory rating - 15 points** **Unsatisfactory - below 15 points**

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

Information Sheet 3- Starting and Operating Winterization/De-Waxing Process

3.1 Operating winterization/de-waxing process

dewaxing is carried out after bleaching and before deodorization. Dewaxing is done conventionally using filter aid at low temperatures, generally known as winterization (less than 10 °C). Since the melting points of waxes are higher than triglyceride melting points they can be removed by cooling and crystallizing and then can be filtered using MF (Microfiltration Membrane) membranes.

Winterisation: Separation of saturated triacylglycerols from e.g. cottonseed oil and partly hydrogenated oils. Winterization is the process of removing compounds such as fats, lipids, waxes, and chlorophyll from the crude oil before the distillation process. Simply put, the winterization of oil involves taking a nonpolar substance (crude oil) and dissolving it in a polar solvent (ethanol) at sub-zero temperatures. This process is applied to certain seed oils, typically sunflower oil, to achieve an oil that will remain clear at lower temperatures. Dewaxing is achieved by cooling the oil to below the crystallization temperature of its waxes. The crystallized waxes are then removed by filtration.

The descriptive term of winterization evolved from the observation that refined seed oil stored in outside tanks during the winter months physically separated into a hard and clear fraction. Topping or decanting the clear oil from the top of the tanks provided oil that remained liquid without clouding for long periods at cool temperatures. In fact, some cottonseed salad oils routinely had cold test results of 100 hours or more when topped from outside storage tanks. The clear oil portion became known as winterized salad oil. The hard fraction from the bottom of the tanks was identified as stearine, which is the solid portion of any fat.

Some oils are dewaxed before packing so as to remove waxes, which are dissolved in the oil. Most of the oils do not need dewaxing as they contain little or no waxes. Only sunflower oil & Rice Bran oil contain appreciable quantities of wax to give a hazy appearance during winter season due to precipitation of dissolved waxes and hence require to be dewaxed. Dewaxing is carried out by chilling the oil up to 10-15°C followed by filtration of precipitated solids. The oil thus treated gives a sparkling appearance even in winter temperatures.

Dewaxing of sunflower oil is essential when the oil is to be used as salad oil. The presence of wax makes the oil appear cloudy at room temperature. The oil normally becomes cloudy in 5–6h but with proper dewaxing the oil remains clear after 24h of storage at 0˚C.

Table 1 wax content of some oils

Source Oil	Typical Wax Content, %
Sunflower Oil	0.2 to 3.0
Safflower Oil	~ 0.5
Corn Oil	0.5 to 1.0
Canola Oil	~ 0.2

3.2 Type of winterizations

There are three type of Winterizations, which are Dry Winterization, Steam Wet Winterization and Radiant Winterization.

3.2.1 Dry winterization: Dry Heat Systems which by far are the most common, heat the property through forced hot air**.** Properties with dry heat systems will have a furnace to heat air and vents and registers on walls and floors to circulate the hot air in the rooms.

3.2.2 Steam "wet" winterization: Steam Heat systems are those that have a Steam boiler, which generates steam that runs through radiators to heat the house.

3.2.3 Radiant "wet" winterization: Radiant heat systems will have Hot water boiler instead of a Steam Boiler, they will also have expansion tanks and hot water running through either radiators or copper tubing located in the floors, walls and ceilings.

3.3 Winterization principle

Winterization is a thermomechanical separation process where component triglycerides of fats and oils are crystallized from a melt. The two-component fractional crystallization is accomplished with partial solidification and separation of the higher melting triglyceride components. The complex triglycerides may have one, two, or all three fatty acids, either all the same or different in any of the possible configurations depending on the source oil and prior processing.

Fat crystallization occurs in two steps: **nucleation**, and **crystal growth**. The rate of nucleation depends on the triglyceride composition of the oil being winterized, the cooling rate of the oil, the temperature of the nucleation, and the mechanical power input or agitation. Growth rate is dependent on the crystallization temperature, time, and mechanical input or agitation. A careful selection of the process variables for a particular oil is very important. The ideal is to produce a small number of nuclei around which the crystals grow larger in size with cooling. A large mass of small crystals that is difficult to filter results when a large number of nuclei are formed. Poor separation and yield also result when crystals group together in clumps that trap large quantities of the liquid phase. The effect of the major processing variables upon winterization performance is discussed below.

3.3.1 Source oil composition

Nucleation and crystal growth depend on the composition of the oil being winterized. The various triglycerides in a particular oil will fractionate in the following order:

- Tri-saturate, S_3;
- Di-saturate mono-un saturate, S_2U;
- Mono-saturate di-un saturate, SU_2; and
- Tri-un saturate, U_3.

A portion of the higher melting glycerides will be found with the lower melting liquid oils as a result of eutectic formation and equilibrium solubility. Because the mixture of triglycerides in an oil is too complex to predict its phase behavior, a given set of winterization conditions is applicable only for the particular feed oil. For partially hydrogenated oils, the composition of the oil and the hydrogenation conditions affect the winterization yield and quality. Hydrogenation conditions should be selected that produce the lowest level of saturates and trans fatty acids, but still affect the desired iodine value endpoint.

3.3.2 Cooling rate

An essential requirement of the winterization process is a slow rate of chilling.

Rapid cooling of the oil results in:

- A mass of very small α-crystals, and
- A high nucleation rate that increases the viscosity, which, in turn, restricts crystal growth. Slow controlled cooling rates produce stable β- or β′-crystals depending on the dominant crystal habit for the source oil winterized, and the viscosity remains low enough to permit nuclei movement to allow crystal growth. Therefore, the cooling rate is dependent on the source oil and prior processing.

3.3.3 Crystallization temperature

The crystal growth rate is affected by the temperature of crystallization. A high viscosity resulting from too low a temperature reduces the crystal growth rate. Control of the

temperature after crystallization begins is important for transformation from the α to the stable β′- or β-crystal habit. If the process is not properly controlled at this stage, an unstable crystal will develop. A temperature differential between the coolant and the oil must be maintained to avoid shock chilling. A 25°F (14°C) differential has been found appropriate for oil at the beginning of the process. The differential can be reduced to 10°F (5.6°C) by the time the oil reaches 45°F (7.2°C). If the coolant is allowed to become too cold in relation to the oil, a heavy layer of stearin will build up on the surfaces and insulate the oil from the coolant.

Table 1 Common winterization/dewaxing temperature and time

Oil product name	Crystallizationtemperature(℃)	Crystallization time(hour)
Palm oil	30	8-10
Cottonseed oil	0-10	10-12
Sunflower oil	5-10	4-6
Rice bran oil	5-10	4-6

3.3.4 Agitation rate

Crystal formation is hastened by stirring to bring the first crystals into contact with more of the liquid; however, mild agitation rates are recommended because high shear rates fragment the crystal during the growth stage, thus producing smaller crystals instead of the desirable large crystal.

3.3.5 Crystallization time

Crystallization is inseparably linked to two elements of time:

- The time it takes to lower the temperature of the material to the point where crystallization will occur, and
- The time for the crystal to become fully grown. The rate of cooling is a primary factor for determining the size, amount, and stability of the crystals formed. In

general, crystals assume their most highly developed and characteristic forms when grown slowly from a melt or solution only slightly supercooled, in which the liquid freely circulates around the crystal. A typical time–temperature sequence for winterization of cottonseed oil is:

1. Refined and bleached cottonseed oil is transferred to the chilling units at 70 to 89° F (21.1 to 26.7°C).
2. The oil is cooled to 55°F (12.8°C) in 6 to 12 hours, when the first crystals usually appear.
3. The oil is cooled to 45°F (7.2°C) in 12 to 18 hours with a reduced cooling rate. At this point, a 2 to 4°F (1.1 to 2.2°C) heat of crystallization temperature increase should be observed.
4. After the oil temperature drops slightly below the previous low, approximately 42°F (5.6°C), it is maintained at this temperature for approximately 12 hours. This period is critical for the effectiveness of the process. Because the oil is viscous and molecular movement is slow, crystals continue to grow after the minimum temperature is reached.

3.4 Solvent winterization

Salad oil production with the traditional winterization procedure is a slow process. Two-to-three-day chilling time is required for good filtration and yield. Most vegetable oils that cloud at refrigerator temperatures can be solvent winterized for better yields and to produce a salad oil of better quality in less time than by the conventional process. Comparison of the two procedures indicates many similarities.

The major advantage of a solvent winterization system include:

- Viscosity is considerably lower, which allows a faster crystal growth for more rapid stearin separation;
- The salad oil produced has a better resistance to clouding at cool temperatures for longer cold tests; and
- Less liquid oil trapped in the stearin component for higher salad oil yields.

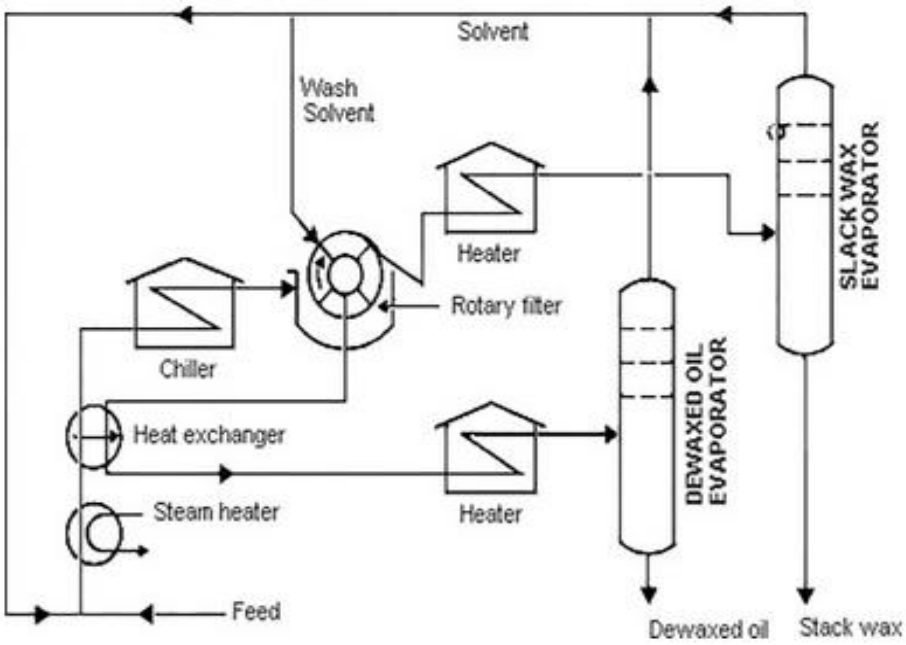

Figure 8 solvent dewaxing unit

Table 2 cottonseed salad oil stearin analysis

Winterization Process	Conventional	Solvent
Iodine value	95.5	71.6
Solids fat index		
50°F/10.0°C	21.6	52.3
70°F/21.1°C	1.3	33.7
80°F/26.7°C	—	1.2
92°F/33.3°C	—	0.1

3.5 Winterization of sunflower seed oil

Crude sunflower oil may contain 300–400 ppm of wax in the oil expelled from well-corticated seeds, and this can be much higher and can be up to 2000 ppm if the seeds are not properly decorticated. The wax content in sunflower oil is reduced through the winterization process. In this process, the oil is heated at first to ensure that all of the waxes are completely melted. The oil is then chilled under controlled cooling rate. This separates the waxes from the oil, which is then separated from the rest of the oil through filtration. Fig.4 shows the schematic diagram for the sunflower oil winterization process.

The typical steps of procedure for the process are described as follows:

- The feed to the winterization process must be of uniform composition. Therefore, it is advised to use oil supply tank with mechanical agitator to maintain uniform conditions for the feed to the chiller. Sometimes it is even referred to as an ocean of oil for feed. agitator to maintain uniform conditions for the feed to the chiller. Sometimes it is even referred to as an ocean of oil for feed.

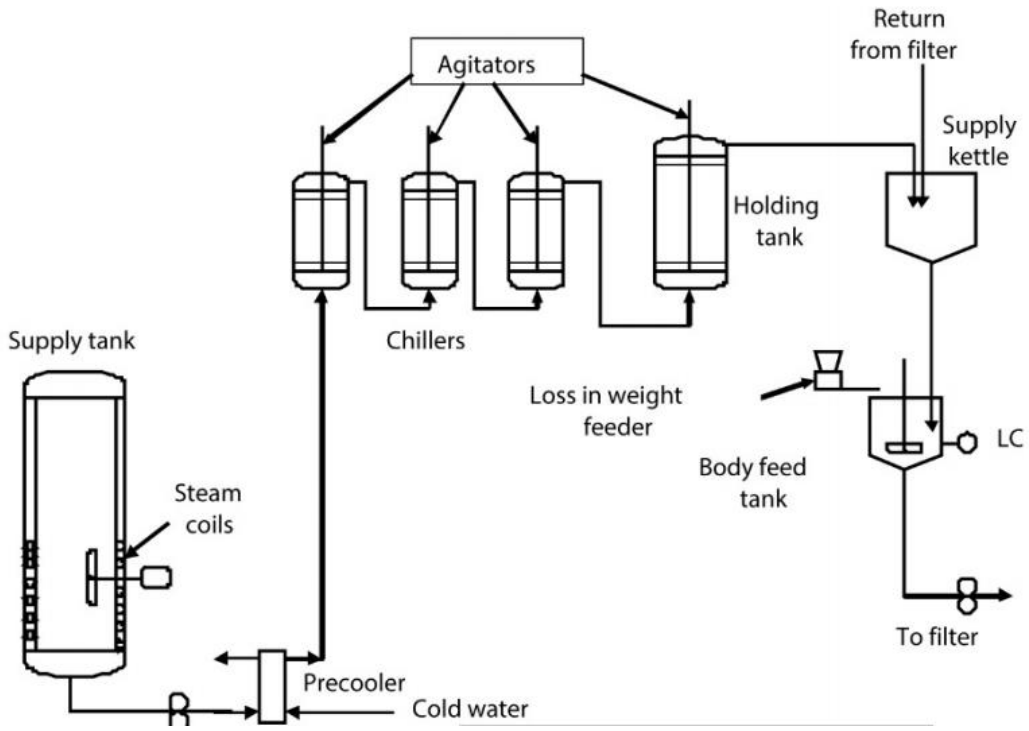

Figure 9 Schematic diagram for sunflower oil winterization process

- The oil from the supply tank is heated to 140°F (60°C)–150°F (66°C) to melt the waxes. The supply tank has a side-entering mechanical agitator, steam coils with temperature controller, and thermodynamic steam trap.
- The oil is then pumped through a precooler to cool the oil to 104°F (40.6°C) as it enters the chiller.
- The chiller is a jacketed stainless-steel tank. The oil is cooled at the rate of 5–7°F/h (3–4°C/h).
- A top-entering scrape-wall agitator running at a speed of 5–10 revolutions per minute (rpm) gently scrapes the inner wall of the chiller. The chilled water in the jacket crystallizes the waxes in the oil. The scrape wall agitator removes the solidified waxes from the walls of the chill tank, keeps them in suspension and, at the same time, keeps the inner wall of the tank free of solids so the heat transfer rate is properly maintained.

- The oil is cooled down to a final temperature of 42–45°F (6–7°C).
- The oil is left in one or two holding tanks for 12–24 h.
- Holding time is critical for the oil for proper growth of the solids.
- The oil is then heated to 50–54°F (10–12°C) to reduce the viscosity of the oil for better pumping.
- The winterized oil is then filtered to separate the solid and the liquid fractions under controlled temperature conditions.
- Wax is removed from the oil in a pressure-leaf filter precoated with diatomaceous earth.
- A constant body feed of diatomaceous earth is maintained in the oil flow into the filter. Without this, the filter screens will clog rapidly, reducing the cycle time for the filter.
- Filtration is stopped as the differential pressure across the screen reaches 30–35 psi (2.18–2.54 kg/cm2).
- The oil inside the filter is blown with air, and the residual oil is blown to the blow down tank. The cake is dried with compressed air. The filter is opened and the cakes are removed from the filter screens.
- Waxes from sunflower oil are collected, the diatomaceous earth is separated, and the wax is sometimes blended with oils to make finished shortening.
- The pressure-leaf filter needs periodic hot oil wash to remove any residual wax on or inside the screens.

3.6 Critical process variables for winterization of sunflower oil

The winterization process is different from the other processing areas in the sense that here the oil is cooled under controlled conditions to separate the solids from the rest of the oil and then filtered. There are several critical process variables that determine the efficiency of the process and the quality of the winterized oil produced. The following are the important process variables for the process:

- incoming oil quality,
- incoming oil temperature,
- cooling rate for the oil,
- final oil temperature,
- agitation during chilling,
- holding time in the chillers, and
- filter operation
  - ✓ filter precoat and body feed
  - ✓ filtration rate
  - ✓ pressure differential across the filter screens
  - ✓ drying the cake
  - ✓ cleaning the filter screens
  - ✓ periodic hot oil washing for cloth screens
  - ✓ cooling the filter after the hot oil wash
  - ✓ maintenance of the filter screens

- **Incoming oil quality**

There are three main impurities in the crude oil that must be reduced with care in the refining and bleaching steps. These are:

Table 3 incoming oil quality

Phosphorus	Must be	<1 ppm
Moisture	Must be	< 0.1%
Soap	Must be	0 ppm

- ✓ Any one of the above impurities at higher level can prematurely blind the filter screens, causing slow filtration.
- ✓ This reduces the filter cycle time and, hence, the productivity.

- ✓ High level of phospholipids (phosphorus) can also interfere with the separation of the solids from the oil in the chillers.

- **Incoming oil temperature**

The oil from the supply tank must be well heated and mixed. As discussed earlier, the desired temperature of the oil is 140°F (65°C) to 150°F (66°C) in order to completely melt the waxes in the oil.

- ✓ The temperature of the oil must be well above the complete melt point of the waxes.
- ✓ A low temperature may cause prenucleation of the high melting fraction. This can cause the following production difficulties:
  - Interference with the growth of proper characteristics for the crystals,
  - Poor separation in the chiller, and
  - Slowing down of the filtration rate.

A very high temperature will increase the energy cost to precool the oil.

- **Cooling rate for the oil**

The rate of cooling is maintained within a certain temperature range to have controlled formation of the nuclei that would promote the crystal growth.

- A rapid cooling rate forms small crystal, which is not desirable in winterization because small crystals can reduce the filtration rate requiring:
  - ✓ Frequent cleaning of the filter,
  - ✓ Reduced filter throughput.
- Slower cooling rate produces larger crystals. This does not impair the flow of oil through the filter. Therefore, improved productivity can be achieved.
- The cooling rate for the oil at any plant needs to be established in order to maximize total productivity in winterization.

- **Final oil temperature**

The final oil temperature in the chiller is 42–45°F (6–7°C). A lower temperature is not necessary. It can also increase the oil viscosity and slow down the filtration rate. At higher temperature, there may be some no crystallized wax left in the oil. This will reduce the cold test of the winterized oil.

- **Agitation**

The oil in the chiller is agitated with a scrape-wall agitator operated at a speed of 5–10 rpm. This agitator removes the solids formed on the wall and keeps the wall surface clean for better heat transfer. A higher speed can agitate the solids too much and disturb the crystal matrix.

- **Holding time**

The chilled oil is held in a holding tank for 12– 24 h for complete crystallization. Sometimes the oil is held for only 4–6 h before filtering. Reduced holding time may reduce the cold test of the winterized oil. This should be tested by the plant. This will also vary with the wax content of the incoming crude oil. Therefore, a longer holding time covers for the higher wax content of the crude oil. Holding tanks are jacketed chilled tanks with temperature control to hold it within ±2°F (±1°C).

- **Filter operation**

Filter precoat and body feed

About 0.25% of diatomaceous earth is added continuously to the oil feed to the filter. This is done with a precision feeder (like a loss-in-weight type feeder) and the diatomaceous earth is dispersed in the oil in a small feed tank before the filter.

Addition of diatomaceous earth as body feed is vital for the operation of the filter.

In the absence of the body feed:

- ✓ The screens get plugged up by the waxes.
- ✓ The pressure differential increases rapidly across the filter screen.

- ✓ The filter loses its throughput.
- ✓ Productivity is decreased.

Filtration rate

The recommended filtration rate 0.015 gpm/ft^{-2} of filter area and 0.125 Imp. gallons/min/m^2.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Define winterization/dewaxing? (5 points)
2. List types of winterization and discus briefly? (6 points)
3. Write fat crystallization steps? (4 points)
4. Write the major advantages of solvent winterization system? (6 points)

Note: **Satisfactory rating - 16 points** **Unsatisfactory - below 16 points**

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

Information Sheet 4- Monitoring Operation of Equipment to Identify Variation

4.1 Monitoring of operation of equipment

Monitoring is the process by which the continuous activities to be done from the pre-processing to final point of the processes in industry. The process will involve the use of quality parameter of edible oil dewaxing. Start, operate and adjust process equipment to achieve required outcomes, including monitoring control points and conducting inspections as required to confirm process remains within specification.

Techniques used to monitor edible oil refining equipment's

- Inspecting/checking
- Measuring
- Testing as required by the process
- Visual observation

Inspection or test points (control points) in the process and the related procedures and recording requirements should be recorded to make an adjustment the overall operation.

4.2 Identifying variation in equipment operation

Techniques of identifying equipment variations

- Assess quality of received components, parts or materials
- Continuously check received components, parts, materials, information, service or final products against workplace standards and specifications for conformance
- Demonstrate an understanding of how the received components, parts or materials, information or service relate to the current operation and how they contribute to the final quality of the product or service
- Identify and isolate faulty components, parts that relate to the operator's work

- Record and/or report faults and any identified causes in accordance with workplace procedures.
- Follow machine manufacturers manual

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Define monitoring? (5 points)
2. Write techniques of monitoring edible oil refining equipment's? (5 points)

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

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

Information Sheet 5- Reporting Maintenance Requirements

5.3 Reporting maintenance requirements

5.2.1 Different type of maintenance and their importance

Proper maintenance is critical to personnel safety, smooth equipment operation and lasting performance. A production system or individual piece of equipment requires regular maintenance to help promote equipment safety, provide an optimum end product and to prevent costly down time. Failure to practice proper maintenance procedures lead to unsafe conditions and shorten the life of the equipment. A preventive maintenance program is imperative. Prior to any maintenance procedure, turn the equipment OFF and disconnect all power sources. Follow the lockout procedure. Failure to follow this warning could result in death or severe personal injury. Never operate any equipment while other persons are cleaning, servicing, or performing maintenance. Wear personal protective equipment (safety garments, safety glasses, gloves, etc.) appropriate for the maintenance process to be performed.

5.2.2 Preventive maintenance

A preventive maintenance program is critical to promote safety, smooth equipment function and to prevent costly down time. Follow the Preventive Maintenance Schedules for each piece of equipment in the technical manual to properly maintain components. Each piece of equipment will have its own schedule. Depending on the operating environment and the product being processed, the equipment may require more frequent maintenance than the intervals recommended maintaining safety and optimum equipment function. Individual operating parameters will help determine the appropriate maintenance intervals.

Maintenance of equipment is frequently handled reactively (e.g. after a breakdown) though it may also be done proactively, as with preventive and predictive maintenance.

Preventive maintenance keeps assets in good repair through regular scheduled service ; predictive maintenance relies on equipment monitoring to detect problems before they result in a breakdown. Predictive maintenance techniques are designed to help determine the condition of in-service equipment in order to estimate when maintenance should be performed. This approach promises cost savings over routine or time-based preventive maintenance, because tasks are performed only when warranted. Thus, it is regarded as condition-based maintenance carried out as suggested by estimations of the degradation state of an item.

5.2.3 Corrective maintenance

Corrective maintenance is a type of maintenance used for equipment after equipment break down or malfunction is often most expensive not only can worn equipment damage other parts and cause multiple damage, but consequential repair and replacement costs and loss of revenues due to down time during overhaul can be significant.

5.2.4 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.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write advantages of proper maintenance? (5 points)
2. What is preventive maintenance? (5 points)
3. What is corrective maintenance? (5 points)

Note: **Satisfactory rating - 15 points** **Unsatisfactory - below 15 points**

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

Information Sheet 6- Monitoring Winterization/De-Waxing Process to Meet Cold Test Specifications

6.1 Winterization process control procedures

The acceptability of winterized oil is almost always determined by cold-test analysis. This method measures the ability of the oil to resist crystallization. The cold-test result is the number of hours at 32°F (0°C) required for an oil to become cloudy. Cottonseed and soybean winterized oil products normally have a minimum cold-test limit of 10 hours and some are as high as 20 hours for special products. Processors have investigated many different potential process control evaluations, procedures, and methods to determine that the winterization process is in control on a timely basis; however, cold test is still the most definitive evaluation, even though the results are not available until a lengthy period after the oil has been winterized. Usually, the winterized oil production is segregated in separate tanks until the cold-test results are available. If the oil fails to meet the specific number of hours, it must be re-winterized.

Oils that meet the requirements are transferred to salad oil storage for subsequent deodorization, packaging, or shipment as required. This after the fact analysis to determine the acceptability of the winterized oil places more emphasis on process control techniques to ensure that all of the best practices are continually observed.

6.2 Procedure of test for refined winterized salad oils (cold test)

- Fill 100 ml sample bottle with oil ,
- cork tightly and seal with paraffin.
- Completely submerge bottle in bucket containing finely cracked ice and add water until it rises to top of the bottle.
- Keep bucket filled solidly with ice by removing any excess water and adding ice when necessary.
- After 5.5 hours remove bottle and examine oil.

- If it is properly winterised, sample will be brilliant, clear and limpid.

Self-Check – 6	**Written test**

Name…… ID……. Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true or false (12 points)

1. If the oil fails to meet the specific number of hours, it must be re-winterized
2. Cold test analysis measures the ability of the oil to resist crystallization
3. The acceptability of winterized oil is almost always determined by cold-test analysis

Test II: Short Answer Question

1. Write procedure of test for refined winterized salad oils (cold test)? (3 points)

Note: **Satisfactory rating - 15 points** **Unsatisfactory - below 15 points**

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

Information Sheet 7- Identifying, Rectifying and Reporting Out-Of-Specification Products

7.1 Identifying out-of-specification product

The term out of specifications, are defined as those results of in process or finished product testing, which falling out of specified limits. The out of specifications (OOS), may arise due to deviations in product manufacturing process, errors in testing procedure, or due to malfunctioning of analytical equipment. The main quality checks concern raw materials, processing conditions, product quality and packaging and storage conditions. Crude oil should be checked to ensure the quality of oil. Quality checks on the product include correct color, flavor, odor, clarity and fill weight. Processed oil should be consistent in all aspects such as:

- Colour,
- Taste and
- Viscosity.

The colour of the oil must be clear and transparent. In addition, the oil should be free of impurities and meet the demands placed upon it for use in cooking. Before being filled, the bottles that hold the oil are cleaned and electronically inspected for foreign material. To prevent oxidation of the oil (and therefore its tendency to go rancid), the inert (non-reactive) gas nitrogen is used to fill up the space remaining at the top of the bottle. The result of identification of out of specification product or out cam should be report to the supervisor or to the concerned body.

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Define out of specification products? (5 points)
2. Write causes of producing out of specification products? (5 points)
3. How do identify out of specification products? (5 points)

Note: **Satisfactory rating - 15 points** **Unsatisfactory - below 15 points**

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

Information Sheet 8- Maintaining Work Area to Housekeeping Standards

8.1 Maintaining work area to housekeeping standards

Maintaining the work area cleanness is playing the vital role of the organizational success. It includes keeping work areas neat and orderly; maintaining halls and floors free of slip and trip hazards; and removing of waste materials (e.g., paper, cardboard) and other fire hazards from work areas.

It also requires paying attention to important details such as the layout of the whole workplace, aisle marking, the adequacy of storage facilities, and maintenance. Good housekeeping is also a basic part of accident and fire prevention. 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 maintenance 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

✓ **Work environment**

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

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.

- **Lay out of pipe lines**

It is preferred to have dedicated lines for groups of oils of a similar fatty acid composition when different types of oils and fats are stored (as e.g. palm oil, lauric oils and liquid oils). The layout of the pipelines should be such that draining by gravity is aided and not hindered. Horizontal pipes should have a slight slope downwards in the direction of the flow. Blowing of pipes should always be from high to low; if needed, a small-diameter pipe can be used to route the blown oil upwards. A pigging system can be used for line clearing when different types of oils and fats are transported via one pipeline.

- **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.

Self-Check – 8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write advantages of maintaining work area? (5 points)
2. Mention good housekeeping practices? (5 points)

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

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

Information Sheet 9- Maintaining Workplace Records

9.1 Types of records

9.1.1 Paper-based records

Paper-based records are one of the most common ways of dealing with information. Examples of paper-based records include:

- Reports
- Magazines, journals and newspapers
- Project files
- Contracts
- Minutes of meetings
- Business letters
- Email messages and memos
- Faxes
- Forms
- Diaries and other note-taking methods.

9.1.2 Electronic records

Examples of electronic records include:

- E-mail messages,
- Word- processed documents,
- Electronic spreadsheets,
- Digital images and databases.

Document relating specifically to operations and services provided by a particular department or division, and which is distinct from the general administrative (housekeeping) records. Also called functional record or unique record.

9.1.3 Recording activities

In oil processing there are many activities to be recorded:

- Equipment performance
- Equipment variation
- Maintenance activities
- Faults and problems
- Out of specification materials etc…

Self-Check – 9	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Mention and discus types of records? (5 points)
2. Write activities to be recorded on oil refining process? (5 points)

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

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

Operation Sheet – 1 Operating Dewaxing Process

Steps for operating dewaxing of vegetable oils

Objective: to separate clear liquid oil from waxes

1. Wear personal protective equipment's
2. Prepare bleached and low moisture content (<0.1%) oil
3. Heat the oil to 55˚C to make sure the oil is fully liquid.
4. Then slowly cool 10–15˚C by using chiller
5. Store the chilled oil in to the insulated crystallizers with a special slow-speed mechanical agitator
6. Retain the oil for several hours at 10–15˚C until crystal formation
7. Crystal formation in the oil defines the completion of cooling
8. Feed slowly the slurry to the filter press through special transfer pump
9. Filter the liquid to get out put clear liquid oil and by product waxes
10. Record the process

Lap Test	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 **4:00** hour. The project is expected from each student to do it.

Task-1 operate dewaxing process

LG # 40	LO #3 Shut Down the Winterization Process

Instruction Sheet

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

- Identifying appropriate shutdown procedure.
- Shutting down the process according to workplace procedures.
- 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:

- Identify appropriate shutdown procedure.
- Shut down the process according to workplace procedures.
- Identify and reporting 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- Identifying Appropriate Shut down Procedure

1.1 Introduction

Shut down is a term used to describe the process of closing all systems of process control systems. Normal shutdown includes steps to render the systems safe, such as removal of hazardous process. The systems might be cleaned as part of the shutdown; cleaning is often a machine shutdown is a temporary closure of a building to perform maintenance. The main activities should be preventative in nature with the focus on equipment inspections. This is the best time to replace worn-out or broken process materials and equipment at their useful end-of-life process unto itself requiring its own set of startup, operation, and shutdown procedures.

1.2 Shut down Procedure

Basic steps of locking and tagging out a system

Lockout and tag out processes involve more than putting a lock on a switch. They are comprehensive step-by-step processes that involve communication, coordination, and training.

Steps of a lockout/tag out program include:

1. Prepare for shutdown

The authorized person will identify which sources of energy are present and must be controlled; and more importantly, identify what method of control will be used. This step involves completing sets of specific work instructions that outline what controls and practices are needed to lock and tag out a system before performing any activity.

2. Notify all affected employees

The authorized person will communicate the following information to notify affected persons:

- What is going to be locked/tagged out.
- Why it is going to be locked/tagged out.
- For approximately how long will the system be unavailable.
- Who is responsible for the lockout/tag out.
- Who to contact for more information.

3. Equipment Shutdown

If the system is operating it should be shut down in its normal manner. Use manufacturer instructions or in-house work instructions. Equipment shutdown involves ensuring controls are in the off position, and verifying that all moving parts such as flywheels, gears, and spindles have come to a complete stop.

4. Isolation of system from hazardous energy

The exact written instructions will be specific to that system in the workplace. In general, the following procedures are used:

Electrical energy - Switch electrical disconnects to the off position. Visually verify that the breaker connections are in the off position. Lock the disconnects into the off position.

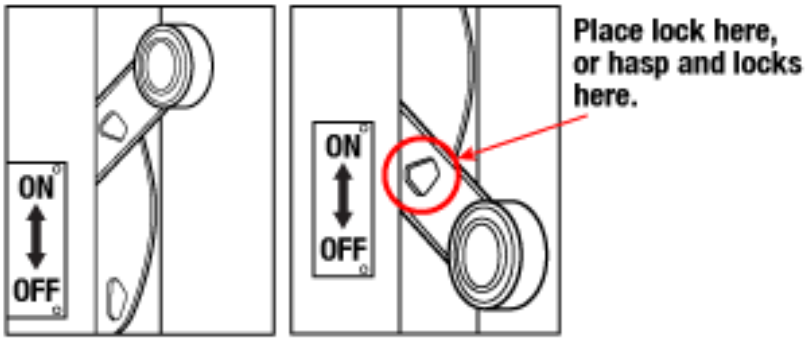

Figure 10 Electrical lockout

Hydraulic and Pneumatic potential energy - Set the valves in the closed position and lock them into place. Bleed off the energy by opening the pressure relief valves, then closing the airlines.

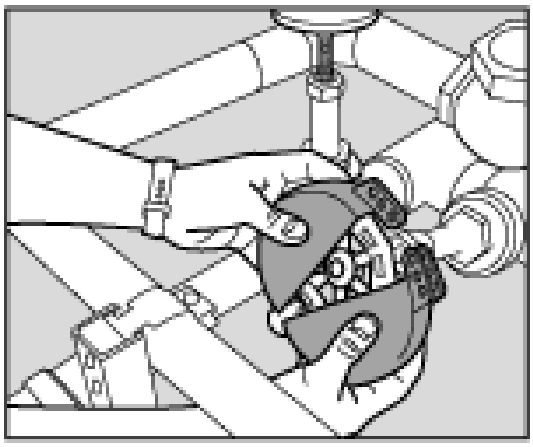

Figure 11 Hydraulic and pneumatic lockout

- Mechanical potential energy - carefully release energy from springs that may still be compressed. If this is not feasible, block the parts that may move if there is a possibility that the spring can transfer energy to it.
- Gravitational potential energy - Use a safety block or pin to prevent the part of the system that may fall or move.
- Chemical energy - locate chemical supply lines to the system and close and lockout the valves. Where possible, bleed lines and/or cap ends to remove chemicals from the system.

5. Dissipation (removal) of residual or stored energy

In general, examples include:

- Electrical energy - To find a specific method to discharge a capacitor for the system in question, contact the manufacturer for guidance. Many systems with electrical components, motors, or switch gears contain capacitors. Capacitors

store electrical energy. In some cases, capacitors hold a charge and may release energy very rapidly (e.g., similar to the flash of a camera). In other cases, capacitors are used to remove spikes and surges in order to protect other electrical components. Capacitors must be discharged in the lockout process in order to protect workers from electrical shock.

- Hydraulic and Pneumatic potential energy - Setting the valves in the closed position and locking them into place only isolates the lines from more energy entering the system. In most cases, there will still be residual energy left in the lines as pressurized fluid. This residual energy can be removed by bleeding the lines through pressure relief valves. Verify depressurization or use flange-breaking techniques. Contact the manufacturer for more specific details, or if no pressure relief valves are available, what other methods are available.
- Mechanical potential energy - Carefully release energy from springs that may still be compressed. If this is not possible, use blocks to hold the parts that may move if the energy is released.
- Gravitational potential energy - If feasible, lower the part to a height where falling is impossible. If this is not possible, contact the manufacturer for guidance.
- Chemical energy - If available, bleed lines and/or cap ends to remove chemicals from the system.

6. Lockout/Tag out

When the system's energy sources are locked out, there are specific guidelines that must be followed to make sure that the lock cannot be removed, and the system cannot be inadvertently operated. These guidelines include:

- Each lock should only have one key (no master keys are allowed).
- There should be as many locks on the system as there are people working on it. For example, if a maintenance job requires 3 workers, then 3 locks should be present - each of the individuals should place their OWN lock on the system. Locks can only be removed by those who installed them, and should only be removed using a specific process - see step 9 below.

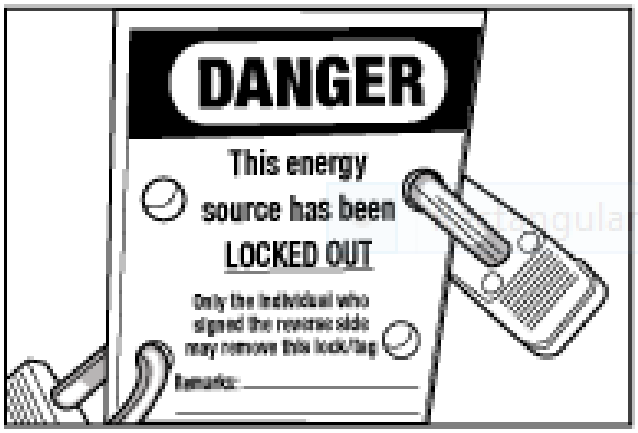

Figure 12 Example of multiple locks on a lockout tag

7. Verify Isolation

Verify that the system is properly locked out before beginning any work. Verification can take place in several ways:

- The machine, equipment, or process controls (push buttons, switches, etc.) are engaged or activated and the result is observed. No response means isolation is verified. Return controls to the safe position (off).
- Visual inspection of:
  - ✓ Electrical connections to make sure they are open.
  - ✓ Suspended parts are lowered to a resting position or blocked to prevent movement.
  - ✓ Other devices that restrain machine or process movement.
  - ✓ Valve positioning for double block and bleed (for pipes or ducts) - closing two valves of a section of a line, and then bleeding (or venting) the section of the line between the two closed valves.
  - ✓ Presence of solid plate used to absolutely close a line - called line blanking (for pipes or ducts).
  - ✓ Any other acceptable method of energy isolation.
- Testing of the equipment:

- ✓ Test circuitry (should be done by a certified electrician) - note: equipment with capacitors needs to be cycled until all energy is drained.
- ✓ Check pressure gauges to make sure hydraulic and pneumatic potential energy has been removed.
- ✓ Check temperature gauges to make sure thermal energy has been discharged.

Choose the method that will best make sure that the energy to the system has been isolated without creating other hazards during the verification.

8. Perform Maintenance or Service Activity

Complete the activity that required the lockout process to be started.

9. Remove Lockout/Tag out devices

To remove locks and tags from a system that is now ready to be put back into service, the following general procedure can be used:

- Inspect the work area to make sure all tools and items have been removed.
- Confirm that all employees and persons are safely located away from hazardous areas.
- Verify that controls are in a neutral position.
- Remove devices and re-energize machine.
- Notify affected employees that servicing is completed.

*Note - it is good practice to make sure any individual who placed a lock on the system should also be present when the system is re-started. This practice helps make sure those employees working on the system are not in a hazardous area when the machine is restarted.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Define the term shut down? (5 points)
2. Mention and describe steps of a lockout/tag out program? (5 points)

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

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

Information Sheet 2- Shutting Down the Process According to Workplace Procedures

2.1 Shutting down process

The shut-down procedure is just as important as the start-up procedure for a refining equipment. By properly shutting down oil refining equipment the start-up will be much quicker and most effective. Shut down the line can have a major impact on your capacity to restart production promptly. In an upcoming article, we will help you restart your machinery, taking the best steps and precautions. In edible oil refining process, oil refining equipment such as chilling unit (Quick Cooler, winterizing/de- waxing vessel, filtration equipment is shut down after finishing product manufacturing.

Shutdown procedure may include:

- 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.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write down the procedures of shut down? (5 points)
2. Write the functions of following shut down procedures? (5 points)

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

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

Information Sheet 3- Identifying and Reporting Maintenance Requirements

3.1 Introduction

Maintenance can be defined as working on something to keep it in a functioning and safe state and preserving it from failure or decline. Maintenance procedures are written instructions that, when followed by the maintenance personnel, will ensure that equipment operates as designed within safe operating limits.

Maintenance may include:

- Cleaning,
- Lubricating,
- Tightening
- Simple tool repairs and adjustments.

3.2 Types of maintenance

3.2.1 **Preventive or proactive maintenance**: is carried out to keep something functional. This type of activity is usually planned and scheduled.

3.2.2 **Corrective or reactive maintenance:** is repairing something to get it working again. This is an unscheduled, unplanned task, usually associated with greater hazards and higher risk levels.

3.3 Routine maintenance tasks

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, cables and plugs.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Write the definition of maintenance? (5 points)
2. Write the main activities performed in maintenance? (5 points)
3. List the main routine maintenance tasks? (5 points)
4. Write types of maintenance? (5 points)

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

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

Reference Materials

Book:

- Manual of methods of analysis of foods, oils and fats(2015)
- Michael Bockisch Hamburg, Fats and Oils Handbook, , Germany(1998)
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- http://www.agicosolution.com/
- https://www.edibleoilrefinerymachine.com/FAQ/cooking_oil_refining_equipment_cleaning_593.html
- https://www.aslpropertypreservation.com/post/what-is-winterization-property-preservation-training

you tube links

- https://www.youtube.com/watch?v=sXPfmW0i6nA
- https://www.youtube.com/watch?v=us9F4gVRfo8

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