Basic Agro Food Processing

Level-I

Based on October, 2019, Version 2 Occupational standards

Module Title: - **Preparing basic mixing**

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LG #50	LO #1- Preparing for mixing/blending

Instruction sheet

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

- Confirming and making available materials with production requirements
- Identifying and confirming Cleaning requirement status
- Entering processing/operating for mixing/blending
- Checking and adjusting equipment performance
- Carry out pre-start checks in workplace requirement

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

- Confirm and make available materials with production requirements
- Identify and confirming Cleaning requirement status
- Enter processing/operating for mixing/blending
- Check and adjust equipment performance
- Carry out pre-start checks in workplace requirement

Learning Instructions:

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

Information Sheet-1	Confirming and making available materials with production requirements

1.1 Food ingredients and additives

A food ingredient is any substance that is added to a food to achieve a desired effect. The term “food ingredient” includes food additives, which are substances added to foods for specific technical and/or functional purposes during processing, storage or packaging.

There are two types of food additives direct and indirect. Direct food additives are used in foods to impart specific technological or functional qualities. For example, stabilizers are used to help prevent separation of nutrients in fortified milk products, while phosphates are used as a leavening agent in baked goods. Indirect additives are not intentionally added to food, but may be present in trace amounts as a result of processing, packaging, shipping or storage.

Food ingredients provide convenience and allow food makers to produce a wide variety of foods that are safe, appetizing, uniform, nutritious and tasty. They are used in very small quantities, but contribute significantly to our vast and varied food supply ensuring that the foods we love look, taste and feel the way we have come to expect. Food ingredients are used for a variety of reasons:

- To support nutrition delivery
- To maintain product quality and freshness
- To prevent spoilage during transport, storage and sale
- To make foods more appealing and ensure that familiar foods have consistent qualities
- To extend shelf-life and prevent food waste
- To make some foods more affordable
- To aid in the processing and preparation of foods

1.1.1 Food additives

Figure 1 food ingredients

Food additives are substances which are added to food to preserve its flavor or enhance its appearance, taste, or other qualities.

Food additives are:

- **Direct additives** are the food additives that are intentionally added to food for specific purpose.
- **Indirect additives** are the ones to which the foods are exposed to during processing, storing, or packaging. Preservatives are the additives that inhibit the growth of yeasts, molds, and bacteria in foods.

1.2 Categories of food additives

1.1 Food additives can be further divided into many groups, though there is some overlapping because some additives have at least two effects; e.g., salt is both a preservative and a flavor, citric acid is a preservative, adds flavor, and an acidity regulator. The following are categories of food additives.

a) Acidity regulators: Acidity regulators are used to control the pH of foods for stability or to affect the activities of enzymes.

b) Antioxidants: Antioxidants, such as vitamins E and C, BHA, BHT, are preservatives by inhibiting food degradation by oxygen.

c) Bulking agents: The bulking agents (e.g. starch) are additives which increase the bulk of food without affecting its taste.

d) Food coloring: The food colorings are added to foods to replace the colors lost during preparation or processing, or to make food more attractive.

e) **Anticaking agents:** The anticaking agents keep powders, e.g., milk powder, from sticking or caking.

f) **Foaming and antifoaming agents:** Antifoaming agents prevent or reduce foaming in foods. Foaming agents do the opposite.

g) **Acidulates:** Acidulates confer acid or sour taste. Common acidulents include citric acid, tartaric acid, vinegar, malic acid, lactic acid, and fumaric acid.

h) **Fortifying agents:** Minerals, vitamins, and dietary supplements to increase nutritional value of foods.

i) **Flavor enhancers:** Flavor enhancers improve the existing flavors of foods. A common example is monosodium glutamate (MSG). A number of flavor enhancers have their own flavors which are independent of the food.

j) **Color retention agents:** Contrary to colorings, the color retention agents are used in foods to preserve the existing color of the foods.

k) **Flour treatment agents:** These treatment agents are added to the flours to improve their color or their use in baking.

l) **Emulsifiers:** Emulsifiers allow oils and water to remain mixed together in emulsion, as in ice cream, mayonnaise, and homogenized milk.

m) **Tracer gas:** Tracer gas allow package integrity testing to prevent the foods from exposure to the atmosphere, thus guaranteeing shelf life.

n) **Preservatives:** Preservatives are one of the most important components of foods, especially commercially made foods. Preservatives inhibit or prevent spoilage of food due to bacteria, fungi, and other spoilage microorganisms.

o) **Flavors:** Flavors are food additives that give food a specific smell or taste, and can be derived from natural ingredients or made artificially.

p) **Glazing agents:** Glazing agents provide protective coating or shiny appearance to foods.

q) **Thickeners:** Thickening agents are food additives which, when added to the food mixture, increase the viscosity of the food without substantially modifying other properties of the food.

r) **Humectants:** Humectants prevent the foods from drying out.

s) **Stabilizers:** Stabilizers, food thickeners and gelling agents, such as agar or pectin give foods firmer texture. They help to stabilize emulsions, although they are not true emulsifiers.

t) **Sweeteners:** Sweeteners are added to food for flavoring. Sweeteners other than sugar, such as sugar alcohols, are added to keep the calories (or food energy) low or because of their beneficial effects regarding tooth decay, diabetes mellitus, or diarrhea.

1.2 Uses of food additives and preservatives

Additives and preservatives are used in foods to maintain or improve nutritional value, maintain product quality and consistency, provide leavening, control pH, maintain palatability and wholesomeness, provide color, or enhance flavor. Food additives can be classified as:

a. Thickening and stabilizing agents, which alter the food texture. Examples include carrageen, which is used as thickener in low-calorie jellies and ice creams, and the emulsifier lecithin, used to keep oil and vinegar blended in the salad dressings.
b. Chelating agents are used to prevent discoloration, rancidity, and flavor changes that may occur during food processing. Examples are malic acid, citric acid, and tartaric acid
c. Bleaching agents, e.g. peroxides, are used in foods to whiten the foods such as cheese, wheat flour.
d. Artificial colors are intended to make foods more appealing and to provide some foods with color which humans associate with a particular flavor; for example, green for lime, yellow for banana, brown for chocolate or coffee, red for cherry.
e. Antioxidants, which prevent damage to foods caused by oxygen and rancidity in foods containing fats. Examples of antioxidants include BHA (butylated hydroxyl anisole), BHT (butylated hydroxyl tolene), propyl gallate, vitamin C, and vitamin E.

f. Antimicrobial agents, which prevent the spoilage of food by microorganisms. These include vinegar, salt, calcium propionate, sorbic acid, etc., which are used in food products such as salad dressings, cheeses, baked goods, margarines, and pickled foods

g. Nutrient additives, including micronutrients (vitamins and minerals), are added to food during fortification or enrichment. For instance, rice is enriched with thiamin, riboflavin, and niacin; milk is fortified with vitamin D; salt is iodized.

h. Artificial flavors and flavor enhancers are the largest class of food additives. They function to give foods a specific taste or to make foods taste better. Common examples are sugar, salt, and vanilla used to complement flavor of some foods. The synthetic flavoring agents, e.g. benzaldehyde for almond or cherry flavor, might be used to simulate the natural flavors. Flavor enhancers, e.g. monosodium glutamate, intensify flavor of other compounds in foods.

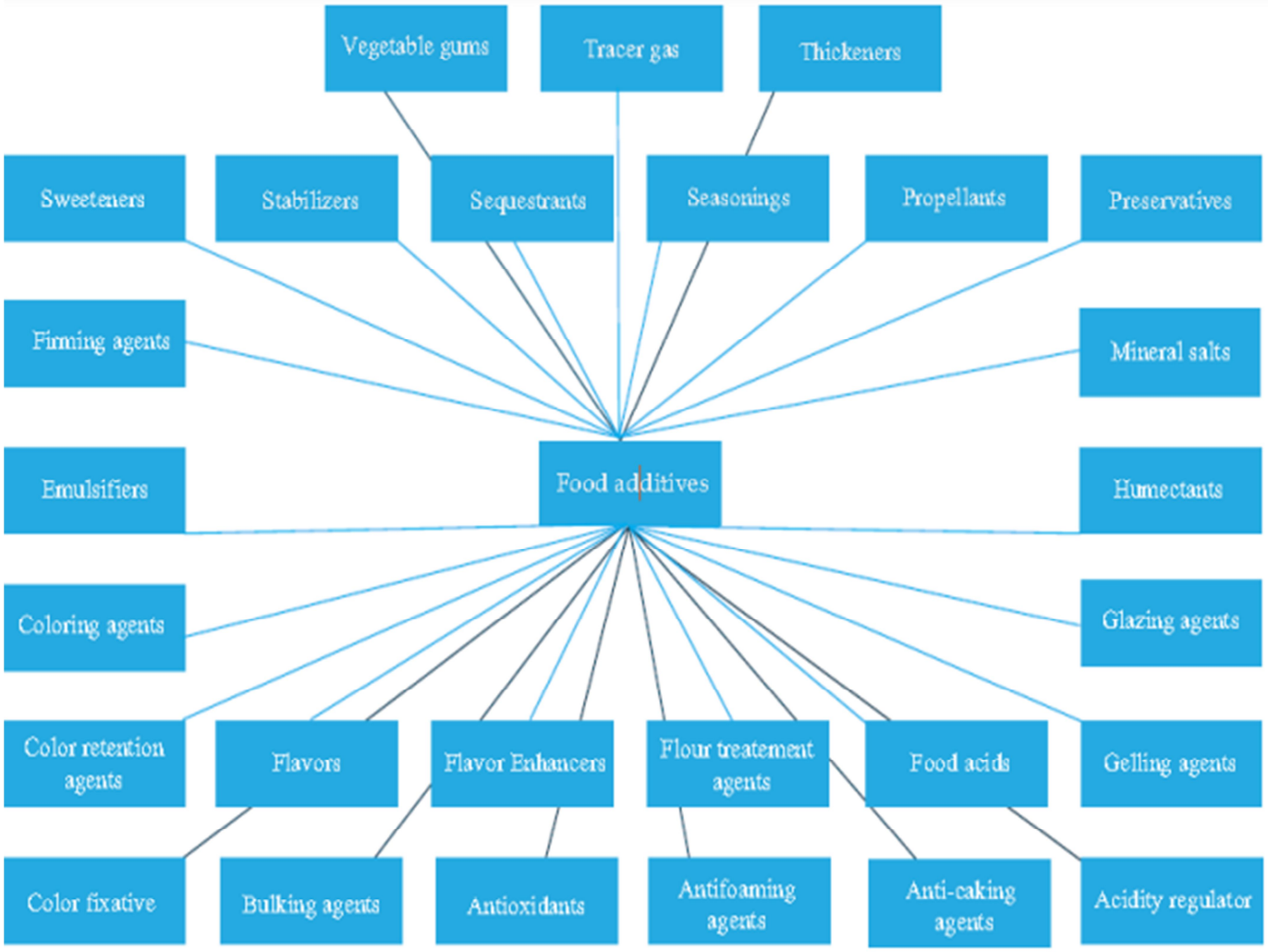


Figure 2 Categories of food additives

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: Fill in the blank space

1. Antioxidants prevent damage to foods caused by oxygen and rancidity in foods containing fats.
2. Glazing agents are used in foods to whiten the foods such as cheese, wheat flour.
3. Sweeteners are added to food for flavoring.
4. Bleaching agents provide protective coating or shiny appearance to foods.
5. Flavor enhancers improve the existing flavors of foods.

Test III: Short Answer Questions

1. Write examples of antioxidants (3points)
2. Why we use variety of food ingredients (4points)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet- 2	Identifying and confirming cleaning requirements and status

1.1 Cleaning requirements and status

Cleaning is the unit operation in which contaminating materials are removed from the food and separated to leave the surface of the food in a suitable condition for further processing. Cleaning should take place at the earliest opportunity in a food process both to prevent damage to subsequent processing equipment by stones, bone or metals, and to prevent time and money from being spent on processing contaminants which are then discarded. In addition, the early removal of small quantities of food contaminated by micro-organisms prevents the subsequent loss of the remaining bulk by microbial growth during storage or delays before processing. Cleaning is thus an effective method of reducing food wastage, improving the economics of processing and protecting the consumer.

General purposes of cleaning are:

- To reduce the risks from food hazards-food poisoning and foreign body contamination
- To comply with local and international legislation
- To meet specific customer requirements.
- To meet the requirements of global food safety standards (GFSI)
- To maintain positive audit and inspection outcomes
- To allow maximum plant productivity
- To present a hygienic visual image
- To promote safe working conditions for staff, contractors and visitors
- To maintain product shelf-life
- To avoid pest infestation

The selection of a cleaning procedure is determined by the nature of the product to be cleaned and by the types of contaminant to be removed. In general, more than one type of cleaning procedure is required to remove the variety of contaminants found on most foods. There two types of cleanings.

1. Wet cleaning

Wet cleaning is more effective than dry methods for removing soil from root crops or dust and pesticide residues from soft fruits or vegetables. It is also dustless and causes less damage to foods than dry methods. Different combinations of detergents and sterilants at different temperatures allow flexibility in operation. However, the use of warm cleaning water may accelerate chemical and microbiological spoilage unless careful control is exercised over washing times and subsequent delays before processing. Examples of wet-cleaning equipment include spray washers, brush washers, drum or rod washers, ultrasonic cleaners and flotation tanks.

Methods of wet cleaning are:

A) Soaking

Soaking is the simplest wet cleaning method. The soil is softened and partly removed along with stones, sand and other abrasive materials that could damage the machinery used in subsequent cleaning or preparation.

Figure 3 wet cleaning method

B) Spray washing

Spray washing is one of the most widely used methods for wet cleaning of fruits and vegetables. The surface of the food is subjected to water sprays. The efficiency of spray washing depends on several parameters such as water pressure, volume of water, temperature, the distance of the foods from jets, the time of spraying and the number of spray jets used. A small volume of water at high pressure is the most effective combination.

Figure 4 Spray washing method

C) Flotation washing method

Flotation washing method is based on the differences in buoyancy of the desired and undesired parts of the raw material to be cleaned. For example, rotten apples sink in water and are removed by fluming the fruits in a tank and collecting the good fruits as overflow. Heavy debris can be removed by fluming dirty product over a series of adjustable weirs arranged in series. The less buoyant contaminants are trapped by the weirs and remain behind, leaving the product contaminated only by material of same or greater buoyancy, which can be separated by passage over a vibrating screen under water sprays

Figure 5 Flotation washing method

E) Dewatering

Wet cleaning results in a cleaned product that may have some excess water adhering to it.

2. Dry cleaning

Dry cleaning procedures are used for products that are smaller, have greater mechanical strength and possess lower moisture content (for example grains and nuts). After cleaning, the surfaces are dry, to aid preservation or further drying. Dry procedures generally involve smaller cheaper equipment than wet procedures do and produce a concentrated dry effluent which may be disposed of more cheaply. In addition, plant cleaning is simpler and chemical and microbial deterioration of the food is reduced compared to wet cleaning. However, additional capital expenditure may be necessary to prevent the creation of dust, which not only creates a health and explosion hazard but also recontaminates the product. The main groups of equipment used for dry cleaning are:

- air classifiers
- magnetic separators
- separators based on screening of foods

1.2 Hygiene equipment and application methods

1. **Manual cleaning**

- **Manual cleaning** using cloths, mops, brushes, pads, etc. It is normally used in small areas, equipment that is non-water proof or requires dismantling or areas which are difficult to clean by other methods. It is a labor intensive method and may limit the use of certain chemicals for safety reasons.

Figure 6 manual cleaning

2. **Foam Cleaning**

- This is the common method for cleaning most food operations.

- A foam blanket, created using a wide range of available equipment is projected from a nozzle and allowed time to act on the soil.
- It is then rinsed off with the released deposits.
- Large areas such as floors, walls, conveyors, tables and well-designed production equipment are ideal for foam cleaning. Foam is a carrier for the detergent.
    - ✓ The foam should be applied in an even layer.
    - ✓ Coverage rates are quick and chemical usage is economical.
    - ✓ Your chemical supplier will advise on the most appropriate chemicals and equipment for your operation.
    - ✓ The equipment itself may be mobile, centralized or satellite.

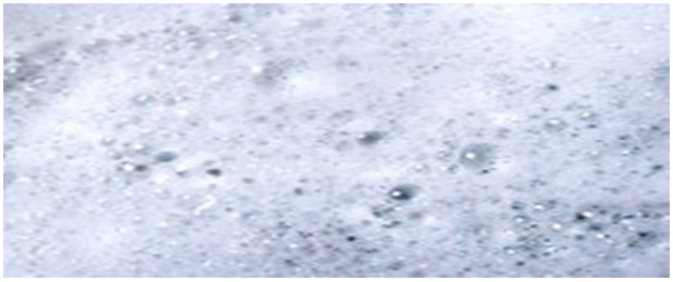


Figure 7 Foam Cleaning

3. **Spray cleaning:** This method can be wasteful of chemical and can be slow to produce foam. It should be used where foaming properties are not essential for the cleaning action

Figure 8 Spray cleaning

1.2.1 Machine washing

This is normally an automatic or semi-automatic washing process conducted within a purpose built machine. There are many machine designs depending on the application, e.g. crate washing or utensil washing. They represent a significant capital investment and need to have a clear business case before purchasing. They tend to consume a large amount of chemicals and water. Failure to maintain them correctly can lead to a contamination risk to the product. Chemicals used in these machines should be low foaming. An effective system for controlling the dose of chemical should be employed and temperature control systems should be used where critical.

CIP or cleaning in place is used extensively for the interior cleaning of pipes, vessels, tankers, heat exchanges, fillers and other enclosed process systems. CIP involves a programed cycle including timed pre-rinse, cleaning and rinsing stages and can be fully automatic or semi-automatic with a system of valves, pumps and detergent tanks controlled by a microprocessor. There are a number of parameters that need to be specified and controlled for effective CIP.

1.2.2 Cleaning procedures

Cleaning is a complex process. To ensure it is conducted correctly a defined and systematic approach is required that takes into account a number of factors previously covered. This approach takes the form of a Procedure and this is usually a legal requirement in addition to a fundamental requirement of global food standards.
A collection of these cleaning procedures forms a Cleaning Plan or Program which is plant specific. A typical cleaning procedure includes the following:

- Cleaning method
- Standards
- Frequency
- Chemicals used

- Equipment used
- Time and temperature specifications

The correct sequence of a general cleaning procedure for surfaces in a food plant is:

1. Gross Clean/Preparation

This step is most often omitted by food companies. This prevents effective cleaning of plant surfaces due to food residues remaining.

Negative impacts include:

- Protection of surfaces and bacteria from the action of detergents
- Reaction with and consumption of the detergent
- Holding bacteria and resulting in recontamination of the surface

A poor gross clean is the single biggest reason for poor or inconsistent bacterial counts on surfaces and for high bacterial contamination in aerosols caused by rinsing. A well designed cleaning procedure will provide for the removal of all food pieces greater than a fingernail before applying detergent. Ideally this should be done dry by hand, scrapping or other physical method. The collected material should be placed in waste receptacles and removed from the area. All ingredients, food and packaging materials should also be removed from the area prior to gross cleaning.

2. Pre-rinsing

The purpose of this step is to remove deposits which cannot be easily removed by picking, scrapping or other manual form of gross cleaning. Excess water should be removed following pre-rinsing to avoid dilution of the detergent in the following step.

3. Detergent Application

The purpose of the **detergent** is to remove the layers of proteins, greases and other food deposits that remain on surfaces. Detergents are not designed to remove large pieces of food deposits or thick layers of fat. It is in these layers that bacteria can survive and grow and make the use of a disinfectant pointless.

Foam should be conducted carefully and methodically and there should be a check to ensure that all surfaces have been covered. Detergents should be made up and

used according to the suppliers instructions and appropriate time should be allowed for the detergent to work.

4. Post Rinsing

The purpose of **post rinsing** is to remove the remaining food deposits. Care should be taken to minimize the amount of splash and aerosol formed which may re-contaminate surfaces. After post rinsing the surface should be free of all visible deposits, layers of soiling and residues of detergent. Any residues of detergent may neutralize the action of any subsequent disinfectant. Any pools or accumulations of water should be removed following post rinse.

5. Disinfection

Disinfection should only be carried out on a visually clean, well rinsed surface, with minimal amounts of water. Direct food contact surfaces should be disinfected at least daily with other surfaces disinfected on a regular basis. Disinfectants should be used safely according to the supplier's instructions.

6. Terminal Rinsing

Most disinfectants are safe to leave on nonfood contact surfaces without final rinsing. In some sections of the food industry there is a requirement to rinse food contact surfaces with water after disinfection. The standard of the water is important to ensure that the disinfected surface is not re-contaminated.

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: Fill in the blank space

1. _____ is the simplest wet cleaning method.
2. _____ is one of the most widely used methods for wet cleaning of fruits and vegetables.
3. _____ using cloths, mops, brushes, pads, etc.

Test I: Short Answer Questions

1. Write the two types of wet cleaning (5points)
2. What are the purposes of cleaning? (5points)
3. What are the typical cleaning procedures? (5points)

Note: Satisfactory rating - ≥9 points Unsatisfactory - below 9 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet 1	Techniques of identifying cleaning requirements and status

Procedure

Step 1 Gross Clean/Preparation

Step 2 Pre-rinse

Step 3 Detergent application

Step 4 Post-rinsing

Step 5 Disinfection

Step 6 Terminal rinsing

LAP TEST	Performance Test

Name…… ID……..

Date……

Time started: _____ Time finished: _____

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

Task-1 Techniques of identifying cleaning requirements and status

2.1 Definition of terms

Mixing is when two or more substances are combined in a vigorous fashion to form a homogenous product. Mixing is often associated with combining solids with a large quantity of liquids or liquids with liquids. Examples of mixes include:

- Dough and pastes
- Creams, soups and sauces
- Mayonnaise and margarine

Poor mixing can lead to surface foaming, the formation of lumps and trapping of unwanted air within the mixture. The final mixed product either remains a liquid or becomes a semi-solid like dough, paste or cream. Mixed products are further processed by methods outside the scope of granular and powder handling.

Blending is when substances are combined in a gentle fashion so that they become inseparable but are not necessarily homogeneous. Blending is associated with the combining of solids (dry) with solids and solids with small amounts of liquids (wet). Poor blending of solids can lead to issues like product settling out while being transported (segregation) or the formation of wet clumps. Simple examples of dry blends in food processing include:

- Powdered milk products
- Beverage mixes
- Cake mixes
- Seasonings

2.2 Processing/operating for mixing/blending

In agriculture and food processing, mixing operations are often used to blend ingredients. For food products to be acceptable, it is necessary that the mixing results in a uniform mixture. In addition to ingredient blending, mixing is used to

cause changes in the properties of doughs. Additional knowledge is needed on mixing of doughs and reformed meats. Design of mixing systems is seen as an art without a general systematic procedure being available.

Mixing can start as early as the preparation of ingredients and can be continuously used until the end of the process. It has been one of the most used steps for food preparation for a long time. Even if it is a very basic step it has not been understood in its totality because of its wide variety of uses. Food mixing can go from nano-emulsions to large particle suspensions, highly viscous pastes to dry powders with or without the incorporation of gas. The major parts of food mixing that are covered are: the basic objective of mixing (homogeneity), the types of equipment used for mixing, solids as well as fluids, and the mixing power correlations.

The ingredients being mixed directly influence the equipment type that should be used depending on the mixing scenario (solid-solid mixing [powders or textural effects], solid-liquid mixing [coffee, sugar] or liquid-solid mixing [butters, pastes and dough], liquid-liquid mixing [emulsions: margarines and spreads] and gas-liquid mixing [fermentation or chlorination]). It is important to consider a balance between the equipment and ingredients properties in order to obtain an effective size of production without using a large quantity of time and energy consumption, this would relapse in a better process and energy efficiency. Another important parameter for sizing the equipment is the rheology.

In the food industry hygienic design and suitability of cleaning are very important issues to consider because of the consequences that could result from a poor hygienic standard, for example the contamination of the product by microbial growth. For the mixing of fluids some of the most important equipment items used are: the paddle mixer, anchor mixers, turbine mixers (different impellers), propeller mixers and the new generation of static mixers.

All these types of fluid mixing equipment are used for different applications: to prevent scorching, to promote heat transfer, mass transfer, phase dispersion, low or high viscosities or the combination of two or more of these items. Mixing of solids is

more difficult than liquids because of its tendency to segregate and the different sizes, shapes and densities.

Mixing in the food industry is used mainly to obtain homogeneity with the best possible equipment and the best relation of the power correlations. Food mixing has not been totally developed because of the constant change in products with different additives, functional ingredients and changing stringent labeling, and because of the many purposes of the “mixing” equipment, for example, the modification of the structure of food or the development of texture in order to get better sensory characteristics. With the development of Computational Fluid Dynamics (CFD), it is easier to explain fluid flow as well as heat and mass transfer phenomena leading to better equipment design and process control for the mixing process.

Finally it is necessary to underline the most important differences between the chemical mixing and the food mixing: cleanliness and sanitation, where official regulations are involved, and the adaptation of the general mixing in order to prevent degradation or unwanted cooking, for example the material of the equipment parts that are going to be in contact with the product should be made of stainless steel or other materials that could stand vigorous cleaning and sanitizing.

Food mixing can happen between liquid-liquid, gas-liquid, and solid-liquid. This article focuses on emulsions, one of the most complicated liquid-liquid mix, and gas-liquid mixing due to its wide application and the reappearance and creation of products based on air as the most abundant ingredient.

2.2.1 Size reduction for proper mixing

The prime objective of mixing is to have homogeneity (uniform distribution) in the product. Usually, the homogenization involves the reduction of particle size achieved by the action of shearing forces. Homogenization is applied very frequently in the food industry such as the processing of fluid milk, emulsification of salad dressing and sauces, mashing of infant food, stabilization of concentrates, etc. Different products require size reduction.

Size reduction or 'comminution' is the unit operation in which the average size of solid pieces of food is reduced by the application of grinding, compression or impact forces. When applied to the reduction in size of globules of immiscible liquids (for example oil globules in water) size reduction is more frequently referred to as homogenization or emulsification.

Size enlargement is achieved by extrusion, agglomeration or forming. Size reduction has the following benefits in food processing:

- There is an increase in the surface-area-to-volume ratio of the food which increases the rate of drying, heating or cooling and improves the efficiency and rate of extraction of liquid components (for example fruit juice or cooking oil extraction).
- When combined with screening, a predetermined range of particle sizes is produced which is important for the correct functional or processing properties of some products (for example icing sugar, spices and cornstarch).
- A similar range of particle sizes allows more complete mixing of ingredients (for example dried soup and cake mixes).

Size reduction and emulsification have little or no preservative effect. They are used to improve the eating quality or suitability of foods for further processing and to increase the range of products available. In some foods they may promote degradation by the release of naturally occurring enzymes from damaged tissues, or by microbial activity and oxidation at the increased area of exposed surfaces, unless other preservative treatments are employed. Different methods of size reduction are classified according to the size range of particles produced:

1. Chopping, cutting, slicing and dicing:
   a. large to medium (stewing steak, cheese and sliced fruit for canning)
   b. medium to small (bacon, sliced green beans and diced carrot)
   c. small to granular (minced or shredded meat, flaked fish or nuts and shredded vegetables).

2. Milling to powders or pastes of increasing fineness (grated products > spices > flours > fruit nectars > powdered sugar > starches > smooth pastes)
3. Emulsification and homogenization (mayonnaise, milk, essential oils, butter, ice cream and margarine).

Self-Check –3	Written test

Name…… ID…… Date…….

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

Test I: write True or False (4points)

1. Poor mixing can lead to surface foaming, the formation of lumps and trapping of unwanted air within the mixture.
2. Mixing is when two or more substances are combined in a vigorous fashion to form a homogenous product.

Test II: Short Answer Questions

1. Write the examples of dry blends in food processing (4points)
2. Write the different methods of size reduction (6points)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

4.1 Condition Monitoring using Operating Equipment Performance

Measuring machinery 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.

4.1.1 Condition Monitoring and Process Analysis

Most machine and process characteristics which affect

- availability
- capacity
- quality
- safety
- Risk and cost can be continually evaluated throughout an asset's lifetime.

This is essential in identifying impending failure and will be applied to critical areas identified in the reliability plan.

The current state-of-health of process plant is important information related to current information, diagnosis and prognosis of various defects, and predicted useful life in the optimization of safety, quality and high production rates.

There are the obvious functions of monitoring and controlling the process for reasons of safety and product specification. Additionally, there is invaluable information to be gained from the process parameters that can give an understanding of the current health of the asset.

Condition Monitoring has historically focused on the acquisition and analysis of measurable parameters that would give useful information as to the condition of machine components and, hence, a forecast of the likely serviceability of the machine. The wider view of Condition Management must take into account

- the performance of the machine
- or the system of which it is a part
- And report on excursions away from previously defined acceptable tolerances.

4.1.2 Applications for Machinery 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)
- **Diesel or Gas Engines**: due to loss of compression (rings or valve leakage)
- **Electrostatic or bag dust filters**: due to fouling, shorting or leakage.

Note: Those electric motors are not included on the list because fall-off in performance is usually measurable by standard condition monitoring processes such as vibration and thermography.

Perhaps the most useful parameter for performance measurement of an induction motor is speed in relation to load. This should always be a constant and variations are measurable with vibration analysis.

4.1.3 Counting stress and overload conditions

One great benefit of performance monitoring electric motors is

- to identify the frequency
- to identify number of times that they are overloaded.

Each **overload** causes stresses to the electric motor components and to those in the machinery it drives. Each overload stress destroys operating life of the parts and causes the motor and the attached machine to fail sooner. By monitoring the extent

of the overload and counting the number of times overloads occur we can develop a relationship between operating conditions and operating life.

Below are some proposals for performance monitoring **of pumps** and **fans** two of the **most common machines in industry** and with much potential for savings in power costs through routine efficiency.

A) Performance Monitoring of Pumps

A typical set of centrifugal pump curves is shown opposite. Pump manufacturers extensively test every pump on a calibrated test tank and produce accurate performance curves. A typical diagram giving the correct names for the parts of a centrifugal pump is also given. For any given liquid the variables shown on these performance curves are as follows:

- **Total Head** (discharge minus suction) expressed as a vertical dimension (e.g. meters) or as pressure differential.
- **Power Consumed** (shaft power).
- **Efficiency**
- **Flow**
- **Impeller Type**
- **Shaft Speed**

In particular **'power'** is not easily measured without taking into account motor and coupling efficiency. This is often an estimate rather than a measurement.

Likewise '**efficiency'** can vary due to wear and recirculation and therefore this is also not a directly measurable parameter.

Head is easily measured using pressure gauges. These are often installed and should be calibrated if any serious measurements are required. Calibration facilities are usually readily available.

Flow is less easily measured if no flow meters are installed. The only practical option in this case may be to use ultrasonic flow measurement.

B) Performance Monitoring of Fans

Centrifugal fans are very simple machines but they can be extraordinarily troublesome in typical industrial applications.

- **Firstly**, they are sometimes poorly built or built to a price with inadequate structural stiffness, cheap bearings, design short-cuts and little consideration for the operational and maintenance demands of a long service life. Induced vibration of duct panels from gasses flowing by have been known to cause premature bearing failure.
- **Secondly**, many fans have to handle gases that may be
    - ✓ Corrosive
    - ✓ dirt-laden
    - ✓ Abrasive and wet.
- This means very harsh duty conditions that may demand significant maintenance. Often that maintenance is neglected resulting in significant efficiency reductions.

4.2 Mixer operation – start up

The procedures of mixer machine startup are:

1. Before starting the mixer check that the blade has been correctly fitted and note the rotational marking on the blade, if so marked. It will be important to check that the indicated blade rotation matches the actual mixer shaft direction of rotation when the mixer is started.
2. When first commissioning the mixer, check that the unit operates with a clockwise rotation (normal), or as otherwise specified in the mixer instructions, by briefly switching on the mixer and then immediately switching the mixer off.
3. In the unusual behavior of the mixer, check with maintenance contractor that all bolts are tight and that all belts are tensioned correctly. Dislocation or loosening of bolts is possible during installation or other unforeseen handling or processing event.
4. If the noise still persists, and the cause is not immediately identifiable, consult with Industrial Mixers for guidance on further check points and if necessary on site-assistance.

Self-Check – 4	Written test

Name…… ID…… Date…….

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

Test I: write true or false (1 point each)

1. Condition Monitoring has historically focused on the acquisition and analysis of measurable parameters.
2. A typical set of centrifugal pump curves is shown opposite.

Test II choose the best answer (2 points each)

1. Performance Monitoring of Pumps includes (2 point each)
    a. Total Head
    b. Power Consumed
    c. Efficiency
    d. Flow
    e. All
2. One great benefit of performance monitoring electric motors is
    a. To identify the frequency
    b. And number of times that they are overloaded.
    c. monitoring the extent of the overload
    d. all

Note: Satisfactory rating - ≥3 points Unsatisfactory - below 3 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

5.1 Preliminary operations

❖ Check if the machine has been damaged during transport

Check the condition of the machine taking a close look at the outside and the inside. Any deformation of the visible parts indicates that the machine has been hit by something during transport. This could lead to malfunctioning. Check the tightening of screws, bolts and fittings.

❖ If damage has occurred:

Damage caused by transport should be attributed to the carrier and the manufacturer or its agent should be informed immediately of the situation.

❖ To cleaning the machine the following point should be considered

- Remove the dust and dirt deposited on the surface during transport.
- Carefully clean and dry each part (varnished or unvarnished) using soft, clean and dry cloths
- Should the box pallets remain outdoors for some time, waiting to transport inside the building, these box pallets should be covered with adequately-sized waterproof tarpaulins.
- If storage exceeds 3 months the box pallets should be stored inside, sheltered from bad weather and protected from excessively high or low temperatures.
- If the machine is unpacked, it should be covered in order to prevent the buildup of dust and dirt

❖ Features of the installation site

A suitable installation site should be chosen considering the overall dimensions of the machine, supplied in the following rules:

- The power supply source, in compliance with the power supply details given on page 17, should be near the installation site.

- Nothing should hinder the free movement of the operator around the machine. The machine should be situated at least 1 metre from the nearest wall or object.
- Cabinets should be accessible at all times and the doors should open wide without obstacle.
- Make sure there is sufficient space for machine operation and maintenance and also for any other additional equipment.

❖ **Protection against external atmospheric agents**

The machine should be installed in a covered building, shielded from direct contact with atmospheric agents.

Lighting

Adequate lighting is necessary to carry out both normal operation and servicing of the machine in a safe way. The machine has no built-in lighting system. A well-lit environment prevents hazards due to shadowed areas.

Acceptable environmental conditions for the installation site:

- **Temperature:** from 5^0C to +40^0C with the average temperature not exceeding 35°C over a period of 24 hours.
- **Relative humidity:** from 50% at a temperature of 40°C up to 90% at a temperature of 20°C.

Preparation for start-up

Electrical connections

The machine has only one connection to the main electricity supply

Hydraulic connections

The machine has only one hydraulic connection. The hose must have ½ “fastening.

DANGER:

- Be sure that the values of the main electricity supply comply with the power specifications of the machine.
- Electrical hazards. Be sure that the machine is adequately earthed before making any other connection to the main power supply.

❖ **Testing**

Before delivery the machine is tested at the manufacture's workshop where the following operations are carried out:

- General setting of the machine, of auxiliary equipment and of the installed safety devices.
- Running test to check all adjustments have been carried out (correct rotation of the motors, tightness of the pneumatic systems, effectiveness of safety devices and of limit switches).
- Performance of test cycles under safe conditions.

❖ **Checking the safety devices:**

- Before starting the machine, the safety devices should be checked according to the following procedure:
  - ✓ Correct operation of the emergency stop button; while the machine is working, press the emergency button: the machine should stop immediately.
  - ✓ Correct operation of the safety limit switches; while the machine is working lift the protection grid. The machine should stop immediately.

Self-Check –5	Written test

Name…… ID…… Date…….

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

Test I: write True or False (2points)

1. Check the condition of the machine taking a close look at the outside and the inside.
2. Adequate lighting is necessary to carry out both normal operation and servicing of the machine in a safe way.

Test II: choose the best answer (4points)

Before delivery the machine is tested at the manufacture's workshop where the following operations are carried out:

i. General setting of the machine, of auxiliary equipment and of the installed safety devices.
ii. Running test to check all adjustments have been carried out
iii. Performance of test cycles under safe conditions.
iv. All

Note: **Satisfactory rating - ≥3points** **Unsatisfactory - below 3 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet 1	Techniques of cleaning machine

Procedure

Step 1 Remove the dust and dirt deposited on the surface during transport.

Step 2 Carefully clean and dry each part (varnished or unvarnished) using soft, clean and dry cloths

Step 3 Should the box pallets remain outdoors for some time, waiting to transport inside the building, these box pallets should be covered with adequately-sized waterproof tarpaulins.

Step 4 If storage exceeds 3 months the box pallets should be stored inside, sheltered from bad weather and protected from excessively high or low temperatures.

Step 5 If the machine is unpacked, it should be covered in order to prevent the buildup of dust and dirt

LAP TEST	Performance Test

Name…… ID……..

Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following task within 8hour. The project is expected from each student to do it.

Task-1 clean mixer machine

LG #51	LO #2- Operate and monitor the mixing/blending process

Instruction sheet

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

- Delivering *ingredients* to the mixer in required quantities
- Start and operate mixing/blending process
- Monitoring and identifying equipment variation operating conditions
- Identifying variation in *equipment operation* and report maintenance requirements
- Monitoring mixing process
- Identifying, Rectifying and reported out-of-specification product/process outcomes
- Maintaining work area (housekeeping standards)
- Conducting workplace environment guidelines /information/

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:

- Deliverer *ingredients* to the mixer in required quantities
- Start and operate mixing/blending process
- Monitor and identify equipment variation operating conditions
- Identify variation in *equipment operation* and report maintenance requirements
- Monitor mixing process
- Identify, Rectifying and reported out-of-specification product/process outcomes
- Maintain work area (housekeeping standards)
- Conduct workplace environment guidelines /information/

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

Information Sheet-1	Delivering ingredients to mixer

Food manufacturing facilities will typically include several pneumatic conveying types. The mode of transfer of raw ingredients or final product is dependent on many process parameters, including material characteristics, distance to be transferred, required rate of transfer, friability of product and/or segregation concerns. In the case of raw material delivery, the type of container in which the ingredient is originally received can also be a factor.

For example, majors such as flour, grains, starches, and sugars are often received by truck or railcar and then stored in silos prior to usage. Pressure Differential (PD) trucks and railcars use positive pressure to unload material, whereas other types of delivery to the blending batching steps can involve either positive pressure or negative pressure. It is therefore important when choosing the conveying method that a full examination of several process parameters be completed, since different options can result in cost savings and efficiency improvements.

Positive pressure systems (see illustration below), are typically used to convey bulk materials from a single source to one or multiple destinations. This is done by use of a positive displacement blower blowing into material entry points located downstream. These entry points then meter each product into the conveying line by means of a rotary airlock valve which maintains the pressure differential between the ambient atmosphere and that of the conveying line.

Material and air blown through the line exit at single or multiple use points where they are separated by means of a filter receiver or cyclone separator, or fed directly into process vessels. Positive pressure conveying systems are typically used to transport product over long distances and at high throughputs. Applications which involve pressure conveying often include loading and unloading of large volume vessels such as silos, bins, railcars, trucks, and bulk bags.

Conversely, negative pressure or vacuum systems are generally used for transporting material from multiple sources such as storage vessels, process

equipment, bulk bags, trucks and railcars, to individual or multiple destinations and are used for lower volumes and shorter distances. Negative pressure is created by a positive displacement vacuum blower located at the downstream end of the system. Material can enter the system via bag dump stations equipped with rotary airlock valves, handheld pickup wands, and pickup hoppers.

Material exits the system through filter receivers that separate the material from the conveying air directly above process equipment, surge hoppers, storage vessels or other discharge points. One of the advantages of vacuum systems is the inward suction created by the vacuum blower and reduction of any outward leakage of dust. This is one of the reasons why vacuum systems are often used in higher sanitary or dust containment applications.

Another advantage of vacuum systems is the simple design for multiple pickup points. It should be noted, however, that the distances and throughputs possible with a vacuum system are limited due to the finite level of vacuum that can be generated.

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: write True or False (3points each)

1. Food manufacturing facilities will typically include several pneumatic conveying types.
2. The mode of transfer of raw ingredients or final product is dependent on many process parameters.

Test II: choose the best answer (4point each)

1. Applications which involve pressure conveying often include loading and unloading of large volume vessels includes:
   A. silos,
   B. bins,
   C. railcars,
   D. Trucks and bulk bags.
   E. All

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Starting and operating mixing/blending process with work place procedures

2.1 Starting and operating mixing/blending process

Ingredients perform a variety of functions in foods, including providing nutrition, flavor, color, physical stability and many more. All ingredients used in food are required by law to be listed on the food's nutrition facts panel.

Food ingredients, including food additives, are as varied in their source as they are in function. Some food additives come from mineral sources that contain phosphorus compounds, which can be used to help foods retain moisture. Other additives come from plant sources like seaweed and kelp, which naturally produce compounds that can be used in the thickening of foods and to maintain texture.

Figure 1 dough mixing

2.1.1 Bread dough mixing

Three basic methods for mixing dough:

2. **Straight dough method.**

The straight dough mixing method is the simplest mixing method of all. It consists of only one step. You don't have to think much about this method, combine all ingredients in the mixing bowl and mix. While using this method, there is a possibility that the yeast doesn't get evenly distributed in the dough. Therefore, it is safer to mix yeast separately with a little water.

- Soften the yeast in a little of the water. Ideal temperature is 43.33ºC (110ºF)
- Combine the remaining ingredients, including the rest of the water, in the mixing bowl. Add the dissolved yeast, taking care not to let it come in contact with the salt.
- Mix to a smooth, developed dough.

3. **Modified straight dough method or modified mixing.**

The modified mixing method is basically for rich sweet dough. This is basically the modification of the straight dough method to ensure that the fact and sugar are evenly distributed in the dough.

- Soften the yeast in part of the liquid, using a separate container.
- Combine the fat, sugar, salt and flavourings and mix until well combined, but do not whip until light.
- Add the eggs gradually, as fast as they are absorbed.
- Add the liquid and mix briefly.
- Add the flour and yeast. Mix to a smooth dough.

4. **Sponge method**

- Many Bakers feel this method of mixing is very effective to achieve a better texture, rise and even the taste for the rich yeast dough recipes. Sponge method allows the yeast to speedily and fully ferment and activate with part of the flour and water in the recipe and later incorporated with the remainder of the ingredients. This method is successfully prepared by following two stages which help the yeast action to get a head start.

✓ Combine the liquid, the yeast, and part of the flour (and sometimes part of the sugar). Mix into a thick batter or soft dough. Let ferment until double in bulk.

- ✓ Punch down and add the rest of the flour and the remaining ingredients. Mix to a uniform, smooth dough.

Basic steps of the straight dough mixing method used for making yeast bread:

1. Combine all of the ingredients for the bread together.
2. Knead the dough until it is smooth and elastic.
3. Cover the dough and let it rise until the volume is double in size.
4. Press down on the dough to release the gas ("punching" the dough).
5. Shape the bread and let it rise again until double in volume.
6. Bake.

2.1.2 Bakery Ingredients

A. Major ingredients

Major, also termed "bulk, "ingredients make up the majority of the formulation. Flour, for example, constitutes around 55 to 60% (formula weight) or more of bread's raw materials.

Figure 2 Major ingredients

A. Minor ingredients

Typically, range from 5-10% (formula weight), and micro ingredients are those added at 5% or less. The basic recipe for bread making includes wheat flour, yeast, salt and water. If any one of these basic ingredients is missing, the acceptable product cannot be prepared. Other ingredients known as optional, for example, fat, sugar, milk and milk product.

Figure 3 Minor ingredients

- The **wheat flour** is the main ingredient in bread production. It is primarily responsible for bread structure and bite characteristics.
- **Water** transforms flour into viscoelastic dough that retains gas produced during fermentation and water provides medium of all chemical reaction to occur. Yeast ferment sugars and produces carbon dioxide gas and ethanol. It, thus, gives us porous and leavened bread. Sugar is the source of fermentable carbohydrate for yeast and it provides sweet taste.
- **Salt** enhances flavor of all other ingredients and adds taste to the bread. It also strengthens the gluten network in the dough. Fat makes the bread texture softer and improves its freshness and shelf life.
- **Baking** is the final step in making yeast-leavened (bread, buns, rolls, crackers) and chemically-leavened products (cakes, cookies). It's a thermal process that uses an oven, which transfers heat to the dough pieces via:
    - ✓ Conduction through heated surfaces
    - ✓ Convection through hot air
    - ✓ Radiation from heat sources such as flames

The heat in turn activates a series of physicochemical changes, responsible for transforming the raw dough into a baked good with a firm, dry crust and a soft crumb.

Procedure of baking

Step 1: Scaling: All ingredients are measured. We would like to recommend two things for this step:

- Measure all wet and dry ingredients by weight.
- Use a formula that is expressed in "baker's math" or "baker's percentages."

This step concludes when all ingredients are accurately measured and lined up in order of use, as well as all tools and equipment are ready for the second step in the bread-making process.

Step 2: Mixing: Ingredients are combined into smooth, uniform dough; the yeast and other ingredients are evenly distributed through the dough, the gluten is developed, and fermentation is initiated.

Step 3: Bulk or Primary Fermentation: The dough is allowed to ferment. Fermentation is the process by which the yeast acts on the sugar and starches and produces carbon dioxide and alcohol.

Step 4: Folding: The purpose of this step is to degas the dough, and we do that for four reasons: to expel some of the carbon dioxide, and avoid by that chocking the yeast; to allow the gluten to relax a bit; equalize the temperature of the dough; and to redistribute the nutrients necessary for the yeast's continued growth.

Step 5: Dividing or Scaling: The dough is divided or scaled into the desired individual portions.

Step 6: Pre-shaping or Rounding: The portioned dough is loosely shaped into smooth, round balls. This organizes the dough into consistent pieces and makes the final shaping easier and more efficient. It also stretches the gluten on the outside of the dough and forms a skin that helps it retain the gases produced by the yeast.

Step 7: Resting: The benching or resting lasts approximately 20 to 30 minutes and relaxes the gluten, making the final shaping of the dough easier.

Step 8: Shaping and Panning: The dough is formed into its final shape and placed in the pan or mold that it will be baked in.

Step 9: Proofing or Final Fermentation: The dough go through one final fermentation. The dough should be placed in a temperature and humidity controlled environment to allow the bread to rise to the desired volume before baking. Optimum rise for this stage is 80 to 85 percent of the dough's overall volume.

Step 10: Baking: The dough is baked. The dough is often scored with a sharp knife prior to baking. This allows the bread to expand without bursting.

Some of the important changes that occur during the baking process are:

- ***Oven spring:*** The initial, rapid expansion of loaf volume that is caused when the trapped gasses in the dough expand as a result of the high heat of the oven. The yeast remains active in this final fermentation process until it is killed at a temperature of about 145°F (63°C).
- ***Coagulation of proteins and gelatinization of starches:*** This contributes to the formation of the crumb and sets the structure of the loaf. This begins at approximately 140°F (60°C) and continues until the temperature reaches between 180°F and 194°F (82°C and 90°C).
- ***Formation and browning of the crust:*** This begins when the surface of the dough reaches 212°F (100°C) It occurs in baked goods in the presence of heat, moisture, proteins, and sugars and continues until the surface temperature reaches 350°F (175°C). Further crust color and flavor develop with caramelization that occurs between temperatures of 300°F and 400°F (149°C and 204°C). When the bread reaches a maximum internal temperature of 210°F (99°C) the bread should be properly baked. Other signs that mark the completion of the baking process are a golden brown crust and a hollow sound emitted when the baked loaf is thumped. The baking process is now complete and the bread is ready to be cooled and stored.

Step 11: Cooling: The loaves are cooled on racks that allow the air to circulate around them and prevent the crusts from becoming soggy. The bread should be cooled at least two hours to allow the crumb structure to stabilize and develop full flavour.

Step 12: Storage: Baked breads will stale most quickly at temperatures between 32°F and 50°F (0°C and 10°C) and therefore should never be placed in the refrigerator.

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: Write True or False (3point each)

1. Water transforms flour into viscoelastic dough that retains gas produced during fermentation.
2. The straight dough mixing method is the simplest mixing method of all.

Test II: choose the best answer (4 points each)

1. Which one is basic methods for mixing dough:
   a. Straight dough.
   b. Sponge.
   c. Modified straight dough
   d. Modified mixing.
   e. All

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation sheet 1	straight dough mixing

Procedure

Step 1 Combine all of the ingredients for the bread together.

Step 2 Knead the dough until it is smooth and elastic.

Step 3 Cover the dough and let it rise until the volume is double in size.

Step 4 Press down on the dough to release the gas (“punching” the dough).

Step 5 Shape the bread and let it rise again until double in volume.

Step 6 Bake.

Operation sheet 2	Bread baking

Procedure

Step 1 Read the recipe thoroughly.

Step 2 Use fresh ingredients.

Step 3 Ensure the ingredients are at room temperature for better mixing - remove from the fridge about 15 minutes before you start.

Step 4 Measure all the ingredients before you begin mixing.

Step 5 Use standard dry measuring cups for dry ingredients and standard liquid measuring cups for wet ingredients

Step 6 Level off dry ingredients when measuring (don't use a heaped measure); measure liquid ingredients on a level countertop for an accurate read.

Step 7 Mix dry ingredients into liquid ingredients slowly and just until combined (don't over mix otherwise the batter or dough will become tough).

Step 8 Preheat oven to correct temperature (use an oven thermometer to confirm its accuracy), and use the center rack for even heat distribution (unless your recipe states otherwise).

Step 9 Line baking pans with foil to prevent sticking and to help with cleanup. Use parchment paper when baking cookies.

Step 10 Use the pan specified in the recipe.

LAP TEST	Performance Test

Name…… ID……..

Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following task within 8hour. The project is expected from each student to do it.

Task-1 make bread baking

Task-1 Straight dough mixing

Information Sheet- 3 Monitoring equipment to identify variation in operating conditions

3.1 Monitoring equipment

❖ **Equipment for solid mixing**

The different equipment involved in solid mixing involves drum blender, tumbler mixer, Paddle mixer, through mixers and vertical screw. The mechanism and applications of the mixers are mentioned below.

1. The drum blender

This belongs to the category of diffusive mixers. It consists of a horizontal cylinder rotating about its axis. Its mixing action is essentially diffusive. The powder to be mixed is placed inside the drum. As the drum rotates, the powder is lifted up, until the angle of repose is exceeded. At that point, the powder falls back on the rest of the bulk and enters a new cycle of lifting and falling. Diffusive mixing takes place during the residence of the powder in air, while falling. Continuous operation can be made possible by tilting the drum.

2. Tumbler Mixer

This belongs to the category of diffusive mixers. Tumblers mix free flowing solids that are used for powders and pastes. Tumblers provide "gentle" blending as material tumbles about a horizontal axis in an enclosed rotating unit. Hence this is used when there is a difference in the particle size and the density. Because the particles in a tumbler mixer hit against the walls and are then deflected to give good mixing. They come in many of the different shapes as given below.

a) Barrel mixer
b) Cube mixer
c) Double cone blender
d) Twin- shell mixer- V-Shaped

Tumbler mixers also belong to the category of diffusive mixers. In the double-cone tumbler, the powder undergoes cycles of expansion and compaction as the vessel rotates. In the V-shaped tumbler, the powder is subjected to cycles of division and

assembly. Convectional elements such as rotating or stationary flow distortion bars (intensifier bars) are sometimes installed in both types of mixers.

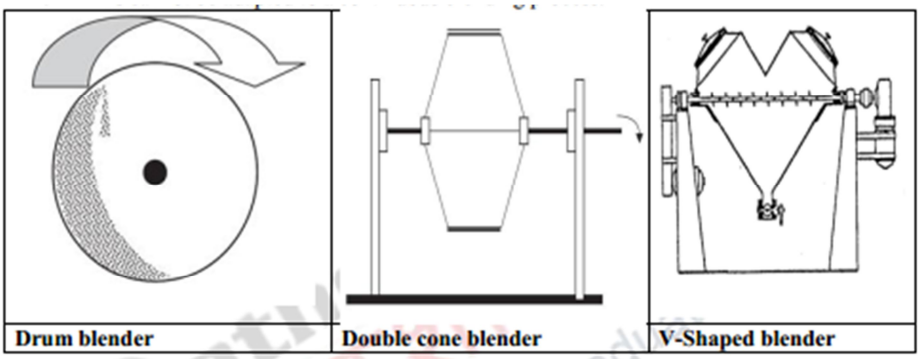
Factors considered in operating tumblers

- Optimum speed should be used:

Too low speed → sliding only

Too high speed → centrifugation → segregation.

- The mixer should be charged with no more than 50% of its total capacity to provide the required space for the expansion for the powder bed movement of particles.



3. Paddle mixer

This is a convective type mixer for particulate solids. This is a powerful mixer in which rotating elements mix the powder both by moving the bed and by fluidizing. A liquid component may be sprayed on the powder while mixing. Mixers of this type are available both for batch and continuous operation. In the developed version of the machine, the entire mixing chamber can be rotated upside-down for rapid discharge of the product, and then rotated back for charging a new batch.

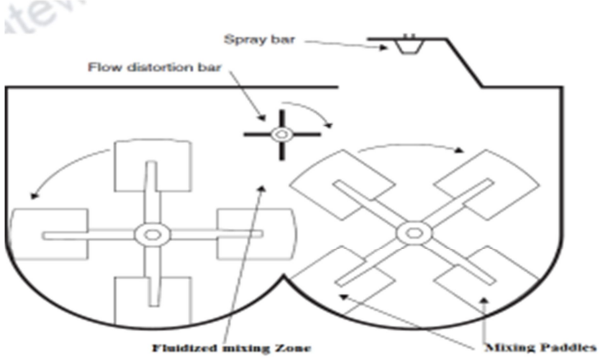


Fig: Paddle mixer

4. Trough mixers

This is also a convective type mixer for particulate solids. Trough mixers consist of conduct with a U-shaped cross-section and a longitudinal rotating shaft carrying various types of mixing elements. The agitating element may be a series of paddles or a screw like a screw conveyor. One of the best known of the trough mixers is the ribbon mixer.

Mixing Mechanism

- Convective effect of the ribbons.
- Shearing action.

5. Vertical screw

It combines the 3 different mechanisms for mixing.

- Diffusive (conical vessel).
- Convective (helical conveyer).
- Shear mixing (rotating arm).

General Mixers Safe Operating Guidelines

1. Always read these instructions in full as well as any other information and manuals provided with the equipment, before operating the mixer.
2. Check and ensure that the mixer is securely fixed to the floor or other holding base such as the wall for wall mounted units. Mixers operate at high speed and use large amounts of power. Machinery that is not properly fixed to a firm base is a dangerous operating environment.
3. Check that any mixing drums, pots or tanks are secure or with locking wheels firmly locked.
4. Electricity can be hazardous and must always be used with great care.
5. Electricity and water make a dangerous combination, so always keep electrical equipment away from rain and water.
6. Check and ensure all the electrical connections and cables are well connected and that there are no lose wires or loosely placed cables. All cables are to be held firmly in place in truncking or suitable brackets with cable ties.

7. The action of this mixer can cause injury or damage if the machine is not used in a careful and controlled way.
8. If you have not used mixer before, familiarize yourself with how the mixer works before you start on the main task.
9. Plan your work and think ahead to make sure you will always be working safely.
10. You must have the prescribed items of personal protective equipment.
11. Mixers must not be used by minors, or by anyone under the influence of drugs and alcohol.
12. This mixer is designed for operation by an able bodied adult. Anyone with either temporary or permanent disability must seek expert advice before using any mixer.
13. Do not use the mixer where there is a danger of explosion. It will ignite fumes from petrol, or gas cylinders, or solvent vapours in the air.
14. The mixer may have been fitted with a flame-proof motor and thus be prepared for operation in a solvent processing plant. If you are working with solvents, only operate the mixer after you have verified that the motor and panel are correct for safe operation with solvents.
15. Make sure that the area is clear and safe and that no one is near to you or could distract you.
16. Protect other people from the noise and other chemicals or dust. Warn others to keep away.

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Test I: Write True or False (3point each)

1. The different equipment involved in solid mixing involves drum blender, tumbler mixer, and Paddle mixer.
2. **Trough mixers** Convective type mixer for particulate solids.

Test II: choose the best answer (2 points each)

1. **Which one is Vertical screw mixing function?**
   A. Diffusive
   B. Convective
   C. Shear mixing
   D. All
2. **The advantage of Trough mixers are:**
   A. Headroom requirement is less
   B. Rapid break down of agglomerates
   C. Minimum dead spots
   D. All

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

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

4.1 Identifying variation in equipment operation

Record and/or report faults and any identified causes to the supervisor concerned, where required, in accordance with workplace procedures. Assess quality of received components, parts or materials Continuously check received components, parts, materials, information, service or final products against workplace standards and specifications for conformance, Demonstrate an understanding of how the received components, parts or materials, information or service relate to the current operation and how they contribute to the final quality of the product or service Identify and isolate faulty components, parts, materials or information that relate to the operator's work, Record and/or report faults and any identified causes in accordance with workplace procedures.

The following steps may help to take corrective action in response to variations:

a. **Define the Problem:-**Take time to adequately define the problem (who, what, when, why, where, how much and how often).
b. **Interim Actions: -** Once a problem as been detected, the first priority should be to contain the problem, and prevent shipment to the customer. If already shipped, the customer needs to be notified to prevent further liability.
c. **Root Cause Analysis:-**The key to resolving a problem is identifying the true root cause. There may be several underlying causes, a new operator, a change in procedure, or another 'rush job' circumventing the system. This is why it is important to find the root cause of the issue and define a permanent solution.
d. **Permanent Actions:-**The process should be reviewed to arrive at a solution for correcting the root cause. This review should engage the 7 basic quality tools. The solution may involve longer term planning, requiring milestone dates, capital justification, training, and/or approval from the customer. It is good to

review progress in management review to assure accountability after the Interim Actions have 'stopped the bleeding'.

e. **Verification:-**Checkpoints in the process should be created to verify effectiveness. This could be accomplished by inspection, internal audits, and/or measurement.

f. **Control:-**If mistake proofing was not part of the solution, then a measurement to detect the root cause early should become part of the system. A procedural change should become part of the system by updating the work instruction and training for accountability. Consider putting a reaction plan in place should the problem reoccur.

g. **Prevention: -** few organizations reach this step. For example, all the above steps are completed, yet the problem returns 6 months later. Perhaps, a new operator shows up who may have been qualified through 'On-the Job' training without verification of their competency. Or the filter was replaced as part of the solution, but it is dirty again and hasn't been placed on the Preventive Maintenance schedule.

4.1.1 variation Equipment operation

The following are Operating Procedures for Dough Mixers

Equipment operation may require: the use of simple operating panels after having made all the adjustments, start the machine and begin work.

- Before use, ensure that the power supply corresponds to that required by the machine and that the external ground wire is securely connected.
- Place the required quantities of flour, water and any other ingredient required, into the bowl.
- Ensure that flour mixing capacity is lower than the maximum flour capacity
- Before starting, make sure that the safety protective guard has been lowered
- Plug the machine into the electricity main, then turn the main switch to the ON position
- Press the START button in order to start the operating cycle. If the operator has selected the dough mixing time settings in timer and the machine will terminate

the work cycle during which it will automatically switch from the first to the second speed. After the automatic stop, the mains voltage is not disconnected and the machine is ready for another batch of dough.

- Do not put hands or hard objects into the bowl while in operation.
- Use the speed control knob to set the required speed level. First, set a lower speed to prevent ingredients from being sprayed around. As soon as they are mixed together, increase the speed to the required level. The speed can be adjusted at any time as required
- As soon as you release the speed control knob, it will automatically return to position 0 (off).
- After you have finished using, set the speed control knob to position 0 (stand-by mode) and disconnect the power cord from the power socket.
- Clean out the food mixer after each use according to the cleaning and maintenance Instructions.

4.2 Reporting maintenance requirements

Before you begin to gather and analyze your data, consider how you can ensure your collection efforts will meet the reporting needs of your primary intended users. From the very beginning, reporting is an integral part of evaluation.

Maintenance procedures are written instructions that, when followed by the maintenance personnel, will ensure that equipment operates as designed within safe operating limits. The above definition follows the same approach as that used for operating procedures. Equipment and facilities must operate in the safe range. Preventive maintenance helps ensure that equipment stays in that range; repair maintenance restores equipment to its normal function.

Many of the techniques described in the previous section can be useful in the preparation of maintenance procedures however, maintenance tasks are not usually so concerned with a long sequence of activities, and they tend to benefit more from the use of equipment sketches and pictures than do operating procedures.

Food and beverage organizations are all unique in how they manage their assets and their reporting requirements. Tight margins, industry regulations, and large operating expenses can result in increased pressure on maintenance departments

The following are Reporting maintenance requirements are:

- communicate what you do;
- monitor and track progress;
- demonstrate impact;
- document lessons learned;
- be accountable and transparent to donors, partners and benefiting communities
- Improve efficiency and field excellence
- Boost operational intelligence and decision-making
- Achieve high compliance standards and be prepared for regulatory audits and internal reviews

Self-Check -4	Written Test

Name…… ID…… Date…….

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

Test 1: Say true or false for the following questions.

1. _____ Permanent Actions:-The process should be reviewed to arrive at a solution for correcting the root cause. (2 point)

Test 2: Choose the best answer for the following questions.

1. Which of the following are note include reporting maintenance requirements? (3 points)

a. communicate what you do
b. monitor and track progress
c. demonstrate impact
d. Verification

Test 3: Give short answer for the following questions.

1. Write the three Reporting maintenance requirements (3pts

Note: Satisfactory rating – ≥4 points **Unsatisfactory - below 4 points**

.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information sheet – 5 Monitoring mixing process

5.1 Monitoring mixing process

Mixing is one of the most common processes across food, chemical, and pharmaceutical manufacturing. Real-time, in-line sensors are required for monitoring, and subsequently optimizing, essential processes such as mixing.

Mixing is one of the most common manufacturing processes. It is not only used for combining materials, but also for increasing heat and mass transfer, providing aeration, and suspending solids. Correct active ingredient dosing in the pharmaceutical industry is critical for patient safety and treatment effectiveness and effective mixing is essential to achieve this. In food manufacturing, mixing provides uniform heating and modifies material structure. In material manufacturing such as the polymer, cement, and rubber industries, final product qualities are determined by the level of homogeneity.

Sensors that provide automatic, real-time data acquisition capabilities are required to monitor critical processes such as mixing. These sensors are termed in- or on-line, where in-line methods directly measure the process material with no sample removal, and on-line methods automatically take samples to be analyzed without stopping the process. Sensors able to characterize whether a mixture is non-mixed or fully mixed offer benefits of reducing off-specification products, early identification of process upset conditions, and reduced resource consumption from overmixing. Furthermore, techniques able to predict the required time remaining until mixing completion would improve batch scheduling and therefore process productivity.

There are numerous in-line and on-line techniques available to monitor industrial mixing processes, with the major categories of techniques being point property measurements,

- ✓ tomographic (e.g., electrical resistance tomography), and
- ✓ spectroscopic (e.g., Near Infrared Spectroscopy (NIRS)).

There are two laboratory-scale mixing systems are monitored:

- ✓ honey-water mixing and
- ✓ Flour-water batter mixing.

As honey is completely miscible in water, this system is representative of the development of homogeneity in liquid–liquid blending. Flour-water batter was used to monitor structural changes as the gluten proteins in the flour become hydrated and aligned into a network, as opposed to air incorporation. Therefore, this flour-water batter system is similar to dough mixing, only with higher water content. This system was chosen as during dough mixing at atmospheric pressure, the dough pulls away from the mixer sides and is therefore not measurable using low-power ultrasound due to the created air gap.

However, industrial dough mixing is typically performed at reduced pressure or vacuum pressure, where the dough will be in contact with the mixer sides. Furthermore, batter mixing has been shown to follow the same physical and chemical changes as dough during mixing, and is therefore representative of industrial dough mixing.

1. honey-water mixing

As the sensors only measure a small area of material properties in a single location, they may be designated as point property measurement techniques. Therefore, the positioning of the sensors is of paramount importance to obtain useful readings; for example, multiple NIR sensors have been used to monitor different mixing dynamics during particulate blending across different locations in a mixer. Therefore, one sensor was located at the centre of the vessel base and the other was closer to the vessel sides, allowing comparison between both sensor positions. Furthermore, sensor fusion could be explored by combining outputs from both sensors to improve prediction.

2. Flour-water batter mixing

NIRS has previously been used to monitor the chemical and surface structure changes occurring during dough mixing and image analysis of the dough surface has

been used to determine optimal mixing time. Measuring the power or torque supplied to the impeller is a common method of monitoring dough mixing. Mixing should be stopped at the maximum power input for optimal bread properties. Beyond this point of maximum resistance to extension, the gluten network begins to breakdown. The power supplied to the motor was monitored using a plug socket power meter to provide a reference measurement for the mixture's state. The optimal mixing time was determined by the time of maximum power drawn to the impeller.

Self-Check – 5	Written test

Name…… ID…… Date…….

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

Test I: Write True or False (3point each)

1. Mixing is one of the most common processes across food, chemical, and pharmaceutical manufacturing.
2. Mixing is one of the most common manufacturing processes.

Test II: choose the best answer. (4point)

1. The two laboratory-scale mixing systems are monitored:
   a. honey-water mixing and
   b. Flour-water batter mixing.
   c. All
   d. None

Note: **Satisfactory rating - ≥7 points** **Unsatisfactory - below 7 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information sheet – 6 Identifying, Rectifying and reporting out-of-specification product/process outcomes

1.1 Identifying and rectifying out-of-specification product/process outcomes

The criteria of identifying an acceptable out-of-specification product/process outcome:

- sensory properties
- functionality
- homogeneity
- Particulate integrity, etc.

1.1.1 Report to others clearly

This means that you:

a) Communicate accurate results of both quality checks and actions taken to the relevant people at the appropriate time

This will include:

- ✓ clearly and accurately informing the relevant people of your findings
- ✓ informing relevant people of any action taken to rectify problems

Check that all required records are accurate, complete, and written clearly by:

- ✓ ensuring that the appropriate records are completed as required by company procedures and are easy to read, signed, and dated as necessary

1.1.2 Report damages or defects

- ✓ Safety and durability of tools & equipment is very important. To check its workability and condition fill up a standard form required by your institution and submit to your facilitator or personnel in-charge of the maintenance for immediate repair or disposal.

✓ Sample Form:

Date Checked	Name of Tools/Equipment	No. of Items (Piece or Unit)	Specification	Condition
06-30-06	Mixing bowl	1 pc	Medium size, glass	With small chip on the rim
	Hand Mixer	1 unit	Electric-driven: 220 volts	No power supply

Self-Check – 6	Written test

Name…… ID…… Date……

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

Test I: Write True or False (2 points)

1. Safety and durability of tools & equipment is very important.
2. Communicate accurate results of both quality checks and actions taken to the relevant people at the appropriate time.

Test II: choose the best answer. (2point)

1. Successful Mixing Process Outcomes includes.
   A. Sensory properties
   B. Functionality
   C. Homogeneity
   D. Particulate integrity
   E. All

Note: **Satisfactory rating - ≥2 points** **Unsatisfactory - below 2 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information sheet – 7 Maintaining work area

2.1 Maintaining work area (housekeeping standards)

Effective housekeeping can help control or eliminate workplace hazards. Poor housekeeping practices frequently contribute to incidents.

Poor housekeeping can be a cause of incidents, such as:

- tripping over loose objects on floors, stairs and platforms
- being hit by falling objects
- slipping on greasy, wet or dirty surfaces
- striking against projecting, poorly stacked items or misplaced material
- cutting, puncturing, or tearing the skin of hands or other parts of the body on projecting nails, wire or steel strapping

To avoid these hazards, a workplace must "maintain" order throughout a workday. Although this effort requires a great deal of management and planning, the benefits are many.

2.1.1 Purpose of workplace housekeeping

Effective housekeeping results in:

- reduced handling to ease the flow of materials
- fewer tripping and slipping incidents in clutter-free and spill-free work areas
- decreased fire hazards
- lower worker exposures to hazardous products (e.g. dusts, vapours)
- better control of tools and materials, including inventory and supplies
- more efficient equipment cleanup and maintenance
- better hygienic conditions leading to improved health
- more effective use of space
- reduced property damage by improving preventive maintenance
- less janitorial work
- improved morale
- improved productivity (tools and materials will be easy to find)

2.1.2 Good housekeeping program plans

A good housekeeping program plans and manages the orderly storage and movement of materials from point of entry to exit. It includes a material flow plan to ensure minimal handling. The plan also makes sure that work areas are not used as storage areas by having workers move materials to and from work areas as needed. Part of the plan could include investing in extra bins and more frequent disposal.

The costs of this investment could be offset by the elimination of repeated handling of the same material and more effective use of the workers' time. Often, ineffective or insufficient storage planning results in materials being handled many times and being stored in hazardous ways. Knowing the workplace layout and the movement of materials throughout it will help when planning work procedures.

Worker training is an essential part of any good housekeeping program. Workers need to know how to work safely with the products they use. They also need to know how to protect other workers such as by posting signs (e.g., "Wet - Slippery Floor") and reporting any unusual conditions.

Housekeeping order is "maintained" not "achieved." Cleaning and organization must be done regularly, not just at the end of the shift. Integrating housekeeping into jobs can help ensure this is done. A good housekeeping program identifies and assigns responsibilities for the following:

- clean up during the shift
- day-to-day cleanup
- waste disposal
- removal of unused materials
- inspection to ensure cleanup is complete

Do not forget out-of-the-way places such as shelves, basements, sheds, and boiler rooms that would otherwise be overlooked.

The final step to any housekeeping program is inspection. It is the only way to check for deficiencies in the program so that changes can be made. Examples of checklists include inspecting offices and manufacturing facilities.

Self-Check – 7	Written test

Name…… ID…… Date…….

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

Test I: Write True or False (3 points)

1. Workers need to know how to work safely with the products they use.
2. The final step to any housekeeping program is inspection.

Test II: choose the best answer.

1. A good housekeeping program identifies and assigns responsibilities for the following:
   A. clean up during the shift
   B. day-to-day cleanup
   C. waste disposal
   D. removal of unused materials
   E. all

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information sheet – 8 conducting workplace environment guidelines

8.1 Conducting workplace environment guidelines

Safe work practices are generally written methods that define how tasks are performed while minimizing risks to people, equipment, materials, environment, and processes. Safe Work Procedures are documented procedures for performing tasks we always conduct our business in a way that considers the environment and which aims to keep any negative impact to a minimum. We always conduct our business in a way that considers the environment and which aims to keep any negative impact to a minimum. This policy is managed by close attention to achieving regulatory compliance and continually improving our environmental performance through careful selection of consumables and working practices designed to reduce waste, energy consumption and emissions.

Awareness of the impact that our activities may have on the environment and the management of measures to control such impacts is encouraged through our environmental principles:

- **Handling chemicals** – these involves procedures on how to handle chemicals in workplace where these are used.
- **Lifting and moving objects** – are procedures that pertain to how objects are to be lifted and moved safely and without strain to the person or worker.
- **Working at heights** – these are procedures that underscore what a worker must observe to keep himself safe while working in an elevated structure or environment.
- **Slips, trips and falls** – are procedures that pertain to safety procedures that should be in place to prevent slips, trips and fall accidents in the workplace.
- **Housekeeping** – are procedures that pertain to how housekeeping activities should be done while keeping in mind safety, health and well-being of workers in a facility or workplace.
- **Electrical equipment** – these are safety procedures that pertain to the installation, repair and maintenance of electrical equipment.

The following steps should be followed to ensure sound Conducting workplaces developed are:

- **Observe the task/activities:** is important to observe the task/activity being performed the preferred way to ensure safest method is documented.
- **Review associated legislative requirements:** Some task/activities are governed by legislative requirements. These must be considered when developing a safe work procedure to ensure any legal requirements are included.
- **Record the sequence of basic job steps:** write down the steps that make up the task/activity.
- **Record potential hazards of each step:** Next to each step identify what may have potential to cause injury or disease
- **Identify ways of eliminating and controlling the hazards:** list the measures that need to be put in place to eliminate or control any likely risk.
- **Test the procedure:** Observe staff/student following the safe work procedure
- Obtain approval: Before the safe work procedure can be used it must be approved by each approver nominated.
- **Monitor and review:** Make sure the activity is supervised to ensure the documented process is being followed

8.1.1 Environmental guidelines

- Work according to applicable environmental laws, conventions, protocols and regulations
- Promote and maintain a positive environmental culture
- Manage our activities to eliminate or reduce any potential negative environmental impact
- Consider sustainability an important element in the way we do business
- Use planning, design and risk assessment to avoid and reduce environmental risk; environmental aspects and registered work are assessed on worksites and projects.

Self-Check -8	Written Test

Name…… ID…… Date…….

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

Test 1: Say true or false for the following questions.

1. _____ Safe Work Procedures performing environment and which aims to keep any negative impact to a minimum. (2 point)

Test 2: Choose the best answer for the following questions.

1. Which of the following are not include Environmental guidelines? (3 points)

a. Work according to applicable environmental laws, conventions, protocols and regulations

b. Promote and maintain a positive environmental culture

c. Manage our activities to eliminate or reduce any potential negative environmental impact

d. Record potential hazards of each step

Test 3: Give short answer for the following questions.

1. Write three environmental principles (3pts

Note: Satisfactory rating – ≥4 points **Unsatisfactory - below 4 points**

.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

LG #49	LO #3- Shut down the mixing/blending 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 • Following shut down process procedures • Identifying and reporting maintenance requirement This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Identify appropriate shutdown procedure • Follow shut down process procedures • Identify and report maintenance requirement
Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the information Sheets 4. Accomplish the Self-checks

Information sheet – 1 Identifying appropriate shutdown procedure

2.1 Appropriate shutdown procedure

A shutdown **p**rocedure is a planned event that impacts a manufacturing or laboratory function by taking the area off line either in partially or entirely for a significant maintenance event or to implement a major project. All major shutdown events require a formally documented plan. The various types of units used in the chemical, hydrocarbons and oil refining industries have differences that affect operation. The procedures outlined in this section are generic and may not apply to all types of equipment.

The types of shutdowns used in a plant unit are:

a. Scheduled shutdown

- ❖ A scheduled shutdown is initiated by the operator during normal operation of the unit when:
  - maintenance is required or
  - Feed supply is low or exhausted.

The shutdown procedure will depend on the type of equipment and the process chemistry. Some steps taken in a unit shutdown may include:

- shutting off the feeds to stop processes and heat generation particularly if processes are exothermic (produce heat)
- recirculating feeds from supply tanks so they do not enter the unit
- shutting off heating or cooling to the unit or feed preheat system
- shutting off mixing and other mechanical operations
- cooling and flushing materials from the unit

b. Maintenance shutdown

- ❖ When maintenance to the unit equipment is required, the equipment may need to be entered so that work can take place.
- ❖ The shutdown should be a scheduled or planned shutdown as per Standard Operating Procedures where equipment is:

- isolated (process, mechanical and electrical)
- cooled and depressurized
- purged and gas freed
- cleaned
- gas tested on a continuous basis prior to and during entry.

❖ A planned unit shutdown will prevent:

- plugging of lines or equipment
- possible damage to equipment
- possible injury.

❖ To prepare the unit for shutdown, the unit may need to be:

- thoroughly drained and pumped out to remove chemical liquids
- purged with steam or inert gas to remove vapours
- solvent washed to remove deposits that build up on the equipment's internal surfaces
- flooded with water or a solvent to remove any remaining chemicals
- any chemicals trapped in the unit must be flushed out.
- isolated to prevent the entry of hazardous chemicals
- drained
- steam cleaned to remove remaining deposits.

❖ During decontamination, regular sampling of the atmosphere inside a unit vessel is required to ensure toxic or explosive atmospheres do not build up inside the unit that could be a hazard to equipment or personnel.

❖ Gas testing must be carried out before anyone enters the vessel to ensure the atmosphere is not toxic, explosive or oxygen deficient.

c. Emergency shutdown

- An emergency shutdown is initiated in the event of a fire, major spill, instrument failure, power failure, or total loss of control of chemical or physical processes.
- Emergency shutdown procedures must be followed during a shutdown sequence.

d. Trips

- ❖ Shutdown of a unit can be initiated by the automatic shutdown system. The systems may be shut down automatically because of temperatures, fluid levels, pressures or flows that are above or below trip points.
- ❖ Typical shutdowns initiated by trips may include:
  - low liquid level in a vessel
  - high liquid level in a storage tank
  - high viscosity causing increased load on pumping or mixing equipment
  - mixer failure
  - pressure to high
  - temperature to high
  - low feed flows.

e. Shutting down to a standby condition

- ✓ When a unit is to be shut down for a short period of time for maintenance on auxiliary equipment, the unit is shut down to a standby condition.
- ✓ A standby shutdown allows a quick startup of the unit after maintenance is completed in order to minimize lost production time and offspec material.
- ✓ Standard Operating Procedures must be referred to when shutting down each type of unit to a standby condition.

- A typical standby condition may include:
- recirculating material upstream and downstream
- reduced heating or cooling (sufficient to maintain a safe process condition)
- slow-rolling compressors
- venting process gases to flare
- diverting process streams to temporary storage.

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: Write True or False (2 points each)

1. Which is a type of shutdowns used in a plant unit?
   A. scheduled shutdown
   B. maintenance shutdown
   C. emergency shutdown
   D. all
2. The followings are not steps taken in a unit shutdown:
   A. shutting on the feeds to stop processes and heat generation
   B. shutting on heating or cooling to the unit or feed preheat system
   C. shutting on mixing and other mechanical operations
   D. cooling and flushing materials from the unit

Note: **Satisfactory rating - ≥2 points** **Unsatisfactory - below 2 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information sheet – 2 Following shut down process procedures

2.1 Shut down process procedures

❖ In achieving this unit you must have:

- ✓ effectively obtained operational instructions
- ✓ accurately determined shutdown time and made appropriate preparations for shutdown
- ✓ effectively briefed relevant personnel on shutdown procedures
- ✓ accurately identified real and potential hazards and protected against them
- ✓ ensured that all information supplied and recorded is accurate, complete and legible
- ✓ worked safely in accordance with operational instructions and associated Safe Systems of Work

Knowledge and Understanding

You must know and understand:

1. how to access and interpret (oral and written) shutdown instructions
2. how to access and interpret operational instructions (to include sequence of shutdown, recommended rate of shutdown)
3. the real and potential shutdown hazards (to include standby equipment operational, vents, noise, heat)

❖ **The types of shutdown process**

a) Item shutdown

It shutdown only the equipment item, without shutting down the entire process or plant.

b) Maintenance shutdown

A Maintenance shutdown will consists of shutting down, then fully isolating, draining and purging an equipment item to make it safe for maintenance work.

c) Unit shutdown

A Unit shutdown will shut down only the process unit in the plant, but not shutdown the entire plant, many units will feed to storage tanks so that downstream processes can take their feed from the storage and continue to operate when another unit is offline.

d) Total shutdown

A Total shutdown will shut down an entire plant.

Fig Difference between types of shut down

e) Emergency shutdown

An Emergency shutdown due to fire, spills or gas release, will shut down an equipment item as quickly as possible, then depressurize and drain equipment and lines to leave them in the safest possible condition.

Fig Alarm button to silence

- **Shut down procedure of tempering equipment**

1. Shut off tempering equipment at stop/start switch.
2. Shut off at disconnect behind tempering equipment.
3. Apply lock to disconnect.
4. Attempt to start tempering equipment, reset or return switch to “off” position.
5. Complete work on tempering equipment.
6. Check the tempering equipment are empty of any loses

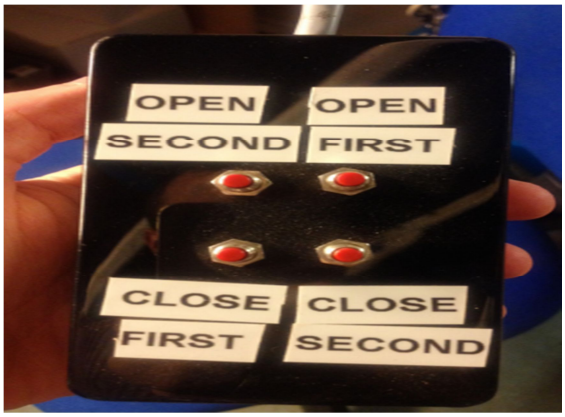


Fig close/open button

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. What is needed to shutdown process (4 points)

Note: **Satisfactory rating - ≥2 points** **Unsatisfactory - below 2 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information sheet – 3 Identifying and reporting maintenance requirements

Identifying and reporting maintenance requirements

❖ Preventive/Predictive Maintenance Indicators of Ineffective PPM

- Low equipment utilization due to unscheduled stoppages
- High wait or idle time for machine operators during outages
- High scrap and rejects indicative of quality problems
- Higher than normal repair costs due to neglect of proper lubrication, inspections or service.
- Decrease in the expected life of capital investments due to inadequate maintenance

1.1.1 Identifying Maintenance requirements

Maintenance requirements are dependent on the size and type of mechanical equipment, transportation of equipment parts, as well as access requirements for tool and lifting clearances.

Maintenance requirements fall into the following categories:

1. **Operational checks to simulate automatic start-up, shut down and emergency shut down**
2. **Inspection and maintenance**
    - **Hardware control systems**
    - **Hydraulics**
    - **Electrical control signals and power system**
    - **Braking system**

The maintenance safety requirements are carried out. The requirements state before a permit for work issued, the following requirements must be carried out:

1. **All electrical sources must be isolated and secured in the open position, by locking and providing caution notes.**
2. **All sources of energy that can cause danger must be dissipated or contained.**

Fig maintenance

3.1.2 Reporting maintenance requirements

- **Reporting maintenance**

The report shows maintenance details of each in the time range, including the setup/takedown time, instructions, Event Time, Facility, Event, ID (Rental, Contract or Event), Service, And Customer.

- **Reporting faults and problems: maintenance**

Every work shop has a different maintenance schedule and it is important that you are familiar with the schedule implemented on the work shop where you work.

There will usually be a routine schedule for particular tools that states how often maintenance checks have to be performed. These will also specify the checks that have to be performed. Some tools may require daily checks and maintenance after use. Other tools, such as power tools, usually must be checked once in 6 months or so. More complicated power tools would need to be serviced on a regular interval; refer to the operation manual.

A maintenance schedule assigns a specific date to specific maintenance tasks. It states what has to be checked and will require that the assigned person signs off the document assuring that the checks were done. If faults are found, the tool must be sent for maintenance and the assigned person that fixes the tool has to report on exactly what was done and when it was completed.

An example of checklist is for how to fill or document maintenance required and report performed maintenance is given below.

Table.2 maintenance schedule

Date	Tool	Maintenance check points	Signature	Maintenance required	Signature
10/2/2013	Chocolate Tempering Machine	screws		Fit the screw	

Maintenance Performed	Date	Signature
Chocolate Tempering Machine	October22,20	

Uses

- **Additional work that is either manually entered or automatically created as an alarm or disturbance can be planned and performed.**

- **Updated maintenance statistics enable you to follow-up on your maintenance**
- **The next scheduled service is available for work**

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 II: Short Answer Questions

1. Write simple guidelines for all types of equipment, covering the tasks to be undertaken (4 points)

Note: **Satisfactory rating - ≥2 points** **Unsatisfactory - below 2 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Reference Materials

https://www.foodingredientfacts.org/facts-on-food-ingredients/what-are-food-additives/

https://www.researchgate.net/publication/340620948_Food_Additives_and_Food_Preservatives_for_Domestic_and_Industrial_Food_Applications

https://www.researchgate.net/publication/221925228_Food_Additive

https://www.researchgate.net/publication/340182304_Monitoring_Mixing_Processes_Using_Ultrasonic_Sensors_and_Machine_Learning

https://bakerpedia.com/processes/baking/

https://www.foodingredientfacts.org/facts-on-food-ingredients/sources-of-food-ingredients/

https://www.foodingredientfacts.org/facts-on-food-ingredients/

https://www.coperion.com/en/industries/food-pet-food/ingredient-transfer-handling

https://www.kraftwhatscooking.ca/article/10-steps-to-successful-baking-000000167

http://bakingstories.blogspot.com/p/12-steps.html

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