Firuit and Vegetable Processing
Level-II
Based on June 2021, Version -3 Occupational Standard (OS)



Module Title: - Operating Homogenizing Equipment

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Introduction to the Module

This module covers the knowledge, skills and attitude required to set up, operates, adjust and shut down homogenizing equipment. Further, it covers preparing the homogenizing process for operation, operating and monitoring the homogenizing process, and shutting down homogenizing equipment.

LG #28	LO #1- Prepare homogenizing process for operation

Instruction sheet

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

- Confirming available materials
- Identifying and confirming cleaning and maintenance requirements and status
- Fitting and adjusting operating machine components
- Entering processing/operating parameters
- Checking and adjusting 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:

- Confirming available materials, identifying and confirming cleaning and maintenance requirements,
- Fit and adjust operating machine components
- Checking and adjusting equipment performance

Learning Instructions:

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

   Do the “LAP test”

Information Sheet -1

1.1. Confirming available materials

1.1.1. Introduction

Homogenization is the process of emulsifying two immiscible liquids (i.e. liquids that are not soluble in one another) or uniformly dispersing solid particles throughout a liquid. The process of homogenization was invented and patented by Auguste Gaulin in 1899 when he described a process for homogenizing milk. Gaulin's machine, a three-piston thruster outfitted with tiny filtration tubes, was shown at the World Fair in Paris in 1900. Since then, his name has become synonymous with homogenization. The benefits include:

- ✓ Improved product stability,
- ✓ Uniformity,
- ✓ Consistency,
- ✓ Viscosity,
- ✓ Shelf life,
- ✓ Improved flavor and
- ✓ Color.

It has become a standard industrial process in food and beverage, chemical, pharmaceutical and personal care industries. The stability of an emulsion is determined by several factors including the choice of emulsifier, the phase-volume ratio, the method of manufacturing the emulsion and the temperature in both processing and storage. A significant improvement in the emulsion can usually be seen by adding the water phase at a slower rate. Most emulsions are sensitive to the temperature of the system.

Generally, homogenization is the process of reducing the particle size of fluid products such as milk, fruit juice, vegetable puree beverage and sauces, under conditions of pressure, sheer, turbulence, acceleration and impact, to improve the viscosity, color, cloudiness, particle size and stability of suspended solids.

1.1.1. Homogenizer and types

Homogenizers are used to produce more consistent emulsions in a high efficiency process. A wide variety of homogenizers has been developed to run at different pressures and capacities depending on the product mixture. In addition to product improvements, today's homogenizers also feature reduced noise and vibration and reduced maintenance.

- The fruit and vegetable homogenizer typically includes:
  - ✓ Supply pump
  - ✓ Homogenizer block
  - ✓ Homogenizing valve
  - ✓ Pressure gauge
  - ✓ Back-pressure valve
  - ✓ Pressure relief valve
  - ✓ Pressure
  - ✓ Micro-gap
  - ✓ Centrifugal and ultrasonic homogenizers
  - ✓ Related equipment may include, but not limited to:
  - ✓ A deaeration unit

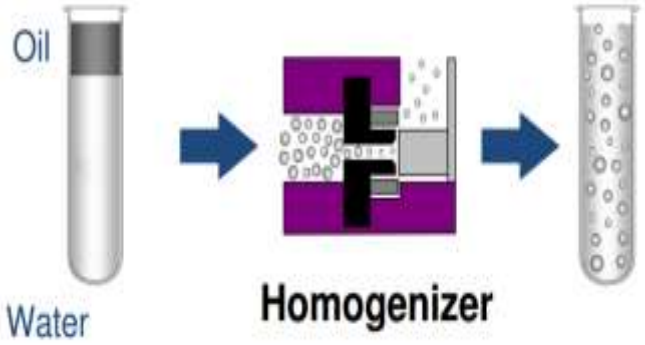


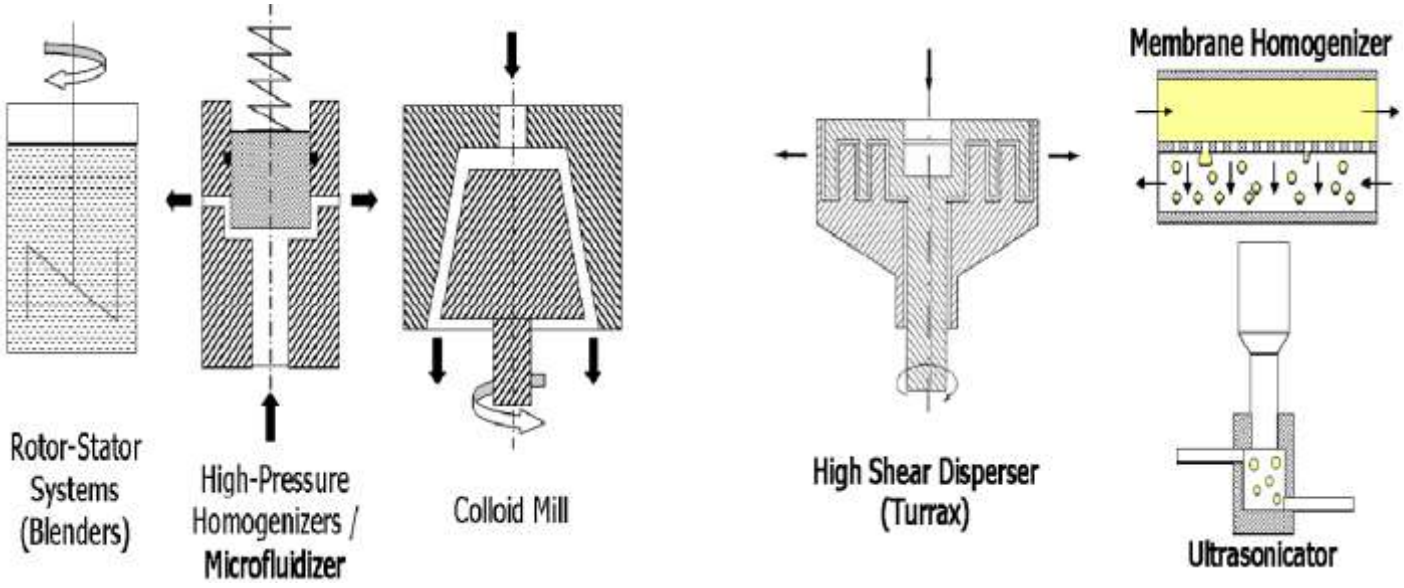
Figure: 1.1 homogenization process

Homogenizers may be equipped with a single valve assembly (single-stage) or two valves connected in a series (two-stage). For most products, a single-stage valve is sufficient. A two-stage assembly, where ~10% of the total pressure is applied to the second stage, controls backpressure and minimizes clumping. This improves the droplet size reduction and narrows the particle size distribution. Generally, two-stage homogenization is used for products with a high fat content or products where high homogenization efficiency is required.

- Common types of homogenizer:-
  - ✓ High Speed Blender
  - ✓ High Pressure Homogenizers
  - ✓ Colloid Mill

- ✓ High Shear Dispersers
- ✓ Ultrasonic Disruptor
- ✓ Membrane Homogenizers

Figure: 1.2.Types of homogenizer



- During homogenization confirm the availability of the following services:-
  - ✓ **Power**: The power source for a homogenizer can be electricity, and it is used to drive the motor that powers the homogenization process.
  - ✓ **Steam**: Steam might be used for sterilizing the equipment or for heating during the homogenization process. This can help maintain sanitary conditions and ensure the quality of the final product.
  - ✓ **Water**: Water is used in a homogenizer for cooling the equipment and regulating temperatures during the homogenization process. It may also be used for cleaning and maintaining hygiene.
  - ✓ **Vacuum**: n a homogenizer, a vacuum might be employed to remove air from the product or to degas the liquid before or during processing. This helps prevent oxidation and enhances the quality and shelf life of the homogenized product.
  - ✓ **Compressed and instrumentation air**: Compressed air in a homogenizer can be used for various purposes, such as actuating valves and controlling pneumatic components. Instrumentation air, being clean and dry, is often used in sensitive instruments and control systems to prevent contamination.

1.2. Identifying and confirming cleaning and maintenance requirements

Cleaning of fruit and vegetable homogenization equipment is a critical aspect of maintaining product quality, ensuring food safety, and prolonging the life of the machinery. Proper cleaning procedures help prevent cross-contamination, eliminate residues, and meet hygiene standards. Maintenance recommendations are based on industry standards and experience in Reclamation facilities. However, equipment and situations vary greatly, and sound engineering and management judgment must be exercised when applying these recommendations. Other sources of information must be consulted (e.g., manufacturer=s recommendations, unusual operating conditions, personal experience with the equipment, etc.) in conjunction with these maintenance recommendations.

Maintenance activities fall into three general categories:-

A) Routine maintenance

Activities that are conducted while equipment and systems are in service. These activities are predictable and can be scheduled and budgeted. Generally, these are the activities scheduled on a time-based or meter-based schedule derived from preventive or predictive maintenance strategies. Some examples are visual inspections, cleaning, functional tests and measurement of operating quantities, lubrication, oil tests and governor maintenance.

B) Maintenance testing

Activities that involve using test equipment to assess condition in an offline state. These activities are predictable and can be scheduled and budgeted. They may be scheduled on a time or meter basis but may be planned to coincide with scheduled equipment outages. Since these activities are predictable, some offices consider them “routine maintenance” or “preventive maintenance.” Some examples are governor alignments and balanced and unbalanced gate testing.

C) Diagnostic testing

Activities that involve using test equipment to assess the condition of equipment after unusual events, such as equipment failure/ repair/replacement or when equipment deterioration is suspected. These activities are not predictable and cannot be scheduled because they are required after a forced outage. Each office must budget for these events. Some examples are governor troubleshooting, unit balancing, and vibration testing.

1.3. Fitting and adjusting operating machine components

To understand how the homogenizer works and what it does, it is first necessary to trace the path of the liquid mixture through the homogenizing valve. The unhomogenized product enters the valve seat from the pump cylinder at a relatively low velocity but at a high pressure. For example, the velocity may be about 10 to 20 feet per second (3.05 to 6.10 m per second). The pressure for this example will be at 3000 psi (207 bar). This pressure is generated by the positive-displacement pump and by the restriction to flow caused by the valve being forced against the seat by an actuating force. The positive-displacement pump provides a relatively constant rate of flow and, therefore, will generate the required pressures as the flow area between the valve and seat is increased or decreased.

The term water supply pump refers to all centrifugal pumps, which transport drinking, or service water either directly to a supply network or through long-distance pipes to a supply area. The valve technology is one of the most critical components of the homogenizer. Poppet valves are typically used for low-viscosity, moderately abrasive products such as ice cream, dairy, vegetable oils or silicone emulsions.

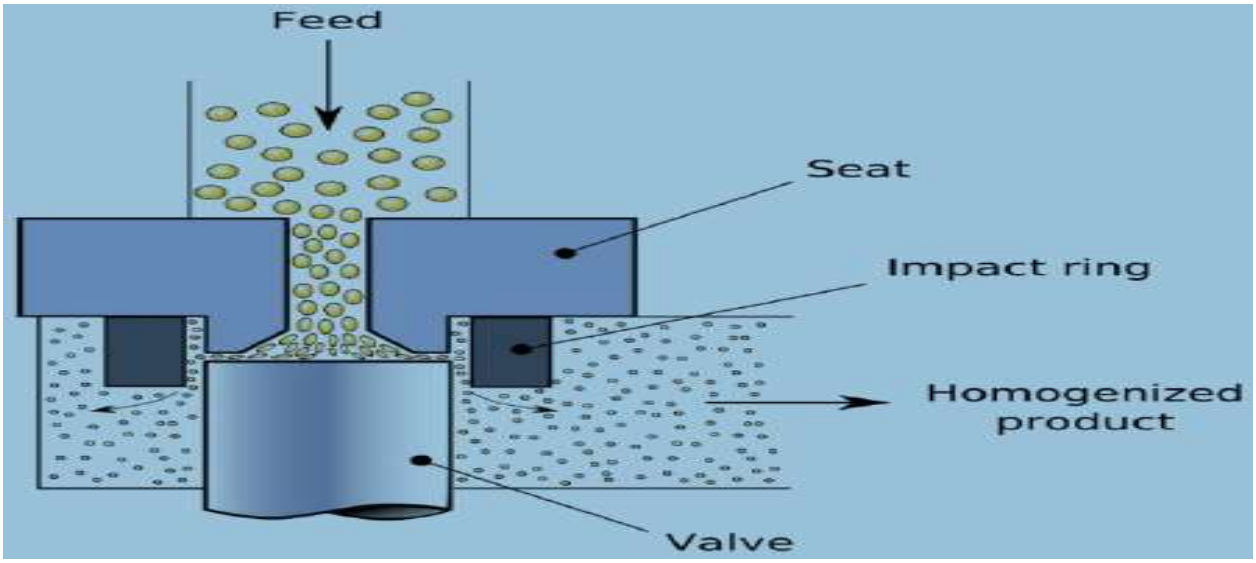


Figure: 1.3. Homogenization

Homogenizers may be equipped with a single valve assembly (single-stage) or two valves connected in a series (two-stage). For most products, a single-stage valve is sufficient. A two-stage assembly, where ~10% of the total pressure is applied to the 2nd stage, controls backpressure and minimizes clumping. This improves the droplet size reduction and narrows the

particle size distribution. Generally, two-stage homogenization is used for products with a high fat content or products where high homogenization efficiency is required.

1.4. Entering /operating processing parameters

A homogenizer is a piece of laboratory or industrial equipment used for the homogenization of various types of material, such as tissue, plant, food, soil, fruit, vegetable and many others. Many different models have been developed using various physical technologies for disruption. Two-stage homogenization is used primarily to reach optimal homogenization results and to break up fat clusters in products with a high fat content. The formation and break-up of clusters in the second stage is illustrated.

- Homogenization process:-
  - ✓ The non-homogenized product enters the valve seat at high pressure and low velocity.
  - ✓ As the product enters the close (and adjustable) clearance between the valve and the seat, there is a rapid increase in velocity and decrease in pressure.
  - ✓ The intense energy release causes turbulence and localized pressure differences, which tear apart the particles.
  - ✓ The homogenized product impinges on the impact ring and exits at a pressure sufficient for movement to the next step.
- Homogenization process parameters
  - ✓ Energy density - minimum droplet size achievable
  - ✓ Energy efficiency - heat losses - manufacturing costs
  - ✓ Volume Flow Rates - throughput - production time
  - ✓ Product rheology - limitations - materials that can be homogenized.

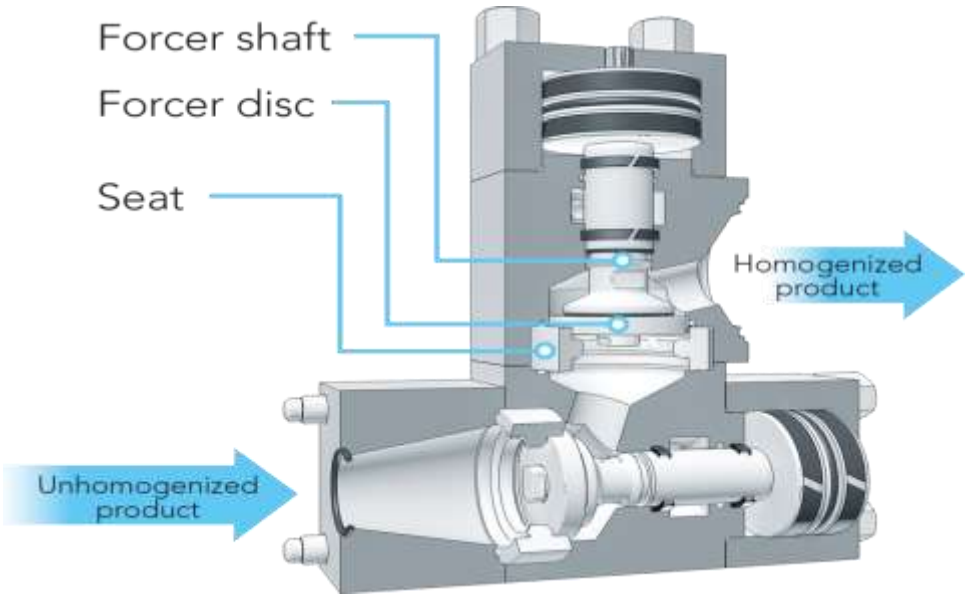


Figure: 1.4. Operation of homogenizer

1.5. Checking and adjusting equipment performance

The valve technology is one of the most critical components of the homogenizer. Poppet valves are typically used for low-viscosity, moderately abrasive products such as ice cream, dairy, vegetable oils or silicone emulsions. Ball valves are used for high-viscosity, abrasive products such as peanut butter, evaporated milk or wax emulsion. High-pressure homogenization (HPH) is a non-thermal, non-conventional, emerging technology for continuous processing of liquid materials. It has been studied as an alternative process for food preservation as well as for improving the physical properties of fruit and vegetable products. HPH can physically change particles, cells and molecules, leading to microbial and enzyme inactivation and positive modification of structure and properties.

- **Efficiency of Homogenization**
  - ✓ Degree of homogenization

The degree of homogenization is defined as the ratio of the volume of fat with fat globules diameter of < 0.7 µ to the total fat content of milk or cream. The value of 0.7 µ was because fat globules with smaller diameter do not form clumps because they break up again due to Brownian movements.

- ✓ Farrall index

It is a widely accepted microscopic method for determining the homogenization efficiency. This index may be defined as the number of fat globules having < 2 µ in diameter. The efficiency of homogenization is apparently based on the number of fat globules larger than 2 µ (if any), as measured under specified conditions.

1.6. Carrying out pre-start checks.

Homogenizer is equipment that assists in the process of homogenizing. The main job of a homogenizer is to form a uniform structure of all solid materials present in the heavy fuel oil. A homogenizer also breaks down large water particles into small homogenous structure, resulting in an emulsion consisting of water molecules spread evenly throughout the whole liquid.

- Before starting the homogenizer, the following points should be checked:-
  - ✓ Water is turned on to lubricate and cool the pistons.
  - ✓ Pressure controls are checked to see that they are in idling position.
  - ✓ Check availability of the product to the machine
  - ✓ Check during starting of the machine whether the oil pressure records > 1 kg/cm2; otherwise the starter will trip.



Figure: 1.5 Pre-start check of homogenizer equipment

Self-check -1	Written test

Name: _____ID: _____ Date: _____

Directions: Answer all the questions listed below.

Test I. For the following questions say true if the statement correct and say false if it is incorrect.

1) The valve technology is one of the most critical components of the homogenizer.
2) Homogenizers may be equipped with a single valve assembly (single-stage) or two valves connected in a series (two-stage).

Test II. Give short answer for the following question

1) What is homogenization?
2) List the common types of homogenizer?
3) List the common types of homogenizer equipment?
4) List three common types of maintaining
5) List homogenization parameters

Operation Sheet-1

1.1. Techniques/Procedures/Methods of carrying out pre-start checks of homogenizer

A. Tools and equipment

I. PPE
II. Cleaning cloths and rags
III. Pressure Gauges
IV. Vibration meter or analyzer
V. Checklists

B. Procedures/Steps/Techniques

- Wear PPE.
- Inspect Overall Condition
  - ✓ Leaks, Safety Guards, Lubrication, Electrical Components, Mechanical Components, Pressure Systems.
- Verify cleaning.
- Check calibration.
- Verify product compatibility.
- Record documentation.

LAP Test -1	Performance Test

Name_____ID_____date_____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2 hour. The project is expected from each student to do it.

Task-1 Perform the pre-start checks of homogenizer

LG #29	LO #2- Operate and monitor the homogenizing process

Instruction sheet

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

- Starting and operating process
- Monitoring equipment identification
- Identifying equipment operation variation and reporting maintenance requirement
- Monitoring process to confirm specifications
- Identifying and reporting out-of-specification product/process
- Maintaining work area
- Conducting work
- 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:

- Start and operate process and monitoring equipment
- Identify equipment operation variation and report maintenance requirement
- Monitor process to confirm specifications and reporting out-of-specification product/process
- Conduct and maintain work area and workplace records

Learning Instructions:

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

Do the “LAP test”

Information Sheet -2

2.1. Starting and operating process

The word “homogenization” is referred to as the ability to produce a homogeneous size distribution of particles suspended in a liquid, by forcing the liquid under the effect of pressure through a specially designed homogenization valve.

- The high-pressure treatments used in food industry include:-
  - ✓ Hydrodynamic treatment (High Pressure Homogenization (HPH)),
  - ✓ Hydrostatic treatments (High Pressure Processing (HPP)).

Both of them can be applied to achieve the same goal but the principle action, the pressure level, the process conditions (temperature, residence time, inlet and outlet temperature, geometry) and the structural characteristics of food matrix determine the effect of each one. HPH applies pressures from 3 to 500 MPa in continuous to fluid products, while HHP is applied in batch systems to both solid and liquid products already packaged, using a pressure between 150 and 900 MPa.

- Processing fruits and vegetables is intended to do two things:-
  - ✓ To preserve them by slowing down the natural processes of decay caused by microorganisms, enzymes in the food, or other factors such as heat, moisture and sunlight.
  - ✓ To change them into different foods, which are attractive and in demand by consumers.

Like chefs and caterers, processors should use their skills to develop attractive recipes and make products that consumers want to eat. By doing this successfully, they can increase sales and earn an income. Diversity is to be expected when homogenization procedures are used. This results from differences in foods, analytical methods, available equipment, etc. Therefore, a great deal of analyst discretion is necessary. Below are comments and examples of procedures that have been useful at FDA.



1) Hydraulic air tank
2) Engine
3) Pressure setting system
4) On/Off button
5) Output system
6) Piston
7) Homogenization stages
8) Inlet tank
9) Outlet hose

Figure: 2.1.Operating computerized Homogenizer. The actual homogenization pressures for both stages and the velocity are displayed on the screen (5).

- **Starting of homogenizer machine:-**
  - ✓ The motor is started.
  - ✓ The homogenizer is run on water for about 5 min., then it is stopped and the water drained off by slackening the inlet union, which is tightened subsequently.
  - ✓ The machine is checked for any leaks.
  - ✓ As soon as the machine starts pumping at full capacity, the pressure-adjusting handle of the second stage valve is adjusted to the desired pressure, followed by adjusting the first stage pressure. This can be observed in the single pressure gauge provided.

- ✓ The product discharge from the machine is diverted back till the desired homogenizing pressure is obtained.
- ✓ When normal operation is attained, the bypass valve is turned to direct the product flow into the processing system.



Figure: 2. 2. High speed fruit and vegetable homogenizer

2.1. Monitoring equipment identification

- **Requirement of monitoring equipment**

Monitoring is the systematic process of collecting, analyzing and using information to track a programmer's progress toward reaching its objectives and to guide management decisions during homogenization. An essential part of any environmental monitoring or measurement project is

the equipment used. Some equipment, like meters and field kits, are intended for spot sampling. Others, like sondes, data loggers and data buoys, are designed for long term monitoring applications.

Monitoring device - display produced by a device that takes signals and displays them on a television screen or a computer monitor. Monitor, Computer, computing device, computing machine, data processor, electronic computer, information processing system machine for performing calculations automatically. Generally, monitoring and evaluation are ways of systematically measuring and assessing programme activities and results. Their purpose is to check on the progress of implementation and outputs systematically. They help to determine when a programme is going to plan and when changes may be needed.

- **Applications for equipment performance monitoring:-**

Machines and Systems for which Performance monitoring surveys may be required on a routine basis include the following items:

- ✓ Pumps – due to impeller wear, seal ring wear (re-cycling) or blockage.
- ✓ Fan Systems – due to filter blockage, blade fouling or re-cycling.
- ✓ Boilers – due to loss of thermal efficiency for many different reasons.
- ✓ Heat Exchangers – due to fouling or blockage.
- ✓ Steam Turbines – due to blade fouling and numerous other reasons.
- ✓ Air Compressors – due to wear, filter blockage, valve leakage (reciprocating), etc.
- ✓ Diesel or Gas Engines – due to loss of compression (rings or valve leakage) etc.
- ✓ Electrostatic or bag dust filters – due to fouling, shorting or leakage

2.3. Identifying variation in equipment operation and reporting maintenance requirement

2.3.1. Identify equipment operation variation

Homogenizer is equipment that assists in the process of homogenizing. The main job of a homogenizer is to form a uniform structure of all solid materials present in the heavy fuel oil. A homogenizer also breaks down large water particles into small homogenous structure, resulting in an emulsion consisting of water molecules spread evenly throughout the whole liquid.

The importance of an effective maintenance program cannot be overlooked because it plays such an important role in the effectiveness of Lean manufacturing. As in personal health care insurance, maintenance may be considered the heath care of our manufacturing machines and

equipment. It is required to effectively reduce waste and run an efficient, continuous manufacturing operation, business, or service operation. The cost of regular maintenance is very small when it is compared to the cost of a major breakdown at which time there is no production.

- In order to verify that equipment is working according to the manufacturer's specifications:-

✓ It is necessary to monitor instrument parameters by performing periodic function checks, which should be done before using the instrument initially, then with the frequency recommended by the manufacturer.

✓ These function checks should also be done following any instrument repairs.

✓ Some examples of function checks are daily monitoring of temperatures and checking the accuracy of wavelength calibration.

2.3.2. Report maintenance requirement

The maintenance of a homogenizer should be carried out on a regular basis. A daily inspection should be made of the oil level visible through the sightglass at the rear of the machine. After draining off any condensate from the oil sump through the pet cock, oil should be added if required, before starting up the homogenizer. The oil pressure should be checked to ensure it is above the recommended minimum when the machine is running. Finally, the water lubrication to the pistons and through the oil cooler should be checked to ensure that it is sufficient.

- The main purpose of regular maintenance is:-

✓ To ensure that all equipment required for production is operating at 100% efficiency at all times.

✓ Through short daily inspections, cleaning, lubricating, and making minor adjustments, minor problems can be detected and corrected before they become a major problem that can shut down a production line.

A good maintenance program requires company-wide participation and support by everyone ranging from the top executive to the shop floor personnel.

- Steps to create a maintenance report in MS word:-

1. Create the Cover Page. Open a new document in MS Word and write the title.
2. Cover Letter. On the next page, include the cover letter.
3. Device Information.
4. New Parts Cost Details.

5. Suggestions and Signature.

Table 2.1.Maintainance reporting format

[*Industry name*]						
Equipment Maintenance Log sheet						
Name of the piece of equipment:						
Label:						
Serial number:						
Manufacturer:						
Manufacturer's contact person + contact details:						
Date of purchase:						
Date put into service:						
Person responsible for equipment:						
Initials of person authorized to use equipment:						
Location of equipment:						
Physical condition:						
Service provider (for maintenance and calibration):						
Service provider contact person + contact details:						
Frequency of maintenance:						
Date:	Description of maintenance:	Maintenance performed by:	Date of validation before put into service:	Validation performed by:	Next maintenance planned on (date):	Remarks:
1						
2						
3						
4						

2.4. Monitoring process to confirm specification

Monitoring is the systematic and continuous collection and analysis of information about the progress of a development intervention. Monitoring is done to ensure that all the people who need to know about an intervention are properly informed, and so that decisions can be taken in a timely manner. There are many different types of monitoring, including financial monitoring, process monitoring and impact monitoring.

- **Monitoring** can also serve several other purposes. Some of the more common are:

✓ Providing managers, staff and other stakeholders with information on the progress being made towards stated goals and objectives in order to demonstrate accountability to different stakeholders;

- ✓ Providing information that enables approaches and strategies to be changed in response to evolving situations;
- ✓ Identifying whether there is a need to change goals, objectives, plans or budgets over time;
- ✓ Testing project or programme assumptions on a regular basis;
- ✓ Identifying the need for further information or research;
- ✓ Providing information that enhances ongoing learning, both within and outside a project or programme; and
- ✓ Demonstrating or communicating activities and changes to other audiences for marketing or fundraising purposes.

2.5. Identifying and reporting out-of-specification product/process

Specification can be defined as a 'statement of needs'. It describes what the customer wants to buy and consequently, what the successful supplier is required to supply. Specifications can be simple or complex depending on the need. The success of the procurement outcome often relies on the Specification being a true and accurate statement of the buyer's requirements. Apart from being a means of identifying the goods / services required, a Specification will form part of any future contract that might result from offers received.

- Ways of writing specification

The process of Specification writing, conducted in parallel with planning, design and drawing work, helps create the proper balance between client, statutory, technical and aesthetic requirements. Options in larger organizations like UQ include:

- ✓ Specialist specification writers,
- ✓ project managers or members of the project design group and
- ✓ Generally not the assigned procurement officer.

- The principal qualifications needed are:-

- ✓ Familiarity with the project, including the design philosophy.
- ✓ Expertise in technical and scientific matters.
- ✓ Willingness and availability.

- Out of specification (OOS) is defined as those results of in process or finished product testing, which falling out of specified limits, that are mentioned in standards of fruit and vegetable processing industries. The frequent occurrence of OOS results indicates that the manufacturing and analytical procedures not in control. The consequences of OOS

may result in market complaints, and rejection of commercial batches, which is an inventory loss for any pharmaceutical industry. Therefore, the OOS result occurrences have to be investigated and addressed. This module describes a typical procedure that can be adopted to handle OOS results.

- Cause of out specification:-
    - ✓ Deviations in product manufacturing process and
    - ✓ Errors in testing procedure, or due to malfunctioning of analytical equipment.

When an OOS has arrived, a root cause analysis has to be performed to investigate the cause for OOS.

The reasons for OOS can be classified as:

- Assignable and
- Non-assignable.

When the limits are not in specified limits, called out of specifications. When OOS has occurred

- The analyst should inform to QC manager.
- Then the senior manager will ask QA for issuing OOS form to analyst.

The designated personnel will classify the OOS as either assignable cause or non-assignable cause. Each out of specification will be identified with a unique identification number.



Figure: 2.3. Identifying and reporting out-of-specification product/process during homogenizing

2.6. Maintaining work area

- Important factors in the work environment that should be considered include:
    - ✓ Building design and age,
    - ✓ Workplace layout,
    - ✓ Workstation set-up,
    - ✓ Furniture and equipment design and quality,
    - ✓ Space,
    - ✓ Temperature,
    - ✓ Ventilation,
    - ✓ Lighting,
    - ✓ Noise,
    - ✓ Vibration,
    - ✓ Radiation,
    - ✓ Air quality.

Keeping your workplace clean can therefore reduce sickness and therefore reduce lost workdays. Practice good housekeeping in the workplace include: Ensure all spills are immediately cleaned up, maintain clean light fixtures to improve lighting efficiency, Keep aisles and stairways clear, regularly inspect, clean and repair all tools.

- Eight easy ways to create and maintain a healthy workplace
    - ✓ Strike the right tone with a careful colour palette.
    - ✓ Enable healthy food choices.
    - ✓ Encourage movement.
    - ✓ Invest in supportive furniture.
    - ✓ Decorate with living plants.
    - ✓ Put on some music.
    - ✓ Deploy good lighting.
    - ✓ Offer free fruit

Generally, working environment is a broad term and means all your surroundings when working. Your physical working environment is, for example, your work tools as well as air, noise and light. However, your working environment also includes the psychological aspects of how your work is organized and your wellbeing at work.

2.7.Conducting work

Homogenization is the process of reducing a substance, such as the fat globules in milk, to extremely small particles and distributing it uniformly throughout a fluid, such as milk, fruit and homogenization. The process involves forcing the milk through small openings under high pressure, thus breaking up the fat globules.

A homogenizer is a piece of laboratory or industrial equipment used for the homogenization of various types of material, such as tissue, plant, food, soil, and many others. Many different models have been developed using various physical technologies for disruption.

The maintenance of cleanliness in a working area requires frequent or continuous cleaning as well as a clean-up at the end of each day. The purpose of this is to keep waste from accumulating during the operating day. It involves:

- ✓ Careful organization
- ✓ Training work scheduling and
- ✓ The best available equipment
- ✓ Method and materials

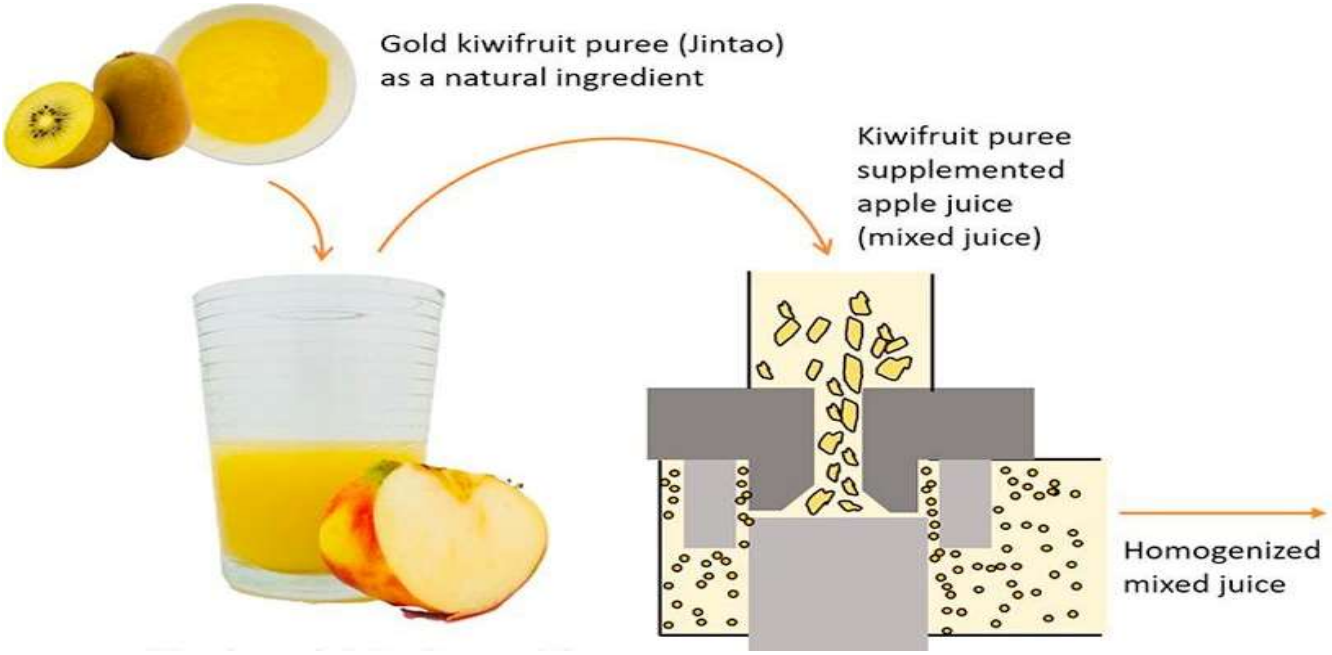


Figure: 2.3. Homogenizing kiwifruit puree and apple juice

2.8. Maintaining workplace records

Maintenance is work that is carried out to preserve an asset (such as a roof or a heating boiler), in order to enable its continued use and function, above a minimum acceptable level of performance, over its design service life, without unforeseen renewal or major repair activities. The maintenance concept is a brief description of the maintenance considerations, constraints and plans for operational support of the system/equipment under development.

- Information is recorded in a manner that represents an accurate history of the product or process.

- ✓ The records are legible, permanent and accurately reflect the actual events, conditions or activities.
- ✓ Errors or changes are identified so that the original record remains clear (e.g., strike out with a single stroke and initial the correction/change).
- ✓ Each entry on a record is made by the person in the position of responsibility at the time that the specific event occurred.
- ✓ The completed records are signed and dated by the person in the position of responsibility.
- ✓ The records are retained for at least one year after the best before date on the label or container.
- ✓ The records are maintained and are available upon request

❖ Watch the homogenization operation equipment by opening the video links below:-
https://video.genyt.net/a9kVrsNX8vM

Self-check -2	Written test

Name: _____ ID: _____ Date: _____

Directions: Answer all the questions listed below.

I: Give short answer for the following questions

1. Write down the major reason of processing fruit and vegetable
2. What is monitoring equipment?
3. List the required items during monitoring machine/systems
4. List the purposes of regular maintenance of equipment (homogenizer)?-
5. List the importance of monitoring processes
6. Define the following terms:

   A. specification

   B. Out of specification

Operation Sheet -2

1.1.Techniques/Procedures/Methods of Operating /homogenizing fruit/vegetable homogenizer equipment

A. Tools and equipment

I. PPE

II. Homogenizer

III. Cleaning cloths and rags

III. Pressure Gauges

IV. Vibration meter or analyzer

V. Checklists

B. Procedures/Steps/Techniques

- Wear PPE
- Collect/receive good quality fruit/vegetable
- Washing/cleaning
- Prepare homogenizing equipment properly
- Mix fruit/vegetable with syrups solution (water, sugar, citric acid) by keeping its rate
- Heat treatment (to dissolve)
- Homogenizing
- Bottling (packing)
- Pastoralizing at 90 ^{o}c for 25 minute
- Cooling/refrigerating
- Clean the used material, store, recycle and dispose according to the work place procedures.

LAP Test -2	Performance Test

Name: _____ID:_____ Date: _____

Time started: _____ Time finished: _____

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

Task-1 Perform homogenizing fruit/vegetable

LG #30	LO #3- Shut down homogenizing equipment

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

Information Sheet -3

3.1. Identifying appropriate shutdown procedure

The planning and scheduling of shutdown work is very similar to other work, with some notable differences. For instance, the level of activity is usually much higher with numerous opportunities for physical interference between jobs. Any maintenance performance problems will also be highlighted, especially if they cause a delay in start-up. In addition, there may be many people around who are not familiar with the site, its people, systems, rules or hazards, as well as conflicting demands for tools, equipment and other resources.

- **Appropriate procedure for a successful homogenizer shutdown:-**
  - ✓ Preparation is essential for accident prevention.
  - ✓ Regular plant inspections and risk assessment.
  - ✓ Keep workers educated about safety.
  - ✓ Disconnect all equipment.
  - ✓ Safely store any hazards.
  - ✓ Test for exposure risk.

3.2 Shutting down process

Major shutdowns in process industries typically happen infrequently (every year or two) and take several days to complete. In general, these shutdowns should have two objectives:

- To repair problems identified during previous major shutdowns and
- To inspect parts of the plant not accessible during operation in order to identify problems that will be repaired during future planned shutdowns.

Of course, problems that must be addressed immediately will be discovered occasionally, but they should be the exception. When these types of issues are found, the inspection process should be updated to avoid similar future surprises.

The key to a successful shutdown is to start the planning process early. Allow plenty of time to plan each job in detail, obtain competitive bids on contract work, manage the process inventory to gain access to tanks and other equipment for inspection, etc. A detailed "shutdown

countdown" process should also be developed, including a list of essential activities, with a deadline for each one.

- 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 process unto itself requiring its:
  - ✓ own set of startup,
  - ✓ operation and
  - ✓ Shutdown procedures.

Either a local or a remote request for shutdown will first reduce the fuel at a predetermined rate until minimum load is reached. The main and field breakers and the fuel valves will be tripped. In an emergency shutdown, the main and field breakers and fuel valves will be tripped immediately without waiting for the load to be reduced to minimum.

3.3. Identifying and reporting maintenance requirements

3.3.1. Requirements of maintenance

- Preventive maintenance is done before a failure occurs and consists of maintenance types like:
  - ✓ Time based maintenance,
  - ✓ Failure finding maintenance,
  - ✓ Risk based maintenance,
  - ✓ Condition based maintenance and
  - ✓ Predictive maintenance.

Major maintenance shutdowns can be stressful for both maintenance and operations personnel, but with careful planning and attention to details, they can also be very rewarding.

- The events relevant to the topic were classified according to the following categories or groups:

• Plant status
• Type of maintenance
• Method for detection of event
• Affected system
• Affected component
• Direct cause

•Root causes • Effect on safety

• Corrective actions

3.3.2. Reporting maintenance requirements

The report shows maintenance details of each event in the time range, including the Setup/Takedown Time, Instructions, Event Time, Facility, Event, ID (Rental, Contract or Event), Service, and Customer.

- Steps Maintenance Report in MS Word
  - ✓ Create the Cover Page. Open a new document in MS Word and write the title
  - ✓ Cover Letter. On the next page, include the cover letter
  - ✓ Device Information.
  - ✓ New Parts Cost Details
  - ✓ Suggestions and Signature.

❖ Watch how starting up and shutting down the homogenizer equipment by opening this video links:- https://video.genyt.net/zCIDyONT6Kc

Self-check -3	Written test

Name: _____ID:_____ Date:_____

Directions: Answer all the questions listed below.

I: give short answer for the following questions

1. List the procedure of homogenizer shut down
2. Write down the two main objectives of shut down
3. List the information should be included in in reporting maintenance requirement

Operation Sheet -3

3.1. Techniques/Procedures/Methods of shutting down homogenizer

A. Tools and equipment

I. PPE
II. Valve Key or Handle
III. Lockout/tag out equipment
IV. Cleaning tools
V. Lubrication tools
VI. Safety gear
VII. Flashlight
VIII. Cleaning agents
IX. Documentation materials
X. Equipment manual

B. Procedures/Steps/Techniques

- Wear PPE
- Reduce pressure
- Empty the product
- Clean the equipment
- Flush the system
- Turn off power
- Secure moving parts
- Perform routine maintenance (if any)
- Document the shutdown
- Secure the area

LAP Test -3	Performance Test

Name:_____ ID:_____ Date:_____

Time started: _____ Time finished: _____

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

Task-1 Perform shutting down homogenizer

Reference materials

Books:

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Schuchmann, H. P., Karbstein, N., Hecht, L. L., Gedrat, M., & Köhler, K. (2012). High-Pressure Homogenization for the Production of Emulsions. Industrial High Pressure Applications: Processes, Equipment and Safety, 97-122.

Web addresses:

https://video.genyt.net/a9kVrsNX8vM: (Accessed date: December, 2023)

https://video.genyt.net/zCIDyONT6Kc: (Accessed date: December, 2023)

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Ministry of Labor and Skills

The experts who developed the learning guide

No	Name	Qualification	Educational Level	Region (College)	Phone number	E-mail
1	Mulugeta Alemu	Horticulture	A	Nefas Silk Polytechnic College , Addis Ababa	09 25322650	mulugetaalex44@gmail.com
2	Gadisa Berhanu	Food Science & Technology	B	Negele Arsi Tvet College ,Oromia	0923450658	gadisabe08gmail.com
3	Kiros Mezgebo	Food Science	A	FTVI	0921310111	kirosmez@gmail.com
4	Habl legese	Food Technology & Process Engineering	B	Nefas silk	0911403703	Habyeleggese88@gmail,com-[
5	Alemayoh Araya	Food science	B	Kolfe Industrial College	0987127971	alemayohmr@gmail.com
6	**Tolina Kebede**	**Food Science & Technology**	**A**	**Oromia**	**0917241112**	**tolinakebede2009@gmail.com**