EDIBLEOILANDFATSPROCESSING

Level III

Based on October 2019, Occupational standards (OS)Version 2 and March 2021, V1 curriculum

Module Title: Operating Shortening and Vegetable Ghee Production Process

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LG #53	LO#1- Prepare shortening and vegetable ghee equipment for operation

Instruction sheet

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

- Identifying and transferring material
- Confirming different ingredients and services
- Identifying and confirming cleaning, maintenance service and status
- Fitting and adjusting machine components and related attachments
- Entering processing /operating parameters
- Checking and adjusting shortening and vegetable Ghee equipment performance
- 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:

- Identify and transfer material
- Confirm different ingredients and services
- Identify and confirm clean, maintenance service and status
- Fit and adjust machine components and related attachments
- Enter processing /operating parameters
- Check and adjust shortening and vegetable Ghee equipment performance
- Carry out pre-start checks

Learning Instructions:

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

Information Sheet 1 - Identifying and transferring material

1.1 Introduction

Shortening is a commercially prepared edible fat used in frying, cooking, baking, and as an ingredient in fillings, icings, and other confectionery items. It may have been so named because, when dough is mixed, water-insoluble fat prevents cohesion of gluten strands, literally ‘‘shortening’’ them and thus generating tender baked goods. Shortening is a typically 100% fat product formulated with animal and/or vegetable oils that have been carefully processed for functionality and to remove undesirable flavor and aroma. Overall, shortening improves the texture and palatability of food products while its calories provide heat and energy to fuel the body.

In its most recognized form, household shortening is a white, relatively soft, plastic solid with a bland flavor and no detectable odor. Some types have a butter like color and flavor added. Household and industrial all-purpose shortenings are products formulated with properties permitting their use in both frying and baking. Pourable types include clear liquid or fluid (opaque) shortenings. Liquid shortenings are typically used as cooking or salad oils. Fluid or opaque shortenings are pourable products with a small amount of solid fat or emulsifier suspended in oil. Because they are convenient to use, pourable shortenings are increasing in popularity especially for frying and baking. Shortening is also available in dry form as powder, pellets, or flakes encapsulated in a water-soluble material. Skim milk, cheese whey, corn syrup, soy protein isolate, and cellulose compounds have proven feasible as encapsulating materials

1.2 Identifying and transferring material

Materials needed in shortening and vegetable ghee production include:

- RBD oil
- Hydrogenated oil
- Freon gas/ammonia

- BHT or BHT or TBHQ
- Colorants
- Flavour

1.2.1 RBD (Refined, Bleached and Deodorized) Oils

Edible oils purchased in stores are known as “RBD” oils. These are oils that have been Refined, Bleached and Deodorized. Each of these steps is used to create a final oil that is consistent in taste, colour and stability. As a result, these oils are generally tasteless, odourless, and colourless regardless of the original oilseed type or quality.

Figure 1: RBD palm oil

1.2.2 TBHQ (tertiary butyl hydroquinone)

- ✓ Is the most effective synthetic antioxidant in unhardened vegetable oils, followed by propyl gallate. TBHQ also appears to be effective for the meat fats but protection is also afforded by butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA).
- ✓ TBHQ displayed a greater stabilizing potential when used at higher concentrations (8000 ppm)

- ✓ Chemical formula : **$C_{10}H_{14}O_2$**

1.2.3 BHT (butylated hydroxytoluene)

- ✓ Among the synthetic antioxidants evaluated, BHT displayed the highest effectiveness in the concentration range from 200 to 7000 ppm.
- ✓ BHT is a dietary supplement for use as an antioxidant.
- ✓ Chemical formula : **$C_{15}H_{24}O$**

1.2.4 BHA (butylated hydroxyanisole)

- ✓ Butylated hydroxyanisole (BHA) and the related compound butylated hydroxytoluene (BHT) are phenolic compounds that are often added to foods to preserve fats and oils and keep them from becoming rancid.
- ✓ They are added to food, cosmetics, and packing of products that contain fats to maintain nutrient levels, color, flavor, and odor.
- ✓ **BHA** is effective synthetic antioxidant in unhardened vegetable oils
- ✓ BHA was found to provide no noticeable increase in the induction time at concentrations greater than 2000 ppm.
- ✓ The combined use of these antioxidants, there is no evidence of any positive synergic effect that would justify their use in binary or ternary mixtures.
- ✓ Chemical formula : **$C_{11}H_{16}O_2$**

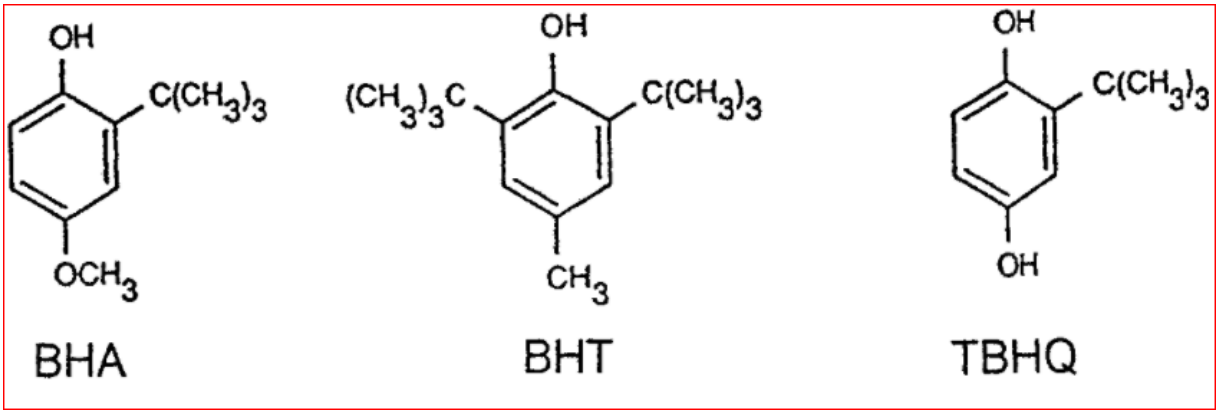


Figure 2- Chemical structure of BHA, BHT and TBHQ

1.2.5 Flavour

Flavour of shortening should be as completely bland as possible so it can enhance a food product's flavour rather than contribute a flavour. In some specific cases the desired shortening flavour is typical of the original flavours of the source oil, for example, a lardy flavour is somewhat desirable in some products. Also, artificial flavours are added to some shortening products to enhance the functionality. Both the bland or typical flavour must be stable throughout the life of the food product. Therefore, the oxidative stability requirements of the finished product must be established to determine the minimum requirements for the shortening.

1.2.6 Hydrogenated oil

Hydrogenated oils require higher storage temperatures. Therefore, low pressure steam is preferred for heating the oil instead of hot water.

- The steam pressure must be 10–25 psig (1.79–2.89 kg/cm2).
- It is recommended to use a thermodynamic traps for the steam coils used for heating the oil.
- The tank must have side mounted agitator with baffle arrangement to maintain a uniform temperature and composition throughout the tank and not to allow any separation of the solids or overheating of the oil on the steam coil surface.
- The agitator must have a low liquid-level cut-off switch to protect the agitator shaft against bending, damaging the agitator shaft as well as from undue whipping of air into the oil.
- The temperature of the hydrogenated oil should be no higher than the melt point of the stock by 10°F (5°C).
- The tank must have a temperature indicator, preferably a temperature monitoring device.

1.2.7 Freon gas/ammonia

Ammonia is an alkaline, colorless chemical compound that is well recognized as the basis for household cleaning products. It also has many agricultural, industrial and

commercial uses. It is available in five generally recognized grades—fertilizer, refrigerant, federal, metallurgical, and semiconductor depending on its level of purity.

Refrigeration grade ammonia is 99.98 percent pure and is relatively free of water and other impurities (maximum: 150 ppm water, 3 ppm oil, 0.2 ml/g non-condensable). It is readily available, inexpensive, operates at pressures comparable with other refrigerants and is capable of absorbing large amounts of heat when it evaporates.
Ammonia is one alternative refrigerant for new, replacement, and existing refrigeration system designs, where compatible. Ammonia has a low boiling point (-28°F at 0 psig), an ozone depletion potential (ODP) of 0.00 when released to atmosphere and a high latent heat of vaporization eight (8.17 at -28°F) times higher than R-12 and six (6.18 at -28°F) times higher than R- 134(a). In addition, ammonia in the atmosphere does not directly contribute to global warming. These characteristics result in a highly energy-efficient vapour-compression cycle with ammonia as the refrigerant with minimal environmental impact.

- **Health and Safety**

The National Institute for Occupational Safety and Health (NIOSH), in its 2007 Pocket Guide2 has set the Immediate Danger to Life or Health (IDLH) level, the level at which an individual could be exposed for 30 minutes without a respirator and not experience any lasting health effects, at 300 parts per million. The purpose of IDLH is to establish when the maximum level of respiratory protection is required by OSHA regulations. Ammonia's sharp, irritating, pungent odour actually helps reduce exposure to potentially dangerous concentrations. The average odour threshold is 5 ppm, well below concentrations that may cause harmful effects to the human anatomy. Public Health Service's Agency for Toxic Substances and Disease Registry (ATSDR), as published in the IIAR Ammonia Data Book, shows the effects of various concentrations of ammonia.

Table 1 - Effects of various concentrations of ammonia

Concentration	Effect
5 ppm	Average odor threshold (well below harmful health effects)[3]
100-200 ppm	Irritated eyes[4]
300 ppm	Respiratory Protection Required above this level- IDLH[2]
400 ppm	Immediate throat irritation[3]
500 ppm and below	No permanent eye damage to even chronic exposure[4]
1,700 ppm	Cough[3]
2,400 ppm	Threat to life after 30 minutes[3]
5,000+ ppm (vapor)	Full body chemical suit required[4]
5,000+ ppm (pure liquid)	Second degree burns with blisters[4]
7,338 ppm	One Hour LC_{50}, lethal concentration (rat)[5]

- **Environmental Aspects**

Ammonia is not a contributor to ozone depletion or global warming.

Thus, it is an environmentally benign refrigerant. Ammonia has no cumulative effects on the environment and a very limited (a few days7) atmospheric lifetime. Because of the short lifetime of ammonia in the atmosphere, it is considered to be biodegradable. It is even used to reduce harmful stack gas emissions by injection into boiler and gas turbine exhaust streams. In such systems, only part of the ammonia is consumed in the emission control process, and a small fraction is released into the environment.

- **Regulatory Classifications**

Anhydrous ammonia (Chemical Abstracts Service, CAS #7664-41-7) is currently classified by the U.S. Environmental Protection Agency (EPA) as an extremely hazardous substance (EPCRA, Sec. 302, 303). Emergency Planning and Community Right-to-Know Act (EPCRA).

- ✓ Reportable Quantity List (Section 304) -Chemicals on this EPCRA list require notification to EPA and state and local agencies of releases in excess of the reportable quantity (currently 100 pounds).
- ✓ Extremely Hazardous Substance List (Section 302) -Chemicals on this EPCRA list, at facilities with quantities in excess of the Threshold Planning Quantity (TPQ), are subject to EPCRA requirements, which mandates numerous reporting and planning provisions. The TPQ of ammonia is 10,000 pounds.
- ✓ Section 313 - Chemicals on this EPCRA list are subject to the annual toxic release inventory reporting (Form R).

1.2.8 Colorants

Food colorants are among the most interesting features at industrial and scientific level. In fact, due to increasing demands by consumers, pronounced advances and opportunities have been achieved in food industry (Carocho et al., 2015; Shahid et al., 2013). Apart from the ancient use of food additives, natural food colorants have received a particular attention, not only for their potent ability to color foods, but also for providing some healthy benefits.

Associated with the increasing demand by consumers for more delightful, attractive and pleasant products, a great interest in the health effects of some food colorants has been also observed. With the growing and continuous search, numerous synthetic food colorants were developed to be added to improve food products quality and organoleptic characteristics, however, over time, most of them were banned due to the clearly evident side effects, signals of toxicity at short and long terms, as also health impairment abilities, including their possible carcinogenic effects (Amchova et al., 2015; Carocho et al., 2014).

Table 2: Synthetic food colorants

Colorant	E code	ADI	Uses
Amaranth	E123	0.8 mg/kg b.w.	Beverages, alcoholic drinks and fish roe
β-carotene	E160a	5 mg/kg b.w.	Sauces, milk, spice blends, marinades, beverages, coatings, fruit juices, margarines
Carminic acid drinks, chewing gum, pills and cough drop	E120	5 mg/kg b.w.	Cakes, cookies, beverages, jam, jelly, ice cream, sausages, pies, dried fish, yogurt, gelatins, cider, tomato, dairy products, cherries, non-carbonated

Self-Check -1	Written Test

Name… ……. ID…….

Date…….

Part –I. Short answer questions

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

1. Write the materials needed in shortening and vegetable ghee production (10 points)
2. Write the chemical formula for BHT (butylated hydroxytoluene) (5pts)

Part –II: Choice

Directions: Choose the best answer for the questions given below

1 In which concentration ammonia can cause immediate throat irritation? (5pts)
A.100ppm B. 200pm C. 400ppm D. 5000ppm

Note: Satisfactory rating – 20 points Unsatisfactory - below 20

You can ask you teacher for the copy of the correct

Information Sheet 2 - Confirming different ingredients and services

2.1 Confirming different ingredients and services

Ingredients and services needed in shortening processing include:

- Power
- Steam
- Gases
- Ice
- water
- Compressed and instrumentation air

- **Power**

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

- ✓ Thermal energy in the form of steam and hot water used for distillation, cleaning, and sterilizing. Frequently an auxiliary boiler is used to generate steam;
- ✓ Electricity for machinery operation, refrigeration, lighting and production of compressed air. Minimum refrigeration requirements are normally determined by regulation.
- ✓ Use heat recovery to heat incoming oil with the outgoing oil thereby reducing energy demand and water demand for steam;
- ✓ Examine other options for heat recovery and insulation, to reduce/supplement energy usage;

Examine options for increasing energy efficiency through modifying work practices and installing energy efficient devices/equipment.

- **Steam**

Steam is used in a wide range of industries. Common applications for steam are, for example, steam heated processes in plants and factories and steam driven turbines in electric power plants, but the uses of steam in industry extend far beyond this.

- **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, presser and to transfer materials through pipes.

- **water**

Vegetable oil facilities require significant amounts of water for crude oil production (cooling water), chemical neutralization processes, and subsequent washing and deodorization.

Environmental, health, and safety (EHS) guidelines for vegetable oil production and processing 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). Wastewater may also have a high content of suspended solids, organic

nitrogen, and oil and fat, and may contain pesticide residues from the treatment of the raw materials. Recommended measures to reduce contaminant loading include the following: install spill collection trays to collect solids at appropriate places in the production line; use emulsion breaking techniques, (e.g., dissolved air flotation (DAF)), to segregate high BOD and COD oils from wastewater.

- Gases

In the hardening process of an oil, hydrogen gas is reacted with oil at a suitable temperature and pressure in the presence of a catalyst with agitation. Used to harden the oil.

- **Ice**

Ice is used in a cooler to condense the crystalized shorten.

Self-Check -2	Written Test

Name… ……. ID…….…

Date…….....

Part –I. Short answer questions

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

1. Write the Ingredients and services used in shortening process (10 points)
2. Write the importance of water in crude oil processing (5pts)

Note: Satisfactory rating – 15 points Unsatisfactory - below 15

You can ask you teacher for the copy of the correct

Information Sheet 3 - Identifying and confirming cleaning, maintenance service and status

3.1 Cleaning

Cleaning is a physio-chemical process involving a number of factors

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

- **Advantages of cleaning equipment**
  - ✓ Improving the quality of crude oil
  - ✓ Reducing the oil loss in cakes.
  - ✓ Adding processing capacity of cleaning equipment and oil pressing machine.
  - ✓ Ensuring safe working and clean working environment.

3.2 Maintenance and their importance

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

There is a lot you can do to look after and prolong the life of the equipment you use.

A. **Learn as much as you can about the equipment you use**

- Find out where the manual is kept-and make time to read it. If possible, keep the manuals close to the equipment.

- Make sure you get every issue of the Community Eye Health Journal over the next three to four years - we are publishing a new series on equipment care, maintenance, and repair which will have practical tips and guidance on the most used items.

B. **Check equipment before use (or at least once a week)**

- Inspect equipment for any sign of damage or parts that may need repair or replacement, and lubricate as necessary (according to instructions).
- Check that equipment is plugged into the voltage stabilizer or uninterrupted power supply, where these are required.

C. **Tell someone if there is a problem**

- As a user, it is your responsibility to report any problems. You will most likely be the first person to know that something is not working as it should.
- Don't assume that someone else will report a fault-what if everyone thinks that someone else will report it?
- It may sound obvious, but a repair can't be attended to if nobody knows there is a problem. The longer you take to report it, the longer before the repair will take place.
- Don't wait for equipment to break down before reporting a fault. Even a small change in how the equipment moves or how it responds could indicate that something has gone wrong or that a part needs to be replaced soon. If left unchecked, a more serious fault may occur, which will be more expensive and time-consuming to repair.

D. **Clean equipment after use (or at least once a day) and lubricate when necessary**

- Dust and then clean equipment, including optical components, with the appropriate cleaning agents and solutions. Lubricate moving equipment as often as indicated. Always follow the instructions.

E. **Protect equipment when not in use**

- Store equipment in a dry, clean environment where it is not in danger of falling and breaking.
- Place plastic dust covers on larger equipment like slit lamps in order to prevent damage to the optics and other delicate components. If cloth is used, ensure it is heavy and non-porous, or else dust will get through.
- When transporting equipment, pack items securely and handle with care.

Figure 3. Floor and equipment cleaning

Self-Check -3	Written Test

Name… ……. ID…….…

Date…….....

Part –I. Short answer questions

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

1. What you have to do to look after and prolong the life of the equipment (10 points)
2. Write the importance /Advantages of cleaning equipment (5pts)

Note: Satisfactory rating – 15 points Unsatisfactory - below 15

You can ask you teacher for the copy of the correct

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

4.1 Introduction

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 workpiece. Those uncertainties are the causes of manufacturing deviations. To control the influence of some uncertainties as screw, displacement reversibility or sideway 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 move the uncertainty zone compared with its nominal position.

Regular checks & adjusting equipment performance are important in hydrogenation of oil in order to maintain equipment efficiency and avoid frequent breakdowns. Machine tools are capable of producing work at a faster rate, but there are occasions when components are processed at the bench. Sometimes it becomes necessary to replace or repair a component, which must fit accurately with another component on re-assembly. This involves a certain amount of hand fitting. The accuracy of work done depends upon the experience and skill of the fitter.

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

Adjusting is prepare/checking the cleanliness, power and operation of oilseed cleaning machines, equipment and containers

4.2 Adjusting equipment performance

Steps for adjusting equipment performance

Steps 1 study current setup.

To initiate the setup realization process, understanding the production floor is a must. Most of the production floor will have a number of duplicate machines or groups of machines, so the setting up activities of every machine will be similar. Therefore, selecting the most important machine among the groups of machines is advisable, rather than focusing individually on each machine.

Step- 2 categorizes setup.

In Step 2, the activities of setup operations are separated according to the categories. The categories are used to identify the value-added (VA) activities, non-value-added but necessary (NVAN) activities, and non-value-added (NVA) activities responsible for performance in the setup operation.

Step- 3 evaluates the setup operation.

Once the category of the setup operation is clearly identified, the information will be used to analyze the overall performance of the setup activities. The developed performance measurement, namely, OPE, originated from the concept of overall effectiveness equipment (OEE). OPE considers two measurement elements.

Step- 4 identifies improvement opportunities.

In Step 4, the improvement opportunity lies in the setup operation. It is carried out by investigating and analyzing the activities that have been categorized under (Step 3). From the opportunity determination, the cause of the occurrence will be brainstormed, and alternatives for setup improvement will be generated.

4.3 Safety during fitting and adjusting equipment

Ensure that all power sources are turned off when the machine is not in use. This includes electrical and pneumatic power. Understand the LOCKOUT procedure and use it before fitting, adjusting, inspecting, maintaining, servicing or cleaning the equipment to help prevent anyone from accidentally turning on power to the machine. Read the manual for any special operational instructions for each piece of equipment

Figure 4. Fitting and adjusting machine engine

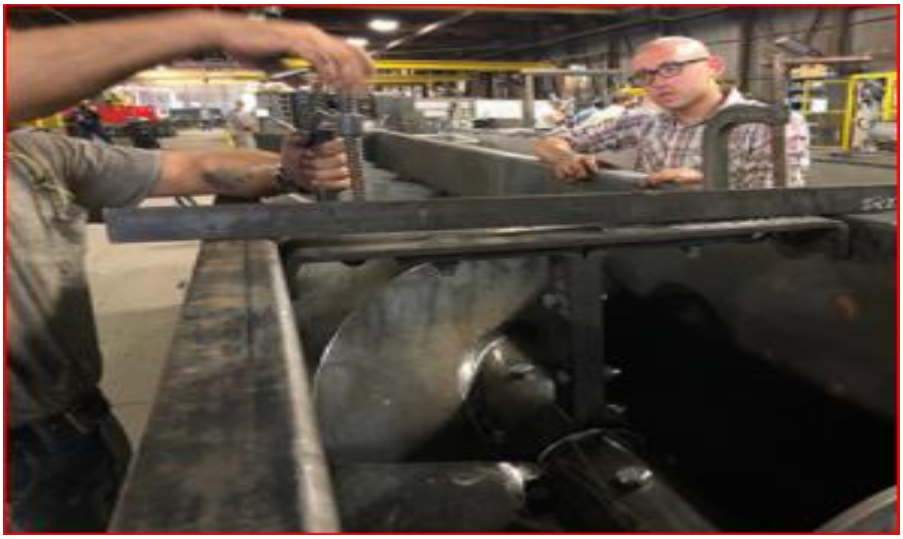


Figure 5. Fitting and adjusting screw conveyer

Self-Check -4	Written Test

Name… ……. ID…….…

Date…….....

Part –I. Short answer questions

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

1. Write the steps for adjusting equipment performance(10 points)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10

You can ask you teacher for the copy of the correct

Information Sheet 5 - Entering processing /operating parameters

5.1 Entering processing /operating parameters

Meaning of parameter is inspection or test points (control points) in the process and the related procedures. When starting up equipment, flow rates or throughput should be gradually and steadily built up to the normal operating parameters. Any changes to operating parameters should be made gradually so that the effect of the changes can be monitored and corrective action taken if required. Measuring equipment health by performance monitoring has the potential to give warning of a developing failure through the changing levels of a suitable parameter being measured, thereby indicating a change in condition of a component, machine or system

5.2 Effect of different equipment parameters

A sudden large change in a parameter of equipment can cause a process leading to:

- Wastage of raw materials
- Production of off special materials
- Equipment shutdown
- Equipment downtime
- Increased production costs
- Damage to plant
- Environmental damage
- Potential personnel hazard.

5.3 shortening process parameters

- **Freezer (cooler) Outlet Temperature**
  - ✓ This temperature will vary depending on the amount of the hard stock in the mix.
  - ✓ The freezer outlet temperature (FOT) must be kept as low as possible to 70°F (21.1°C).

✓ The FOT should be controlled within ±2°F (1°C).

- **Tempering Temperature**
  - ✓ This is maintained at 9°F (32.2°C) to maximize the transformation of the crystals to beta phase.

- **Tempering Time**
  - ✓ The residence time in the tempering tank should be at least 45–60 min (can be up to 90 min) to ensure a complete transformation of all beta prime crystals to beta.

- **Agitation in the Tempering Tank**
  - ✓ The recommended agitator speed is 5–10 rpm, using a soft scraper to remove the crystals from the wall without breaking them.

- **Hot Water Temperature in the Jacket**

✓ The water in the jacket must be maintained at 88–92°F (31–33.3°C).

Self-Check – 5	Written Test

Name… ..... ID…..…

Date…….....

Part –I. Short answer questions

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

1. Define the meaning of process parameter (4 points)
2. Write and explain the shortening process parameters (5pts)

Note: Satisfactory rating – 9points Unsatisfactory - below 9

You can ask you teacher for the copy of the correct

Information Sheet 6 - Checking and adjusting shortening and vegetable Ghee equipment performance

6.1 Introduction

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

6.2 Checking and adjusting equipment

Checking can vary in its extent, as the following

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

Work equipment which is exposed to conditions causing deterioration that could result in a dangerous situation should be checked and adjusted at suitable intervals, and after every event liable to jeopardize its safety. The frequency of inspection may vary, depending on environmental conditions. The frequency of inspection should be determined through risk assessment, taking account of the manufacturer's recommendations, industry advice and your own experience.

6.3 Shortening and vegetable ghee processing equipments

Equipments used in shortening and vegetable Ghee processing which needs checking and adjustment include but not limited to:

- Emulsion tankers
- Filters
- Compressor
- High pressure pumps
- Crystallizers
- Conveyors
- Scraped surface heat exchangers
- Ingredient addition systems
- Refrigeration system

6.2.1 Emulsion tankers

Emulsion tanker is a kind of tanker intended to convey condensed loads. Emulsion tanks are typically round and hollow yet there may likewise be varieties like rectangular, cone shaped, curved or semi-rectangular. The material use or making the tanker is stainless steel, carbon steel and aluminum relying upon the application or thing being transported. Tanker truck bodies and trailers are compartments redone and intended for the transportation of dry mass load, fluids, semi-fluids and gases. A standout amongst the most vital components of guaranteeing unsafe materials transportation security is the outline of the holder. Emulsion Tank trucks are portrayed by their size or volume limit. Huge trucks ordinarily have limits running from 5,400 to 11,500 US gallons (20,400 to 43,500 L). A couple of cases of sorts of tanker bodies fabricated are mass encourage tanker bodies, Pneumatic dry mass tanker, Crude oil tanker bodies, Petroleum tanker and Vacuum bodies and so on.

Figure 6. Emulsion tankers

6.2.2 Filters

Filters are used to remove the bleaching agents in the bleaching process and to remove the catalyst in the hydrogenation process. An oil filter is used to remove the dust particles/contaminants from the oil before it is feeding to the storage tank. In most refineries pressure leaf filters are used. These filters require pre-coating of the screens with diatomaceous earth that creates a thin porous bed on the screen. This allows the oil to be filtered without clogging the screens.

Types of oil filters

There are three (3) types of oil filters and those are:

- Cartridge Type Oil Filter
- Edge Type Oil Filter
- Centrifugal Type Oil Filter

Cartridge Type Oil Filter

Cartridge type oil filter consists of filtering elements which are placed in the metallic casing for removing the impurities present in the lubricating oil and is mostly used in automobile engines. Currently, filter elements with fine pores have been employed

which has made it practicable to stop or arrest the particles of size down to within the region of 5 microns. In the filter shown in the figure, the oil enters the filter at the top of the casing and passes through the filter elements as shown by the arrow marks. The pure oil has to be passed through the porous metallic tube from where the oil goes to the outlet for circulation. A drain plug is also provided as shown in the figure:

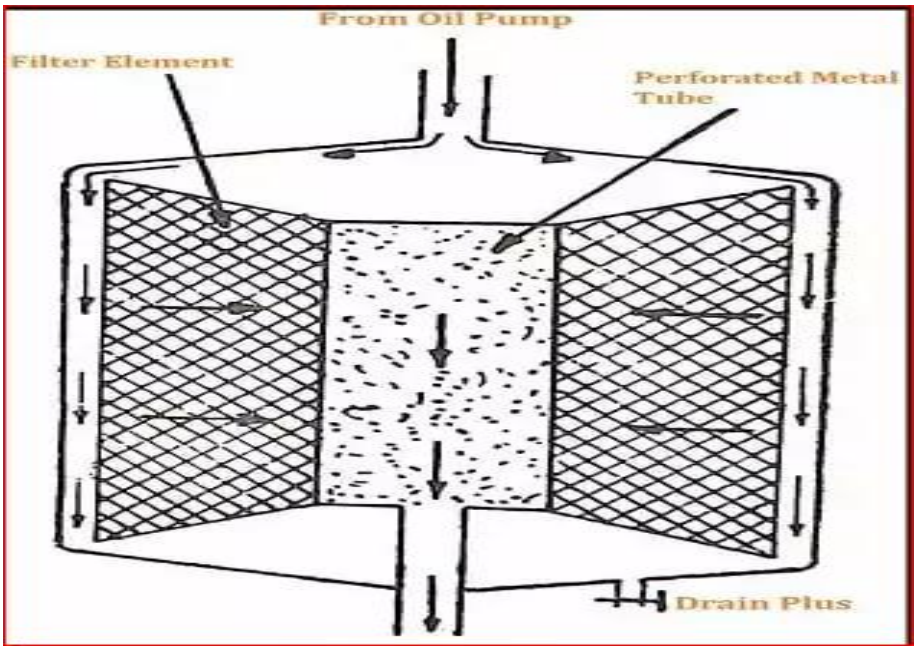


Figure 7. Cartridge Type Oil Filter

Edge Type Oil Filter

Edge type oil filter is also called a stack type Oil filter.

In this oil filter, the oil is made to pass through several closely spaced discs which are mounted on the center spindle as well as the square rod alternately as shown in the figure:

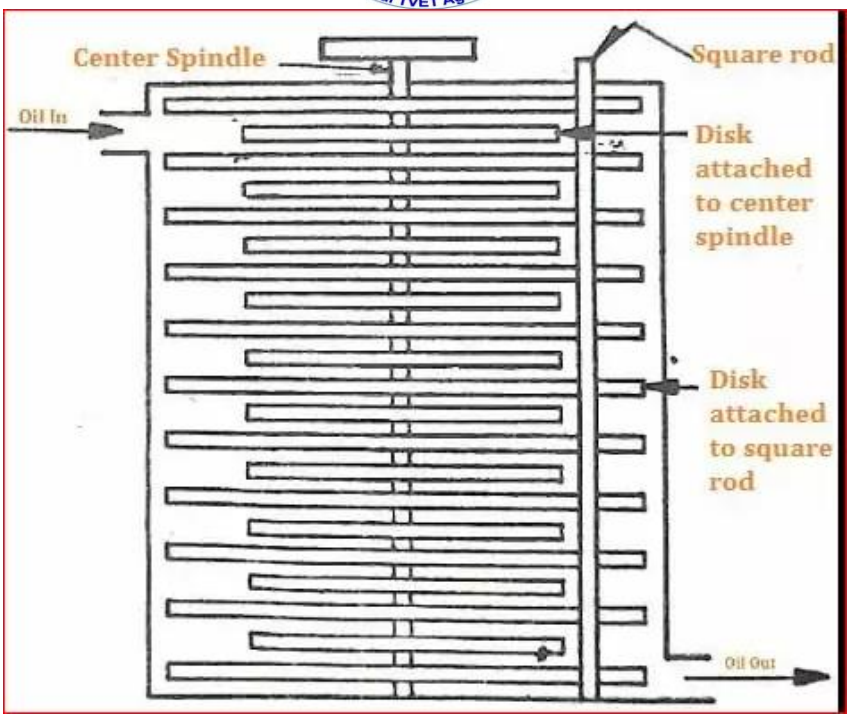


Figure 8. Edge Type Oil Filter:

The clearance or gap between two successive discs is of few microns only. The oil is allowed to pass through these spaces between the discs and due to the small spaces involved in between the discs, the impurities are left on the disk periphery itself from where they are removed periodically using operating the central knob. This may be connected to the clutch system and operated periodically using clutch action or it can be done either manually also.

Centrifugal type oil filters

In this Oil Filter, the impure oil from the engine enters the hollow Central spindle having holes around its periphery as shown in the figure. The impure/dirty oil comes out of these holes and fills the rotor casing after which it passes through the tubes A at the ends of which Jets are attached. The oil under pressure passes through these jets and due to the reaction of which, it gives motion to the rotor casing in the opposite direction so that it starts rotating. The oil impinges on the outer stationary casing under heavy pressures where the impurities are retained there itself and cleaned oil falls below from where it is to be passed to other parts of the engine.

Depending upon the oil pressure circulating the oil, the working speed of the rotor is usually between 2000 rpm and 7000 rpm.

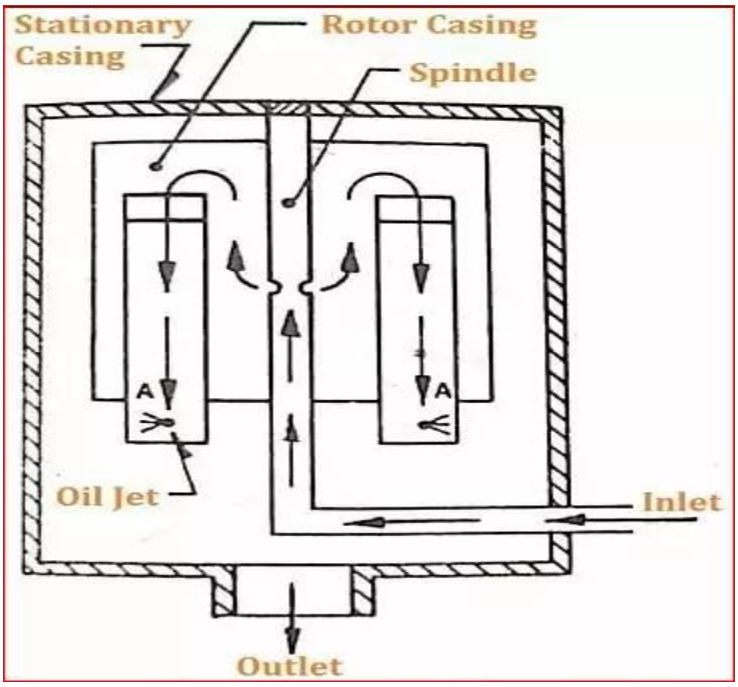


Figure 9. Centrifugal Type Oil filter:

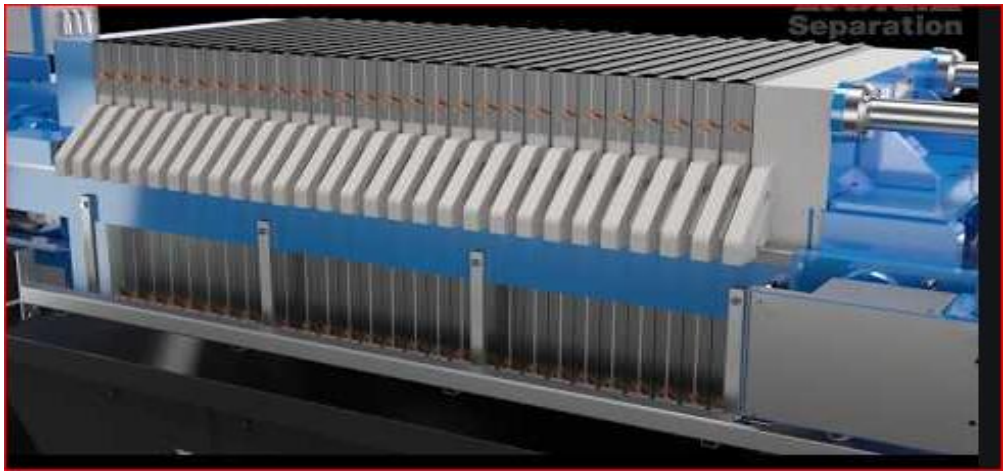


Figure 10. Filter

6.2.3 Compressor

Compressor is a pneumatic device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When the tank's pressure reaches its engineered upper limit, the air compressor shuts off. The compressed air, then, is held in the tank until called into use. The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank. An air Compressor must be differentiated from a pump because it works for any gas/air, while pumps work on a liquid

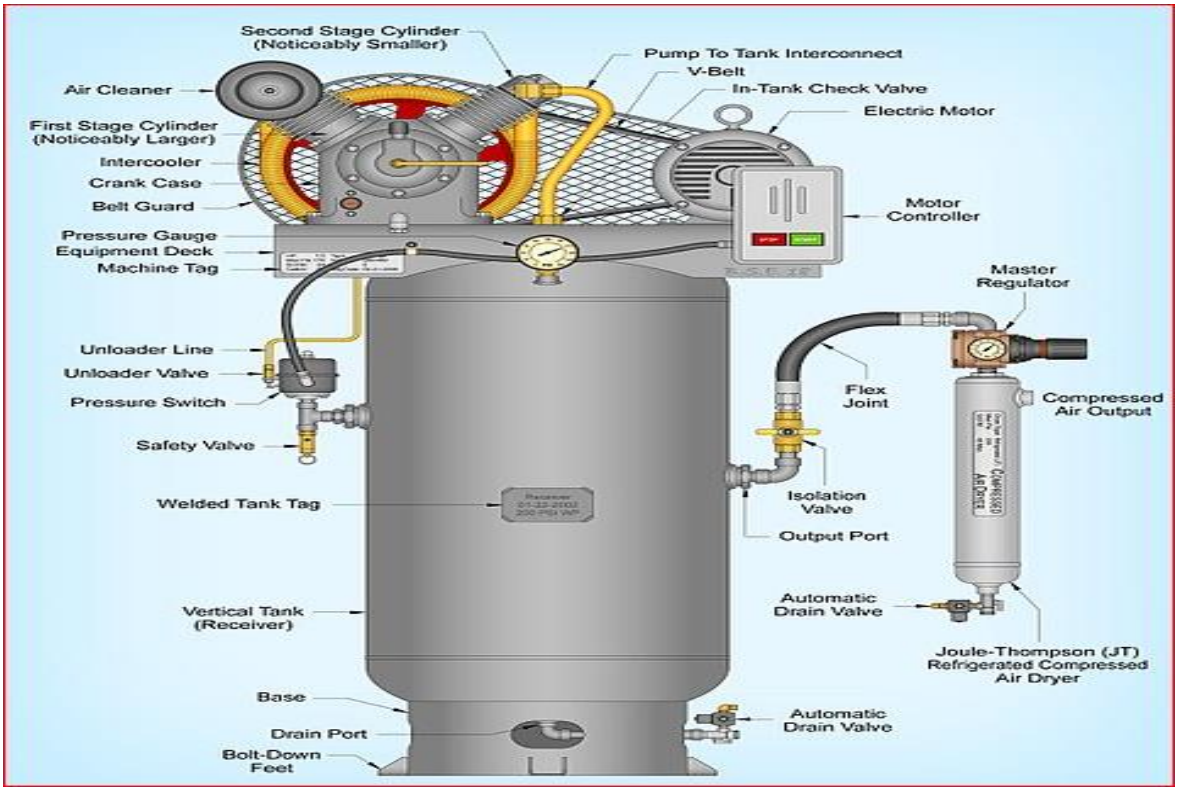


Figure 11. Compressor

6.2.4 High pressure pumps

Refrigeration systems that use one, two, three or four stages of compression have been successfully operated in many applications. The number of levels of refrigeration depends upon the number of compression stages required interstage heat loads, economics and the type of compression. These stages are illustrated in the following sections.

Figure 12. High pressure pumps

6.2.5 Crystallizers

Crystallizers are used in industry to achieve liquid-solid separation.

They are capable of generating high purity products with a relatively low energy input.

There are two types of crystallizers.

A. Continuous crystallizer- high production, controlled crystallization
B. Batch crystallizer - low production, incrustation problems

- **Advantages Continuous crystallizers**

✓ Economical in operating and labor costs
✓ Reduced space

- ✓ Amount of mother liquor needed reworking is small
- ✓ Elimination of impurities by flushing out
- ✓ Higher reproducibility of crystal size distribution
- ✓ High production rate

- **Drawbacks**

- ✓ Encrustation of heat exchangers and pipes
- ✓ Problem of continuous withdrawal
- ✓ Need denser slurry for limitation of the volumes of filtration
- ✓ Periodical stops problem of steady state recovery
- ✓ Difficulty for controlling secondary nucleation

Figure 13. Crystallizers

6.2.6 Conveyors

Conveyor is a mechanical apparatus for moving articles or bulk material from place to place (as by an endless moving belt or a chain of receptacles)

These are gravity or powered equipment commonly used for moving bulk or unit load continuously or intermittently, uni-directionally from one point to another over fixed path, where the primary function is conveying of the material by the help of movement of some parts/components of the equipment.

Type conveyors

I. Belt Conveyor

A belt conveyor consists of an endless flat and flexible belt of sufficient strength, made of fabric, rubber, plastic, leather or metal, which is laid over two metallic flat pulleys at two ends, and driven in one direction by driving one of the two end pulleys. Material is placed on this moving belt for transportation. Belt Conveyor are generally classified as:

- Flat Belt Conveyor
- Troughed Belt Conveyor.
- Closed Belt Conveyor.
- Metallic Belt Conveyor.
- Portable Conveyor.
- Telescoping Belt Conveyor.

General Characteristics

- ✓ Belt conveyors operate in one vertical plane, horizontally or with an inclination (up or down) depending on the frictional property of the load conveyed.
- ✓ For changing direction of the materials being conveyed, in the horizontal plane, more than one belt conveyors are needed.
- ✓ Conveying capacity of a conveyor can be controlled by changing belt speed.
- ✓ Belt conveyors are generally employed for continuous flow of materials.
- ✓ Metal/special belts can carry hot, abrasive or reactive materials

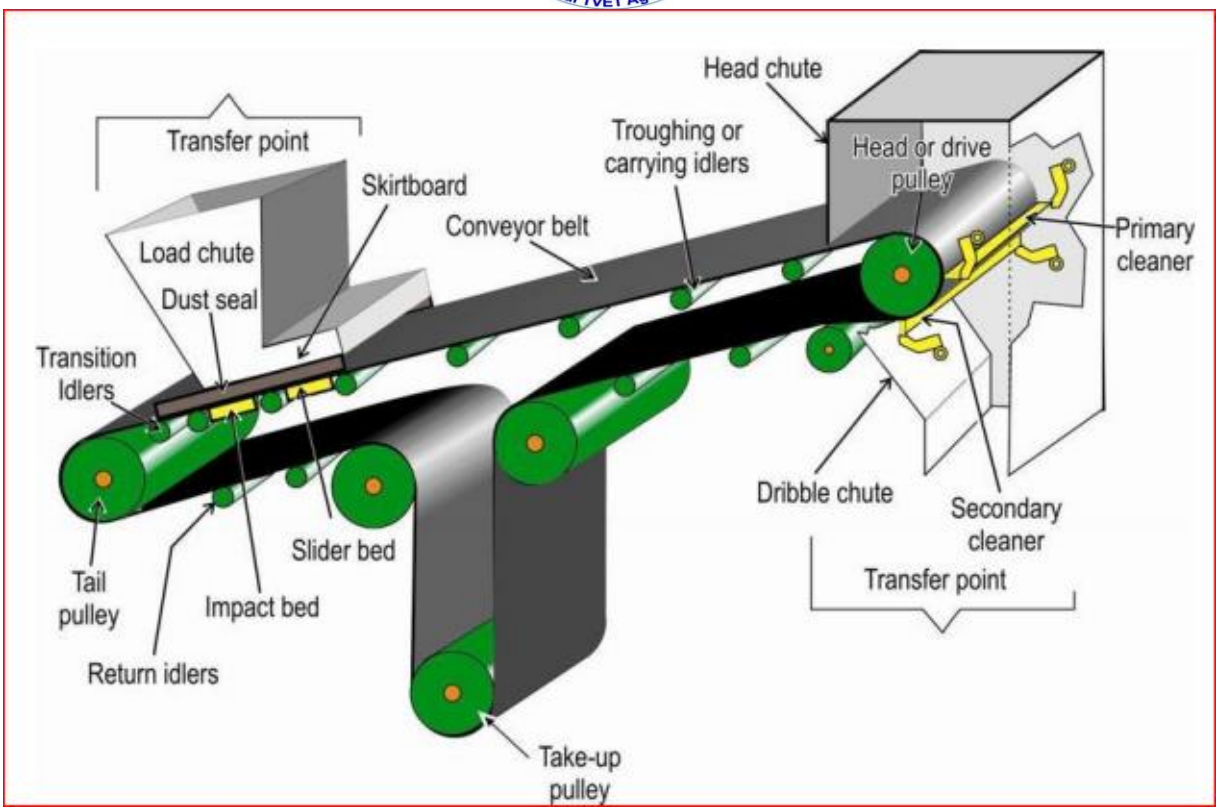


Figure 14. Parts of belt conveyors

Fugure 15. Belt Conveyor

II. Chain Conveyor

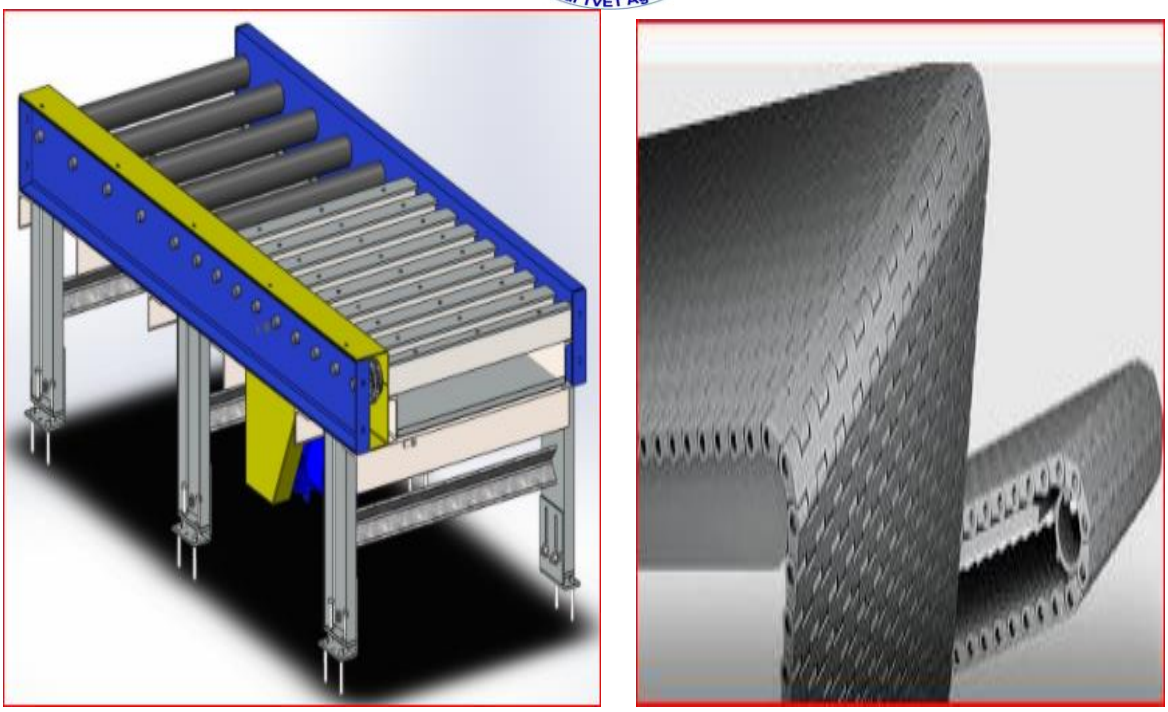
The term chain conveyor means a group of different types of conveyors used in diverse applications, characterized by one or multiple strands of endless chains that travel entire conveyor path, driven by one or a set of sprockets at one end and supported by one or a set of sprockets on the other end. Materials to be conveyed are carried directly on the links of the chain or on specially designed elements attached to the chain.

Chain Conveyor are generally classified as:

- ✓ Apron or pan
- ✓ Slat
- ✓ Cross-bar or arm
- ✓ Car type/pallet
- ✓ En-mass
- ✓ Carrier chain and flat-top
- ✓ Trolley
- ✓ Power and free
- ✓ Suspended tray or swing-tray

General Characteristics

Different types of chain conveyors are used in wide varieties of applications. It is, therefore, not possible to have a set of common characteristics for all these chain conveyors. Chain, compared to belts of a belt conveyor, have certain advantages as well as disadvantages. The major advantages are that the chain easily wraparound sprockets of small diameter and the drive is positive i.e. no slippage takes place between chain and sprocket. The chain stretch is also little. The disadvantages of chain are its high weight, high initial cost, higher maintenance cost and most importantly, limited running speed because of dynamic loading that come into play in chain-sprocket drive causing intensive wear at high speeds. Maximum length and maximum lift of chain conveyors are limited by the maximum allowable working tension of the chain used**.**



Fugure 16. Chain Conveyor

III. Haulage Conveyor

Haulage conveyor is a special group of chain conveyors. As the name implies, the material is dragged, pushed or towed by means of a chain or chains, making use of flights or surfaces which are parts of the chain themselves. The weight of the material is generally carried by stationary troughs, surfaces, or wheeled trucks/dollies on rails/floor. In certain designs, the chain may be replaced by cables. These conveyors are run at slow speed (15 to 60 mpm) and being built for heavy duty need little maintenance. However, the chains undergo wear under heavy tension and work in one direction only.

- ✓ Drag chain
- ✓ Flight
- ✓ Tow (a) over-head, (b)flush-floor (c) under-floor

Applications

- ✓ Bulk materials

- ✓ Hot materials, (transferring hot steel sections)
- ✓ Abrasive materials,
- ✓ Logs/timber,
- ✓ Packages,
- ✓ Moving car assembly

IV. Cable Conveyor

These conveyors form a distinct group of materials handling equipment to transport people and bulk materials in load carrying buckets, using overhead moving cables and/or wire ropes and are com-posed of one or more spans from the loading point to the discharge point/points covering long distances upto several kilometers. These conveyors are also known as ropeways or aerial tramways.

Applications

- ✓ Handling of Coal
- ✓ Used in Cranes
- ✓ Transporting People (Carrying Bucket)
- ✓ Bulk Material

V. Bucket Conveyor

These conveyors convey bulk loads in bucket shaped vessels which are attached to a system of moving chains or belt. These are generally classified as :

- ✓ Gravity discharge bucket conveyor
- ✓ Pivoted bucket
- ✓ Bucket elevator (also included under III)

Fugure 17. Bucket Conveyor

VI. Roller Conveyor

A roller conveyor supports unit type of load on a series of rollers, mounted on bearings, resting at fixed spacing on two side frames which are fixed to stands or trestles placed on floor at certain intervals. A roller conveyor essentially coveys unit loads with at least one rigid, near flat surface to touch and maintain stable equilibrium on the rollers, like ingots, plates, rolled stock, pipes, logs, boxes, crates, moulding boxes etc. The spacing of rollers depend on the size of the unit loads to be carried, such that the load is carried at least by two rollers at any point of time. These are generally classified as

- ✓ Gravity
- ✓ Powered/driven
- ✓ Portable

Fugure 18. Roller Conveyor

VII. Screw Conveyor

A screw conveyor consists of a continuous or interrupted helical screw fastened to a shaft which is rotated in a U-shaped trough to push fine grained bulk material through the trough. The bulk material slides along the trough by the same principle a nut prevented from rotating would move in a rotating screw. The load is prevented from rotating with screw by the weight of the material and by the friction of the material against the wall of the trough.

A screw conveyor is suitable for any pulverized or granular non viscous material, and even at high temperature. The conveyor is particularly suitable for mixing or blending more than one material during transportation, and also for controlling feed rate of materials in a processing plant. Abrasion and consequently certain amount of degradation of the material is unavoidable, hence it is not suitable for brittle and high abrasive materials. It is also not suitable for large-lumped, packing or sticking

Advantages

- ✓ Shorter distance,
- ✓ Totally enclosed from atmosphere,
- ✓ Cheap Initial Cost,
- ✓ Simple and Compact, materials.

Disadvantages

- ✓ High Power Consumption
- ✓ Length is limited up to 30m
- ✓ High Maintenance

Fugure 18. Screw Conveyor

6.2.7 Scraped surface heat exchangers

Double pipe scraped surface heat exchangers can be used as crystallizers by cooling a product which has a lower freezing point than other products in a mixture. Such cooling generates crystals in which purity is very close to 100%. Armstrong Engineering has decades of experience with over 350 different chemical mixtures.

Scraped Surface heat exchangers may also be used as viscous coolers, controlling the viscosity and temperature of exothermic fluids. Scraped surface crystallizers have been used almost universally in solvent dewaxing processes. Exchangers may be one double pipe element or as many as 14, stacked 7 per side in a frame. Lengths vary from 12 feet/ 4M to 50 feet / 16M overall. Mechanical seals eliminate release of unwanted solvent to atmosphere. Single drive motors on each double pipe element will allow the processing of high volume / wt. solids

Advantages of Scraped surface heat exchangers over other crystallization methods:

- The modular design provides scalability to account for changes in process requirements.
- The exchangers are designed to run without clogging for extended periods between hot washings.
- Fouling tendencies of some slurries are overcome by continuous scraping of the heat transfer surface.
- The design is capable of handling higher MTDs than shell and tube equipment.
- Operating temperatures range from -75 °C to +250 °C.
- Weight percent solids as high as 65% have been handled.
- Can handle process fluids with viscosities in excess of 10,000 cP.
- Near plug flow profile allows for easy transition from batch to continuous process.
- Scraped surface crystallizers are more cost effective for larger installations where vacuum crystallization may seem attractive.
- The design minimizes shear stress on delicate crystals but is rugged enough to handle tough crystals.
- Simple, self-contained construction eliminates the need for excessive instrumentation, condensers, vacuum systems, etc.

Figure 19. Scraped surface heat exchangers

6.2.8 Refrigeration system

The refrigeration system is important to feed cold air to the cooler to cool the shortening to 70°F (21.1°C).

Self-Check - 6	Written Test

Name… ..... ID…..…

Date…….....

Part –I. Short answer questions

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

1. List at list five Shortening and vegetable ghee processing equipments (10 points)
2. Write the importance/advantages of Scraped surface heat exchangers (10pts)
3. Write and explain the three(3) types of filters(10pts)

Note: Satisfactory rating – 30 points Unsatisfactory - below 30

You can ask you teacher for the copy of the correct

Information Sheet 7 - Carrying out pre-start checks

7.1 Introduction

Pre starts often involve routine inspections conducted by the machine or equipment operator. Prior to operating any oilseed cleaning equipment, the operator of that equipment completes a visual assessment, check levels, wear, indicator lights, or signs of damage. The Prestart checklist ensures the operators assessments are recorded and saved, this acts not only as a verification that checks are done, but also an accountability measure for operators of that equipment to take responsibility for their equipment.

7.2 Purpose of pre-start checks

- To make the process easy
- To reduce hazards
- To take action

7.3 Carrying out pre-start checks

Conduct pre-start checks on equipment includes

- condition to identify any signs of wear,
- selecting appropriate settings and/or related parameters,
- confirming that equipment is clean and correctly configured for processing requirements,
- positioning valves and sensors and controls correctly,
- ensuring any scheduled maintenance has been carried out, an confirming that all safety guards are in place and operational
- Positioning sensors and controls correctly

- Ensuring any scheduled maintenance has been carried out
- Confirming that all safety guards are in place and operational
- start, operate, monitor and adjust neutralization process equipment to achieve required outcomes

Figure 20. Pre-start checks on tube fitting in a machine

Self-Check 7	Written Test

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

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

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

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

LG #54	LO#2 - Operate and monitor the shortening and vegetable ghee process

Instruction sheet

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

- Policies and procedures
- Starting and operating process
- Legislative requirements
- Monitoring shortening and vegetable ghee processes to identify variation
- Identifying and reporting variation in equipment operation and maintenance
- Monitoring shortening and vegetable ghee processes to confirm the product specifications.
- 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:

- Policies and procedures
- Start and operate process
- Legislative requirements
- Monitor shortening and vegetable ghee processes to identify variation
- Identify and report variation in equipment operation and maintenance

- Monitor shortening and vegetable ghee processes to confirm the product specifications.
- 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. Read the information written in the information Sheets
3. Accomplish the Self-checks
4. Perform Operation Sheets
5. Do the “LAP test”

Information Sheet 1 - Policies and procedures

1.1 Introduction

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

1.2.1 Company policies and procedures

Policies are a statement of purpose, which highlight broad guidelines on action to be taken to achieve that purpose. The statement of purpose should not be more than one page in length, but this will vary depending on the policy.

Policies and procedures may include:

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

Workplace policies are statements of principles and practices dealing with the ongoing management and administration of the organization.

Policies act as a guiding frame of reference for how the organization deals with everything from its day- to-day operational problems or how to respond to requirements to comply with legislation, regulation and codes of practice.

It is important that policies are reasonable, that employees are aware and clearly understand what the policy is trying to achieve.

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

- **Benefits of workplace policies**

Well-written workplace policies:

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

Self-Check # 1	Written Test

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

1. Write the benefits of workplace policies (5pts)
2. Write the difference between policies and procedures(5pts)

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

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

Information Sheet 2 - Starting and operating shortening process

2.1 Introduction

Shortening is a solid vegetable fat that is typically made by hydrogenating, or solidifying vegetable oils. Trans-free shortenings are now available. Shortening is used in baking to help make products crumbly, flaky and tender. It is 100 percent fat as opposed to butter and lard, which are about 80 percent fat, so shortening results in especially tender cakes, cookies and pie crusts. Shortening tenderizes by coating protein and starch particles, thereby disrupting continuity of their structure. Shortening also enhances apparent moistness, fineness and uniformity of grain, and keeping quality.

Figure 21. Shortening product

2.2 Shortening attributes

The development of a shortening for a food application is dependent on many interlaced factors. These requirements may differ from customer to customer depending on the equipment, processing limitations, product preference, customer base, and many other contributors.

The important attributes of a shortening in different food products vary considerably. In some food items, the flavor contributed by the shortening is of minor importance; however, it does contribute a beneficial effect to the eating quality of the finished product. This fact has been relearned by the developers and experienced by the initial consumers, to their dissatisfaction, with many of the fat-free products recently introduced. A characteristic failing of the fat-free products was a lack of the eating characteristics normally contributed by shortening. In many products, such as cakes, pie crusts, icings, cookies, and other pastries, shortening is the major contributor to the product structure and eating character as well as contributing other significant effects upon the finished product's quality. Satisfactory shortening performance is dependent on many factors.

Five of the most important considerations, which affect most applications (shortening process or performance) are:

- Flavor
- Physical characteristics
- Crystal structure
- Emulsification and
- Additives

- **Flavor**

In some specific cases the desired shortening flavor is typical of the original flavor of the source oil for example, a lardy flavor is somewhat desirable in some products. Also, artificial flavors are added to some shortening products to enhance the functionality. Both the bland or typical flavor must be stable throughout the life of the food product. Therefore, the oxidative stability requirements of the finished product must be established to determine the minimum requirements for the shortening

- **Physical characteristics**

Hydrogenation has been the primary process used to change the physical characteristics of oils. Melting points or hardness of an oil can be completely altered with this process and the changes controlled by the conditions used to hydrogenate the oil. In the hardening process, hydrogen gas is reacted with oil at a suitable temperature and pressure in the presence of a catalyst with agitation. Control of these conditions and the end point enables the operator to better meet the desired physical characteristics of the shortening products.

- **Crystal Structure**

Each source oil has an inherent crystallization tendency, either β or β_o. The small, uniform, tightly knit β_o crystals produce smooth textured shortenings with good plasticity, heat resistance, and creaming properties. The large β_o crystals can produce sandy, brittle consistency shortenings that result in poor baking performance where creaming properties are important. However, the large β crystals are desirable for some applications such as pie crusts or frying.

- **Emulsification**

Shortening emulsifying properties are accomplished with adjustment of the fat structure and with the addition of surface-active agents. The typical food emulsifiers supplement and improve the functionality of a properly developed shortening, i.e., act as lubricants, emulsify fat in batters, build structure, aerate, improve eating qualities, extend shelf life, crystal modifier, anti-sticking, dispersant, moisture retention, etc. Obviously, no single emulsifier or emulsifier system can perform all of these different functions. In selection of the proper emulsifier or system, the developer must consider the usage application, the preparation method, emulsion type, effects of the other ingredients, economics, and any other applicable criteria for the finished product. Most of the emulsifiers used in shortenings are listed in

(table -3) with Code of Federal Regulations (CFR) Title 21 Part numbers and a suggested application guide.

Table 3: The most common emulsifiers used in shortenings

Emulsifier	CFR 21	Applications[a]
Mono- and diglyceride	182.4505	All
Lecithin	182.1400	All
Lactylated monoglyceride	172.852	C and M
Calcium stearyl lactylate	172.844	B and S
Sodium stearoyl lactylate	172.846	B and S
Propylene glycol mono esters	172.856	C,M,B, and S
Diacetyl tartaric monoglycerides	182.4101	B
Ethoxylated monoglycerides	178.834	B
Sorbitan monostearate	172.842	C and M
Polysorbate 60	172.836	All
Polyglycerol esters	172.854	All
Succinylated monoglycerides	172.830	B
Sodium stearoyl fumarate	172.826	B and S
Sucrose esters	172.859	C,B, and S
Stearoyl lactylate	172.848	C,B, and M

Applications code: B, bread; **C**, cake; **F**, fillings; **I**, icings; **M**, cake mix; **S,** sweet dough's; **All**, all applications.

- **Chemical Adjuncts**

In addition to emulsifiers a number of other chemical compounds provide a specific function for certain types of shortenings. These additives can be classified into the following categories:

- ✓ **Antifoamers**.

Dimethyl polysiloxane serves as an antifoaming agent that forms a mono molecular layer on the surface of a heated frying shortening to retard oxidation and foaming. The silicone compounds are added to frying shortenings at levels of 0.5–3.0 ppm. Higher concentrations do not inhibit foaming any more effectively and can cause

immediate foaming at levels in excess of 10 ppm, the maximum allowed by U.S. federal regulations.

Other potential problem areas with antifoamer use are:

- Unintentional addition to bakery shortenings can cause cake failures,
- Glazes may not adhere to donuts fried with an antifoamer present, and
- Potato chips may lack crispness

✓ **Antioxidants**

Antioxidants are materials that can retard the development of off flavors and odors by inhibiting oxidation. Vegetable oils contain natural antioxidants, tocopherols that can survive most processing. Several phenolic compounds have been identified that can also provide oxidative stability. In general, tertiary butyl hydroquinone. (TBHQ) is the most effective synthetic antioxidant in unhardened vegetable oils, followed by propyl gallate. TBHQ also appears to be effective for the meat fats, but protection is also afforded by butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA).

✓ **Metal In activators**

Fats and oils obtain metal contents from the soils where the plants are grown and later from contact during crushing, processing, and storage.

Many of the metals promote autoxidation that results in off-flavors and odors accompanied by color development in the finished shortening. Studies have identified copper as the most harmful metal with iron, manganese, chromium, and nickel following. Metal scavengers, added at low levels during or immediately following deodorization, facilitate removal of the harmful metals. The most widely used chelating agent is citric acid at 50–100 ppm. Phosphoric acid at 10 ppm and lecithin at 5 ppm have also been used to inactivate metals.

- ✓ **Colorants**

Pigments used in shortenings are usually the oil-soluble carotenoids in the yellow to reddish orange range. The carotenoids with U.S. Food and Drug Administration (FDA) approval include the carotenes, bixin, and apo-6-carotenal. Carotenoids are heat sensitive but can be stabilized with BHA and BHT for greater heat stability. Lakes are FDA approved and heat stable but violent agitation is required to keep these oil-insoluble colorants in suspension. Apocarotenal, βsynthetic, FDA-approved pigment is used primarily as a color intensifier for β′carotene (15).

- ✓ **Flavors**

Most of the flavors used in shortenings are butter like. Di-acetyl was the major butter flavor used in fat and oil products until improved analytical techniques identified other flavor components in butter. Today, the U.S. FDA regulations allow safe compounds that impart a suitable flavor to the finished product. The choice of a particular flavor or blend of flavors depends on the expertise and the taste preference of the product developer.

‘‘shorten’’ or tenderize foods, particularly baked goods, by their ability to interpose films of fat through the food in such a manner that the protein and carbohydrate components do not cook to a hardened mass. In cakes and icings, shortenings also make possible the incorporation of tiny air bubbles that greatly assist in the attainment of fine, uniform, and stable structures. Liquid oils do not possess this ability. The simplest type of shortening consists of a fully hydrogenated fat (stearine) blended with a liquid vegetable oil. These products are plastic at room temperature and are marketed as ‘‘all-purpose’’ shortenings, generally suitable for general pan frying and less critical baking operations in the home. Other products have been developed (which may include emulsifiers and other ingredients) that have greater creaming qualities and exhibit greater resistance to oxidation.

2.3 Starting and operating shortening process

There are two operating process in processing industry.

A Batch process

Batch processes are mainly performed within a single piece of equipment; the process steps are sequential in time. The input is discontinuous at the start of the sequence, the output discontinuous at the end.

Main advantages of batch processes

- ✓ Short product change overtime;
- ✓ Suited for small production lots;
- ✓ Flexible recipe;
- ✓ Simple maintenance;
- ✓ Can be operated manually

Main disadvantages:

- ✓ limited scope for heat recovery;
- ✓ requires sequence control;
- ✓ many parallel

B Continuous process

In continuous processes, the process steps are simultaneous in different pieces of equipment; both input and output are more or less constant over time.

Main advantages:

- ✓ Suited for high-capacity lines (low space requirement);
- ✓ Input/output heat recover
- ✓ simple automation and control
- ✓ low manning level

Main disadvantages:

- ✓ Long product changeover time;
- ✓ Complex and costly maintenance;
- ✓ High electrical energy consumption.

The two process are applied to single or different product types

2.3.1Solid Fat Profiles for Shortening

The SFI profile is a good indicator of the plastic range of a fat formulated for shortening. High-stability shortenings have a steep SFI (Solid Fat Index) profile and a narrow plastic range. Typical all-purpose plastic shortenings retain much of their solid fat content over a wider temperature range than high-stability types and consequently possess much flatter profiles. Liquid pourable shortenings include clear oils as well as fluid or opaque types. Pourable shortenings contain low solids levels with very flat SFI profiles. Specialty shortenings have been formulated for specific applications including cakes, dry cake mixes, bread, Danish and puff pastry, pie crust, cookies, crackers, icing, creams and fillings, coating fat, nondairy products, and frying. Specialty shortenings may be of any general type depending on the requirements for that specific application, and their SFI profiles will be characteristic of that particular type.

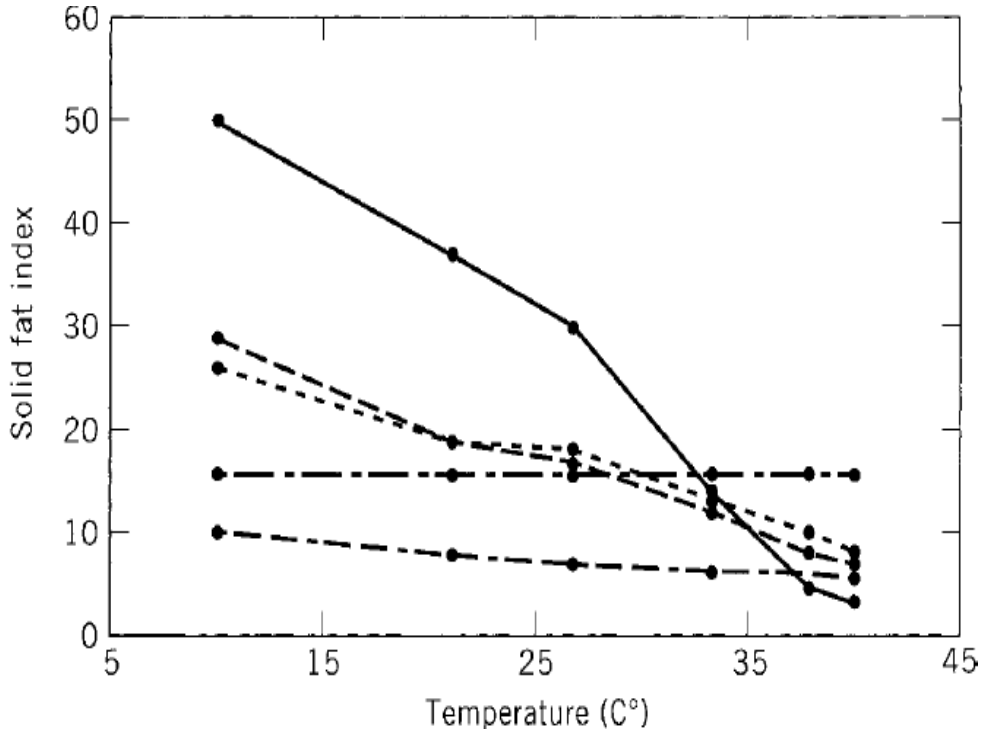


Figure 22. Typical solid fat indices for shortening

Table 4. Critical Process Variables in Fat Crystallization

Process condition	**Operating condition**	**Consequence of noncompliance**
Feed temperature	Typically >150°F (65.6°C)	To ensure that all saturated triglycerides are completely melted, otherwise the desired consistency for the shortening will not be achieved
Cooler or Freezer outlet temperature	The outlet temperature must be controlled at the target ±2°F (1°C)	• Higher FOT will produce larger crystals; softer initial product, after tempering will

(FOT)		be firmer than the target • Lower FOT will produce smaller crystals; firmer initial product will be softer than the target after tempering
Agitator shaft speed (cooler)	1200–1300 scrapes/min	A higher rpm may permanently destroy the primary bonds
Total residence time in the system	1.5–2 min	• A longer residence time in the Cooler may start the crystallization process in it or in the piping between units cooler and pro; this will clog up the system

2.3.2 High-Stability Shortenings

A steep SFI profile is indicative of a narrow plastic range. Products with this type of profile are often referred to as high-stability shortenings.

The SFI values may be 50 or greater at 10 ^{0}C (50^0 F) but usually less than 10 at 40^{0}C (104^{0}F). As their SFI profiles indicate, these shortenings are not intended to be workable over a wide temperature range. They tend to be hard and brittle below 18.3 ^{0}C (65^{0}F) and soft above 32.2^{0}C (90^{0}F). High-stability shortenings are used for deep frying, as center fat for confectionery and bakery items, replacements for butter and coating fats, in vegetable/dairy systems, and for crackers and hard cookies.

2.3.3 Specialty Shortenings

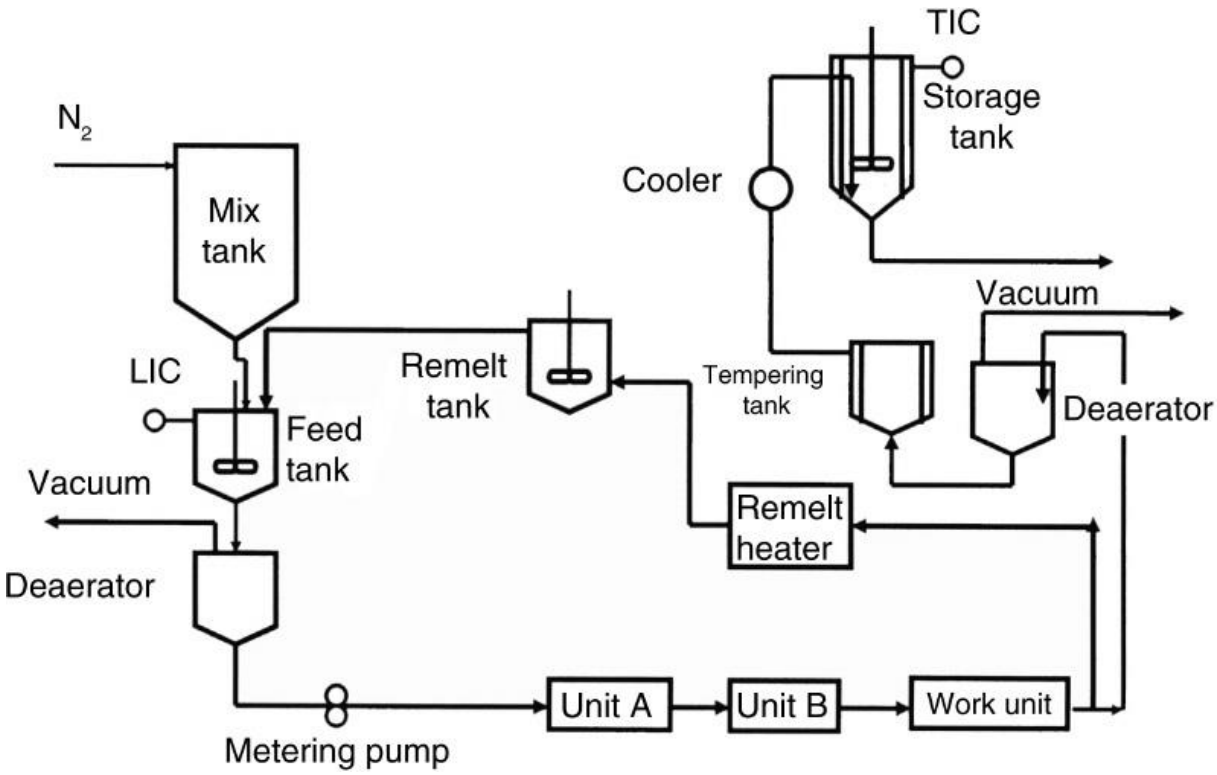
Roll-in shortenings are specialty products used almost exclusively for baking. Their primary use is as an ingredient in puff pastry. Puff pastry is prepared by placing a layer of shortening on a layer of dough. This is folded and sheeted until there are more than 700 fat–dough layers. When baked, the shortening melts, liberating moisture that becomes steam ‘‘puffing’’ the thin dough layers into a very delicate flaky structure. The SFI profile for puff pastry is fairly flat with solid levels of 40% or higher at 10^0C (50^0F) to about 20% at 33.3^0C (92^0F). Dry shortenings are fats that have been encapsulated in a water-soluble coating material; their fat content is generally between 75% and 80%. Dry shortenings are used in ready-to-use mixes where only water is added to form a batter ready for baking.

2.3.4 Pourable liquid shortening

This is an opaque fluid product made from hydrogenated vegetable oils. The product can remain fluid at room temperature for a long time. Pourable shortening is made from a mixture of fully hydrogenated fat (hard stock) and liquid oil using a crystallization process with a somewhat similar crystallizer as for the solid shortening, but in many ways it is quite different in principle from the process for making solid shortening. It is not unusual to classify an edible fat or oil as shortening simply to differentiate it from products such as margarine that contain moisture and other nonfat materials. Liquid shortenings include clear oils as well as fluid, opaque pourable products. The SFI profiles for clear oils are very flat as they normally contain very low levels of oil-soluble emulsifiers or hard fat. Clear oils can be used in household grilling and frying and in institutional deep frying provided the turnover rate is high enough (15–25%) so that stability is not a concern. The flavor and oxidative stability of such oils is greatly improved by partially hydrogenating soybean, safflower, corn, sunflower, or other source oils. After hydrogenation, the oil is fractionated and the clear liquid oil is separated from solid portion. Above 16^0C (60^0F), these oils are usually free of suspended solids.

Fluid shortenings can be distinguished from liquid shortenings by their opacity resulting from the suspension of high-melting emulsifiers or fully hydrogenated fats. The total amount of suspended solids ranges between 5% and 15%. These products are usually fluid between 18.3^{0}C (65^{0}F) and 32.2^{0}C (90^{0}F); outside of this range, opaque shortenings may lose their pour ability or become more fluid depending on how temperature has altered their solid content.

Fluid shortenings are widely used in commercial frying but have also been formulated and marketed successfully for baking cakes, bread, buns, rolls, and pie crust.



Key: Unit A (cooler); Unit B(Work unit); LIC, Level Indicator Controller; TIC, Temperature Indicator Controller

Figure 23: Schematic flow diagram for making pourable shortening.

Processing Steps for Making Pourable Liquid Shortening

A The blend of the solid and the liquid fractions is transferred from the mix tank to the feed tank.

B The mix temperature must be sufficiently high to melt the hard stock and produce a high-temperature differential (DT) between the oil and the refrigerant temperature to produce small crystals.

C The mix is deaerated under vacuum in the deaerator vessel, before the oil mix enters unit A.

D The nuclei formed in unit A then enter unit B to produce crystals.

E A work unit is added after unit B to provide some additional time for crystallization and breaking any agglomerates.

F During start-up, the product leaving the work unit is recycled back to are melt tank where the product is heated to at least 10°F (5°C) above the complete melt point of the mix.

G The residence time in the are melt tank is at least 45 min.

H The mix is returned to the mix tank for recycling.

I Once the process conditions reach the steady state, the product is diverted to a second deaerator under vacuum to remove any air or nitrogen entrapped in the product.

J The product then passes through a jacketed tempering tank, which is maintained at 90°F (32.2°C).

K The tank has a scrape-wall top-entering agitator that runs at a very slow rpm to keep the tank walls clean of crystals without damaging them.

L The residence time in the tempering tank is 45–60 min (can be up to 90 min) to ensure complete transformation of all crystals to the beta form.

M The product is cooled to 70°F (21.1°C) in a cooler using cold water.

N The product is stored in a jacketed storage tank with a slow agitator to keep the product in motion without breaking the crystals.

O The product is checked for fluidity before it is either loaded into trucks or sent to packaging.

A Use of Pourable Shortening

- The traditional pourable shortening uses partially hydrogenated soybean oil or partially hydrogenated canola oil as the major component in the formula.
- Partially hydrogenated oil provides oxidative stability to the pourable shortening, but at the same time it contributes a significant level of trans fat in the shortening.
- The modified composition seed oils can be used to replace the partially hydrogenated oil, obtain the same functionality, and oxidative stability without the trans-fat in the shortening

B Special Properties

The liquid shortening offers the following distinct advantages:

- It can be poured out of a can or a bottle.
- It can be squeezed out of a soft bottle.
- It can be easily poured in a cup for recipe preparation.
- It can be easily mixed with dry ingredients.

2.3.5 Critical Control Points of shortening

- **Formulation of the Mix**
  - ✓ The mix formulation must be done accurately.
  - ✓ Care must be taken that not even a trace amount of cottonseed or palm hard stock gets blended in the mix.

- **Deaeration**

The mix must be deaerated before it enters cooler. In the absence of this step the product fails for the reasons as listed:

- ✓ The product can get thicker (lower fluidity) than desired.

- ✓ The product can separate in the package during storage, showing a floating layer of the solid fraction separated from the product.

- **Freezer (Unit A) Outlet Temperature**

✓ This temperature will vary depending on the amount of the hard stock in the mix.

✓ The freezer outlet temperature (FOT) must be kept as low as possible. Normally it is about 70°F (21.1°C).

✓ A lower FOT produces smaller crystals.

✓ The FOT should be controlled within ±2°F (1°C).

- **Tempering Temperature**

✓ This is maintained at 9°F (32.2°C) to maximize the transformation of the crystals to beta phase.

- **Tempering Time**

✓ The residence time in the tempering tank should be at least 45–60 min (can be up to 90 min) to ensure a complete transformation of all beta prime crystals to beta.

- **Agitation in the Tempering Tank**

✓ The recommended agitator speed is 5–10 rpm, using a soft scraper to remove the crystals from the wall without breaking them.

- **Hot Water Temperature in the Jacket**

The water in the jacket must be maintained at 88–92°F (31–33.3°C).

- **Storage Tank Design**

✓ It must be a jacketed tank with a cone bottom and heated with warm water.

✓ Alternatively, electrical tape on the outside of the tank could be used.

- ✓ The jacket temperature should be maintained at 91–100°F (33–38°C).
- ✓ This will melt the product along the inner wall, producing a very thin layer of liquid oil a few microns thick, which facilitates the movement of the product during a transfer either to a tank truck or to packaging.
- ✓ The tank should preferably have a top-entering scrape-wall agitator running at 5–10 rpm.

- **Storage of Pourable Shortening in the Warehouse**
  - ✓ The maximum recommended storage temperature is 77°F (25°C).
  - ✓ The product can separate into liquid and solids with the liquid floating at the top if it is exposed to a temperature exceeding 86°F (30°C).

- **Shipping (Transit)**

✓ The warehousing temperature conditions also apply for shipping.

Table 5. Comparison of Solid and Liquid Shortenings

Areas of comparison	Solid shortening	Liquid shortening
Consistency	Solid	Fluid (pourable)
Applicability	Baking	Baking
	Cakes	Bread
	Pastries	Soft cookies
	Cookies	Nutri bars
	Crackers	
	Bread	
	Pie Shells	
	Frying	Frying
	Heavy-duty frying	Heavy-duty frying

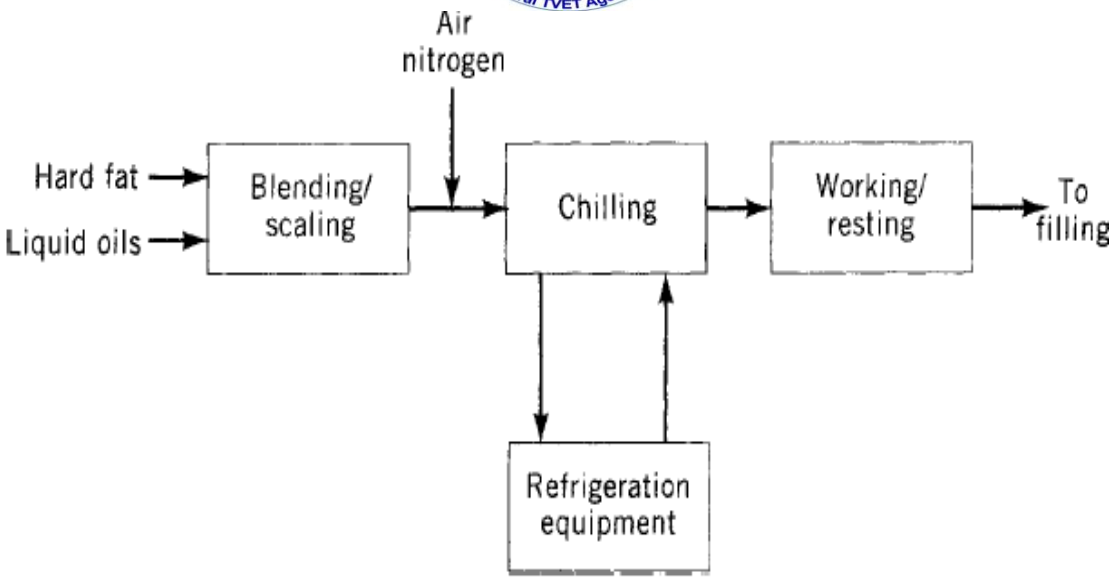


Figure 24. Simple Flow process for shortening

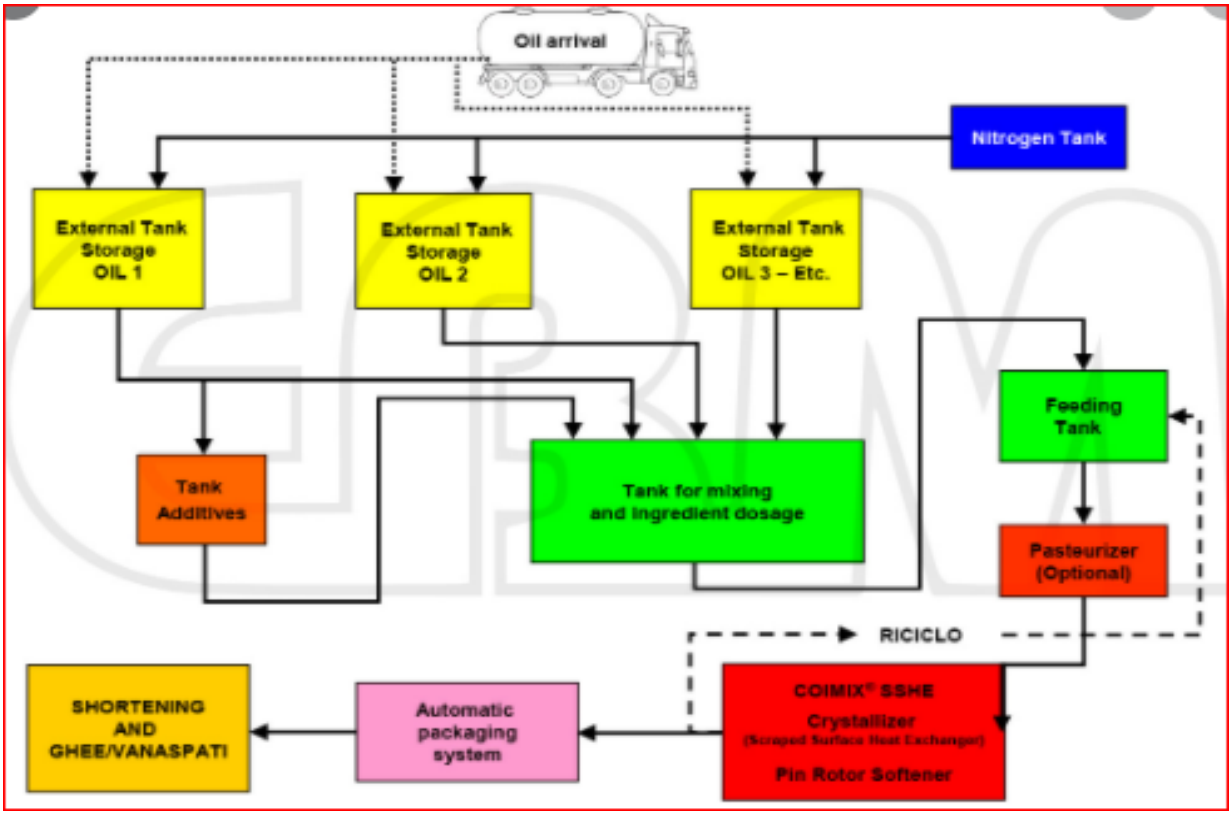


Figure 25. Industry Flow process for shortening

Self-Check - 2	Written Test

Name… ……. ID…….…

Date…….....

Part –I. Short answer questions

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

1. Define shortening (2 points)
2. Write and explain each shortening attributes in detail (15pts)
3. Write the common emulsifiers that used in shortening (5pts)
4. Write the critical variables I fat crystallization (10pts)
5. Write all shortening process (10pts)

Note: Satisfactory rating – 42 points Unsatisfactory - below 42

You can ask you teacher for the copy of the correct

Information Sheet 3 - Legislative requirements

3.1 Legislative requirements

Food safety regulatory system is authorized and mandated in Ethiopian Food, Medicine and Healthcare Administration and Control Authority (FMHACA) Proclamation No. 661/2009. This legislation provided the legal authorities for the government to consolidate the pre-existing food regulatory system with the aim of better 'protect the public from health risks emerging out of unsafe and poor quality food.' In particular, the Proclamation authorizes the setting of standards and regulations for locally-produced and imported foods, in areas such as production, promotion, storage, packaging and labeling, distribution, and laboratory testing

FMHACA was given further statutory authority to enforce and implement food safety and quality regulations as defined in the Food Medicine and Healthcare Administration and Control Councils of Ministers Regulation No 299/2013. This legislation states that food must be wholesome and produced in accordance with the relevant safety and quality requirements. Imported products failing to meet these standards will be returned to the country of origin or destroyed at the point of entry. For example, products that are expired or have deteriorated in quality may be seized and returned or destroyed. In a case where the violative product was detected in post-market surveillance, FMHACA has the authority to pull it from stores' shelves and destroy it. This regulation also provides broadly-defined requirements dealing with food storage, handling, and transportation, and prohibits counterfeiting and adulteration.

3.2 Food Additive Regulations

FMHACA regulates the use of additives which must comply with both international and national food safety standards. Individual food and beverage standards, where

applicable, reference both permitted and prohibited additives. For example in the case of wine, tanic acid can be used for clarification purposes, but coloring substances are prohibited with the exception of isoenocyanine or caramel. In addition, there is a specific national standard for food additives.

3.3 Pesticide & Other Contaminants:

The Ministry of Agriculture (MOA) regulates and requires all pesticides to be registered prior to use. The registration process requires the applicant to provide efficacy, safety and quality data. Once registered, the pesticide can be used for up to 5 years at which time the registration may be renewed.

3.4 Packaging & Container Regulations

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

3.5 Labeling Requirements

The following information below must be clearly and indelibly marked on the labels of pre-packaged foods in either English or Amharic. (Note: Packaged foods with a surface area less than 10cm2 may be exempt from having to display some of these labeling elements.) Labels found on U.S. food products are commonly accepted.

Required Labeling Elements for Pre-packaged Foods:

- Name of the food

- Nutrition content
- List of ingredients (except for single ingredient foods) in descending order of weight
- List of minerals or vitamin supplements added to fortify foods (if needed)
- List of ingredients that may cause an allergic reaction
- Net weight or volume of contents
- Name and address of the manufacturer, packer, distributor, importer, exporter or vendor
- Country of origin
- Production and expiration dates
- Instructions for use (if needed)
- For beverages containing more than 1.2 percent alcohol, the alcohol proof is required on the label.
- GM foods must carry the label with the following statement: 'genetically modified food'.

3.6 Legislative requirements of Ethiopia

Legislative requirements include**:**

- Ethiopian Food Standards Code
  - ✓ Mandatory edible oil standard
  - ✓ Weights and measures legislation
  - ✓ Ethiopian Food and Drug Authority
- Environmental Protection Authority

- **Ethiopian food standard code**

  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. 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. Ethiopian Authority for standardization establishment proclamation No. 328/1987, which repealed Proc. No64/1970 was enacted. The objective of this proclamation was promoting standardization and quality control with a view to ensuring the quality and safety of products (Ethiopian Standards, 2009). Ethiopian Standards Regulations No. 12/1990 was promulgated to provide for the compulsory Ethiopian standards and 389 standards are developed and made compulsory, from which about 180 of them deal with food and food products. A new public health proclamation No.200/2000 was also enacted by incorporating provisions which deal with the issues of food quality.

- ✓ **Mandatory edible oil standard**

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

Table 6: Mandatory oil seed and edible oil standard

No	Product	Ethiopian Standard Number	Ethiopian Standard Title
1.	Edible Vegetable oil	CES 21-2013	Edible Vegetable Oils-Packing
2.	Edible groundnut oil	CES 16-2013	Groundnut (Peanut) Oil-Specification
3.	Sunflower seed oil	CES 17-2013	Sunflower Seed Oil- Specification
4.	Edible cottonseed	CES 19-2013	oil Cottonseed Oil-Specification
5.	Edible linseed oil	CES 18-2013	Linseed Oil-Specification
6.	Edible sesame seed oil	CES15-2013	Sesame Seed Oil– Specification

Figure 26: Bleached canola oil (left) and un-bleached canola oil (right)

- ✓ **Ethiopian Food and Drug Authority**

The Ethiopian Food and Drug Authority (EFDA) is the National Regulatory Body of Ethiopia which is under the Ministry of Health. The Authority is responsible to ensure the quality, safety and/or efficacy of medicines, food, cosmetics and medical devices, the standards of health and health related institutions, the healthcare practice, and competence and ethics of Health professionals.

- **Environmental Protection Authority**

The most important step in setting up the legal framework for the environment in Ethiopia has been the establishment of the Environmental Protection Authority (EPA) by proclamation No. 9/1995. According to this proclamation the Environmental Protection Authority (EPA) has amongst its '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.

Self-Check - 3	Written Test

Name… ……. ID…….…

Date…….....

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

1. Write legislative requirements needed in oil product processing (5pts)
2. List and write five oil products with its Ethiopian standard number (5pts)

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

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

Information Sheet 4 - Monitoring shortening and vegetable ghee processes to identify variation

4.1 Introduction

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.

4.2 Causes of variation

Some examples of 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.

Variability due to common causes is also known as the natural variation in a process. When a process operates under a stable system of common causes only, it is said...

Self-Check – 4	Written Test

Name… ……. ID…….…

Date…….....

Part –I. Short answer questions

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

1. Write the causes of variation (10 points)

Note: Satisfactory rating – 10 points Unsatisfactory – 10 below

You can ask you teacher for the copy of the correct

Information Sheet 5 -	Identifying and reporting variation in equipment operation and maintenance

5.1 Introduction

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

5.2 Variables to be monitored to minimize variations

There are different variables in a processing industry that must be monitored and controlled. Variables to be monitored to minimize variations in equipment operations include

- Production capacity
- Equipment durability
- Equipment performance (e.g. Speed, output, variations)
- Equipment component performance
- Sequences and timing of operation
- Materials changes (desired and not desired)

For example: During oil mixing using, if the rotation speed of screw high the time to obtain the crude oil increase. But due to the temperature developed between the screw barrel the protein component of the cake may be damaged.

5.3 Objective of maintenance

- To maintain plants and equipments at its maximum operating efficiency,
- Reduce down time and ensuring operating safety

- To safeguard investment by minimizing rate of deterioration implementation of suitable procedures for procurement, storage and consumption of spare parts , tools and consumable materials etc. (inventory control)
- Standardization of spares and consumable in conforming in plants,
- To keep production cycle within the stipulated range.
- To improve productivity of existing machinery
- To prologue the useful life of the plant and machinery

5.4 Reporting maintenance

Maintenance is an auxiliary operation and an important engineering function for restoration of machineries and equipments at their original effectiveness.

Deterioration of industrial facilities could happen due to;

- Tools and dice wear out of friction
- Atmospheric conditions deteriorate tools/machineries
- Aging also affect the normal operation of machines (lifetime)
- Improper handling of equipments and materials.

In oil seed processing industry there are many equipment that needs maximum maintenance due to the operation they have perform. The major equipments that needs maintenance in oil processing are; heat exchanger, heat exchanger tubes, oil extractors, oil condensers, evaporators and so on.

Table 4: maintenance report checklist

Maintenance Performed	Date	Signature
Heat exchanger body welded	5- 8 /3/2021	Mr. B
Tube replaced	3 - 10/3/2021	Mr. C
Temperature sensor replaced	7- 9 /3/2021	Mr. C

Fig.27. Heat exchanger pipe maintenance

Self-Check 5	Written Test

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

1 Write the Objective of maintenance (6pts)

2 What brings variations in equipment operations (4pts)

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

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

Information Sheet 6 - Monitoring shortening and vegetable ghee processes to confirm the product specifications

6.1 Monitoring shortening and vegetable ghee processes to confirm the product specifications

Start, operate, monitor and adjust process equipment required to confirm process specification, such as:

- Operation of addition/dosing equipment
- Agitator speed
- Emulsion temperature
- Shortening and vegetable ghee texture
- Shortening and vegetable ghee output speed

Agitator speed

✓ The recommended agitator speed is 5–10 rpm, using a soft scraper to remove the crystals from the wall without breaking them.

Emulsion temperature

Shortening emulsifying properties are accomplished with adjustment of the fat structure and with the addition of surface-active agents. The typical food emulsifiers supplement and improve the functionality of a properly developed shortening, i.e., act as lubricants, emulsify fat in batters, build structure, aerate, improve eating qualities, extend shelf life, crystal modifier, anti-sticking, dispersant, moisture retention, etc. Obviously, no single emulsifier or emulsifier system can perform all of these different functions

- **Shortening and vegetable ghee texture**

Grain size and quantity of commercial ghee ranged from 0.200 to 0.330 mm and 1 to 40%, respectively, when incubated at 29 °C for 24 h. Laboratory ghee samples showed a grain size and quantity of 0.241 mm and 42%, respectively. Commercial samples with poor granularity had a lower level of saturated fatty acids, while those with bigger grains had a higher level of palmitic acid (>35%). The ratio of unsaturated to saturated fatty acids showed significant variation in these samples. Differential scanning calorimetric analysis of the samples also showed variation in melting and crystallization behavior.

Moisture level

The moisture content of product which is maintained at 90°F (32.2°C) passes through a jacketed tempering tank

Emulsion temperature

The total amount of suspended solids ranges between 5% and 15%. These products are usually fluid between 18.3^{0}C (65^{0}F) and 32.2^{0}C (90^{0}F); outside of this range, opaque shortenings may lose their pour ability or become more fluid depending on how temperature has altered their solid content

Self-Check 6	Written Test

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

Write moisture and emulsion temperature of shortening product (6pts)

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

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

Information Sheet 7-	Identifying, rectifying and/or reporting out-of-specification product/process outcomes

7.1 Identifying out-of-specification of product

Out-of-specification (OOS) the term results includes all test results that fall outside the specifications or acceptance criteria established in edible oil shortening production industry or by the manufacturer. The term also applies to all in-process laboratory tests that are outside of established specifications

The main quality checks concern raw materials, processing conditions, product quality and packaging and storage conditions. Raw materials should be checked to ensure that there is no moulds growth, and that they are correctly dried, cleaned and sorted. During processing, the temperature and time of conditioning, the moisture content of the raw material, and the yield of oil should be routinely checked. Quality checks on the product include correct color, flavor, odour, clarity and fill weight.

Shortening such as:

Five of the most important factors that leads the shortening product into out-of-specification, and which affect shortening process or performance) should be consistent in all aspects are:

- Flavor
- Physical characteristics
- Crystal structure
- Emulsification and
- Additives

Flavor

Artificial flavors are added to some shortening products to enhance the functionality. So, the flavour type and amount to be added is conducted carefully.

Physical characteristics

Hydrogenation has been the primary process used to change the physical characteristics of oils. Control of these conditions and the end point enables the operator to better meet the desired physical characteristics of the shortening products.

Crystal structure

Each source oil has an inherent crystallization tendency, either β or β′. The small, uniform, tightly knit β′ crystals produce smooth textured shortenings with good plasticity, heat resistance, and creaming properties. The large β crystals can produce sandy, brittle consistency shortenings that result in poor baking performance where creaming properties are important.

Emulsification

In selection of the proper emulsifier or system, the developer/manufacturer must consider the usage application, the preparation method, emulsion type, effects of the other ingredients, economics, and any other applicable criteria for the finished product.

Additives

- ✓ There are different types additives used in edible oil shortening process. To prevent the out-of-specification of shortening, the recommended amount or level of additives like; antioxidants, flavors, colorant, and anti-foamers must added carefully. For example; Dimethyl polysiloxane serves as an antifoaming agent that forms a mono molecular layer on the surface of a heated frying shortening to retard oxidation and foaming. The silicone compounds are added to frying shortenings at levels of 0.5–3.0 ppm. Higher concentrations do not inhibit foaming any more effectively and can cause immediate foaming at levels in excess of 10 ppm, the maximum allowed by U.S. federal regulations.

Self-Check 7	Written Test

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

1 Write and explain most important factors that leads the shortening product into out-of-specification,?(10pts)

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

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

Information Sheet 8 - Maintaining work area to housekeeping standards

8.1 Maintaining the work area to workplace housekeeping standards

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

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

8.1.1 Housekeeping standards

The purpose of housekeeping is to improve the livability and conditions of the dwellings owned and managed by the authority and to preserve authority property for future generations, uniform standards for resident housekeeping have been developed for all tenant households.

Housekeeping Standards are as follows:

8.1.11 Inside the Dwelling

1 General

a. Walls: Must be clean, free of dirt, grease, holes, cobwebs, and fingerprints.
b. Floors: Must be clean, clear, and free of hazards.
c. Ceilings: Must be clean and free of cobwebs.
d. Windows: Must be clean and not nailed shut. Shades should be intact.

e. Doors: Must be clean, free of grease and fingerprints. Doorstops should be present. Locks must work.
f. Heating Units: Must be dusted and access uncluttered.
g. Trash: Must be disposed of properly and not left in the dwelling. “Proper Disposal” means that the trash is placed in a sealed plastic bag and put down the chute or in the dumpster.
h. Hallways, Walkways, and Stairways: Must be clear of furniture and other belongings so as to permit easy passage.
i. Motor vehicle parts, or other similar machine parts, may not be stored in the dwelling.
j. Flammable materials shall not be stored in the dwelling.

2 Food process lab

a. Stove: Must be clean and free of food and grease.
b. Refrigerator: Must be clean, refrigerator and freezer doors must close properly.
c. The freezer shall have no more than one inch of ice/frost build-up.
d. Cabinets: Must be clean and neat. Cabinet surfaces and countertops must be free of grease and spilled food. Cabinets must not be overloaded. Storage under the sink must be limited to only those items (lightweight) which will permit easy access for purposes of repairs or inspections. Heavy pots and pans shall not be stored under the sink.
e. Exhaust Fan/Vent: Must be free of grease and dust.
f. Sink: Must be clean, free of grease and garbage, dirty dishes must be washed and put away in a timely manner.
g. Food Storage Areas: Must be neat and clean without spilled food.
h. Trash/Garbage: Must be stored in a covered container until removed to the disposal area

3 Bathroom

a. Toilet and Tank: Must be clean and odor free.
b. Tub and Shower: Must be clean and free of excessive mildew and mold. Where applicable, shower curtains must be in place and of adequate length.
c. Bathroom Sink: Must be clean.
d. Exhaust Fans: Must be free of excessive dust.

4 Storage Areas

a. Closets must be neat and clean
b. No flammable materials or newspapers are to be stored in the dwelling.
c. Other storage areas must be clean, neat, and free of hazards.

8.1.12 Outside the Dwelling

The following standards apply to family, elderly, and scattered site property. Further, the standards apply even if the Tenant shares the area with other Tenants.

- Yards: Must be free of debris, trash, and abandoned cars.
- Exterior Walls: Must be free of graffiti.
- Porches (front and rear): Must be clean and free of hazards. Any items stored on the porch shall not impede access to e the dwelling.
- Steps (front and rear): Must be clean and free of hazards.
- Sidewalks: Must be clean and free of hazards
- Storm Doors: Must be clean
- Parking Lot: Must be free of abandoned cars. There must be no car repairs done in the parking lot.
- Hallways: Must be clean, uncluttered, and free of hazards.
- Stairwells: Must be clean, uncluttered, and free of hazards.
- Laundry Areas: Must be clean and neat. The Tenant owned dryers must be properly vented.
- Utility Room: Must be free of debris, motor vehicle parts, and flammable

- No motorized vehicles are to be driven or stored on lawns or grounds except in driveways and parking lots. Dirt bikes, snowmobiles, and boats are prohibited.

8.2 Cleaning and sanitation procedure work area

The correct order of events for cleaning/sanitizing of working area is as follows:

- Rinse
- Clean
- Rinse
- Sanitize

Cleaning

Cleaning is the complete removal of food soil using appropriate detergent chemicals under recommended conditions. It is important that personnel involved have a working understanding of the nature of the different types of food soil and the chemistry of its removal.

Sanitization

Sanitization is the process of reducing the number of microorganisms to a level that has been officially approved as safe. It is important to differentiate and define certain terminology:

Self-Check # 8	Written Test

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

1. Write cleaning and sanitation procedure in a work area (6pts)

Note: Satisfactory rating – 6 points Unsatisfactory - below 6 points

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

Information Sheet 9- Maintaining workplace records

9.1 Introduction

Among the specific expectations and work habits that must be followed and practiced in the work place, the following are very important : -

- Positive attitude,
- Traits of honesty and dependability,
- Work with others,
- Time management,
- Safety on the job,
- Good communication skills,
- Appropriate use of computers and internet,
- Appropriate behavior,
- Health

9.2 Types of records

- **Paper-based records**

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

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

- **Electronic records**

  Examples of electronic records include:

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

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

- **Recording activities**

  In oil seed and pulse processing there are many activities to be recorded:

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

Self-Check # 9	Written Test

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

1 Mention the types of recording and give examples? (5 points)

2 Write recording activities? (5 points)

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

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

OperationSheet-1: Steps/procedures for shortening making/manufacturing

Sequence for Shortening Making/manufacturing

1. Wear personal protective equipment's
2. Held the shortening base in liquid state in the heated and agitated tank (MT)
3. Maintain the temperature of the melted shortening base at 15–20°F (8.3–11.1°C) above its complete melt point.
4. Pump the melted product (shortening or margarine) through one (or two or more) scrape-wall coolers
5. Chill down the product rapidly to a very low temperature, using brine ammonia or a Freon chilling system.
6. Control temperature of the product at the exit of cooler within ±2°F or 1°C.
7. Rotate the shafts scrape-wall coolers that have fixed blades along the horizontal axis of the shaft chiller to facilitate the formation of nuclei.
8. Rotate the shaft approximately at 300 – 330 rpm.
    - The speed varies with the type of product, as well as the diameter of the freezer unit.
9. Apply back pressure of 300–350 psi (21.9 –25.5 kg/cm2) at the outlet of cooler.
    - This pressure can vary with the type of product being made.
10. Inject atomized nitrogen into the oil as it enters cooler when aerated and a white-looking product is desired.
11. Run the shaft typically at 600–700 rpm.
    - Shaft speed can vary with the size of the cooler and the type of product being made.
12. There is a rise in the product temperature, indicating crystallization of the fat (shorten)
13. Pack the product
14. Apply 5S
15. Record process and maintenance activities

Operation Sheet 2: Steps/procedures for Pourable Liquid shortening making/manufacturing

Sequence for Pourable Liquid shortening Making/manufacturing

1 Transfer the blend of the solid and the liquid fractions from the mix tank to the feed tank.
2 The mix temperature must be sufficiently high to melt the hard stock and produce a high-temperature differential (DT) between the oil and the refrigerant temperature to produce small crystals.
3 De-aerate the mix under vacuum in the de-aerator vessel, before the oil mix enters cooler.
4 Form the nuclei in cooler then enter crystallizer to produce crystals.
5 During start-up, the product leaving the cristalizer is recycled back to are melt tank where the product is heated to at least 10°F (5°C) above the complete melt point of the mix.
6 Set the residence time in the melt tank at least 45 min.
7 Return the mix into the mix tank for recycling.
8 Divert the product into second deaerator under vacuum to remove any air or nitrogen entrapped in the product; once the process conditions reach the steady state.
9 Pass the product through a jacketed tempering tank, which is maintained at 90°F (32.2°C).
10 Set the residence time in the tempering tank to 45–60 min (can be up to 90 min) to ensure complete transformation of all crystals to the beta form.
11 Cool the product to 70°F (21.1°C) in a cooler using cold water.
12 Store the product in a jacketed storage tank with a slow agitator to keep the product in motion without breaking the crystals.
13 Check the product for fluidity before it is either loaded into trucks or sent to packaging.
14 Pack the product
15 Apply 5S and conduct or report maintenance

LAP TEST	Practical Demonstration

Name…… ID …….. Date……

Time started: _____ Time finished: _____

I- 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.

Task- 1: Operate or conduct shortening making/manufacturing

Task- 2: Operate or conduct Pourable Liquid shortening making/manufacturing

LG #55	LO#3 - Shut down the shortening vegetable ghee 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 requirements

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

- Identify appropriate shutdown procedure
- Shut down the process
- Identify and reporting maintenance requirements

Learning Instructions:

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

Information Sheet 1- Identifying appropriate shutting down procedure

1.1 Identifying appropriate 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.

Step 1: 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, Mixers and blenders, Motors, Piping, Pumps, and Valves.

Step 2: 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.

Step 3: 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.

Step 4: 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.

Step 5: 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.

Step 6: 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

Step 7: 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. Housekeeping staff accidentally hits a piece of equipment. A wrench left on an asset may have fallen.

1.3 Advantage of appropriate shut down procedure

- Reduced unplanned downtime
- Reduced overtime and
- Reater operational efficiencies

Self-Check -1	Written Test

Name… ..... ID…..... Date…….....

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

Test –I. Short answer questions

1. Write the seven steps/procedures for a successful shutdown (10 points)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10

You can ask you teacher for the copy of the correct

Information Sheet 2- Shutting down the process

1.1 Shutting down process

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

1.2 Shut down the process includes

Shutdown procedure may include but not limited to:

May include but not limited to:

- cleaning
- in some cases cleaning may be carried out by a dedicated cleaning crew

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

- First switch off power of mixer
- Un-plug power socket
- Clean external parts of mixer
- Clean internal parts like, agitators
- If maintenance are needed, list out damaged parts in maintenance check list and report to maintenance operators or supervisors.

1.3 Uses of Shutdown Processes

- Safely shut down of the equipment.
- To locate emergency stop functions on the equipment.

Self-Check # 2	Written Test

Name… ..... ID…..... Date…….....

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

Test –I. Short answer questions

1. Define shutdown process mean (4 points)
2. Shut down the process includes (6points)

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

You can ask you teacher for the copy of the correct

Information Sheet 3 - Identifying and reporting maintenance requirements

3.1 Definition of maintenance

Maintenance requirements are the processes of maintaining work area to meet housekeeping standards and Respond to and/or report equipment failure within level of responsibility. 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.

3.2 Identifying and reporting maintenance requirements

To minimize the hazards that might be happen during equipment operation, you have to check that the equipments are 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. Maintenance requirement requires that all sorting and grinding, extracting, refining and desolventizing equipment be maintained in an efficient state, in efficient order and in good repair. Where any machinery has a maintenance log, the log is kept up to date; and that maintenance operations on work equipment can be carried out safely.

3.3 Maintenance activities

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

maintenance (e.g. connection-disconnection of hoses, greasing, lubrication and lubricant systems, adjusting sealing glands, cleaning and changing filters, 'nipping up' flanges) General cleaning Removal and replacement (e.g. gland packing, changing blades or cutters, replacing gaskets, replacing /maintaining seals, changing filter elements, servicing strainers).

3.4 Uses of Maintenance Requirement

Are used to maintain typical equipment faults and related causes, including signs and symptoms of faulty equipment and early warning signs of potential problems

3.5 Routine maintenance checklist

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

Table 1. Routine maintenance checklist

Date	Tool	Maintenance check points	Signature	Maintenance required	Signature
14-10 /2020	mixer	agitator	Mr. A	Agitator	
		Shaft	Mr. A	Shaft	Mr. B
		Screw	Mr. A	None	

Maintenance performed were reported using a checklist below.

Table 2. Maintenance report checklist

Maintenance Performed	Date	Signature
The dies was replaced	16-10/2020	Mr. C
The shaft was replaced		

Self-Check # 3	Written Test

Name…… ID…… Date……..…

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

Test - Short Answer Questions

1. Define maintenance requirement (3points)
2. Describe uses of maintenance requirement (3pts)

Operation Sheet - 1: Procedures of Shutting down the process

Sequence for procedures of shutting down the process

1. Wear personal protective equipment's
2. First switch off power
3. Un-plug power socket
4. Clean working area
5. Maintain if needed, list out damaged parts in maintenance check list and report to maintenance operators or supervisors.
6. Record all activities

LAP TEST # 1	Practical Demonstration

Name……. ID …….. Date……

Time started: _____ Time finished: _____

I- Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1 hour. The project is expected from each student to do it.

Task- 1: Conduct shutdown process

Reference

1. T. J. Weiss, Food Oils and Their Uses, AVI Publishing Co., Westport, Connecticut, 1983,p. 129.
2. (Kamal–Eldin et al., 1994; Shyu and Hwang, 2002)
3. DPPH antioxidant assay revisited. Om P. Sharma and Tej K. Bhat, Food
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