EDIBLE OIL AND FATS PROCESSING

Level III

Based on October 2019, Version 2 OS and March. 2021, V1 Curriculum

Module Title: - Operating a Deodorizing Process

LG Code: IND EOP3 M12 LO (1-3) LG (41-43)

TTLM Code: IND EOP3 TTLM V1

March, 2021

Bishoftu, Ethiopia

With the support of

United Nations Educational, Scientific and Cultural Organization

Republic of Korea Funds-in Trust

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LG #41	LO #1- Prepare the deodorizing equipment for processing

Instruction sheet

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

- Confirming available materials
- Identifying and confirming cleaning and maintenance requirements
- Confirming different services in available quantity
- Fitting and adjusting machine components and related Attachments.
- Entering processing/operating parameters to safety and production.
- Checking and adjusting deodorization equipment.
- Carrying out 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:

- Confirm available materials
- Identify and confirm cleaning and maintenance requirements
- Confirm different services in available quantity
- Fit and adjust machine components and related Attachments.
- Enter processing/operating parameters to safety and production.
- Check and adjust deodorization equipment.
- Carry out pre-start checks

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” which are placed following all information sheets.

5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work

6. If you earned a satisfactory evaluation proceed to “Operation sheets

7. Perform “the Learning activity performance test”

Information Sheet 1- Confirming available materials

1.1 Introduction

Deodorization is a high-temperature, high-vacuum steam-distillation process to remove volatile, odoriferous materials present in edible fats and oils. The deodorization process systems use lower temperatures and less steam to deodorize or deacidify your edible oils, stripping them of unwanted odor, flavor, color and other volatile substances, safely and reliably. Whether deodorizing palm, soybean, rapeseed or other edible oil, this essential process significantly reduces unwanted volatiles as well as the formation of glycidyl esters (GEs) & trans-fatty acids (TFA) isomers. Get more effective treatment and better quality, safety and yield.

Deodorization is a steam stripping process wherein a good-quality steam, generated from de-aerated and properly treated feed water, is injected into oil under low absolute pressure and sufficiently high temperature to vaporize the Free Fatty Acid (FFA) and odoriferous compounds and carry these volatiles away from the feedstock. Oil losses during deodorization can be classified into two categories: chemical and mechanical. Chemical losses consist of the removal of the undesirable components: FFA, aldehydes, ketones, peroxides, polymers, and other volatiles.

The role of deodorization in processing and refining of edible fats and oils has long been accepted as the last step in preparing the oil for use as an ingredient in margarine, shortening, salad oil, cooking oil, hard butters for the confectionery industry, and many other products in the food industry. The finished, deodorized oil can be classified as “acceptable” over a wide range of specifications that depend on the market likes and dislikes of the people within the particular country or region in which the products will be consumed.

1.2 Confirming available Materials

The large majority of commercially produced edible fats and oils have available materials. May include:

* **Bleached oil;** is the oil free from undesired color materials.
* **Citric acid;** is added to all deodorized fats and oils in the cooling section of the deodorizer. About 0.01 percent of citric acid is often added during this step to inactivate pro-oxidant metals such as iron or copper. Fifty percent citric acid solution is added under vacuum before the oil is pumped through an external cooler. Citric acid decomposes at temperature higher than 290°F (143°C) producing a number of compounds that are not effective metal chelators like citric acid. Therefore, addition of citric acid at higher temperatures is not recommended.
* **Hydrogenated oil;** Hydrogenated oil can be produced with low–trans fatty acid content using a platinum catalyst. These catalysts are highly reactive and the reaction can be carried out at very low temperatures compared to a nickel catalyst.
* **Polish filter** ; The Polish Bag Oil Filters provide simple surface filtration for filtering suspended fine solids from liquids, and removing the trace contaminants. The filter bags are allowed to sit inside the metal basket which is sealed into the housing. The basket is fitted with quick opening type arrangement.

* **Bags;** The Bags are the primary filtering elements here. The filter bags are made from different materials such as Polyester, PP, PPS or any special cloth depending on fluid. The cleaning of the filter bags is very simple as it can be removed easily without use of tools. The pore sizes range from 5 microns to 50 microns depending on the requirements. The Dual bag filters of double polishers ensure continuous filtration with fewer changeovers. Flow of contaminated liquid is from inside to outside of the bag. Filtration in bag filter is pre-dominantly surface filtration with a degree of partial depth filtration with felted media. All these contaminants are collected in the bag, simplifying disposable of bag and contaminant change out in allowing incineration.
* **others** are soybeans , oil palm , rapeseed/canola , sunflower seeds ,maize/corn , peanuts/groundnuts , cottonseed , coconut , palm kernel and fish and animal fats.

1.2.1 Materials Removed During Deodorization

The materials removed by Deodorization include free fatty acids (FFA); various flavor and odor compounds classified largely as aldehydes, ketones, alcohols, and hydrocarbons; and other compounds formed by the heat decomposition of peroxides and pigments.

As a by-product of the heat treatment received in the deodorizer, many oils emerge from the deodorizer lighter in color than when they entered owing to the breakdown of pigments, predominantly carotenoids that are unstable at deodorizer operating temperatures. Concentration of individual constituents in the deodorized oil is generally no greater than about 0.1% unless the oil has been abused.

Long-chain aldehydes and ketones are major contributors to the odoriferous and flavor compounds found in vegetable oils together with breakdown products formed during the thermal decomposition of peroxides caused by exposure of the oil to air.

Normally the level of flavor and odor components in oil prior to deodorization is less than 1000 ppm, and with good handling and refining it can be as low as 200 ppm. Combining this with the human palate's frequent ability to detect such compounds in the 1–10 ppm concentration range and in some cases the parts per billion (ppb) ranges, sets a high target for the deodorization process.

With normal deodorization practice, by the time the peroxide value of the oil is approaching zero and the free fatty acid level of the oil has been reduced to 0.02%, the majority of the flavor and odor components in the oil have been successfully removed.

It must, however, be remembered that the achievement of a low free fatty acid level does not guarantee an acceptable oil flavor, because low levels of air leakage into the deodorizer during processing or high levels of prior oxidative abuse can result in flavor component concentrations that exceed the deodorizer's ability to remove them and generate a bland oil.

Self-Check 1	Written Test

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

1. Write purpose of citric acid for deodorization process?
2. Write the materials removed during deodorization?

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 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 Cleaning and Maintenance requirement

The objective of proper oil processing is to obtain finished oil with long oxidative stability, long thermal stability, long flavor stability, long storage stability, and long shelf life of food products formulated with the oil. It is critical that processors understand the basic constituents of oil, its properties, and how to maintain process conditions that deliver oil with the quality standards.

2.1.1 Cleaning requirement

Cleaning in the food industry is not an easy task. However, it is a critical step within food production since it is crucial to maintain and guarantee food safety. Understanding various soil challenges, why we clean and how detergents and disinfectants work is key to ensuring a safe, hygienic manufacturing environment.

Why do we clean?

- **Prevent Transfer of Products/Ingredients**

If a number of products are manufactured on the same machine, it is undesirable to cross-contaminate chemicals or alternate from one product to the next.

- **Avoid Microbial Contamination**

This can lead to a number of problems—reduced product quality, harm to health or even life threatening circumstances in some cases. Cleaning alone is no guarantee of decontamination, but it is a pre-requisite to disinfection.

- **Ensure Disinfectant Efficiency**

Soil impacts the effectiveness of a disinfectant. The less soil on the surface, the more effective the disinfect will be at reducing microbiological contamination.

- **Improve Plant Efficiency**

Soil contamination reduces the efficiency of equipment and the production process.

- **Increase Safety**

Facilities that are not cleaned effectively have more potential safety risks like slips and falls due to food waste on floors. Also, major incidents due to buildup of soil in equipment can also occur.

- **Impact Financial Implications**

Reducing waste from spoilage can significantly extend the life of equipment and machinery.

- **Minimize Legal Ramifications**

Although it may not be common knowledge, there are often legal requirements for food facilities to clean surfaces and equipment to a specific standard.

- **Boost Stakeholder Confidence**

Finally the appearance of plant and premises is often overlooked but the psychological benefits and confidence gained from clean, hygienic equipment and tidy surroundings have a significant impact on both worker satisfaction and customer confidence.

2.1.1.1 Periodic cleaning of the deodorizer

A deodorizer must produce clean-flavored oil. One of the reasons for poor flavor in the freshly deodorized oil is that the deodorizer is not clean. The unsaturated fatty acids and even some triglyceride molecules can oxidize and polymerize inside the deodorizer. Polymer deposits can be found on the heating coils, steam bubble caps, mammoth pumps, packed columns, deodorizer trays, walls, and demisters. Polymers at low concentration can produce unacceptable fresh oil flavor. In addition, the flavor can deteriorate very rapidly if the dimer or polymer content is over 1% in deodorized oils.

This is why it is recommended that all deodorizers be caustic washed once a year or more frequently. Packed column deodorizers require more frequent caustic cleaning. Cleaning the deodorizer is a long and tedious process, but it is absolutely necessary. The lye wash setup would be similar for a batch deodorizer and a semi continuous unit. A continuous deodorizer requires a somewhat different setup for lye washing. A specific caustic wash (sometimes called lye wash) procedure should be established by the plant personnel. A generalized step-by-step lye washing procedure is outlined as follows.

- Shut down the deodorizer.
- Shut off the heating and stripping steam.
- Shut off the cooling water.
- Blow the entire system with nitrogen to push the residual oil and collect it in the appropriate tanks.
- Open all drain valves to let any residual oil out of the system. Sometimes a scavenger pump can be used.
- Close the drain valves.

A Batch Deodorizer

- Fill the deodorizer with cold water covering the coils.
- Add a sufficient amount of caustic solution totaling approximately 5% strength.
- A stronger caustic solution does not clean the vessel any better.
- Heat the water to 180–190°F (82–87°C).
- Use stripping steam to agitate the water.
- Leave the small stage ejector on if the pressure in the vessel begins to rise.
- Most of the time it is not necessary to turn on the ejector.
- Leave the caustic solution with the steam on overnight.
- Shut off the steam the next day and drain the water with the proper amount of phosphoric acid added to the water to meet the guidelines of the local municipality.
- Refill the deodorizer with cold water. Agitate with stripping steam.
- Add a certain amount of phosphoric acid to neutralize the residual caustic in the vessel.
- The pH of the water must match that of the city water, and not necessarily 7.0. The pH should preferably be measured by a pH meter and not by litmus paper.
- Let the vessel cool down.
- Take down the demisters and clean them in a vat of light caustic solution in hot water.

- Rinse and treat the demisters with phosphoric acid.
- Sometimes it is better to replace the demister pad when the deodorizer is cleaned once a year. It is not very easy to clean the demister pads well.
- The deodorizer must be sprayed with deodorized oil as soon as the vessel is dry. This step is not so critical if the unit is built with 304 or 316 stainless steel.
- The deodorizer is ready for reuse.

B Semi continuous Deodorizer

The semi continuous deodorizer is lye washed in the same manner as a batch unit. The deaerator vessel and each tray are handled as with a batch deodorizer. It is a good idea to replace the demister pads if they look black.

C Continuous Deodorizer

A continuous deodorizer requires recirculation of hot caustic solution through the system. This requires a separate tank to supply the deodorizer with hot caustic solution.Shows a schematic diagram for a caustic wash arrangement for a continuous deodorizer. The step-by-step procedure is outlined as follows:

- Fill the tank with water.
- The capacity of the tank should be 30% more than the total capacity of the deodorizer system.
- A centrifugal pump with a capacity of 100–200 gallons per minute (gpm) with proper NPSH calculated on the basis of water temperature of 200°F (93.3°C) is used for pumping water through the system.
- Caustic is added to make a 5% solution in the tank.
- The water in the tank is heated with low-pressure steam. A self-actuated temperature control valve could be used for temperature control with a thermodynamic steam trap.
- The caustic solution from the tank is recirculated for an hour while it is being heated.
- After the water reaches a temperature of 180–190°F (82–87°C), the water is pumped through the deodorizer system.

- All control valves are kept open with manual override.
- The isolation valve to the ejector system is kept closed.
- The caustic solution is circulated for 12–24 h. The temperature of the caustic solution is maintained.

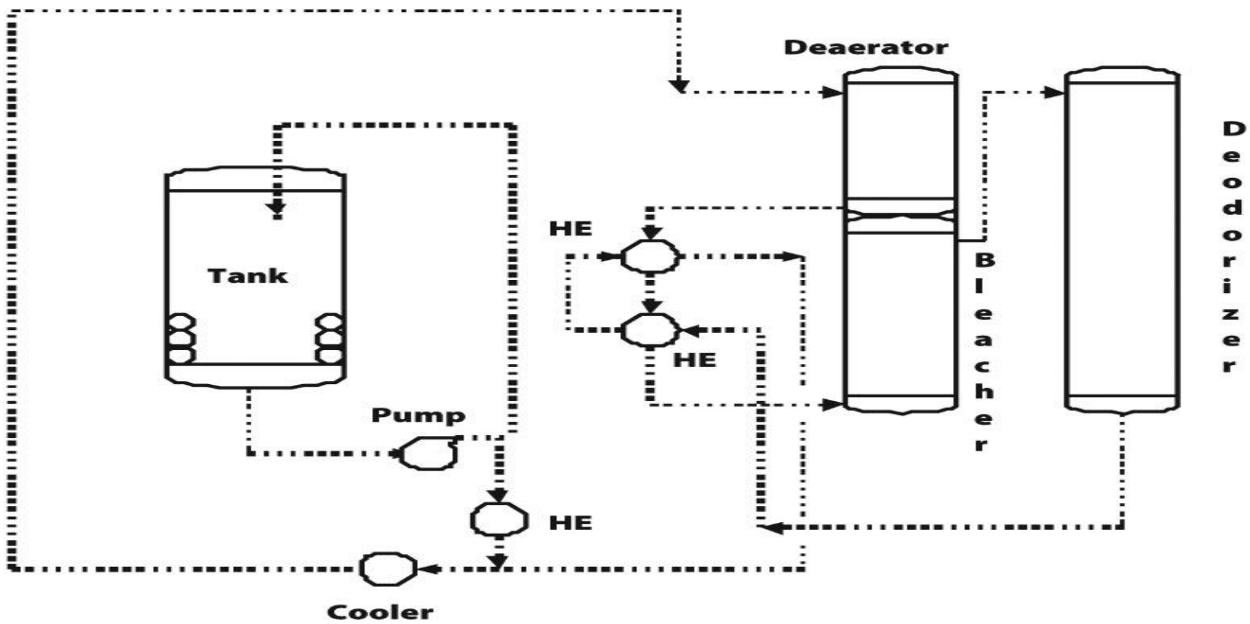

Figure 1 Schematic diagram for caustic wash system.

- Neutralize the caustic with phosphoric acid and circulate it for 2–4 h.
- Drain the liquid from the system.
- Open all the drain lines at the low spots as before and drain the residual water.
- Turn on the vacuum system.
- Fill the deodorizer with startup oil.
- Heat the oil slowly to 250°F (121.1°C) and recirculate it until full vacuum is established.
- Heat the oil to full temperature and start deodorizing.

2.1.2 Maintenance requirement

Physical equipment of any field or of any plant and industry are susceptible to failure through breakdown, deterioration in performance owing to wear and tear with time and to obsolescence due to improvement in technologies. Therefore, machinery should be regularly checked with respect to its performance.

Equipment maintenance checks should include an assessment of the equipment's overall condition and integrity (e.g., is it working properly), the sources of physical contaminants (e.g. damaged, lost or worn parts, rust, loose/flaking paint, broken parts such as needles and blades, looseparts on equipment prone to vibration, polymeric deposits, friction, fatigue, chemical reaction, etc.), the microorganism harbourage sites (e.g., worn or frayed hoses, gaskets or belts, porous welds, product contact surfaces). Increase in noise, lubricant consumption, temperature rise or increased leakage is usually the consequence of failure of equipment and its components.

Worn parts should be replaced as soon as practical, not only to ensure that production is maintained but also to prevent that debris from worn or broken parts enters the product or contaminates the production line.

The operator also must ensure equipment used for critical measurements is calibrated, and uniquely identifiable. It must be used within its design and capacity (e.g. accuracy, calibration range, conditions of use). Items requiring calibration could include thermometers, temperature recorders, scales, test weights, metal detectors, gas analyzers, pressure or heat sensors, chemical assessment equipment, flow meters, etc.

- **Scheduled preventive maintenance**

Scheduled preventive maintenance should be preferred over inefficient "breakdown" maintenance and repetitive repair. No longer does the maintenance department have the luxury of extended periods of available equipment downtown in order to carry out maintenance. Instead the maintenance function is moving toward a more predictive approach. If the failure characteristics of the equipment are known, predictive maintenance can detect the failure well in advance and appropriate actions can be taken in a planned and organized manner.

Predictive maintenance makes use of a group of emerging scientific technologies that can be employed to detect potential failures: vibration analysis, thermal imaging, ultrasonic measurement and oil analysis. The maintenance technicians should be skilled to use these diagnostic tools, and they must have detailed knowledge of the operating characteristics of the equipment to make the correct failure diagnosis.

By means of a risk analysis, the manufacturer may define which parts of the system are critical, allowing defining the necessary treatment (to which interval, to which time point, and with which measures). That maintenance schedule should be frequently reviewed during the initial operating period of an installation to establish the optimum maintenance frequency (Jha, 2006).

Self-Check 2	Written Test

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

1. Why we do cleaning deodorizing equipment?
2. Write the periodic cleaning of the deodorizer?

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 in available quantity

3.1 Different services for deodorization process

Services; May include:

- **Power**

Electric power is the most important in any processing industry. Without electric power it is impossible to operate or produce any product using machine. It provides energy to operating equipments and machines which helps to process the feed raw materials in to new products. If power shortages happen during processing, it may cause many damages to raw materials, product and machine.

- **Thermal fluid**

Thermal fluid is circulated in the entire system for heat transfers to the desired processes.

a. **Advantages over steam boilers:**
   - Better temperature control
   - Greater reliability
   - Greater temperature range (because oils have higher boiling points than water)
   - No corrosion
   - Self-lubricating

b. **Our full system configuration services include:**
   - Designs for exterior or interior applications
   - Electrical heating system options
   - Optional drain tanks and secondary heating controls for varying applications
   - Physical unit options, such as horizontal or vertical configurations and stand-alone or skid-mounted heating units

- Thermal fluid systems that can use gas, oil, or waste fuel by design—fluid options include biodiesel; bunker C; fuel oils #2, #4, or #6; natural gas; propane; or waste gas product
- Three-pass, high-efficiency heater designs that evenly distribute heat throughout the system

c. We also provide all system components, such as:

- ✓ Burners
- ✓ Control packages
- ✓ Isolation valves
- ✓ Pumps

- **Steam**

Steam is water in the gas phase. It is commonly formed by boiling or evaporating water. Steam that is saturated or superheated is invisible; however, "steam" often refers to wet steam, the visible mist or aerosol of water droplets formed as water vapour condenses. It is useful in:

- ✓ Cleaning ,heat, and cook process of oil seeds
- ✓ Cleaning of oil processing equipment
- ✓ Internal combustion engines and part
- ✓ Cleaning floors

- **Water**

Water is used in deodorization process as generating good quality steam for steam stripping process, cleaning machinery and equipment, sanitation and treatment

- **Vacuum**

Deodorizers operated under vacuum to facilitate stripping and protect the oil against oxidation.

- **Compressed and instrumentation air**

Compressed air is air kept under a pressure that is greater than atmospheric pressure. Compressed air is an important medium for transfer of energy in industrial processes, and is used for power tools such as air hammers, mill, and presser and to transfer materials through pipes.

Self-Check 3	Written Test

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

1. Write function of thermal fluid system?
2. Discus advantage of water for deodorization process?

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 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 machine components and related Attachments

In deodorization process used much machinery. Including:

4.1.1 Deodorizer

Figure 2. Deodorizer

4.1.1.1 Batch deodorizer

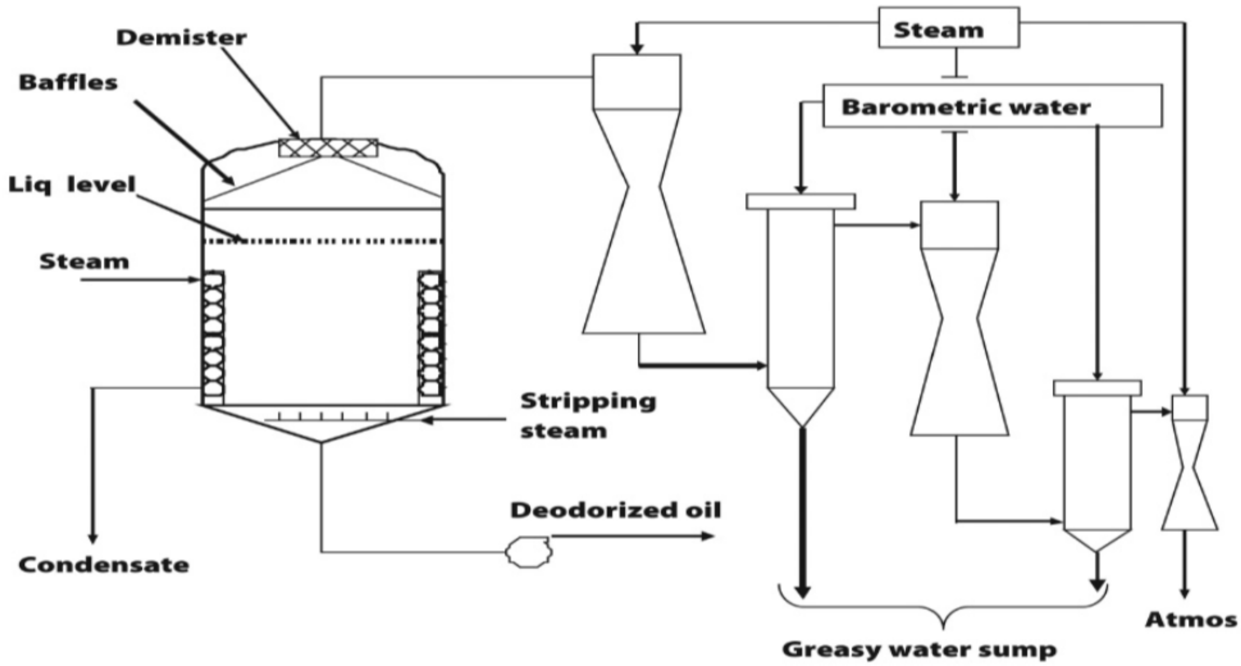

Figure 3 Schematic diagrams for Batch Deodorizer

The batch deodorizer with a vacuum system and superheated steam stripping was introduced in the United States in the late 1800s. The first high-temperature batch deodorizer with a vacuum system and made from nonoxidizing material was developed in France in the early 1900s. Several design modifications have been made to batch deodorizers since that time and are still used in many oil-processing plants around the world. Some modern plants are using batch deodorizers made from stainless steel for vegetable oils and specialty products.

Typical Operating Steps in a Batch Deodorizer

In this process, the oil is deodorized in several stages as outlined:

- The vacuum is turned on.
- A batch of oil is charged into the deodorizer through a distributor ring with nozzles.
- The oil is heated by using either steam or thermal fluid.
- The steam is at a pressure of 450 psi (32.7 kg/cm2).
- The deodorizer oil temperature should be set at 250°F (121.1°C) for deaeration.

- The deaeration step can take 30 min or a little longer.
- A small amount of stripping steam is injected to agitate the oil for deaeration.

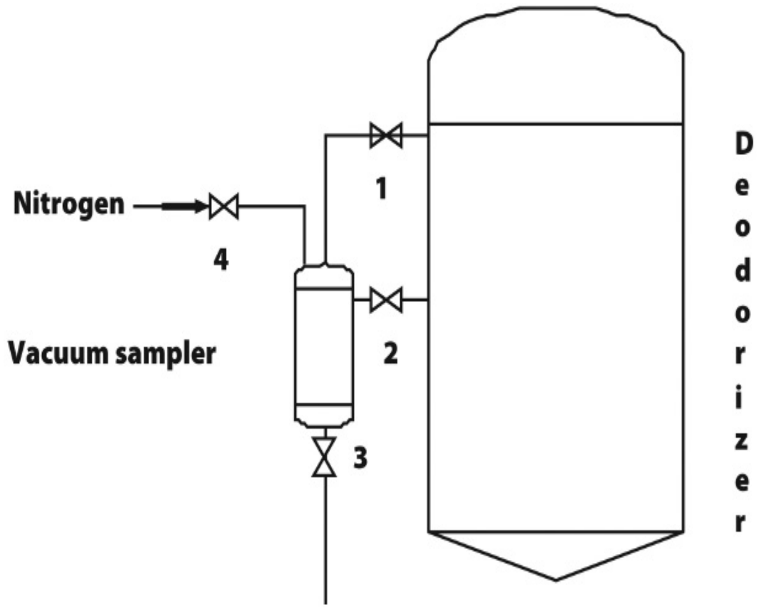

Figure 4. Vacuum oil sampler

- The volume of the stripping steam is increased after deaeration and as the oil temperature rises. The amount of stripping steam at this time is generally 3% (2%–4% in the older designs and <2% in the newer designs).
- Deodorizer temperature is maintained at 460–480°F (238–249°C).
- The oil is deodorized for a predetermined amount of time, which is established from prior experience. The end point is established from the satisfactory quality of the deodorized oil.
- The oil is cooled down to <290°F (143°C) and 50 ppm of citric acid is added into the oil to chelate (scavenge) trace metals, such as iron, copper, etc.
- A deodorizer sample is collected by using a specially designed sampler.
- Stripping steam is shut off when the oil temperature reaches 250°F (121.1°C) otherwise there will be condensation of steam in the deodorized oil if the stripping steam is left on while the oil temperature drops below 250°F (121.1°C).
- The oil is cooled down in an external cooler and handled.
- Antioxidant is added, sometimes before the oil is discharged from the deodorizer.

- Alternatively the antioxidant can be added as the oil is transferred to storage. An inline mixer, such as a static mixer can be used. However, a high shear mixer is recommended.

Vacuum Sampler

The schematic diagram for the vacuum sampler is shown. It is a very small pressure vessel connected to the side of the deodorizer as shown. There are four connections to the sampler. The step-by-step operation is described as follows:

- Initially check that all four valves are closed.
- Using thermally protected gloves and face shield, open valve #3 with a
- Bucket underneath to collect any oil residue from the vacuum sampler.
- Leave valve #3 open.
- Slowly open valve #4 and let some nitrogen flow through the sampler.
- Close both valves #3 and #4.
- Open valve #1 to bring the sampler to the same vacuum as the deodorizer.
- It will take only a second or two to equalize the vacuum between the two vessels.
- Close valve #1.
- Open valve #2 for a few seconds to allow the oil from the deodorizer to flow into the sampler.
- Close valve #2.
- Crack open valve #4 very slowly to let nitrogen flow into the sampler to break the vacuum, and then close it.
- Hold a thermally insulated safe sample collector at the bottom of the drain line.
- Slowly open valve #3 and very slowly crack open valve #4 again.
- Collect the oil in a safe sample collector.
- Close valves #4 and #2.
- Chill the oil immediately in the laboratory.
- Bubble nitrogen through it for 5–10 min while it is being chilled.
- Analyze the sample.
- Make sure all four valves on the vacuum samplers are fully closed after collecting the sample.

4.1.1.2 Continuous deodorizer

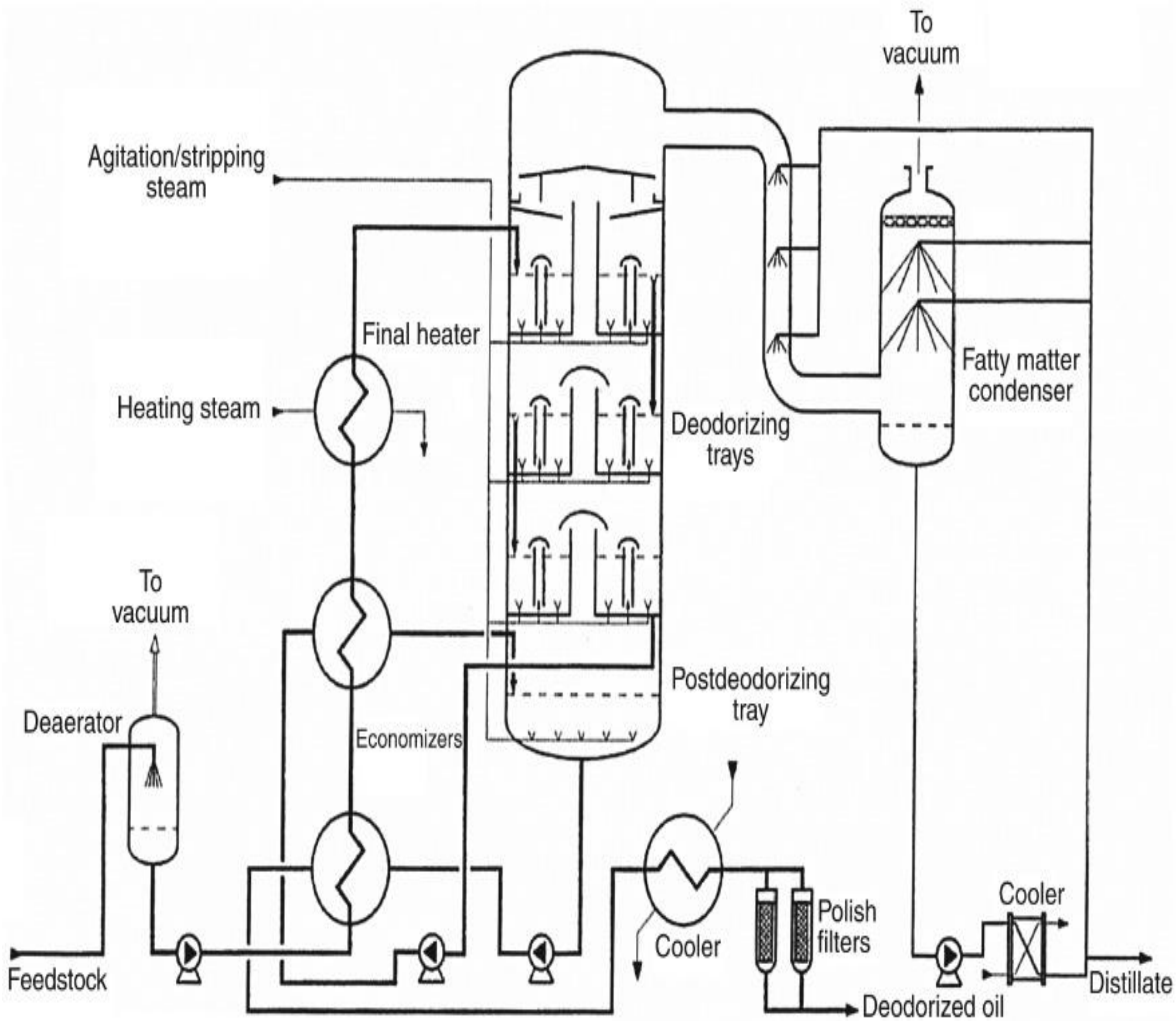

FIGURE 5 Schematic diagrams for continuous deodorizer

- The oil is deaerated in an external deaerator.
- Deaerated oil is then pumped through economizers using the hot oil from the deodorizer.
- A steam heater then brings the oil to the deodorization temperature.
- There are three trays in this deodorizer stacked vertically.
- The hot deaerated oil enters the top tray and goes down the next two while getting heat bleached and deodorized with the help of stripping steam.

- The hot deodorized oil leaving the last tray is passed through one of the two economizers to preheat the deaerated feed.
- The hot oil returns to the bottom of the deodorizer shell, which is also referred to as the post deodorizing tray. Here the oil undergoes further deodorization under vacuum with stripping steam.
- The oil from the post deodorizing tray is pumped through the economizer which first heats the deaerated oil. Then it is further cooled, filtered through polish filters, and stored under nitrogen.
- It is highly recommended that an inline gas diffuser be used to inject nitrogen gas into the deodorized oil as it leaves the deodorizer.
- The combination of nitrogen diffusion and nitrogen blanket in the storage tank protects the oil from oxidation.

4.1.1.3 Semi continuous deodorizer

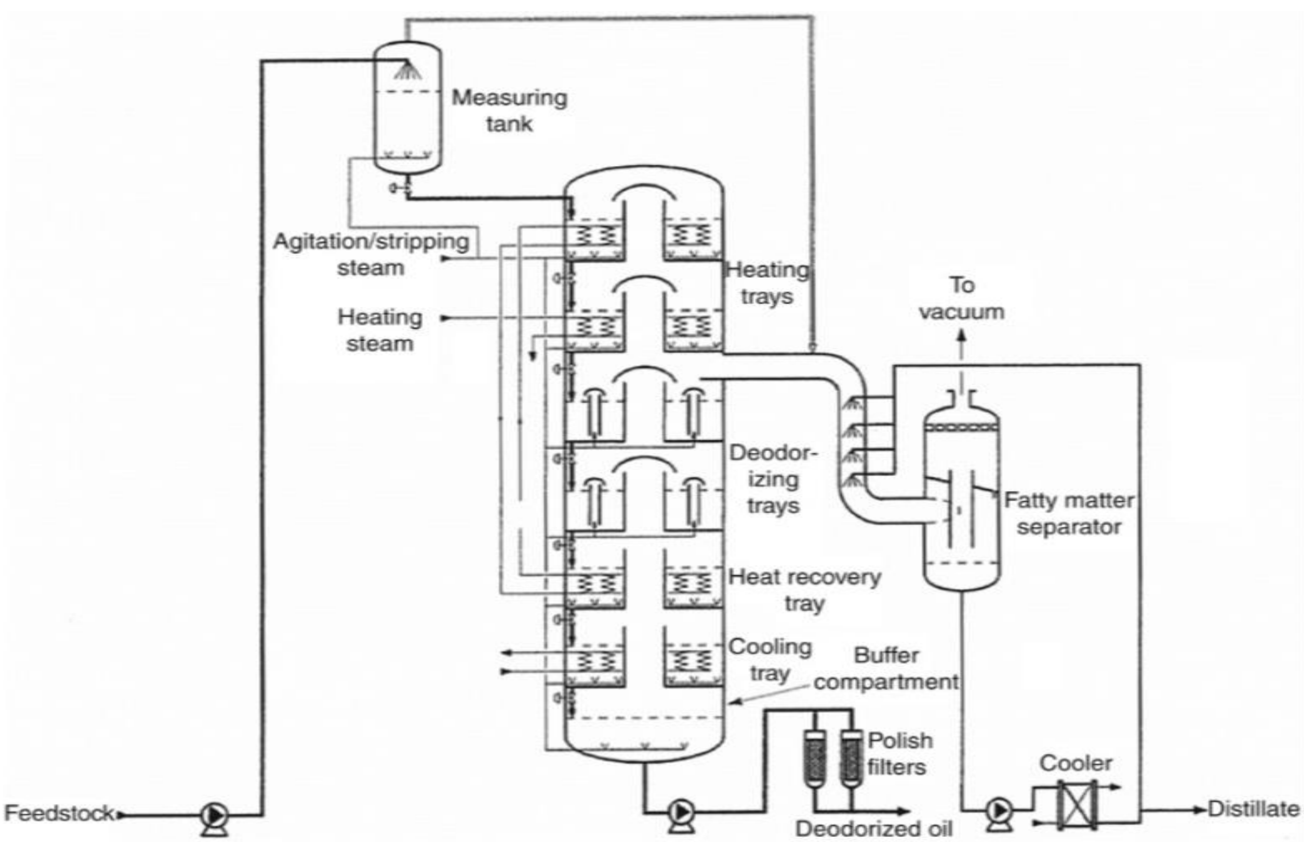

Figure 6 Schematic diagrams for semi continuous deodorizer.

- Oil is measured and deaerated in an external measuring tank using the same vacuum system as that of the deodorizer.
- The oil is automatically discharged into the first tray when it goes empty. Here the oil is heated further with steam stripping. The typical heating coils used in a semicontinuous deodorizer.
- The oil drains into the second tray, which is also used for heating and heat bleaching.
- The oil drains into the third tray. The oil drains into the next tray after the predetermined residence time.
- The third and the fourth trays are for deodorizing. One can see the mammoth pumps for steam stripping and oil recirculation.
- The fifth tray is used for heat recovery from the hot oil by the oil in the first tray.
- The final tray is used for precooling the oil, and for the addition of citric acid, and possibly other additives.
- The oil drops to the buffer tank at the bottom of the vessel before it is pumped out of the deodorizer.
- The oil is cooled to a temperature.
- The oil is saturated with nitrogen and stored under nitrogen protection, to be discussed later.
- The oil passes through a polish filter before it goes to through the external cooler.
- The vapors leaving the deodorizer enter the indirect-contact type condensing ejector, where the volatiles, such as fatty acids and the entrained triglycerides are captured in liquid form.
- The fatty acids are collected at the bottom of the fatty matter separator, cooled through an external cooler, and then returned to the vapor line coming from the deodorizer to make the initial contact with the vapor before the separator.
- The uncondensed vapor leaves the separator at the top and goes to the vacuum system.
- Most modern ejectors have four stages. Some combinations of liquid rings vacuum pumps (or dry vacuum pumps) and steam ejectors are used. Liquid ring

vacuum pumps cannot deliver the very low pressure required by modern ejectors on a reliable basis.

- The fatty acids are collected in stainless steel tanks and sold as a byproduct.
- Dowtherm was used as the heating medium. This required a Dowtherm boiler for each deodorizer. The Dowtherm was heated by natural gas either in a liquid boiler or in a Dowtherm vaporizer. Dowtherm vaporizers are still in use, except the new thermal medium is different.
- Steam spargers are located at the bottom of the coils.

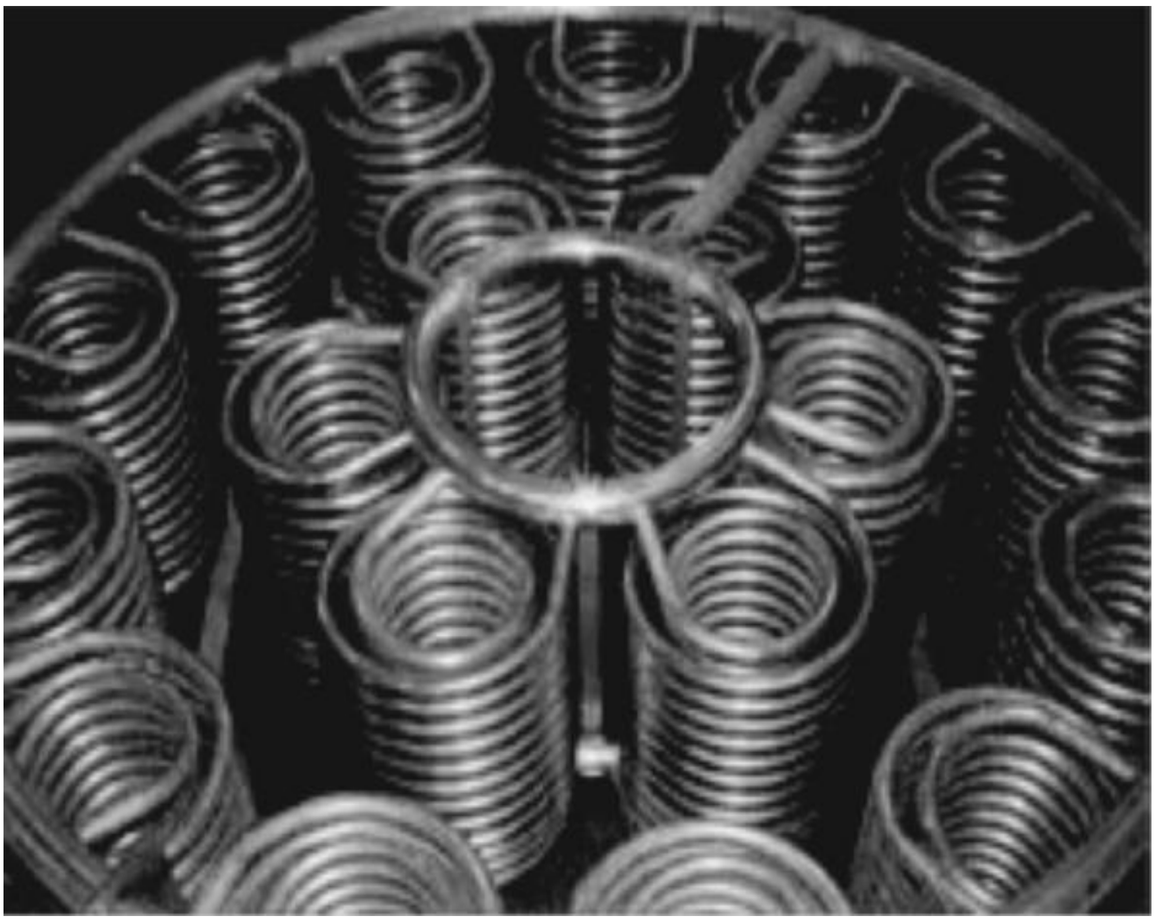

Figure 8. Internal coils for heating and cooling in trays.

4.1.2 Deodorized storage tank

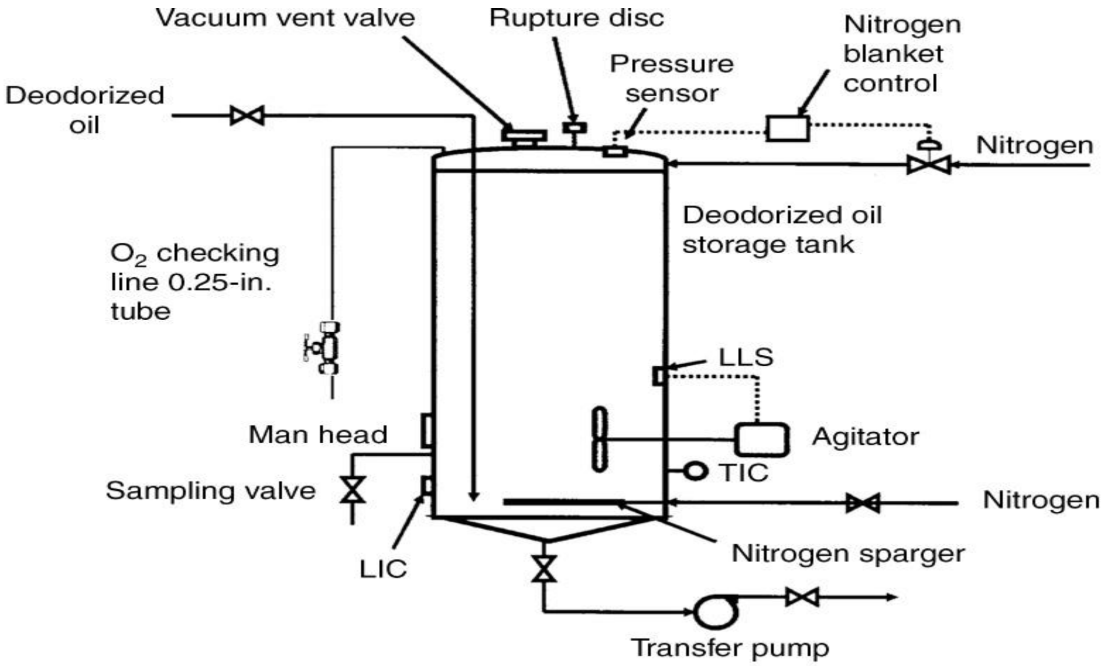

Figure 9. Schematic diagram for Deodorized Oil Storage tank

- The line loading the tank with deodorized oil is extended to the floor of the tank.
- The tank has a side entering mechanical agitator with a low-level cutoff switch (LLS).
- The tank has a vacuum vent valve at the top.
- There is a rupture disc at the top of the tank.
- A nitrogen control device regulates nitrogen flow into the tank to maintain maximum oxygen content of 0.5%.
- The tank has a temperature indicator controller (TIC).
- A level indicator controller (LIC) with high level cut off, which shuts the oil inlet valve to the tank and diverts the oil from the deodorizer to a similar storage tank.
- A ¼-in. tube coming down from the top of the tank where the headspace oxygen content can be measured with a hand-held oxygen meter.
- A sampling line and a valve are used for collecting samples for analysis

4.2 Adjustment of machine components

There are four types of machine component adjustment.

4.2.1 Functional requirement

Regarding the definition of adjustment, optimal adjustment needs a direct expression of functional requirement. Usually, assembly and positioning are two functional studied requirements having a geometrical expression. The concept of boundary translates cleverly the assembly condition. A part of a mechanism fits all the other parts if none of its manufactured points violates the interchangeability boundary.

ISO standard allows to use the Virtual Condition with the Maximum Material Requirement. This condition describes near perfectly the concept of boundary and so the functional requirement of assembly. A manufactured part fits for use if it is entirely on the good side of the interchangeability boundary. A part is all the better since its matter is near the boundary without violating it. Therefore, the deviation, and more exactly, the smallest deviation between the part and the boundary evaluates numerically the respect of the function.

4.2.2 Manufacturing deviations, adjustment parameters and measurement

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.

Those uncertainties are the causes of manufacturing deviations. To control the influence of some uncertainties as screw, displacement reversibility or slide way defects, 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, and diameter. 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 translate 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.

4.2.3 Adjustment model for the determination of the correction

We define a model built on a geometrical representation of the interchangeability boundary. Variation of some dimensions, which correspond to adjustment parameters, allows to distort the model. They allow to fit at best adjustment model to the geometry given by the measurement of first (or a couple of) manufactured part on the coordinate measuring machine for example. After moving and distorting of the model, the variations of dimensions give directly the value of the corrections of the adjustment parameters. Therefore, after having introduced these corrections, the following manufactured part has more chances to fit at best the interchangeability boundary and consequently the functional requirement.

4.2.4 Geometric adjustment method

To explain the proposed method, we use an application that is quite representative of the industrial adjustment problem. Its first function is to respect an assembly condition: when the cover lies on the A plan and when a shaft goes through the cylinder, two screws have to fit with the part. The cover is manufactured on a conventional machine tool, it lies on the A plan, a drilling tool drills both holes with a diameter of 12.5 mm. A boring tool finishes the diameter of 28 mm. Three adjustable longitudinal stops put each tool in its work position. The machine gives the other cross- position and the direction of drilling. There is no difference with a numerical machine tool; just we deal with numerical

Self-Check 4	Written Test

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

1. Write four types of machine component adjustment?

Note: Satisfactory rating – 5 points Unsatisfactory - below 5 points

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

Information Sheet 5- Entering processing/operating parameters to safety and production

5.1 Processing/operating parameters

The four process variables/parameters that determine the effectiveness of deodorization:

I. Pressure

The low absolute pressure necessary for low-temperature distillation of the odoriferous substances is affected by the vacuum system. The boiling point of the fatty acids and the vapour pressure of the odoriferous materials decrease as the absolute pressures decreases.

The required low absolute pressure, usually between 2 and 4 mbar, is commonly generated by vacuum systems consisting of a combination of steam jet ejectors, vapour condensers, and mechanical vacuum pumps. Special vacuum systems have been developed to reach lower pressures and operating costs and, at the same time, reduce emissions by a more efficient condensing of the volatiles.

II. Temperature

Deodorizations temperatures must be high enough to make the vapour pressure of the volatile impurities in the oil conveniently high. The vapour pressure of the odoriferous materials increases rapidly as the temperature of the fat is increased. For example, the vapour pressure of palmitic fatty acid is 1.8 mm Hg (2.4mbar) at 350°F (176.7°C), 7.4 mm Hg (9.86mbar) at 400°F (204.4°C), 25.0 mm Hg (33.3mbar) at 450°F (232.2°C), and 72 mm Hg (95.9mbar) at 500° F (260°C).

Assuming that the vapour pressure–temperature relationship for all the odoriferous materials is similar to that of palmitic fatty acid, each 50°F (27.8°C) deodorizer temperature increase would triple the odoriferous material removal rate. Or, stated another way, it would take nine times as long to deodorize an oil at 350°F (177°C) than at 450°F (232°C).

Higher deodorizer temperatures definitely provide shorter deodorization times; however, excessive temperature results in the development of the polymerization, isomerization to produce trans fatty acids, thermal cracking with formation of odoriferous and Iow boiling products, colour reversion, and distillation of tocopherols. Generally, trans fatty acid formation during deodorization is negligible below 428°F (220°C), becomes significant between 428 and 464°F (220 and 240°C), and is nearly exponential above 464°F (240°C).

Thermal degradation of the tocopherols becomes significant at Deodorisation temperatures above 500°F (260°C). It has been determined that twice as many tocopherols and sterols are stripped out at 525°F (275°C) as at 465°F (240°C), and that pressure variations of 2 to 6 mbar had only a slight effect on tocopherol/sterol stripping. Deodorizer operation at elevated temperatures can also promote thermal decomposition of some constituents naturally present in oils, such as pigments and some trace metal–pro oxidant complexes. The carotenoid pigments can be decomposed and removed by Deodorisation beginning at 446°F (230°C), therefore, a compromise must be determined between time and temperature for deodorizing particular fats and oils.

Optimum deodorizer operating temperatures vary from product to product. In general, animal fats require less stringent conditions than the vegetable oil products. Chemically refined oils are easier to deodorize than physically refined oils due to lower FFA levels and more effective removal of polar components, oxidation products, and pigments.

Among the vegetable oils, those containing relatively short-chain fatty acids, such as coconut and palm kernel oils, require lower Deodorisation temperatures than the domestic oils composed of longer chain fatty acids. Hydrogenated oils are usually more difficult to deodorize because of higher FFA contents and the distinctive odour imparted by the hydrogenation reaction.

III. Stripping Medium

Steam deodorization is feasible because the flavour and odour compounds that are to be removed have appreciably greater volatility than do triglycerides. Operation at high temperature increases the volatility of these odoriferous compounds; furthermore, introduction of an inert gas, such as stripping steam, into the deodorizer greatly increases the rate at which the odoriferous compounds are volatilized. Steam is sparged to carry away the volatiles and to provide agitation.

While deodorisation removes FFA from the oil, the FFA content cannot be reduced below about 0.005% because hydrolysis of the oil by the stripping steam is continually producing more FFA. The rate of hydrolysis decreases as the oil's FFA content decreases. Eventually the rate of FFA formation by hydrolysis equals the rate of removal by the stripping steam, and the oil's FFA cannot be reduced any further. A reduction in absolute pressure in the deodorizer also reduces the hydrolysis rate by a small but definite amount.

Due to this, nitrogen was proposed as a replacement for steam. However using nitrogen give rise to the following disadvantages:

- Cost of nitrogen is higher than steam
- Larger capacity vacuum system required

Any inert gas can be used, but steam has the advantage of being readily available and is readily condensed; thus cost of the vacuum-producing equipment is minimized

The amount of stripping steam required is a function of both the absolute operating pressure and the mixing efficiency of the equipment design. Agitation of the oil, necessary to constantly expose new oil surfaces to the low absolute pressure, is accomplished by the use of carefully distributed stripping steam.

Therefore, oil depth is a primary factor for establishing both the stripping steam requirement and the deodorizing or holding time. The quantity of fatty acids distilled with each kg of steam is directly proportional to the vapour pressure of the fatty acids. It must be noted that when removing volatiles, it is not the mass but the volume of live steam which determines the results. For example, 1-mbar operation will require a lower weight percentage of stripping steam than will 6-mbar operation. Therefore higher temperature and low pressure are beneficial for increasing the steam volume. Excessive live steam as mentioned above may cause hydrolysis and increased energy consumption for the vacuum system. Typical stripping steam deodorization conditions for chemically refined oils are 5 to 15 wt% of oil for batch systems and 0.5 to 2% for continuous and semi-continuous deodorizer systems.

IV. Retention Time

Deodorizer holding time is the period during which the fat or oil is at deodorizing temperature and subjected to stripping steam. Stripping time for efficient deodorization has to be long enough to reduce the odoriferous components of the fats and oils products to the required level. This time will vary with the equipment design. For example, a batch deodorizer with an 8- to 10-foot depth of oil above the sparging steam distributor will require a longer deodorization time than will a continuous or semi-continuous system that treats shallow layers of oil.

Typically, the holding time at elevated temperatures for batch deodorizer systems is three to eight hours, whereas the holding times for continuous and semi-continuous systems vary from 15 to 120 minutes. Additionally, certain reactions with the oils deodorized are not related to removal of FFA, but instead help provide a stable oil after deodorization

Self-Check 5	Written Test

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

1. Write the process /operating parameter that determine the effectiveness of deodorization?

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 deodorization equipment

6.1 Deodorization equipment

Edible oil deodorizing equipment and processes have been developed as a result of advances in hot-pressing and extraction of oil-bearing materials. Early methods included masking of odors by means of aromatics, washing out of odors and neutralization or destruction of odors by means of various chemical treatments. Commercial deodorization methods involve steam distillation in vacuo. Most efficient equipment uses low absolute pressures and high temperatures in equipment constructed of corrosion-resistant metals and supplied with suitable recording instrument. May include but not limited to:

•**Tankers;** Tankers are specialized vessels that include crude oil, product, chemical, LNG, and other tanker types. Tankers spend considerable time in ballast given the typical one -way nature of the underlying trades. Tankers are self-discharging and most are equipped with a series of pumps that allow for a fast turnaround in port.

- **Pumps**: Pumps are used in the industrial production of edible household oils, mainly in the refining processes.
    - ✓ During degumming
    - ✓ During neutralization, also called deacidification.

The pumps meter phosphoric acid, citric acid or caustic soda during the process.

- **Deodorizer;** Deodorizer or deodorants, substance used to absorb or eliminate offensive odors…Some substances, such as chlorophyll, eliminate odors by combining chemically with odorous impurities. Glycols, which are disinfectant as well as deodorizing substances, are sprayed into the air to absorb odors.

- **Vapor condenser;** The vapor condenser extracts the latent heat of vaporization from the vapor, as a higher-temperature heat source, by absorption in a heat-receiving fluid of lower temperature. The vapor to be condensed may be wet, saturated, or superheated. The heat receiver is usually water but may be a fluid such as air, a process liquid, or a gas. When the condensing of vapor is primarily used to add heat to the heat-receiving fluid, the condensing device is called a heater and is not within the normal classification of a condenser.

- **Steam injection system;** (Non condensable gases (air….)) is the volatile substances are condensed by creating an intimate contact between the vapor and fatty acid distillate circulating in the scrubber. The distillate which is circulated is at its lower possible temperature (just above its melting point).
  - ✓ Used superheated steam as a stripping agent (to avoid hydrolysis).

- **Vacuum system;** this highly efficient, structured packed column is designed to condense and recover free fatty acids (FFA) and other volatiles from the deodorization process and to prevent carryover of these materials to the vacuum system.
  - ✓ to facilitate stripping and protect the oil against oxidation)

- **Cooling heat exchanger,** cooling the oil with process cold water or city water. Deodorized oil is cooled to less than 290°F (143°C). Finally the oil is cooled in the two stages. First in the economizer, and then to the specified final temperature. It then undergoes polish filtration and is transferred to subsequent processes, storage or packaging.

- **Thermo packs boiler/high pressure steam boiler;**
  - ✓ **High pressure steam boilers**

Designed to heat steam above 15 psi and water at pressures that exceed 160 psig.Temperatures in high pressure boilers will exceed 250 degrees F. Due to the extreme pressure levels at which these boilers operate, they need to be monitored to ensure safety at all times.

The pressure of the boiler above 80 bars

- ✓ **Thermo pack boiler**

To servicing of thermic fluid heater, NON-IBR steam boiler, pressurized hot water generator, waste heat recovery unit and hot air generator.

6.1.1 Basic operating principles of equipment

- Identify main equipment components
- Identify status and purpose of guards
- Identify equipment operating capacities and applications
- Identify the purpose and location of sensors and related feedback instrumentation
- inspecting equipment condition to identify any signs of wear
- confirming availability of tank space
- selecting appropriate settings and/or related parameters
- confirming that equipment is clean and correctly configured for deodorizing process requirements
- positioning sensors and controls correctly
- ensuring any scheduled maintenance has been carried out

6.1.2 Equipment faults and related causes

Typical equipment faults and related causes, including

- Signs and symptoms of faulty equipment
- Early warning signs of potential problems
- Improper operation
- Failure to perform preventive maintenance

✓ Signs of early failure are missed
✓ Maintenance schedules suffer
✓ Reduced equipment efficiency
✓ Asset lifespan shrinks
✓ Breakdowns and downtime rise
✓ Costs skyrocket

- Too much preventive maintenance
  - ✓ Overspending increases
  - ✓ Wear and tear on asset soars
  - ✓ Technician time is wasted
  - ✓ Unnecessary inventory is used
  - ✓ Inaccurate information is collected
- Failure to continuously monitor equipment
- Bad (or no!) reliability culture

Self-Check 6	Written Test

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

1. Distinguish the difference between pump and tanker?
2. Write equipment faults and causes?

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

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

Information Sheet 7- Carrying out pre-start checks

7.1 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.

7.2 Carrying out Pre-start checks

Pre-start checks on machinery and equipment in used for deodorization process.conduct pre-start checks, such as

- inspecting equipment condition to identify any signs of wear,
- confirming availability of tank space,
- selecting appropriate settings and/or related parameters,
- confirming that equipment is clean and correctly configured for deodorizing process requirements,
- positioning sensors and controls correctly,
- ensuring any scheduled maintenance has been carried out, and
- confirming that all safety guards are in place and operational
- Inspecting equipment condition (signs of wear)
- Selecting appropriate settings and/or related parameters
- Cancelling isolation or lock outs as required
- Confirming that required screens are fitted and related equipment is clean and correctly configured as per cleaning process requirements
- Positioning sensors and controls correctly
- Ensuring any scheduled maintenance has been carried out
- Confirming that all safety guards are in place and operational
- Check that equipment is plugged in correctly
- Ensure that the electrical cords are in good condition and not frayed or broken.
- Start equipment in accordance with the organizations or manufacture's guidelines.
- Use safety guards or safety clothing (if applicable). Some equipment can have areas that can cause injury such as cutting blades and overheated areas.

Self-Check 7	Written Test

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

1. Write pre-start checks on machines and equipment used for deodorization process?

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

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

Operation Sheet #1-	Procedure for identifying and confirming cleaning and maintaining requirement

Objective: To prepare batch deodorizing machines for deodorization process.

Purpose: The main purpose of cleaning batch deodorizer is to avoid poor flavor and odor from freshly deodorized oil.

Steps of cleaning batch deodorizer for processing

1. Apply personal protective equipment
2. Fill the deodorizer with cold water covering the coils.
3. Add a sufficient amount of caustic solution totaling approximately 5% strength.
4. A stronger caustic solution does not clean the vessel any better.
5. Heat the water to 180–190°F (82–87°C).
6. Use stripping steam to agitate the water.
7. Leave the small stage ejector on if the pressure in the vessel begins to rise.
8. Most of the time it is not necessary to turn on the ejector.
9. Leave the caustic solution with the steam on overnight.
10. Shut off the steam the next day and drain the water with the proper amount of phosphoric acid added to the water to meet the guidelines of the local municipality.
11. Refill the deodorizer with cold water. Agitate with stripping steam.
12. Add a certain amount of phosphoric acid to neutralize the residual caustic in the vessel.
13. The pH of the water must match that of the city water, and not necessarily 7.0. The pH should preferably be measured by a pH meter and not by litmus paper.
14. Let the vessel cool down.
15. Take down the demisters and clean them in a vat of light caustic solution in hot water.
16. Rinse and treat the demisters with phosphoric acid.
17. Sometimes it is better to replace the demister pad when the deodorizer is cleaned once a year. It is not very easy to clean the demister pads well.
18. The deodorizer must be sprayed with deodorized oil as soon as the vessel is dry. This step is not so critical if the unit is built with 304 or 316 stainless steel.

19. The deodorizer is ready for reuse.

Operation Sheet #2-	Procedure for identifying and confirming cleaning and maintaining requirement

Objective: To prepare contentious deodorizer machines for deodorization process.

Purpose: The main purpose of cleaning contentious deodorizer is to avoid poor flavor and odor from freshly deodorized oil.

Steps of cleaning continuous deodorizer for processing

1. Apply personal protective equipment
2. Fill the tank with water.
3. The capacity of the tank should be 30% more than the total capacity of the deodorizer system.
4. A centrifugal pump with a capacity of 100–200 gallons per minute (gpm) with proper NPSH calculated on the basis of water temperature of 200°F (93.3°C) is used for pumping water through the system.
5. Caustic is added to make a 5% solution in the tank.
6. The water in the tank is heated with low-pressure steam. A self-actuated temperature control valve could be used for temperature control with a thermodynamic steam trap.
7. The caustic solution from the tank is recirculated for an hour while it is being heated.
8. After the water reaches a temperature of 180–190°F (82–87°C), the water is pumped through the deodorizer system.
9. All control valves are kept open with manual override.
10. The isolation valve to the ejector system is kept closed.
11. The caustic solution is circulated for 12–24 h. The temperature of the caustic solution is maintained.
12. Neutralize the caustic with phosphoric acid and circulate it for 2–4 h.
13. Drain the liquid from the system.

14. Open all the drain lines at the low spots as before and drain the residual water.
15. Turn on the vacuum system.
16. Fill the deodorizer with startup oil.
17. Heat the oil slowly to 250°F (121.1°C) and recirculate it until full vacuum is established.
18. Heat the oil to full temperature and start deodorizing.

LAP TEST #1	Procedure for identifying and confirming cleaning and maintaining requirement

Name………………………………. ID………………. Date …………….

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 16 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: Procedure for identifying and confirming cleaning and maintaining requirement

Task- 1.1 Steps of cleaning batch deodorizer for processing

Task- 1.2 Steps of cleaning continuous deodorizer for processing

LG #42	LO #2- Operate and monitor the deodorizing process

Instruction sheet

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

- Requiring workplace policies and procedures
- Starting and operating deodorization process
- Monitoring equipment variation in operating conditions.
- Identifying and reporting variation in equipment operation and maintenance
- Workplace information.
- Monitoring deodorization process to meet odor and flavor specifications
- Legislative requirements
- Identifying, rectifying and/or reporting out-of-specification product/process outcomes
- 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:

- . Require workplace policies and procedures
- Start and operate deodorization process
- Monitor equipment variation in operating conditions.
- Identify and report variation in equipment operation and maintenance
- Workplace information.
- Monitor deodorization process to meet odor and flavor specifications
- Legislative requirements
- Identify, rectify and/or report out-of-specification product/process outcomes
- Maintain work area to housekeeping standards.
- Maintain workplace records

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” which are placed following all information sheets.
5 Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6 If you earned a satisfactory evaluation proceed to “Operation sheets
7 Perform “the Learning activity performance test” which is placed following “Operation sheets” ,

Information Sheet 1- Requiring workplace policies and procedures

1.1 What are Policies and Procedures?

Policies and procedures go hand-in-hand but are not interchangeable.

A 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.

A 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.

Work is carried out according to

- company policies and procedures
- regulatory and licensing requirements,
- Legislative requirements, and
- Industrial awards and agreements.

1.1.1 company policies and procedures

Policies are a statement of purpose, which highlight broad guidelines on action to be taken to achieve that purpose. 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. 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.

1.1.2 Regulatory and licensing requirements

Regulation 5 of the Environmental Protection Regulations 1987 (EP Regulations) specifies that any premises listed in Schedule 1 of the EP Regulations is a prescribed premises.

- **Environmental Protection Regulations**

Environmental issues associated with the operational phase of oil production and processing primarily include the following:

I. Solid waste and by-products

The amount of waste generated depends on the quality of the raw materials and on process efficiency. Wastes, residues, and by-products may be used for producing commercially viable by-products or for energy generation. Other solid wastes from the vegetable oil manufacturing process include soap stock and spent acids from chemical refining of crude oil; spent bleaching earth containing gums, metals, and pigments; deodorizer distillate from the steam distillation of refined edible oils; mucilage from degumming; and spent catalysts and filtering aid from the hardening process.

Recommended techniques for minimizing the volume of solid waste and by-products for disposal include the following:

- Reduce product losses through better production/storage control (e.g., monitor and adjust air humidity to prevent product losses caused by the formation of molds on edible materials).
- Collect residues from the raw material preparation phase for conditioning (drying) and reprocessing (grinding) to yield by-products (e.g., animal feed).
- Return waste and residues to fields to assist in soil nutrient management; for example, EFBs from oil palm plantations with tree trimmings are a valuable soil amendment and/or can be composted with vegetable oil wastewater effluent.
- Use waste and residues for energy generation in the project plant's boiler(s).
- Investigate the following options for the responsible disposal of spent bleaching earth:

- ✓ Use as fertilizer, if not contaminated with heavy metals such as nickel, pesticide residues, or other contaminants.
- ✓ Recover non-food-grade oils from spent bleaching earth that could be used in other applications (feedstock for conversion to biodiesel or in bio-lubricants).
- ✓ Avoid direct recycling on agricultural land. Add spent earth to other organic waste and compost to avoid contact with air and risk of spontaneous combustion of spent bleaching earth.
- ✓ If contaminated, manage according to the waste management.
- ✓ Consider use as a feedstock for brick, block, and cement manufacturing.

- Investigate the following options for the use of distillates (e.g., free fatty acids and volatile organic compounds (VOCs)), depending on the level of contaminants (pesticides and/or residues).
- The nickel catalyst from hydrogenation should be either: o recycled and recovered for reuse as a nickel catalyst or as nickel metal, salt, or other application, or o stored and disposed of according to the hazardous waste management guidance.
- Manage filtering aid mixed with nickel in accordance with the recommendations for nickel catalyst.
- Use uncontaminated sludge and effluent from on-site wastewater treatment as fertilizer in agricultural applications or as a supplemental boiler fuel.

II. Water consumption and management

Oil facilities require significant amounts of water for crude oil production (cooling water), chemical neutralization processes, and subsequent washing and deodorization. General recommendations to reduce water consumption, especially where it may be a limited natural resource. Sector-specific recommendations to reduce water consumption, optimize water use efficiency, and reduce subsequent wastewater volumes include the following:

- When economically viable, consider the use of physical refining instead of chemical refining to reduce water consumption.

- Replace water-based conveyor systems by mechanical systems (augers or conveyors).
- Apply Cleaning-in-Place (CIP) procedures to help reduce chemical, water, and energy consumption in cleaning operations.
- Recover and reuse condensate from heating processes.
- Upgrade equipment water sprays (e.g., to include jets or nozzles).
- Use dry cleanup techniques before rinsing floors.
- Manually clean vessels before rinsing to remove solids for recovery or disposal.
- Use high-pressure, low-volume washing systems, and auto shut-off valves.
- Vegetable oil processing wastewater generated during oil washing and neutralization may have a high content of organic material and, subsequently, a high biochemical oxygen demand (BOD) and chemical oxygen demand (COD).

III. Energy consumption and management

Oil processing facilities use energy to heat water and produce steam both for process applications (especially for soap splitting and deodorization) and cleaning processes. Other common energy consumption systems include refrigeration and compressed air. In sector-specific recommendations include the following:

- Improve uniformity of feed to stabilize and reduce energy requirements.
- Increase efficiency of air removal in sterilization vessels to improve heat transfer.
- Identify and implement opportunities for process heat exchange; e.g., optimized oil-oil heat exchangers in continuous deodorization.
- Reduce stripping steam consumption by improving process efficiency; e.g., improve stripping tray design. Where possible, consider technologies such as dry ice condensing systems that may lower energy consumption.
- Consider co-generation (combined heat and power (CHP)) to improve energy efficiency.

- Consider more advanced approaches—such as the use of enzymes—for processes such as degumming and oil recovery.
- Where feasible, use anaerobic digestion for wastewater treatment and capture methane for heat and / or power production.

IV. Atmospheric emissions

Particulate matter (dust) and VOCs are the principal emissions from vegetable oil production and processing. Dust results from the processing, including cleaning, screening, and crushing, of raw materials, whereas VOC emissions are caused by the use of oil-extraction solvents, normally hexane.

Several sources within vegetable oil processing plants generate solvent emissions, including the solventrecovery unit, the meal dryer and cooler, leaks in piping and vents, and product storage. Additional emissions will result from the refining process if a fractionation method is used. Small quantities of solvent may be present in the crude vegetable oil if the oil has been extracted by a solvent and will volatilize during the oil refining process, particularly during deodorization. Odor emissions are produced by multiple sources (e.g., cookers, soap splitting, and vacuum generation).

V. Greenhouse gas emissions

The high nutrient loading of wastewater can be a source of methane (CH4) when treated or disposed of anaerobically. It can also be a source of nitrous oxide (N2O) emissions associated with the degradation of nitrogen components in the wastewater (e.g., urea, nitrate, and protein). Recommended measures to prevent and control non-fossil-fuel-related GHG emissions.

VI. Hazardous material

Vegetable oil processing involves the transport, storage, and use of bulk quantities of acids, alkalis, solvents, and hydrogen during extraction and refining. Their transport, storage, and handling provide opportunities for spills or other types of releases with potentially negative impacts on soil and water resources. Their flammability and other potentially hazardous characteristics also present a risk of fire and explosions.

1.1.3. Legislative Requirements

Legislative requirements means any applicable law, statute, bye-law, regulation, order, consent, permit, approval, regulatory policy, guidance or industry code, rule of court or directives or requirements of any Regulatory Body, delegated or subordinate legislation or notice of any Regulatory Body. Legislation is law which has been promulgated (or "enacted") by a legislature or other governing body or the process of making it.

Before an item of legislation becomes law it may be known as a bill, and may be broadly referred to as "legislation", while it remains under consideration to distinguish it from other business. Legislation can have many purposes: to regulate, to authorize, to outlaw, to provide (funds), to sanction, to grant, to declare or to restrict. It may be contrasted with a non-legislative act which is adopted by an executive or administrative body under the authority of a legislative act or for implementing a legislative act.

1.1.4 Industrial awards and agreements

Industrial award: In simple terms, awards set the minimum standards that an employer in your industry is allowed to pay for your kind of work. More technically, it's a legal ruling which grants all employees in one industry or employer the same conditions of employment and wages. Awards are designed to protect employees' wages and conditions. An award is an enforceable document containing minimum terms and conditions of employment in addition to any legislated minimum terms.

In general, an award applies to employees in a particular industry or occupation and is used as the benchmark for assessing enterprise agreements before approval. Industrial agreements can contain anything that directly relates to the employment relationship between an employer and employees, such as conditions of employment, leave, training, consultation and remuneration.

Self-Check 1	Written Test

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

1. Write the difference between policy and procedure?
2. Briefly discuses industrial award and agreement?

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

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

Information Sheet 2- Starting and operating deodorization process

2.1 Introduction

Deodorization is the final step in the processing sequence of converting crude oil or fat to an acceptable product for human consumption. In the deodorization process, the remaining impurities are either removed or reduced to a sufficiently low level for the production of acceptable flavor and functional edible oils and fats. While oils and fats do not harbor the growth bacteria and other organisms, one of the benefits of deodorization is to completely sterilize final product (Bockisch, 1998).

With deodorization, relative bland flavor and odor, essentially complete removal of residual herbicide and pesticide residue, low free fatty acid content, removal of oxidation products (zero peroxide content), low moisture content (about 0.05%), color reduction through heat bleaching of the carotene pigments improvements achieved. Normally, a chelant, like citric acid, is injected into the deodorized oil stream for reacting with any residual metals. The metal salts formed are subsequently removed from the oil by filtration (H. Yesim Karasulu, 2011).

2.2 Purpose of Deodorization

The final step in refining of fats and oils is deodorizations. It was introduced at the end of the 19th century to improve the taste and smell of refined oils. Today, the process is still commonly named ‘deodorization’, but the objectives have become much broader than just the removal of off-flavors. In fact, the current deodorization process has four main objectives:

- Stripping of volatile components such as FFA (in the case of physical refining), valuable minor components (tocopherols, sterols etc.) and contaminants (pesticides, light polycyclic aromatic hydrocarbons etc.)
- Actual deodorizations by removal of different off-flavors’
- Thermal destruction of pigments (so-called heat bleaching) and peroxides

- Rendering of the oil, by means of some chemical change, as more flavour-stable during its shelf life.

Deodorisation increases the oil's flavour and oxidative stability by nearly complete removal of FFA and other volatile odour and flavour materials, by partial removal of tocopherols, and by thermal destruction of peroxides. The thermal treatment that is a necessary part of the Deodorisation process also heat bleaches the oil by destruction of the carotenoids that are unstable at Deodorisation temperature.

2.3 Deodorization principle

Deodorization is actually a stripping process in which a given amount of a stripping agent (usually steam) is passed for a given period of time through hot oil at a low pressure. Hence, it is mainly a physical process in which various volatile components are removed. However, since it is usually carried out at high temperature (>200°C), some chemical and thermal effects may take place as well.

A. Vacuum stripping of volatile components

Theoretical aspects of vacuum stripping have been described extensively by many authors [3-5]. Stripping of a given volatile component from the oil is determined by its intrinsic volatility (vapor pressure curve) and the deodorizing conditions applied (temperature, pressure and amount of sparge steam). For a batch and cross-flow deodorization process, the stripping effect is described by the following mathematical equation:

$$S = \frac{P_t}{E.P_i^0}.\ln\frac{V_a}{V_0} + \left(\frac{P_t}{E.P_i^0} - 1\right)(V_a - V_o)$$

- with S = total moles of steam or any other stripping agent per mole of oil (to express the amount of steam as a percentage of the oil, the factor S has to be multiplied by a factor of 2.); P_t = total pressure of the gas phase = system pressure; P_i^0 = Vapor pressure of a given fatty acid i; E = vaporization efficiency; V_a = initial amount of the volatile component in the oil (moles), V_0 = final amount of the volatile component in the oil (moles). Other, similar equations have been derived for counter- and co-current deodorization.

From equation (1), it can be concluded that the amount of sparge steam required for the stripping of a given volatile component (e.g. free fatty acids) is:

- Directly proportional to the absolute pressure in the deodorizer;
- Inversely proportional to the vapour pressure of the volatile component;
- Inversely proportional to the overall vaporization efficiency E

From the factor (ln V_a/V_0), it can also be derived that :

- It is impossible to eliminate all volatile components during deodorization;
- Halving the concentration of a given volatile component requires the same amount of stripping steam, irrespective of its absolute concentration

Edible oils contain various components, each with its specific volatility. In physical refining, it is mainly free fatty acids (FFA) that need to be stripped. Apart from FFA, other volatile components, either valuable (tocopherols, sterols, etc.) or unwanted (off-flavors, pesticide residues, light polycyclic aromatic hydrocarbons, dioxins, etc.), are also removed during deodorization.

The vaporization efficiency E in equation (1) is a deodorizer design-specific factor. It should be seen as a measure of how saturated with volatile components the stripping agent (steam) becomes during its contact with the oil.

In an ideal (theoretical) case, E = 1, but industrial deodorizers usually have a vaporization efficiency of 0.3-0.7, depending on their design (steam injection geometry, depth of oil layer, elimination of reflux, etc.).

B. Thermal effects

Another objective of deodorization is the thermal destruction of flavor precursors and heat-sensitive color pigments. The latter effect is called ‘heat bleaching’ and it is most pronounced during deodorization/steam refining of palm oil, where the thermal breakdown of carotenes is targeted. Heat degradation of carotene is very slow at 210°C, but takes only a few minutes at T > 260°C. This is one reason why palm oil is typically deodorized at 260°C.

However, there is a general trend to lower the ‘heat load’ (residence time at high temperature) used during deodorization. This evolution towards milder process conditions is caused by the increasing awareness of the potentially harmful health effects of thermal degradation products (trans fatty acids, polymeric triglycerides and glycidyl esters) that can be formed during deodorization. In addition, there is the desire for maximum retention of the natural oil characteristics.

C. Effective deodorization: combination of stripping and thermal effect

Perfect deodorization is a complex process which includes the removal of volatile off-flavors already present in the bleached oil as well as the off-flavors that are formed during thermal degradation of higher molecular weight flavor precursors. Removal of the first group is similar to FFA stripping and can be achieved in a short time. Longer deodorization time is required to convert non-volatile flavor precursors into volatile off-flavors that can be stripped from the oil.

In practice, this means that time is an important process parameter in obtaining refined oil with a bland and stable taste. If the deodorization time is too short, some flavor precursors will stay in the deodorized oil, resulting in the development of off-flavors during storage or usage. This phenomenon, which is known as 'flavor reversion', is well known but at the same time still poorly understood.

2.4 Processing steps of deodorization

The deodorization process is fully determined by four process parameters: (1) temperature, (2) time, (3) pressure and (4) amount of stripping steam.The effects of process conditions on the standard quality parameters and the nutritional quality of the refined oil**.** Deodorization is a multistep process comprising deaeration, multistage heating, deodorization-deacidification, and multistage cooling of the oil.

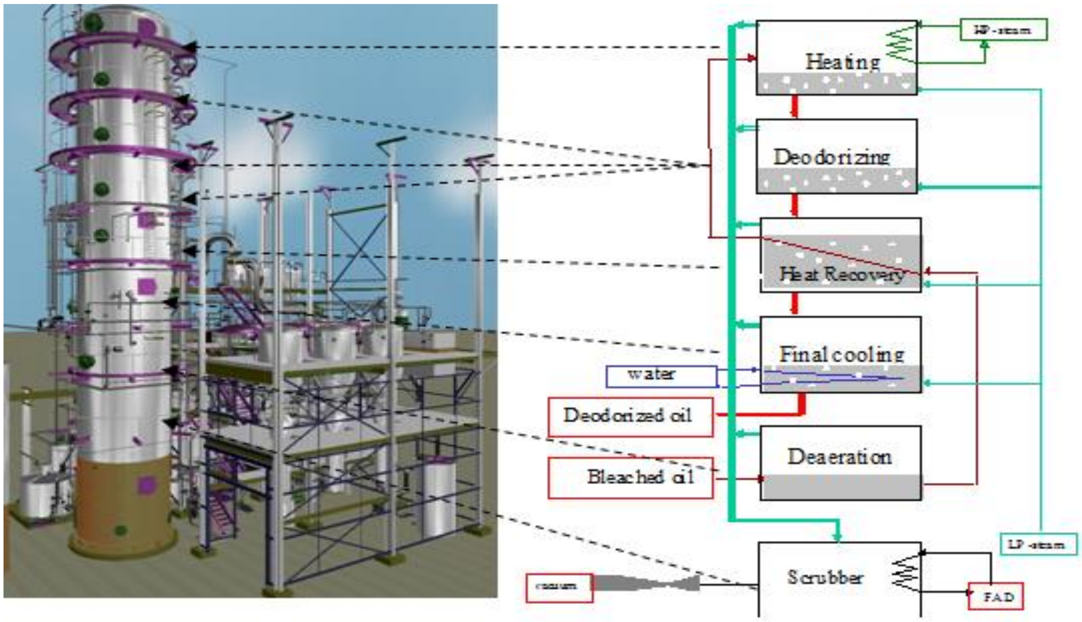

Figure 10. Schematic presentation of the different stages of the deodorizing process

I. Oil deaeration

Degummed, bleached oil is deaerated prior to heating to deodorizing temperature to avoid oxidation and polymerization. It is accomplished in a separate external vessel connected to the vacuum system of the bleacher (50 mbar) or, at even lower pressure, in an integrated compartment of the deodorizer. Some refiners add a bit of sparge steam to improve deaeration.

II. Heating and cooling

Heating of the oil is usually accomplished in two or more stages. To minimize the net energy cost, bleached oil is first pre-heated in one or two stages in a heat exchange device with either hot deodorized oil or steam.The highest energy recovery (up to 85%) can be achieved in continuous deodorizers in which bleached oil is pre-heated indirectly with hot deodorized oil. This heat recovery usually takes place in a heat recovery compartment of the deodorizer, but it can also be realized in a separate, external heat exchanger.

Both options have their pros and cons. External heat exchangers result in a high heat recovery and provide easier access for cleaning. On the other hand, heat exchange in the deodorizer ensures less product intermixing and less risk of fouling and it also takes place under vacuum.

The thermosiphon system is a special method of heat recovery that is used in semi continuous deodorizers. Steam produced in the oil cooling section flows in a closed loop to the oil pre-heating section. It will condense there and the water flows back to the cooling section. In this way, a heat recovery of 45-75% can be achieved, depending on the design of the thermosiphon system (single or double loop, with or without generation of low-pressure steam).

III. Deodorization-deacidification

Since the concentration of most volatile components in edible oils is quite low, a stripping agent must be injected during deodorization. For economic reasons, steam is the most commonly used stripping agent, but the use of nitrogen has also been studied extensively. Nitrogen is an inert gas and theoretically, its use will result in lower losses (no hydrolysis) and also a higher quality of the deodorizer distillate. However, in industrial practice, nitrogen is not used primarily because it is a noncondensable gas. This makes the required vacuum system much more expensive than the use of steam, which is condensable.

Most semi- and continuous deodorizers are so-called tray deodorizers which operate according to the cross-flow principle. Deodorization-deacidification is accomplished in a number of compartments (trays) where stripping steam is introduced into the oil through special sparge coils with very fine holes or by steam lift pumps. The latter give good agitation with continuous refreshing of the oil in the top layer (where deodorization effectively takes place), thereby ensuring a high overall deodorization efficiency

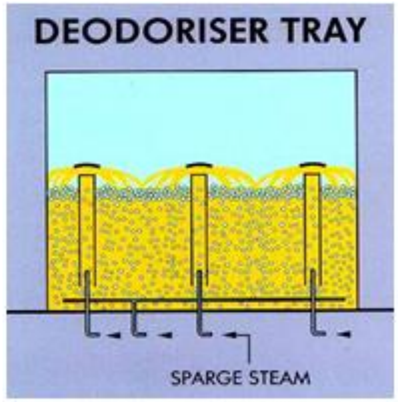

Figure 11. Principle of a steam lift pump for the introduction of sparge steam.

The stripping efficiency of a deodorizer can be further improved by incorporating a packed column stripper. Such a stripper is filled with a structured packing with a high surface area (250-350 m2/m3) .The countercurrent contact of oil and stripping steam over the structured packing results in very efficient stripping in a short contact time.

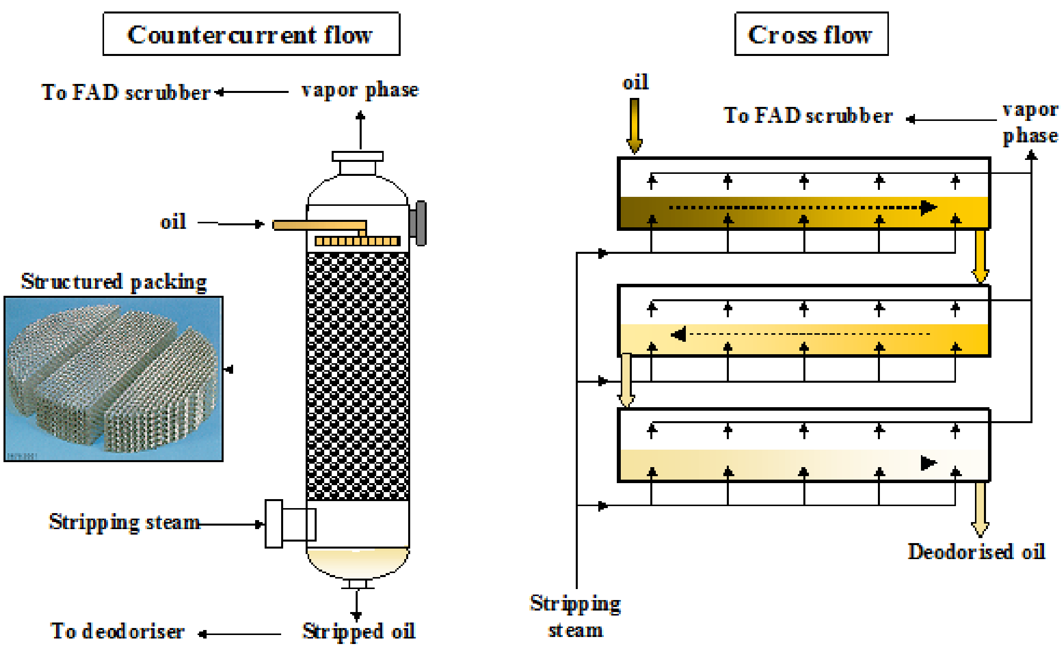

Figure 11. Principle of countercurrent and cross flow stripping

Packed column strippers have been applied in edible oil deodorization for many decades. They are often installed to increase the capacity of existing deodorizers. It is a very efficient device for the stripping of FFA or volatile contaminants (pesticides, PCB, light PAH, etc.). The short residence time makes it especially suitable for the stripping of heat-sensitive oils (e.g. algae oil, fish oil, cocoa butter, etc.). At the same time, this short residence time will not give much heat bleaching or complete deodorization. For this purpose, an additional retention vessel has to be provided before or after the packed column.

IV. Vapour scrubbing systems

The vapors leaving the deodorizer consist of steam, volatile components (fatty acids, sterols, tocopherols, contaminants, etc.), minor amounts of mechanically entrained neutral oil (mono-, di- and triacylglycerols) and some noncondensables (e.g. air, etc.). Condensation of the volatile components is achieved in a scrubber and results in a by-product called deodorizer distillate.

Condensation is achieved by creating a very good contact between the hot vapour phase and the cold deodorizer distillate that is partially recirculating over the scrubber. In practice, this is done by a series of sprayers built in the duct or on a packed bed of limited height in the scrubber vessel itself. An additional demister is usually installed ahead of the vacuum unit to minimize carryover of fatty matter to the barometric condenser water.

V. Vacuum systems

Vacuum in the deodorizer is usually created by a combination of steam ejectors (boosters), vapor condensers and mechanical (liquid-ring) vacuum pumps. These quite robust systems typically reach pressures in the deodorizer between 2.5 and 5 mbar but motive steam consumption is high (up to 85% of the total steam consumption).

Motive steam consumption can be significantly reduced (by a factor of 2.5-3) by cooling the barometric condenser water. However, the benefit of a lower motive steam consumption must be weighed against the extra chilling capacity required (higher electricity consumption). Another benefit from using a chilled water barometric vacuum system is a better condensation of the volatile matter, which also gives a lower pressure in the deodorizer (e.g. 1.5 mbar).

These classical vacuum systems are increasingly being replaced by dry (ice) condensing systems. With such systems, the stripping steam is condensed on surface condensers operating alternately at very low temperature (-30°C). The efficient solidification of steam and other volatile matter will give a very low pressure in the deodorizer (<1.5 mbar) and will also strongly reduce odor emission. As with the chilled water barometric vacuum system, dry ice condensers require extra electrical energy.

Commercially available systems consist of two or more freeze condensers with horizontally or vertically orientated straight tubes, a refrigeration plant for the generation of the cold refrigerant which is evaporated in the tubes and a vessel for defrosting and cleaning of the tubes after a certain period of freezing.

2.5 Deodorization system /unit operation

Deodorization is carried out in batch, semi-continuous or continuous systems. The deodorization principles are the same regardless of the system used. By heating the oil up to a temperature in the range (230-260°C) under a vacuum of 2 to 10 mmHg absolute, the non-triglyceride components and steam (vapor steam) are removed from the deodorization vessel by the vacuum system**.**

Edible oil deodorization is performed industrially in different ways (continuous, semi continuous or batch wise) with various configurations of deodorizers (horizontal or vertical vessels, tray-type or packed columns). Selection of the most appropriate process technology is mainly determined by the total plant capacity and the number of feedstock changes. The system choice depends on several factors, such as the number of feedstock changes, heat recovery, investment, operating costs, ecology requirements, physical or chemical refining, and so forth.

2.5.1 Batch

This is basically the simplest type of deodorization system that can be installed. The principal component parts consist of a vessel in the form of a vertical cylinder with dished or cone heads. The vessel is fabricated from type 304 stainless steel to avoid the deleterious catalytic activity of copper and iron on oils, welded to prevent air leaks, and well insulated to minimize heat loss.

The usual range of capacity is 10,000 to 40,000 pounds, although the preference appears to be batch sizes of 15,000 to 30,000 pounds. Vessel diameters are usually chosen to give a depth of 8 to 10 feet of oil and have a similar amount of headspace above the surface of the oil. It is necessary to allow sufficient head space to avoid excessive entrainment losses from the rolling and splashing of the oil caused by the injected steam. Stripping steam is injected into the bottom of the vessel through a distributor. In addition to the steam ejector system, means for heating, cooling, pumping, and filtering the oil are required.

The batch Fats and oils ProCessing 157 system controls include a device for indicating oil temperature and a pressure gauge designed to indicate accurately low pressures within the deodorizer. Equipment operating at a high temperature and 6- to 12-mbar pressure requires about eight hours for a complete deodorization cycle of charging, heating, deodorizing, cooling, and discharging the oil. Some systems operating at higher pressures or lower deodorization temperatures may require as long as 10 to 12 hours for a deodorization cycle.

The total amount of stripping steam required may vary from approximately 10 to 50 pounds per 100 pounds of oil, with the average usage probably about 25 pounds per 100 pounds of oil. The stripping steam is ordinarily injected at 3 pounds per 100 pounds of oil per hour at 6-mbar pressure. The oil must be cooled to as low a temperature as practicable after deodorization before it is discharged to atmospheric conditions to minimize oxidation.

A temperature of 100 to 120°F (38 to 49°C) is preferred for liquid oils, with higher temperatures being necessary for higher melting products, but still maintained as low as possible. Batch deodorization has the advantage of simplicity of design, flexibility, and ease of operation. It can be operated for as long or as short a period as required, with frequent product and even deodorization condition changes. Mechanically, batch deodorizer systems require very little maintenance; however, the cost of utilities for batch deodorization is considerably higher than for the continuous or semi continuous systems.

Batch systems do not provide a convenient means of recovering any substantial portion of the heat required, they have high stripping steam consumption and they require large vacuum systems with high steam and water requirements. But, the lower labor and capitalization costs for the original installation may offset a portion of the higher utility costs.

2.5.2 Semi continuous Deodorization

These systems operate on the basis of handling finite batches of oil in a timed sequence of deaeration-heating, holding-steam stripping, and cooling such that each quantum of oil is completely subjected to each condition before proceeding to the next step. The semicontinuous deodorizer consists principally of a tall cylindrical shell of carbon steel construction with five or more type 304 stainless steel trays stacked inside of, but not quite in contact with, the outer shell. Each tray is fitted with a steam sparge and is capable of holding a measured batch of oil.

By means of a measuring tank, oil is charged to the top tray where it is deaerated while being heated with steam to about 320 to 330°F (160 to 166°C). At the end of the heating period, the charge is automatically dropped to the second tray, and the top tray is refilled. In the second tray, the oil is heated to the operating temperature and again after a timed period is automatically dropped to the tray below. When the oil reaches the bottom tray, it is cooled to 100 to 130°F (38 to 54°C) and discharged to a drop tank from which it is pumped through a polishing filter to storage.

Semi continuous deodorizers are usually automated and controlled from a central panel with a time-cycle controller and interlocks such that the sequence steps are interrupted in the event of insufficient batch size, improper drop-valve opening or closing, or the oil not reaching the preset heating or cooling temperatures in the allotted time. One of the principal advantages of the semi continuous deodorization system derives from the fact that all of the trays are under the same relatively high vacuum.

All oil receives substantially identical treatment, and the annular space between the trays and the shell provides some insurance against oxidation due to inward leakage of air. The deodorizer arrangement avoids refluxing of once-distilled undesirable materials back into the oil. This reflux, plus any mechanical carryover, is permitted to drain from the bottom of the deodorizer shell.

The ability to accommodate frequent stock changes with a minimum of lost production and practically no intermixing is an important advantage for the semi continuous systems over the continuous deodorization systems; however, heat recovery is less efficient than a continuous operation, and 10 to 20% more sparge steam is required. There are five trays (in the original design) or six trays (in the newer design) that are vertically stacked. These trays perform several functions, such as:

- deaeration
- heating
- deodorizing
- cooling

2.5.3 Continuous Deodorization

Continuous deodorizers provide uniform utility consumption by not being subject to the peak loads attendant with batch-type heating and cooling of semicontinuous operations. This permits smaller heating and cooling auxiliaries and optimum heat recovery through interchange between incoming and outgoing oils. Processors requiring infrequent product changes can benefit from continuous deodorization; however, processors requiring multiple stock changes will not realize the benefits.

Continuous deodorization benefits are lost with as few as three or four stock changes in a 24-hour period due to loss of production (30 to 60 minutes for each stock change) and the likelihood of commingling product. Continuous deodorization can involve tray or thin-film deodorizers. Tray deodorizers are based on a series of steam-agitated trays or compartments often stacked vertically in a cylindrical shell. Stripping of FFA and other volatile compounds and heat bleaching are carried out simultaneously.

The retention time per tray is usually 10 to 30 minutes. Typically, liquid levels of 0.3 to 0.8 meters are maintained by overflow pipes or weirs. The trays are drained by separate discharge valves .Physical refining, or the removal of fatty acids from oils by steam distillation rather than by caustic refining, can be carried out in semicontinuous or continuous deodorizers; however, continuous deodorizers containing packed columns are particularly suited to the removal of large amounts of FFA. Thin-film deodorization has structured packing to create a maximum surface-to-volume ratio.

The oil flows over the packing and meets the sparging steam counter-currently for FFA stripping. Heat bleaching is accomplished in a retention section after the packed column. The counter-current principle introduces efficiencies through more effective use of the injected steam to reduce the quantity required and smaller vacuum requirements due to the small volume of oil treated at a time.

Also, a large percentage of the heat is recovered by preheating the feedstock oil by passing it counter-currently through a heat exchanger opposite the other oil flow. The retention time at high temperatures is reduced to a minimum to retain a high level of tocopherols and limit trans fatty acid development. Due to the high oil–metal contact surface in packed columns, the risk of fouling is higher.

The frequency of cleaning as well as efficiency of the structured packing material is determined by the type of oil processed, the frequency Fats and oils ProCessing 159 of shutdowns, feedstock changes, and the purity of the feedstock. Packed columns processing physically refined oils require more frequent cleaning, each 6 to 10 months, and replacement of the structured packing every 2 to 3 years. Deodorization of chemically refined oils with this system extends the cleaning frequency to once a year and the structured packing lifetime to three to four years.

2.6 Deodorization Process Control

Deodorization is the last major processing step where flavor, odor, and many of the stability qualities of an edible fats and oils product can be affected. From this point forward, all of the efforts are directed toward retaining the quality of the freshly deodorized product. In order to produce a quality deodorized product, attention must be focused on all the factors involved with the process. The various factors that influence the quality of the finished deodorized oil include:

i. Undeodorized oil preparation:

Preparation of the oil before deodorization has a significant effect on the finished deodorized product; therefore, the first process control requirement is to ensure that the processing steps prior to deodorization have been performed properly as specified.

For example, deodorization of high peroxide oils will thermally decompose the peroxides, but the rate of peroxide formation in the oil during subsequent storage will probably increase and the flavorstability will be compromised. Proper handling of the oil would be to rebleach it prior to deodorization. Steam distillation does not remove secondary oxidation products, soap, or phosphatides, which are adsorbed in bleaching.

ii. Air elimination:

Oil must be scrupulously protected from contact with air throughout the deodorization process. At elevated temperatures, oils react instantly with oxygen to form polymeric and oxidized triglycerides, which may be detrimental to health. Some potential air sources are

a. Deaeration of the feedstock is essential because the oil may contain dissolved oxygen from previous exposure to the atmosphere. Proper deaeration is achieved by sparging the oil into a tank under reduced pressure. Usually, the oil is heated to >175°F (80°C) and sprayed into a tank kept at a pressure of <50 mbar.113

b. Air leaks can occur at deodorizer fittings below the oil level and in external pumps, heaters, and coolers; allow the oil to oxidize and polymerize.

c. The stripping steam must be generated from deaerated water to be oxygen free.

Iii. Deodorization construction materials:

Heavy metals, particularly those possessing two or more valency states, generally increase the rate of oxidation. Of all metal, copper is the most potent catalyst. A concentration high enough to produce a noticeable oxidative effect lies in the proximity of analytical detection limits, probably 0.005 ppm. The corresponding content for iron is 0.03 ppm. Other metals have exhibited varying catalytic powers.

iv. Metal chelating

Fats and oils obtain metal contents from the soils where plants are grown and later from contact during crushing, processing, and storage. Many of the metals promote autoxidation, which results in off-flavors and odors accompanied by color development in the finished fat and oil products.

Studies have identified copper as the most harmful metal, followed by iron, manganese, chromium, and nickel. The effects of pro-oxidants can be diminished by using chelating agents before and after deodorization. The most commonly used chelating agents are citric Fats and oils ProCessing 161 acid, phosphoric acid, and lecithin. Citric acid is metered into the oil as an aqueous or alcoholic solution at levels of 50 to 100 ppm.

Citric acid decomposes at 347°F (175°C), and the usual practice is to add it during the cooling stage in deodorization. Citric acid added prior to deodorization decomposes at deodorization temperatures, but still affords a degree of protection from trace quantities of oxygen present during preheating. Phosphoric acid, when used, is added to the deodorizer in an aqueous solution at a concentration of no more than 10 ppm because a slight over-addition can lead to off-flavors in some oils (e.g., watermelon flavor in soybean oil). Lecithin has been used to chelate metals at 5 ppm.

v. Oil polishing:

The final stage of deodorization should be filtration of the oil. The deodorized oil is normally pumped through an enclosed polishing filter to remove any fine particles of soaps, metallic salts, rust, filter aid, polymerized oil, or any other solid impurities. Horizontal plate filters have long been used as the polishing filter of choice for deodorized oils.

These filters are well adapted to this service because oil clarity is excellent and the amount of solids to be removed from the oil is minimal. The disadvantages of this type of filter are the labor requirements to clean and redress the filter plus the space requirements, thus small cartridge or bag filters have become popular for this purpose. These oil-polishing filters are relatively inexpensive, require a minimum space, and are much less labor intensive; also, the bags are relatively inexpensive.

vi. Operating conditions

Operating variables, such as temperature, pressure, stripping steam rate, and time of steaming affect the quality of the finished product. The temperature of the steam required is proportional to the absolute pressure. The time required for efficient deodorization depends on the rate at which steam can be passed through the oil and is limited by the point at which appreciable mechanical entrainment occurs.

The lower the system pressures at a fixed vapor pressure or temperature and sparge steam rate, the greater the FFA reduction. Because the vapor pressure of the FFA and the other volatiles is directly proportional to the temperature, an increase in both temperature and sparge steam rate will increase FFA reduction;
however, the maximum temperature that can be used is limited because of the detrimental effects upon oil stability and trans acids development.

2.7 Deodorized oil quality

Deodorized oil is evaluated for certain physical and chemical attributes as well as for organoleptic acceptability.

2.7.1 Physical Attributes

The deodorized oil must have the following characteristics:

- odorless,
- have a clean taste with no unpleasant aftertaste,
- must be light in color, and
- Lovibond color must meet the company standards.

2.7.2 Chemical Attributes

The deodorized oil must meet the chemical standards.

2.7.3 Organoleptic Attribute—AOCS Method Cg-2-83 (09)

Chemical attributes, such as PV, pAV, conjugated dienes, AOM, and OSI are good tests for the oil but they do not always correlate to the flavor of the freshly deodorized oil or oil in storage. This is because the deodorized oil may contain some volatile compounds at less than a 1 ppb level that still can affect the flavor but cannot be detected in the standard analysis of the deodorized oil.

The oil may exhibit a slight off flavor with bitter aftertaste in the fresh oil when the polymer level is high. Unacceptable flavor in the oil becomes noticeable after storage. Product made with the questionable-flavor oil may have acceptable flavor initially, but it deteriorates rapidly during storage. Therefore, testing flavor of the oil is an important part of determining oil quality, and it is essential that the plant personnel are trained to do so and they also conduct some storage stability tests.

2.7.4 Significance of the Deodorized Oil Quality Standards

It would be appropriate to go over the deodorized oil quality and discuss the significance of each of the quality standards in terms of deodorizer performance or other factors that could be driving these specific quality parameters

Self-Check 2	Written Test

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

1. What is deodorization process?
2. Discus the stages of deodorizing process?
3. What are the deodorization system /unit operation?
4. Discus the deodorization principle?
5. Write the factors that influence the quality of the finished deodorized oil?

Note: Satisfactory rating – 25 points Unsatisfactory - below 25 points

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

Information Sheet 3- Monitoring equipment variation in operating conditions

3.1 Monitoring equipment variation

Material handling includes a number of operations that can be executed either by hand (manual) or by mechanical means or devices to convey material and to reduce the human drudgery. The most common deodorizing equipment (Tankers ,Pumps .Deodorizer , Vapor condenser , Steam injection system , Vacuum system , Cooling heat exchanger, Thermo pack boiler/high pressure steam boiler).

Process Equipment

- Verifiable preventative maintenance program exists
- Equipment designed for clean ability
- Ladders, catwalks, and crossovers have protective shields underneath them to protect products and food contact surfaces
- No metal-to-metal moving surfaces

Multi steps of deodorization process:

- Deaeration
- multistage heating
- deodorization-deacidification, and multistage cooling of the oil

Operation Qualification

- Performed to verify operation within specified parameters such as temperature, pressure, flow.
- Should be accomplished via established and approved protocol that describes all aspects of the testing of the equipment in detail
- Involves the verification of the proper operation of controllers, indicators, recorders, alarms and interlocks
- Confirmation that the equipment or system can sequence through its operating steps
- That key functions and process parameters are checked
- Assure they meet the operating specifications
- Ensure there are no undesirable operations

- Assure the system appropriately responds under fault or failure conditions

Self-Check 3	Written Test

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

1. Write the most common deodorizing equipment?

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

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

Information Sheet 4- Identifying and reporting variation in equipment operation and maintenance

4.1 Identifying and reporting variation in equipment operation and maintenance

Variability is present in any manufacturing process. Part of this variability is due to a set of causes known as common causes or chance causes. Common causes are those that are inherent in a process. Common causes of variability can be reduced but never completely eliminated. Variability due to common causes is due to several sources that are inherent to the process, and it impacts all items processed.

Common causes of variation are as follows:

- Poor product design
- Poor process design
- Unfit operation
- Unsuitable machine
- Untrained operators
- Inherent variability in incoming materials from vendor
- Lack of adequate supervision skills
- Poor lighting
- Poor temperature and humidity
- Vibration of machinery
- Inadequate maintenance of equipment, and
- Inadequate environmental conditions due to noise and/or dust.

4.2 Equipment operation and maintenance

Operation and maintenance items include:

- Conditions that may cause operation and maintenance problems
- Facility requirements for operation and maintenance personnel
- Periods when the facilities will be operated
- Monitoring and control requirements
- Communications requirements
- Requirements for preparation of Designers'
- Operating Criteria and availability of operation and
- Maintenance personnel and equipment.

Self-Check 4	Written Test

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

1. Write common cause of equipment variation ?

Note: Satisfactory rating – 5 points Unsatisfactory - below 5 points

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

Information Sheet 5- Workplace information

5.1 Workplace information

Information is constantly received, used, stored, prepared and distributed in the workplace. Everyone is involved – it doesn't matter if you manage stock, prepare meeting agendas or collect forensic specimens. Every workplace is different and requires different types of information to keep it running smoothly, efficiently and profitably. Different businesses collect and use different types of information. May include:

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

3.1.1 Standard Operating Procedures (SOPs)

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.

Inspect to ensure free of chemicals, tools, and cleaning supplies before starting the equipment, and ensure that guards and safety mechanisms are in place

- Run equipment prior to inspecting
- Complete the formal pre-op spelled out in the plant's SOP
- Correct all deficiencies and provide feedback to the person responsible
- Pre-op the facility regularly for other deficiencies

Purpose of SOPs

- Prevent or minimize problems and possible issues affecting food safety
- Ensure the defined procedures are conducted in a consistent manner

Implementation (Monitoring) Requirement of SOPs

a) Each official establishment shall conduct the pre-operational procedures in the Sanitation SOPs before the start of operations.

b) Each official establishment shall conduct all other procedures in the Sanitation SOPs at the frequencies specified.

c) Each official establishment shall monitor daily the implementation of the procedures in the Sanitation SOPs.

Steps in Developing SOPs

- Identify the tasks
- Use a team approach
- Conduct analysis of tasks that are determined to be included in procedure
- Identify possible operational barriers to procedure
- Task analysis includes
    - ✓ researching regulations, guidelines, and policies;
    - ✓ reviewing the operation;
    - ✓ identifying the steps in the procedure; and
    - ✓ developing a flow diagram
    - ✓ Use systematic approach in development
    - ✓ Determine the goal of the procedure

Benefits

- The improvement and use of SOPs promotes quality through consistent implementation of a process or procedure within the organization reduced work effort, along with advanced data comparability, credibility, and legal defensibility.
- The details in an SOP standardize the process and support step-by-step how-to instructions that enable anyone within your operation to perform the task in a consistent manner.
- They abbreviate difference and advance quality through constant impact of a process or procedure inside the organization, although there are temporary or permanent personnel changes

3.1.2 Specifications

- Up-to-date specifications shall exist for all:
- Raw materials including packaging materials;
- Finished products; and
- Intermediate products when appropriate.
- All specifications shall be pertinent and thoroughly defined, and shall ensure compliance with the QMS and food safety
- guidelines of the organization as well as other regulatory requirements
- All specifications shall, when appropriate, be formally agreed to with customers or any other required person, company or organization.
- The operator shall operate a specification review procedure for its customers and shall have all appropriate documentation relating to product quality and safety.

3.1.3 production schedules and instructions

Production scheduling has become a must for manufacturing operations that are looking to take their production facility to the next level. Production scheduling refers to the allocation of resources, operations, and processes required to create goods and services.

5 Components of Production Scheduling

The five components of production scheduling include the following:

a. **Planning:** The planning component of production scheduling is by far the most important. This component pertains to deciding what will be done in the future. Without a plan, production scheduling cannot even begin or take place. Preparing a plan through charts, production budgets, or various others visual representations can provide a sound basis for steps down the road pertaining to production. There are two types of planning that can be used: static planning and dynamic planning. Static planning assumes that all steps will be completed on time with no changes, while dynamic planning assumes that some process steps will change.
b. **Routing:** Production routing is the process that is used to determine the route or path that a product must follow. This route entails the path from raw materials until it is transformed into a finished product.
c. **Scheduling:** Scheduling coincides with the time and date that the operation must be completed. Scheduling is an essential and crucial portion of production scheduling and lays the foundation and groundwork for all of the steps within the production process. There are three types of scheduling that an operation utilizes, such as master scheduling, manufacturing or operation scheduling, and retail operation scheduling. Overall, scheduling is key for a manufacturing operation to proceed.
d. **Dispatching:** Dispatching relates to the process of assigning the order of job from the preconceived production plan. Dispatching is concerned with giving a practical shape to an overall production plan. This will also include issuing any orders and instructions and other important information pertaining to production.
e. **Execution:** The last component of production scheduling is the proper execution of the created schedule. Staff members must work together to ensure that items are produced in the right order and delivered on time. A proper schedule execution would be one that has the fewest amount of bottlenecks or late orders.

Self-Check 5	Written Test

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

1. What is workplace information?
2. Discus standard processing operation ?
3. What are five components of production scheduling?

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 deodorization process to meet odor and flavor specifications

6.1. Monitoring deodorization process to meet odor and flavor specifications

6.1.1 Monitor critical control points for the deodorizing process

The critical control points for deodorization are

6.1.1.1 Incoming oil quality

This is critical for the deodorizer to process the oil under standard operating conditions and deliver high-quality products. Feed oil quality plays a significant role in determining the performance of the deodorizer. Feed oil Refined Bleached (RB) quality to the deodorizer varies in terms of FFA and Lovibond color, depending on the type of oil, but they all must be low in certain trace impurities without exception.

6.1.1.2 Deaeration

The oil must be deaerated before it is heated to heat bleaching or deodorization temperature. The purpose is to remove the dissolved oxygen from the oil to prevent oxidation and formation of oxidative polymers and also to remove the dissolved moisture from the oil. This is accomplished through the following steps:

- The oil is heated to 185–195°F (85–90°C) and then distributed through a distribution ring and nozzles into a deaerator which is maintained at the same vacuum as the deodorizer.
- In a batch deodorizer, the vacuum is pulled before the oil is heated to any higher temperature.
- In a semicontinuous deodorizer, this is done in the deaerator tray maintained at the same vacuum as the deodorizer.
- A continuous deodorizer uses a separate deaerator vessel under full vacuum as the deodorizer.

Deaeration temperature and vacuum are both very critical for the final oil quality. Dissolved air under poor vacuum and at a temperature of 285°F (140°C) or higher produces oxidative polymers in the oil.

6.1.1.3 Heating the oil for deodorization

Heating of the oil before deodorization is a very critical step. The oil must be deaerated as mentioned earlier. Seed oils high in polyunsaturated fatty acids can get seriously polymerize at 300°F (149°C) in the presence of air. Most of these are oxidative polymers and are very harmful to oil flavor stability. Even oils like palm oil or palm olein must be deaerated before heat bleaching in order to protect the oil against oxidation.

This is why deaeration is critical. Deaeration of the oil has another important consequence for palm oil or palm olein. Beta carotene and other carotenes in these oils are heat bleached (except for red palm oil) in the heat bleacher and the deodorizer. The presence of oxygen oxidizes these compounds, causing color fixation that cannot be removed in deodorization. The oil remains darker after deodorization. This also increases the yellow color of shortening when measured on the Hunter Color machine.

6.1.1.4 Operating pressure (vacuum)

The process of deodorization is carried out at a low absolute pressure and at high temperature. It must be clear from the discussion in the previous section that the temperature of the oil must be raised in order to increase the vapor pressure of the components, such as FFA and other volatile compounds.

The absolute pressure in the deodorizer must be lower than the combined vapor pressure of these components so they will distill from the oil. times. A higher than normal operating pressure (lower vacuum) reduces the ability of the deodorizer to remove the odoriferous compounds from the oil. Poor vacuum in the deodorizer can arise from:

- Poor performance of the vacuum ejector,
- A possible air leak in the system, and
- Higher than designed amount of stripping steam.

6.1.1.5 Operating temperature

As stated earlier, the temperature of the oil must be sufficiently high to volatilize compounds like FFA, aldehydes, ketones, and other volatile oil decomposition products in order to obtain good flavor in the deodorized oil.

On the other hand, very high deodorizer temperature can oxidize and polymerize the oil. Therefore, the oil must always be deodorized at the minimum possible temperature that produces the best oil quality, including flavor. Sometimes, it is necessary to increase the deodorizer temperature in order to remove the odoriferous compounds from the oil. One must always remember that this temperature must never be excessively high. In such cases it is advised that the plant supervisor check the quality and the history of the deodorizer feed stock and take corrective action to fix it because the deodorizer cannot and should not be used to correct any fundamental issue with the oil quality prior to deodorization.

6.1.1.6 Amount of stripping steam

The stripping steam is injected into the oil in the deodorizer. This serves several purposes:

- It creates agitation in the oil, which helps remove the volatile matters from the oil.
- The steam expands under the reduced pressure, which increases the specific volume of the steam many times, increasing the specific surface area. This enhances the contact between steam, oil, and the volatile components in oil.
- Owing to the expanded volume, the steam can remove the volatile matter more effectively.

In deodorizing, the FFA is removed quite readily. It takes additional time to reduce the red color and distill some of the odoriferous compounds.

Vaporization of the volatiles is highest at the surface of the oil. Therefore it is very important that the entire mass of the oil reach the surface as many times as possible during deodorization to maximize the vaporization process. This is why it is essential to inject stripping steam into the oil through a sparge ring at the bottom of the oil with a mammoth pump (an eductor) to circulate the oil to bring all of the oil to the surface. Eductor hats are also used to enhance the effect of splashing of the oil with the stripping steam.

The amount of stripping steam varies with the type of deodorizer. For example:

- A batch deodorizer requires 3%–4% steam in older designs; newer designs uses <2% steam.
- A semicontinuous deodorizer uses 1%–2% steam.
- A continuous deodorizer uses 0.25%–1.0% steam.
- A thin film deodorizer requires 0.3%–0.6% steam.

6.1.1.7 Batch size or oil flow rate

Batch size in a batch system is determined by the production requirements. However, building a batch deodorizer larger than 45,000 pounds (20,450 kg) is not practical. The
amount of oil in the deodorizer must be at its minimum in order to achieve maximum reduction of the volatile matter in the oil. Given that all conditions remain within the operating limits, a batch deodorizer must not be overfilled, or the semi continuous or a continuous deodorizer must not be operated at higher than the designed flow rate.

6.1.1.8 Citric acid addition

Citric acid is added to the deodorized oil at the cooling stage of the deodorization process. Citric acid acts as a chelating agent to complex with trace metals like iron, calcium, and magnesium. The following are the required conditions for citric acid addition:

- Citric acid dosage- 50 ppm (of the oil).
- Citric acid addition temperature <290°F (143.3°C).
- Deodorizer condition under normal vacuum with stripping steam.

At higher temperature, citric acid decomposes, leaving very little or no beneficial effect on the oil. Some commercial antioxidants containing citric acid are used by many manufacturers. This makes it easier for the oil processors to add these additives into the oil. However, the majority of the processors do not use any high-shear mixing. Some even add the additives in the trucks and argue that the agitation in the truck during transit disperses the additives into the oil.

The author finds this to be “wishful thinking,” especially when it comes to mixing two immiscible liquids in such disproportionate ratios to be uniformly distributed in the oil from the movement of the truck. A properly designed citric acid addition system is highly recommended for all deodorization operations.

6.1.1.9 Cooling the deodorized oil before storage

The deodorized oil must be cooled before storage. This should also be done with care and taking into consideration of the type of oil being processed. Oils high in polyunsaturated fatty acids must be cooled down to a temperature of 300–375°F (149–190°C) under vacuum and with stripping steam, in order to prevent the formation of undesirable flavor in the oil.

Cooling the oil directly through an external cooler may produce unacceptable flavor in the oil. On the other hand, using stripping steam at a temperature below 250°F (121.1°C) in the deodorizer may increase moisture content in the deodorized oil. Citric acid addition to the oil in the deodorizer makes it necessary to cool the oil as discussed earlier.

6.1 Methods to monitor the deodorizing process

Deodorization of refined and bleached oil is carried out under vacuum and at an absolute pressure of 1–6 mm of mercury depending on the type of vacuum system on the deodorizer. The various steps involved in the deodorization process for monitoring are outlined as follows:

- The refined, bleached (RB), and possibly hydrogenated (RBH) oil, meeting all oil quality standards is deaerated at a temperature of 185–195°F (85–90°C) under the same vacuum as the deodorizer.
- The oil is then heated to a temperature of 480–490°F (249–254°C), under the same vacuum as the deodorizer for heat bleaching, which reduces the red and the yellow color from the carotenes in the oil.

For palm oil deodorization (not red palm) the temperature can be higher, such as:

- ✓ Heat bleaching 446–509°F (230–265°C).
- ✓ Deodorizing At a temperature as high as 518°F (270°C).

- The oil is then steam distilled under very low pressure using dry saturated sanitary stripping steam injected at the bottom of the oil bed in the deodorizer. The temperature is normally maintained below 500°F (260°C). At temperatures above this, oils like soybean, sunflower, cottonseed, corn oil, and low linolenic soybean oil polymerize. The oil also exhibits higher levels of trans fatty acids after deodorization. However, the higher temperature is needed to deodorize physically refined oils because of the higher FFA content.

- The combined effect of the low vacuum and the stripping steam produces the bland-tasting light-colored oil, which meets consumer acceptance.

- The deodorized oil is cooled to less than 290°F (143°C). Fifty percent citric acid solution is added under vacuum before the oil is pumped through an external cooler. Citric acid decomposes at temperature higher than 290°F (143°C) producing a number of compounds that are not effective metal chelators like citric acid. Therefore, addition of citric acid at higher temperatures is not recommended.
- The oil is cooled down to about 260°F (127°C) inside the deodorizer under vacuum before it is pumped through an external cooler. Below 250°F (121°C), there is some condensation of the steam into the oil. Therefore, the oil temperature is maintained slightly higher 260°F (127°C) as mentioned earlier.
- The temperature of the oil after the final cooler depends on the type of oil. For example:
  - ✓ Liquid soybean, liquid cottonseed, sunflower, safflower, corn, and palm olein oil must be cooled down to <100°F (38°C) and not exceeding 110°F (43°C).
  - ✓ Palm oil and palm stearine must be cooled down to <120°F (49°C).
  - ✓ Hydrogenated products must be cooled down to a temperature not exceeding 10°F (5°C) above the complete melt point.

- The cooled oil is stored under nitrogen protection.

Methods to monitor the deodorizing process Such as:

- Inspecting,
- Measuring and Testing as required by the process.

Self-Check 6	Written Test

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

1. Write critical control point of deodorization process?
2. List the method to monitor deodorization process?

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

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

Information Sheet 7- Legislative requirements

7.1 Legislative requirements

Legislative Requirement means Acts, ordinances, regulations, subordinate legislation, by-laws, orders, awards and proclamations and delegated legislation (whether national, state, territory or local) applicable where the Subcontractor's Activities or any part thereof are being performed.

Legislative Requirement means legislation and subordinate legislation of the Commonwealth of Australia or any State or Territory applicable to the Supply, and any instruments made under such legislation or subordinate legislation, and the requirements of any local government, utility or other person or party having power at law to make decisions in relation to the Supply or any other matter which is the subject of the Agreement. May include but not limited to:

7.1.1 Ethiopian Food Standards Code

- **Standardization**

Standardization is a process of ensuring uniformity in products and services by use of appropriate standards. The process ensures efficient utilization of resources through reduction of wastes. Food and beverages standards are documents containing requirements, specifications, guidelines or characteristics that can be used consistently to ensure that food materials, products, processes and services produced are fit for human consumption. In any country, food and beverages standards are established by regulatory authorities and enforced by governments, food companies and retailers.

- **Food Safety Standards**

A standard is a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose. Product standards and code of practice assist manufacturers to produce commodities that meet minimum specifications for quality and safety

- **International food standard International**

Food standard (IFS) is a food safety standard which has uniform safety system that is used to qualify and select suppliers. It can be explained as one common audit standard, globally accepted by the food industry in order to continuously improve food safety for consumers. Standard helps super market chains in ensuring food safety of the product they are selling to their buyers and to monitor quality level of suppliers of their private labels. International Food Standard has been developed for the purposes of auditing suppliers who cooperate with networks of so called private label manufacturers.

- **International System of Standards**

The growing quality requirements regarding food quality and the rapidly increasing trade in food products and safety problems connected with it stimulated and stimulate the programs of international harmonization of food standards. Of the organizations and programs active worldwide in this field, first at all the International Standardization Organization (ISO) and the Joint FAO/WHO Food Standards Program should be mentioned. In 1946, ISO delegates from twenty-five countries met in London and decided to create a new international organization, the object of which would be “to facilitate the international co- ordination and unification of industrial standards.”

I. Weights and measures legislation

The Standards of Weights and Measures, enforces uniform standards of weights and measures, based on the metric system. Based on the suggestions of General Conference of Weights and Measures (CGPM), International Organization of Legal Metrology (OIML), the 1956 act was replaced by a comprehensive legislation, The Standards of Weights and Measures are administered by the ministry of Consumer affairs, Food and Public Distribution.

II. Ethiopian Food and Drug Authority

The Ethiopian Food and Drug Administration (EFDA) are mandated, in the proclamation 661/2009, to ensure the safety, quality and efficacy of medicines. To achieve this, the authority has been working on different regulatory activities. The medicine market authorization system is one of the top priority areas that have been implemented. In addition to the dedicated assessors, the authority uses a national drug advisory committee for the assessment and registration of medicines.

This has evolved through the years to improve the medicine dossier evaluation system. As the Socioeconomic development of the nation is transforming, there is a high flow of investments in the healthcare. However, the market authorization system available at this time is yet unable to satisfy and fully accommodate the demands coming into the country.

7.1.2 Environmental Protection Authority

Environment" means the totality of all resources whether in their natural state or as modified or changed by man as well as the external conditions and impacts which affect the quality and quantity of said resources and the welfare of human beings.

"Environmental Protection" means the protection of land, water, air and similar other environmental resources, factors and conditions which affect the life and development of all organisms including human beings.

"Environmental Management" means the study, protection and conservation as well as the control of the utilization of the environment in general.

"Person" means any natural or juridical person

Powers and Duties of the Authority

- The Authority shall have the following powers and duties.
- To prepare environmental protection policy and laws; and, upon approval, follow up their implementation.
- To prepare directives and systems necessary for evaluating the impact of social and economic development projects on the environment; follow up and supervise their implementation.
- To prepare standards that help in the protection of soil, water and air as well as the biological systems they support, and follow up their implementation.
- To carry out studies required to combat desertification and, in cooperation with the concerned organs, create favorable conditions for their implementation.

- To make recommendations on the application of diverse encouragement and regulatory measures for the better protection of the environment.
- To provide instruction required to enhance awareness of the need for environmental protection.
- To follow up the implementation of international treaties on environmental protection to which the country is a party.
- To render advice and technical support to Regions on environmental protection.
- To own property, enter into contracts and sue and be sued in its own name.
- To carry out such other activities as are necessary for the fulfillment of its objective.

7.2 Identify OHS hazards and controls

Occupational Safety and Health is a planned system of working to prevent illness and injury where you work by recognizing and identifying hazards and risks. HAZARD is a situation in the workplace that has the potential to harm the health and safety of people or to damage plant and equipment anything that could hurt you or someone else. Three steps to manage health and safety at work:

- Spot the Hazard (Hazard Identification)
- Assess the Risk (Risk Assessment)
- Make the Changes (Risk Control)

7.3 Apply food safety procedures to work practices

Food safety is used as a scientific discipline describing handling, preparation, and storage of food in ways that prevent food-borne illness. The occurrence of two or more cases of a similar illnesses resulting from the ingestion of a common food is known as a food-borne disease outbreak. This includes a number of routines that should be followed to avoid potential health hazards. In this way food safety often overlaps with food defense to prevent harm to consumers. The tracks within this line of thought are safety between industry and the market and then between the market and the consumer.

In considering industry to market practices, food safety considerations include the origins of food including the practices relating to food labeling, food hygiene, food additives and pesticide residues, as well as policies on biotechnology and food and guidelines for the management of governmental import and export inspection and certification systems for foods. In considering market to consumer practices, the usual thought is that food ought to be safe in the market and the concern is safe delivery and preparation of the food for the consumer.

Food can transmit pathogens which can result in the illness or death of the person or other animals. The main mediums are bacteria, viruses, mold, and fungus. It can also serve as a growth and reproductive medium for pathogens. In developed countries there are intricate standards for food preparation, whereas in lesser developed countries there are fewer standards and less enforcement of those standards.

Another main issue is simply the availability of adequate safe water, which is usually a critical item in the spreading of diseases. In theory, food poisoning is 100% preventable. However this cannot be achieved due to the number of persons involved in the supply chain, as well as the fact that pathogens can be introduced into foods no matter how many precautions are taken. The five key principles of food hygiene

- Prevent contaminating food with pathogens spreading from people, pets, and pests.
- Separate raw and cooked foods to prevent contaminating the cooked foods.
- Cook foods for the appropriate length of time and at the appropriate temperature to kill pathogens.
- Store food at the proper temperature.
- Use safe water and safe raw materials.

7.3.1 Food safety practices and procedures

There are a number of reasons to follow appropriate food and health and safety practices when working within the hospitality industry. One of which is the importance of avoiding food-poisoning outbreaks. Unlike other food safety issues, this is something that only becomes known after the event has occurred when it is too late to take steps to stop it. All you can do is investigate the cause and put procedures in place to prevent it happening again. It is much better to make sure that those procedures and practices are in place from the start.

By following good food safety practices and procedures, you are likely to:

- Reduce the likelihood of a food poisoning incident/outbreak
- Reduce any consequent harm to either the customer or the business
- Be con dent that all those working within the business are aware of food safety practices and procedures, and how to implement them.

Benefits of implementing food safety practices

- Good reputation
- Happy, motivated workforce
- Effective use of resources
- Safe and secure working environment
- Good relationships with suppliers

Self-Check 7	Written Test

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

1. Discus legislative requirement?
2. Write benefits of implementing food Safty practice?

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

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

Information Sheet 8- Identifying, rectifying and/or reporting out-of-specification product/process outcomes

8.1 Identifying out-of-specification product/process outcomes

Quality changes (free fatty acids, peroxide values, tocopherols, sterols and phosphatides) were determined, and also stability against oxidation (Rancimat test) beside the fatty acid composition. It is clear that there was no change in the phosphatides according to deodorization temperature and time

Peroxides and free fatty acids content were significantly ($P<0.05$) reduced in all samples with the increase of deodorization temperature and nearly completely removed at 250°C. Tocopherols were decreased as a result of elevated temperature, and high decrease happened in high temperatures of 210 and 250 °C in all samples except MBOH2O, where tocopherols completely removed during deodorization temperatures.

The effect of deodorization on fatty acid composition indicates that, oils did not undergo any changes in the fatty acid compositions during deodorization. The oxidative stability was affected by temperature and time of deodorization, the stability increased as affected by elevated deodorization temperature in all studied samples.

Table 1. Trouble Shooting Deodorizer Process

Symptom	Probable cause	Recommended solution
FFA > 0.05%	• High absolute pressure in the deodorizer (poor vacuum). • Low oil temperature. • Oil flow rate is high. • Not enough stripping steam. • Poor distribution of stripping steam. • Too much sparge steam affecting the vacuum. • Incoming oil has high FFA.	• Correct ejector problem • Increase the oil temperature by 5°F (2.5°C) and check FFA. • Reduce oil flow rate. • Increase stripping steam flow. Make sure it does not raise the • Operating pressure in the deodorizer (reducing the vacuum). • Clean steam sparger if the steam distribution appears uneven. • Reduce sparge steam flow. • Investigate the cause for high FFA in the deodorizer feed and correct it. Increase deodorization time by reducing the size of the batch in a batch deodorizer or increase residence time in a semicontinuous deodorizer or reduce flow rate in a continuous deodorizer.
Freshly deodorized oil has PV > 0.	Poor vacuum due to: • Ejector issue. • Air leak into the deodorizer.	Identify the cause for poor vacuum. • Correct vacuum ejector issue. • Identify the source of air leak and correct it.
Deodorized oil is too dark.	• Deodorizer feed oil has poor quality and contains one or more of the following impurities: ✓ High soap.	• Correct the problem in the RB oil, whether it is in the refining, or in the bleaching step. • Rectify the issue. • Check and make sure that the correct amount of citric acid is being added. The citric acid addition

	✓ High phosphorus. ✓ High iron or nickel. • Old or abused incoming oil with dark color. • No or low citric acid in the deodorized oil. • Reflux of the distillate into the batch deodorizer due to High level in the catchall. • Deodorizer coil is not fully covered by the oil in a batch or a semi continuous deodorizer or in continuous deodorizers where heating coils are used. • Deodorizer temperature is too high. • Deodorized oil is not cooled properly in the deodorizer and also through the external cooler to the correct temperature.	temperature is too high. • Empty the catchall and set up a regular emptying schedule for the catchall accumulation. • Check and verify the oil level in the deodorizer. Also check the level control to make sure that it did not drift. • Reduce the deodorizer temperature and make sure that the FFA and oil flavor are satisfactory after reducing the temperature. • Make sure the oil cooling is carried out properly in the deodorizer under vacuum with steam sparge and also check if cooler is working properly. If not rectify the issue.
Deodorized oil has poor flavor.	• Deodorizer feed oil is of poor quality. • Poor vacuum.	• Flow in a semicontinuous or a continuous deodorizer. • Increase deodorization time in a batch

	• Deodorizer temperature is low. • Insufficient stripping steam. • Stripping steam distribution is poor. • Deodorizer needs a caustic wash.	deodorizer. • Correct the vacuum issue. • Raise the deodorizer temperature by a few degrees, recheck the oil flavor. • Increase the amount of stripping steam without affecting the vacuum. • Check and clean the steam sparger. • Shut down and caustic wash the deodorizer.
Deodorized oil shows high level of polymers.	• Deodorizer feed oil is oxidized. • The deodorizer vacuum is poor. • The deodorizer temperature is too high.	• The deodorizer feed oil is high in PV, possibly high pAV and polymer. Correct the deodorizer feed oil oxidation issue. • Fix the vacuum issue. • Reduce deodorizer temperature. Recheck the deodorized oil quality.

Self-Check 8	Written Test

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

1. What are the reason out-of specification product/process outcomes?

Note: Satisfactory rating – 5 points Unsatisfactory - below 5 points

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

Information Sheet 9- Maintaining work area to housekeeping standards

9.1 Work area in housekeeping standards

Housekeeping is relevant in all workplaces—whether at the office, factory, shipyard, construction site, storage facility, hospital, laboratory, retail shop or industrial kitchen.

Effective housekeeping can eliminate many workplace hazards and help get work done safely and properly. A clean and tidy workplace also enhances a company's image and provides immediate visible evidence of its commitment towards workplace safety and health (WSH). Housekeeping is not just about the cleanliness of a workplace. It is also about keeping workplaces in order. Workplace housekeeping may be defined as activities undertaken to create or maintain an orderly, clean, tidy, and safe working environment.

Good housekeeping entails the effective organisation of the workplace and it contributes to better WSH performance, increased productivity and better quality control. It also includes good workplace traffic management, proper storage of raw materials and finished goods, neat and tidy work areas as well as adequate workplace illumination. With good housekeeping practices, workplaces can be kept safe from potentially dangerous objects or substances present in the work environment. An organised and clutter-free work area also makes it easier to respond to or evacuate in the event of an emergency.

Good housekeeping can result in more effective use of space;

- Better inventory control of tools and materials;
- reduced handling to ease the flow of materials;
- More efficient equipment clean-up and maintenance;
- reduced equipment and property damage through better preventive maintenance;
- More hygienic workplace conditions that would lead to improved workers' health;
- Improved overall look and feel of work environment; and
- Improved staff morale and wellbeing.

Poor housekeeping, on the contrary, creates workplace hazards that can lead to various accident types like Slips, Trips and Falls (STF), Caught In-between Objects (CIBO), Struck by Falling Objects (SBFO), Struck by Moving Objects (SBMO), Cut/ Stabbed by Objects (CSBO) andStruck against Objects (SAO). Additionally, poor housekeeping may create fire hazards thatinevitably lead to increased fire risk.

Examples of workplace accidents caused by poor housekeeping:

- slipping on a spilled substance or oily, wet or dirty surfaces;
- tripping over loose objects on floors, stairs and platforms;
- striking against protruding, improperly stacked or misplaced items;
- being hit by objects falling from a high shelf or the top of a cupboard; and
- being cut or punctured by a protruding nail or sharp object

Good Housekeeping Basics

There are three key factors to good housekeeping. They are:

A) Overall cleanliness and orderliness

No matter the level of occupancy, a company can improve the conduciveness, hygiene and safety of its work environment by keeping all its work areas clean, organised and uncluttered. This can be achieved through regular housekeeping, timely disposal or removal of items that are seldom used or no longer needed.

B) Adequate space and proper layout

Work activity requires space and the presence of people, equipment and materials tend to obstruct orderly movement throughout the premises. A careful review of space requirements based on actual operations may suggest ways for a better layout. A well designed work space with equipment arranged for optimum workflow will improve efficiency and productivity, as well as the ease with which work activities can be carried out.

C) Correct storage and materials handling

Proper storage and handling equipment (e.g., engineered shelving, forklifts, handling robots, and conveyor systems) are necessary to facilitate the movement and placement of materials in a factory, construction site or storage facility. This will prevent haphazard storage which can lead to blocked exit paths and/ or obstructed access to fire control equipment (e.g., fire extinguishers, fire hose reels). Poorly organised storage may also result in the accumulation of unwanted items, debris and/ or waste materials especially in any available vacant space.

Responsibility for Housekeeping

Good housekeeping is everyone's responsibility. Keeping a workplace safe, clean and clutter free is an ongoing activity in which all employees have to do their part;

1. **Prevent slips, trips and falls.**
   - ✓ Do not stack items along walkways or passageways;
   - ✓ Put away electrical cords and water or air hoses; and
   - ✓ Put away tools and keep drawers closed.
2. **Limit spills.**
   - ✓ Clean up spills immediately;
   - ✓ Repair leaks as soon as possible; and
   - ✓ Sweep up debris.
3. **Ensure machine safety**.
   - ✓ Inspect machines and ensure that all guards are in place before use;
   - ✓ Keep area around machines clear;
   - ✓ Put away tools; and
   - ✓ Clean machines regularly.
4. **Prevent fires.**
   - ✓ Store flammable or combustible liquids in labelled and closed containers;
   - ✓ Keep flammable or combustible materials away from sources of ignition;
   - ✓ Keep electrical equipment clean; and
   - ✓ Inspect electrical cords before use.

5. **Ensure exits and access routes to fire equipment are clear.**

- Do not block emergency exits;
- Keep evacuation routes clear;
- Check that fire extinguishers are accessible; and
- Ensure that electrical panels can be opened

9.2 What are the elements of an effective housekeeping program?

Maintenance; The maintenance of buildings and equipment may be the most important element of good housekeeping. Maintenance involves keeping buildings, equipment and machinery in safe, efficient working order and in good repair. It includes maintaining sanitary facilities and regularly painting and cleaning walls

- **Dust and dirt removal**; Enclosures and exhaust ventilation systems may fail to collect dust, dirt and chips adequately. Vacuum cleaners are suitable for removing light dust and dirt that is not otherwise hazardous. Industrial models have special fittings for cleaning walls, ceilings, ledges, machinery, and other hard-to-reach places where dust and dirt may accumulate.

- **Employee facilities**; Employee facilities need to be adequate, clean and well maintained. Lockers may be necessary for storing employees' personal belongings. Washroom facilities require cleaning once or more each shift. They also need to have a good supply of soap, towels plus disinfectants, if needed.
- **Surfaces**; Floors: Poor floor conditions are a leading cause of incidents so cleaning up spilled oil and other liquids at once is important. Allowing chips, shavings and dust to accumulate can also cause incidents.
- **Maintain light fixtures**; dirty light fixtures reduce essential light levels. Clean light fixtures can improve lighting efficiency significantly.
- **Aisles and stairways**; Aisles should be wide enough to accommodate people and vehicles comfortably and safely. Aisle space allows for the movement of people, products and materials. Warning signs and mirrors can improve sight-lines in blind corners. Arranging aisles properly encourages people to use them so that they do not take shortcuts through hazardous areas.

- **Spill control**; the best way to control spills is to stop them before they happen. Regularly cleaning and maintaining machines and equipment is one way. Another is to use drip pans and guards where possible spills might occur. When spills do occur, it is important to clean them up immediately.

Absorbent materials are useful for wiping up greasy, oily or other liquid spills. Used absorbents must be disposed of properly and safely.

- **Tools and equipment**; Tool housekeeping is very important, whether in the tool room, on the rack, in the yard, or on the bench. Tools require suitable fixtures with marked locations to provide an orderly arrangement. Returning tools promptly after use reduces the chance of it being misplaced or lost. Workers should regularly inspect, clean and repair all tools and take any damaged or worn tools out of service.
- **Waste disposal**; The regular collection, grading and sorting of scrap contribute to good housekeeping practices. It also makes it possible to separate materials that can be recycled from those going to waste disposal facilities.

- **Storage;** Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual material handling is required. The location of the stockpiles should not interfere with work but they should still be readily available when required. Stored materials should allow at least one metre (or about three feet) of clear space under sprinkler heads.

Stacking cartons and drums on a firm foundation and cross tying them, where necessary, reduces the chance of their movement.Flammable, combustible, toxic and other hazardous materials should be stored in approved containers in designated areas that are appropriate for the different hazards that they pose.

Self-Check 9	Written Test

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

1. What is housekeeping standard?
2. Write the three key factors to good housekeeping?
3. List responsibility for housekeeping?

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

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

Information Sheet 10- Maintaining workplace records

10.1 Maintaining workplace records in workplace requirement

Keeping accurate and up-to-date records is vital to the success of any business. The business must realise that records kept will be one of the most important management tools it possesses and, therefore, it should be allocated due importance. Many business owners invest a lot of time and effort into the running of their business and yet fail to realise the importance of maintaining good documentation. The business owner is looking for the maximum return from their investment and the maintaining of good records is part of that equation.

Any record keeping system should be accurate, reliable, easy to follow, consistent as to the basis used and be very simple. Good record keeping is vital in regards to meeting the financial commitments of the business and providing information on which decisions for the future of the business can be based. While the business maintains records to monitor and record its normal business activities, it is also necessary because of obligations under the taxation laws.

A. The importance of keeping accurate employee records

- Employee data and GDPR compliance
- Monitoring performance and productivity
- Keep on top of competency
- Ensure health and safety
- Manage hours worked and holiday allowance
- Minimize disputes
- Retain former employee details within the law

B. Types of records

- **Correspondence records:** Correspondence records may be created inside the office or may be received from outside the office. For example, letters, circulars, memos, notices etc.
- **Accounting records:** The records relating to financial transactions are known as financial records. For example, cash receipt, deposit slip, sales records, profit or loss statement, vouchers, balance sheet etc.
- **Legal records;** the records that meet the legal requirements of the organization are called legal records. They maintain the legal procedures and help in fulfilling the legal requirements and formalities. Their documents involve memorandum of association, articles of association, government rules and regulation etc. it can also be presented at the court.
- **Personnel records:** The records that are related to personnel of organization is known as personnel records. It includes personnel history card, salaries and bonuses to employees, their promotion and work history, history of absenteeism, name, address morality etc.
- **Progress records;** the record that gives the information about the progress of the organization or department is called progress records. It includes the records of sales, purchases, cost, budget, liquidity and so on.
- **Miscellaneous records;** The records which are not covered by above types of records are known as miscellaneous records. They are related to expansion, diversification and other activities of the business.

Self-Check 10	Written Test

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

1. What is workplace record in workplace information?
2. List and discus types of workplace record?

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

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

Operation Sheet #1-	Procedure for Monitoring deodorization process to meet odor and flavor specifications

Objective: To Monitor deodorization process to meet odor and flavor specifications

Purpose: The main purpose of produce good quality and edible oil to human consumes.

Procedure for operate the deodorizing process

1 The refined, bleached (RB), and possibly hydrogenated (RBH) oil, meeting all oil quality standards on bleaching and on hydrogenation, is deaerated at a temperature of 185–195°F (85–90°C) under the same vacuum as the deodorizer.

2 The oil is then heated to a temperature of 480–490°F (249–254°C), under the same vacuum as the deodorizer for heat bleaching, which reduces the red and the yellow color from the carotenes in the oil. For palm oil deodorization (not red palm) the temperature can be higher, such as:

- Heat bleaching 446–509°F (230–265°C).
- Deodorizing at a temperature as high as 518°F (270°C).

3 The oil is then steam distilled under very low pressure using dry saturated sanitary stripping steam injected at the bottom of the oil bed in the deodorizer. The temperature is normally maintained below 500°F (260°C). At temperatures above this, oils like soybean, sunflower, cottonseed, corn oil, and low linolenic soybean oil polymerize. The oil also exhibits higher levels of trans fatty acids after deodorization. However, the higher temperature is needed to deodorize physically refined oils because of the higher FFA content.

4 The combined effect of the low vacuum and the stripping steam produces the bland-tasting light-colored oil, which meets consumer acceptance.

5 The deodorized oil is cooled to less than 290°F (143°C). Fifty percent citric acid solution is added under vacuum before the oil is pumped through an external cooler. Citric acid decomposes at temperature higher than 290°F (143°C) producing a number of compounds that are not effective metal chelators like citric acid. Therefore, addition of citric acid at higher temperatures is not recommended.

6 The oil is cooled down to about 260°F (127°C) inside the deodorizer under vacuum before it is pumped through an external cooler. Below 250°F (121°C), there is some condensation of the

steam into the oil. Therefore, the oil temperature is maintained slightly higher 260°F (127°C) as mentioned earlier.

7 The temperature of the oil after the final cooler depends on the type of oil.

8 The cooled oil is stored under nitrogen protection.

LAP TEST #1	Operate and monitor the deodorizing process

Name………………………………. ID………………. Date ……………..

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 8 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: Procedure for operating the deodorizing process

LG #43	LO #3- Shut down the deodorizing 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
- Identifying and reporting maintenance requirement

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
- Identify and report maintenance requirement

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" which are placed following all information sheets.
5 Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work.
6 If you earned a satisfactory evaluation proceed to "Operation sheets
7 Perform "the Learning activity performance test" which is placed following "Operation sheets" ,

Information Sheet 1- Identifying appropriate shutdown procedure

1.1 Identifying shutting down procedure

Shutdown procedure which will be done after extracting oils may include but not limited to:

- Workplace procedures in the process of shutting.
- Equipment is dismantled and prepared for cleaning.

1.2 Seven steps/procedures for a successful shutdown

Follow these steps to ensure a successful outage and restart. Scheduled outages may be plant wide, occur through different sections or be cold or running. Job plans for each asset is a prerequisite.

I. A comprehensive list

A checklist with every piece of equipment involved in the outage should be available for review. Every stakeholder should examine this list to ensure nothing is missing. Examples of assets for most plant checklists include: Agitators, Airlocks, Conveyors, Doors, Dust baggers, Gearboxes Man ways Mixers and blenders, Motors, Piping, Pumps, and Valves.

II. Have it in inventory

Ensure that all replacement parts, accessories and rebuilt equipment are in stock before the shutdown. The last thing any team needs is to have staff on hand to conduct maintenance, replacements and new installations only to be held up waiting for rebuilt equipment to return from a shop.

III. Safety first

Safety should be the top priority during any outage. Before beginning work, all lock out/tag out (LOTO) procedures should be followed and personnel must wear all required personal protective equipment (PPE).Because equipment is shut down, personnel may have a false sense of security

IV. Within current specifications

Double check that all equipment (new and rebuilt) is within current operating parameter specifications. When assets were specified, they met the requirements of the process at that time. Condition changes, such as fluid temperature, flow requirement or process fluid pH must be considered. Different parts or different equipment may need to be used.

V. Inspect before installation

Personnel should inspect all equipment before anything is installed; look for wear or damage. Installing new components into a worn piece of equipment is almost always counterproductive. Demise of the new components begins immediately.

VI. Precise installation

While this step seems obvious, improper installation happens all the time. Reliability begins with the asset selection and correct installation. If installed imprecisely, failure begins at startup

VII. Inspection before restart

The plant team should give everything one more look before restarting the plant or process. Even when every step is taken and every job plan is followed, stuff happens. A motor is bumped during work on another piece of equipment, causing misalignment.

Self-Check 1	Written Test

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

1. Discus the seven procedures for effective shutdown process?

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

2.1 Shutting down the deodorization process

- Shut down the deodorizer.
- Shut off the heating and stripping steam.
- Shut off the cooling water.
- Blow the entire system with nitrogen to push the residual oil and collect it in the appropriate tanks.
- Open all drain valves to let any residual oil out of the system. Sometimes a scavenger pump can be used.
- Close the drain valves.

Self-Check 2	Written Test

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

1. Write the criteria shutting down of deodorization process?

Information Sheet 3- Identifying and reporting maintenance requirements

3.1 Identifying maintenance requirements

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.

3.1 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.

3.2 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).

3.3 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.

3.4.1 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

3.4.2 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.

Self-Check 3	Written Test

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

1. Discus the maintenance requirement?

Operation Sheet #1-	Procedures for Shut down the deodorizing process

Procedure for Shut down the deodorizing process

- Shut down the deodorizer.
- Shut off the heating and stripping steam.
- Shut off the cooling water.
- Blow the entire system with nitrogen to push the residual oil and collect it in the appropriate tanks.
- Open all drain valves to let any residual oil out of the system. Sometimes a scavenger pump can be used.
- Close the drain valves.

LAP TEST #1	Procedure for Shut down the deodorizing process

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: Procedure for Shut down the deodorizing process

Reference Materials

Book:

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WEB ADDRESSES

http://dx.doi.org/10.1016/B978-1-63067-050-4.00007-6

AKNOWLEDGEMENT

We would like to express our appreciation to the TVET instructors and experts of regional TVET bureau, TVET College, and Federal Technical and Vocational Education and Training Agency (FTVETA) who made the development of this learning module with required standards and quality possible.

We wish thanks and appreciation to the representatives of BEAR II UNESCO PROJECT who covers the financial expenses, scarifying their time and commitments to develop this learning module.

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