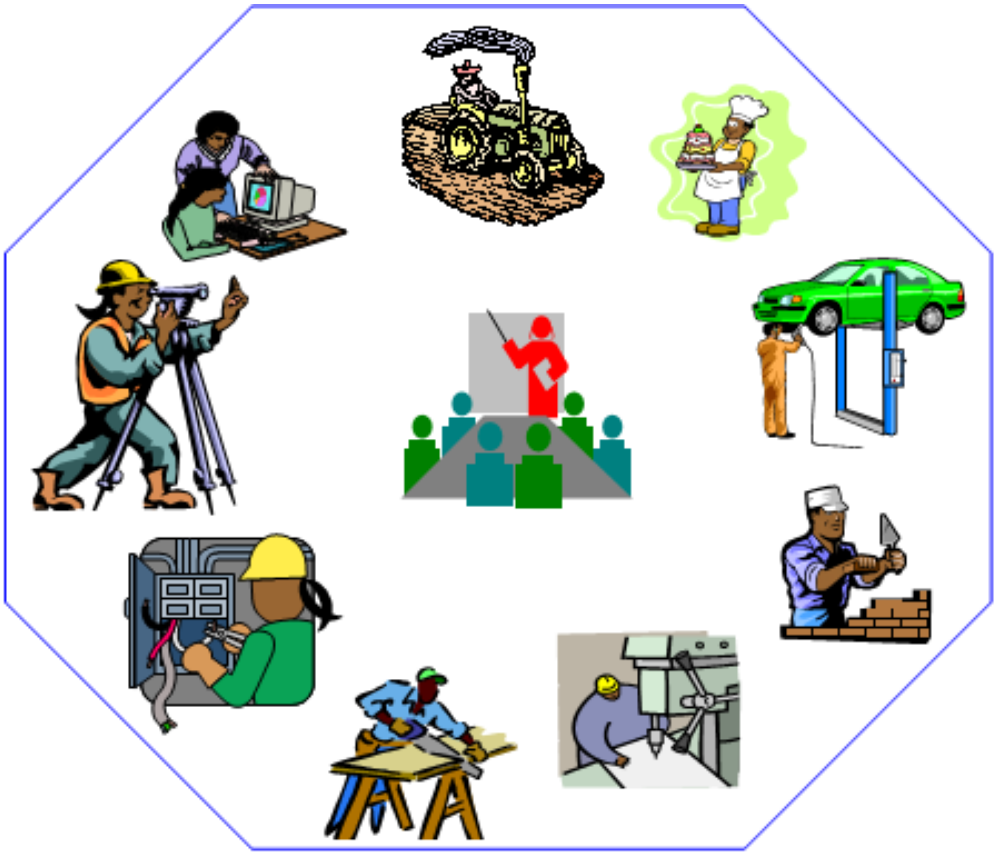
Fruit and Vegetable Processing Level III

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



Module Title: - Conducting Chemical Wash for Fresh Produce

LG Code: IND FVP3 M06 LO (1-4) LG(15-18)

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LO #4- Shut down the washing process .. Error! Bookmark not defined.

LG #15	LO #1- Confirm required use of chemicals

Instruction sheet

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

- Identifying chemicals used for washing of fresh produce and confirming required levels.
- Identifying risk associated using chemical and implementing control measures
- Identifying implication of incorrect chemical levels
- Identifying storage and handling requirements for chemicals

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:

- Identifies chemicals used for washing of fresh produce and confirm required levels.
- Identifies risk associated using chemical and implement control measures
- Identifies implication of incorrect chemical levels
- Identifies storage and handle requirements for chemicals

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
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6. If your performance is satisfactory proceed to the next learning guide,

Information Sheet 1- Identifying chemicals used for washing of fresh produce and confirm required levels.

A chemical is a form of matter having constant chemical composition and characteristic properties. Some references add that chemical substance cannot be separated into its constituent elements by physical separation methods, i.e., without breaking chemical bonds. Chemical substances can be simple substances, chemical compounds, or alloys. Chemical elements may or may not be included in the definition, depending on expert viewpoint.

1.1. Chemicals used for washing fruit and vegetable are:

- Sodium/calcium hypochlorite
- Peroxyacetic acid
- Chlorine (free chlorine, combine and total chlorine
- Potassium permanganate and etc

Required chemical confirm based on:

- concentration
- level of chemical
- types of chemical

1.2. Equipment used for wash fresh produce

- Water tank
- Flumes
- Pumps
- Water baths
- Hoses
- Conveyor and etc

Chlorine: Free or available chlorine is used to describe the amount of chlorine in the form of chlorine gas, hypochlorous acid or hypochlorite ion. The rate at which bacteria are inactivated is proportional to the concentration of available chlorine.

• Combined chlorine is the quantity of chlorine that has reacted with nitrogen-containing compounds in the water such as ammonia to form chloramines that do not work well in a sanitizing capacity.

• Total chlorine is the sum of free (available) and combined chlorine

1.3. Chemicals used for washing fresh produce and required levels

Generally, maintaining 2-7 part per million (ppm) of free chlorine and a pH of 6.0-7.5 in wash water at all times is sufficient to kill bacteria in water. However, it is recommended that fresh fruit and vegetables packers add 50-150 ppm of total chlorine to their wash water to start.

Potassium Permanganate Chemistry

Fresh fruits and vegetables, while extremely healthy, can also pose a danger. Some fruits and vegetables are exposed to pests that can carry bacteria and diseases, as well as destroy crops. Exposure of fruits and vegetables to chemical pesticides to deter pests leaves residues that can also harm humans. Washing fruits and vegetables with a solution of potassium permanganate can help eliminate both pesticide residue and harmful bacteria.

Chemically, potassium permanganate consists of one potassium or K ion, one manganese or Mn ion, and four oxygen or O ions, in the chemical formula KMnO4, according to Hepure Technologies. Also known as Condy's crystals, a dilute potassium permanganate solution appears slightly purplish-pink. About 7 grams of pure purple-bronze potassium permanganate crystals can dissolve in about 100 grams of water. Much more dilute solutions are used, however, when washing fresh fruits and vegetables.

Sodium hypochlorite solutions are clear, greenish to yellow liquids with an odor of chlorine.

Calcium hypochlorite is a white solid that readily decomposes in water releasing oxygen and chlorine. It also has a strong chlorine odor. ... Sodium and calcium hypochlorite are used primarily as bleaching agents or disinfectants

Peroxyacetic acid, which is also known as peracetic acid or PAA, is a commonly used sanitizer in the produce industry. PAA goes by many trade names, such as Sanidate 5.0, VigorOx 15 F&V, BioSide HS-15%, and Tsunami 100, all of which are a mixture of PAA, water, hydrogen peroxide and acetic acid

Washing tank: Washing tanks Stainless steel tanks with their respective band and drive system and recirculation system and spraying water to wash different products. ... proceed granulating and water cleaning at the same time.The fruit is filled on the tank through a basket, washed and kept in motion thanks to nozzles that inject air inside the tank, producing a grumbling effect that removes impurities and soil residues from the product.

The Flume Wash is suitable for a variety of fresh-cut produce including shredded, chopped, and whole leaf lettuce, cabbage, baby spinach, and spring mix as well as whole, sliced, and diced vegetables and fruits. It handles up to 3000 kg (6600 lb) of leafy product or 7000 kg (15,400 lb) of fruits or vegetables per hour. Processors can cut directly over the flume entry area or feed the wash system from a belt, shaker, or manually. The initial laminar flow provides a gentle product entry while adjustable water nozzles create a full immersion section in each flume for thorough washing and product mixing. The open flume provides dosification access for sanitation agents.

Figure -1- Flume washer

1.4. Factor affecting chlorine activity

- Contact time
- PH of solution
- Water temperature

Self-check 1	Written test

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

Test I: Short Answer Questions

1. Write atleast three chemical used to wash fesh produce ?(4pts)
2. Write the difference between total chlorine with combined chlorine ?(3pts)
3. Mention atleast two factor affecting chlorine activity? (3 pts)

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

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

Score = _____

Rating: _____

Information Sheet 2- Identifying risk associated using chemical and implementing control measures

2.1. Risks associated using chemicals

The assessment of health risks of chemical substances is a continuous process where information of the chemical hazards is made available through a variety of sources. It is well established that pathogenic microorganisms associated with whole or fresh-cut produce can cause disease outbreaks, thereby demonstrating the need for improved mitigation efforts to reduce risks associated with these products.

What are the risks of using chemicals?

Depending on the chemical, these longer-term health effects might include:

- Organ damage.
- Weakening of the immune system.
- Development of allergies or asthma.
- Reproductive problems and birth defects.
- Effects on the mental, intellectual or physical development of children.
- Cancer.

1.2. Implement control measure of risk chemical

- Improving safe use of chemicals can be achieved at deiferent levels
- Technical measures can be used prevent hazards at source and to prevent the transfer of dangerous chemicals.
- Adjust the pH of water
- Adjust the concentration of washed chemicals
- Proper use of chemical ratio with water amount
- In most systems the level of microbial reduction on the surface of fruits or vegetables is generally thought to be 1-2 logs.
- use washing and sanitizing protocols that are efficient.

Self-Check – 2	Written test

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

Test I: Write Short Answer Questions

1. Write atleast three risks of using chemicals?(4pts)
2. Mention two control measure of risk chemicals ?(4 pts)

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

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

Score = _____

Rating: _____

Information Sheet 3- Identifying implication of incorrect chemical levels

3.1. Incorrect chemical levels

- causes raw material damage or change texture of product
- Accelerate quality decay by accumulation of chemical in some areas of the product
- Affect worker health condition
- Shrinkage of washed product
- Accidents or incorrect use of household chemical products may

cause immediate health effects such as:

✓ skin or eye irritation or burns or poisoning.

There can also be longer-term health effects from chemicals. When these occur, they are usually the result of exposure to certain chemicals over a long period of time

Chlorine concentrations that are too high can damage the product and harm employees. Concentrations that are too low will not adequately control the growth and survival of microorganisms that cause spoilage and human illness.

High levels of chlorine can cause pitting or burning of the product and can be hazardous to workers.

3.2. Potential health risks

The health risks of chemicals depend on several factors, including:

- the type of chemical
- the amount you're exposed to
- when and how long you are exposed
- how you're exposed (through food, water, air, products)
- your age and general state of health

3.3. Potential health effects

Accidents or incorrect use of household chemical products may cause immediate health effects, such as skin or eye irritation or burns, or poisoning.

There can also be longer-term health effects from chemicals. When these occur, they are usually the result of exposure to certain chemicals over a long period of time.
Depending on the chemical, these longer-term health effects might include:

- organ damage
- weakening of the immune system
- development of allergies or asthma
- reproductive problems and birth defects
- effects on the mental, intellectual or physical development of children
- cancer

Self-Check – 3	Written test

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

Test I: Write Short Answer Questions

1. Define define the variation of chlorine concentration?(3pts)
2. Write at least two incorrect chemicals? (3pts)

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

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

Score = _____

Rating: _____

Information Sheet 4- Identifying storage and handling requirements for chemicals

4.1. Storage and handling requirements of chemicals

During handling chemicals Check the label to verify it is the correct substance before using it.

During handling chemical Wear appropriate chemical resistant gloves before handling chemicals, label chemical containers as to the content, concentration, hazards, date, and your initials, use spatula to remove a solid reagent from a contaniners, donot directly touch any chemical with your hands,Use a hot water bath to heat flammable liquids. Never heat directly with a flame,Add concentrated acid to water slowly. Never add water to a concentrated acid, Weigh out or remove only the amount of chemical you will need. Do not return the excess to its original container, but properly dispose of it in the appropriate waste container, Never touch, taste, or smell any reagents.

When transporting chemicals (especially 250 mL or more), place the immediate container in a secondary container or bucket (rubber, metal or plastic) designed to be carried and large enough to hold the entire contents of the chemical.

During storage, the degradation of chlorine solutions leads to the formation of chlorate/perchlorate. These degradation products are introduced into the wash water during chlorination and it is undesirable to have these degradation products absorbed into the fresh produce.

To avoid this, chlorine solutions should be stored in the dark, at cool temperatures, and in diluted solution if possible. Also, it is preferable to use sodium hypochlorite (NaClO) solutions within a few weeks after production. At 5 °C, the degradation is very limited in the absence of heavy metal contamination, and with an increase in temperature of 10 °C, the degradation rate increases

Cleaning and sanitizing chemicals may be toxic, and should be stored in dry, secure, and ventilated areas away from facility traffic and processing operations. They should be handled by employees trained in the use of such chemicals.

Store in air-tight non-metallic containers, away from heat, light and humidity in a ventilated area. Carefully close containers after use, Never place them in contact with water, acid, fuel, detergents, organic or inflammable materials (e.g. fruit and vegetable, paper or cigarettes), Clearly labeling toxic chemicals

Storing toxic chemicals in a manner that protects against contamination of food, food-contact surfaces, and food-packaging materials be fixed with chains to upright position and the acids in the area or cupboard meant only for them. The fumes or splashes should never reach the area where tanks are kept.

Written instructions of storage practices should be provided, and chemical safety data sheets of dangerous substances kept in stock should be available in the storage area.

Figure-1. Chemical(liquid chlorine) storage area

Self-Check – 4	Written test

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

Test I: Short Answer Questions

1. Mention at least two chemical handling system?(4pts)
2. Wrtite at least three procedure to cleaning and sanitizing chemicals?(4pts)

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

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

Score = _____

Rating: _____

LG #16	LO #2- Prepare for washing operation

Instruction sheet

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

- confirming and preparing raw material for washing
- confirming, fitting and adjusting washing equipment and its components
- carrying out Pre-start checks
- measuring and adding chemical dose
- checking performance of chemical dosing equipment
- checking and confirming water quality

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 prepare raw material for washing
- Confirm, fit and adjust washing equipment and its components
- Carry out Pre-start checks
- Measure and add chemical dose
- Check performance of chemical dosing equipment
- Checks and confirm water quality

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Information Sheet 1- confirming and preparing raw material for washing

1.1. Raw materials required for washing of fresh produce

- Fruits like (apple, mango, orange, pineapple, and others) and vegetables like(tomato, cabbage, carrot and others)
- Potable water

Fruit and vegetables confirm based on:

- Smoothness
- Rippness
- Maturity
- Appearance
- Visual inspection and others confrimitiy assessments
- Firmness
- Texture

fresh produce at the before stores clean external parts of product in order to minimize soils, debris, remove dirty. If you wash your produce and let it air-dry completely, you can help reduce the risk. The ingredients in this produce wash are not able to kill the microorganisms, but they can help break up debris on the surface of your produce.

Figure-2. Ready fresh produce for wash

1.2. prepare chemical for wash

Work in a well ventilated room or, better still, outside in the shade but protected from the wind.

- Wear personal protective equipment
- Prepare solutions with clean, cold (or room temperature) water, in plastic containers only (corrosion of metal, inactivation of chlorine).
- Respect the recommended dilutions (an over-diluted product is less active; an over-concentrated product can cause irritation and corrosion).
- Use a clean, dry, plastic or glass receptacle to measure the dose of product or the measurer (e.g. measuring spoon) provided by the manufacturer.
- Pour the amount of water required into a container then add the product (and not the other way round) without splashing. Mix well using a clean stirrer used only for this purpose.
- Do not add any other product (e.g. a detergent) to chlorine solutions.
- For calcium hypochlorite, leave the solution to rest for a few minutes and only use the supernatant. Transfer the supernatant into another receptacle and discard the calcium residue into a waste pit after each preparation.
- Label the containers, specifying the chlorine concentration.

1.3. Quality Attributes of fresh produce

Quality attributes of fresh fruits and vegetables can be classified into three classes according to the occurrence of product characteristics when they are encountered or consumed:

Table 3. Quality attributes of fresh product

Class of attribute	**Quality attribute**	**Measurement of quality attribute**

External	Appearance (sight)	Visual evaluation of size, shape, gloss and colour May be accompanied by visual guides and colorimeters
	Feel (touch)	Manual evaluation of firmness and texture May be accompanied by mechanical texture analysis
	Defects	Visual evaluation of absence of defects or deterioration of colour May be accompanied by mechanical methods (e.g. ultrasound)

1.4. Quality control and assurance

Quality control (QC) is the process of maintaining an acceptable quality level to the consumer. Quality assurance (QA) is the system to assure that the overall QC job is being done effectively. Quality control starts in the field with the selection of the proper time to harvest until marketing

1.5. Purpose of confirming materials availabilitity for washing

- To ensure the performance of materials
- To achieve the exact washing goal
- To maintain materials if it is needed

Self-Check – 1	Written test

Name…… ID……

Date…….

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

Test I: write the Short Answer Questions

1. List raw materials reuired for washing?(3pts)
2. Write at least two Purpose of confirming materials availability (4pts)
3. Write three quality attributes of fresh produce?(3pts)

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

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

Score = _____

Rating: _____

Answer sheet

Test I

1_____

2_____

3. _____

Information Sheet 2- confirming, fitting and adjusting washing equipment and its components

2.1. Introduction

Definition of fitting and adjusting equipment components

Fitting is make correct and proper the equipment components for washing fruit and vegetables and adjusting means prepare or checking the washing and operation of fruit and vegetable washing equipment. Optimal adjustiment needs a direct expression of fuctional requirements usually, assembly and positioning are two fuctional studied requirements having geometrical expression one way of improving product quality is in controlling the geometrical tolerance by:- Either adjusting washing equipment in order to respect at best a set of standard functional requirements applied to a part, Simulating the geometrical effect of manufacturing fault causes and adjustment Parameters (temperature, time and pressure) in the respect of functional requirements. In fruit and vegetable washing process operation any spare art must fit and adjustable like Temperature, time and pressure parameter that fit the washing equipment in order to get the final quality

2.2. Washing equipment required for wash fruit and vegetables

- Wash baths
- Tanks
- Hoses
- Pumps
- Flumes
- Brush spray fruit washing machine
- roller

2.3. washing tank for fruit and vegetable and its components

washing tank with grumbling effect suitable to the working of fruit and vegetables.

Completely built in stainless steel AISI 304, equipped with basket for the washing of the product.

The fruit is filled on the tank through a basket, washed and kept in motion thanks to nozzles that inject air inside the tank, producing a grumbling effect that removes impurities and soil residues from the product.

2.3.1. washing tank for fruit and vegetable and its components

washing tank with grumbling effect suitable to the working of fruit and vegetables.

Completely built in stainless steel AISI 304, equipped with basket for the washing of the product.

The fruit is filled on the tank through a basket, washed and kept in motion thanks to nozzles that inject air inside the tank, producing a grumbling effect that removes impurities and soil residues from the product.

Figure .2. washing tank

2.3.2. components of fruit and vegetable washing tank

- Total water drainage valve for the cleaning
- Overflow valve
- Valve
- for water entry
- Blowing pump for air distribution to guarantee grumbling effect
- Inside pierced moving basket for product holding complete of hooks for the raising
- The dimensions of the washing tank change according to the required productivity capacity
- Complete of on/off buttons

Brush Type Vegetable & Fruit chemical wash Machine

Figure -3. Brush type washer

The fruit and vegetable raw materials are making irregular rotation under the effect of rotary brush roller to carry out spraying and brushing simultaneously. The brush is made of high temperature resistant nylon wire through two kinds of technologies such as hair planting and stainless steel winding.

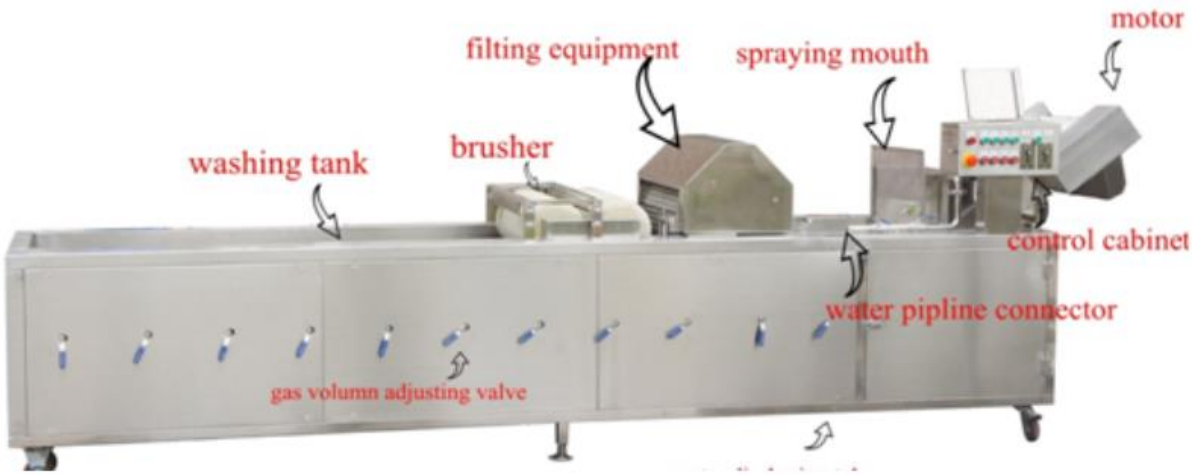

Figure-4. Multi fuctional washer

2.4 Components of washing and features of machine

2.4.1. Components of fruit and vegetable washing equipment/ machine

- Washing tank
- Brusher
- Filling equipment
- Spraying mouth
- Motor
- Gas volume adjusting valve
- Control cabinet
- Water pipe line connector

Figure- 5 tomato wash in conveyor

2.4.2. **Features of washing machine**

- High-pressure air bubble and spraying water on the end of the machine can washing off dirt, sands, and other residue.
- Continuously supply water for spraying and high-pressure. And the supplying water can be adjusted.
- There are many gas regulator which can adjust gas supply.
- It is equipped with filter and filtering water tank which can separate residue and hair and other things
- It has ozone sanitizer which can clean pesticide residue on fruit and vegetable
- one side is wider 150-250mm which is convenient to put basket or other things. It is made based on customer's requirement.
- The speed can be adjusted

2.5. Purpose of fitting and adjusting washing equiment components

optimal adjustment of a equipment/machine for, status and purpose of guards, equipment operating capacities and, Applications, and the purpose and location of sensors and related feedback instrumentation, to improve the quality of its manufactured products**,** improving the geometrical quality of machined parts,minimize machine error, increase capacity

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 the short Answer Questions

1. Write difference between fitting and adjusting?(3pts)
2. List out at four washing equipment for fruit and vegetable? (4pts)
3. Mention the components of washing tank? (3 pts)

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

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

Score = _____

Rating: _____

Answer sheet

Test I

1_____

2._____

3._____

Information Sheet 3- carrying out Pre-start checks

3.1. introduction

3.1.1. Meaning of pre-start checks activity includes

Monitor and adjust process equipment to achieve required quality outcomes and take corrective action in response to typical faults and inconsistencies Visual inspections of important features prior to starting the machine, Visual & function tests while the machine is turned on but stationary

Testing the machine's functions during a short drive, Positioning sensors and controls correctly,

Ensure any scheduled maintenance has been carried out, Place sand filters/scourers in base of percolators

3.2. **pre-start checks**

3.2.1. Equipment start up and operation procedures

Undertaking a pre-start check on our washing equipment before we start a washing process, happens in three steps.

- Visual inspections of important features prior to starting washing equipment
- Visual and function tests while the equipment is turned on and adjust washing chemical level
- Measure and adjust chemical dose for start function
- As part of our daily routine we should check the various chemical level and efficiency of washing equipment.
- To ensure washing equipment is not damaged on start-up and also to prevent possible injury to personnel during start up, the operational status of safety systems must be checked.
- Ensure that washing equipment is properly fitted and adjusted.

- Start chemical washing equipment in accordance with the organizations or manufacture's guidelines.
- Use safety guards or safety clothing (if applicable). Some chemicals can have areas that can cause injury after washing product. our workplace policies and procedures should include detailed information on how to clean, start and operate washing equipment.
- You should receive training in the safe operation of this washing chemicals and washing equipment.
- you will be required to wear appropriate PPE including goggles, gloves, hairnets, safety boots or shoe covers. It is your responsibility to ensure we wear the PPE correctly.

3.3. **Required equipment for Pre-operational checks includes**

- Pre-start and safety checks including the service and maintenance system.
- Checking level of chemical, type equipment with respective oil seed type, fuel, and lubricants needed, fan belts, lines, connections and transmission.
- Inspection of safety guards
- Checking and confirming equipment calibration settings and operating methods
- Observing and monitoring noise levels for correct operation.
- Preparation of independently powered tools may include cleaning, priming, tightening, basic repairs and adjustments.
- Identify and segregate unsafe or faulty equipment for repair or replacement

3.4. **Purpose of pre-start checks**

- To make the process easy
- To reduce high chemical dose effect
- To take action before cause happen

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 the short Answer Questions

1. Write atleast two purpose of pre start checks?(4pts)
2. List at least two required equipment for pre operational checks? (4pts)

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

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

Score = _____

Rating: _____

Answer sheet

Test I

1_____

2_____

Information Sheet 4- Measuring and adding chemical dose

4.1. introduction

4.2. measuring and adding chemical dose

There are many different ways to measure free chlorine, including

- Color changing test strips
- Colorimetric titration methods
- Manual color wheels
- Photometric instruments
- Indirect electronic probes
- Ion-specific

Color changing test strips

Test strips are convenient tools for rapid, semi-quantitative analysis of a variety of parameters by dipping them for a few seconds in a sample solution followed by a simple colorimetric read-out. Their sensitivity is mainly determined by the reactivity of the test dyes on the reaction zone and is not sufficient for some applications. The detection limit of commercially available free chlorine test strips, for example, is at present not low enough to confirm the absence of this analyte as disinfectant in rinsing solutions after disinfection or to control required residual amounts of chlorine in drinking water

Figure 4.1. chlorine test stripe

Colorimetric titration methods:

Colorimetric analysis is a method of determining the concentration of a chemical element or chemical compound in a solution with the aid of a color reagent. It is applicable to both organic compounds and inorganic compounds and may be used with or without an enzymatic stage

Manual color wheels:

Color wheel test kits use a powder or tablet chemical DPD (N,N diethyl-p-phenylene diamine) that causes a color change to pink in the presence of chlorine. ... The test kit can be used to measure free chlorine and/or total chlorine, with a range of 0 – 3.5 mg/L, equivalent to 0 – 3.5 ppm (parts per million).

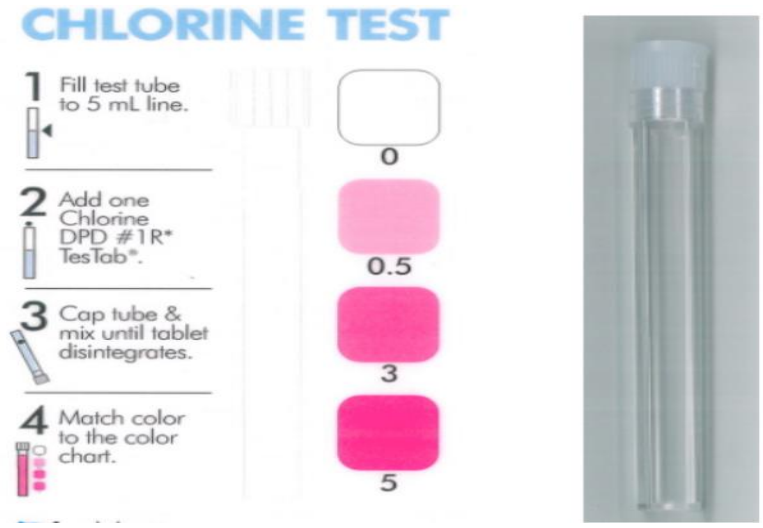

Figure 4.2. manual color wheels

Each of these methods represents trade-offs between cost, simplicity of use, and accuracy and precision. For example, the test strip might be viewed as the simplest method to use: dip the strip in the water, and match th e color to a preprinted chart. However, there is more that needs to be known:

a. The increments of measurement on the preprinted chart must be considered. For example, they might be 5, 10, 15, 20, and 25 ppm; these increments imply an accuracy of no greater than ±2.5 ppm (half the distance between the increments). So a reading of 10 is most

likely between 7.5 and 12.5 ppm. If 10 ppm is the critical limit that has been set, then the operational limit must be set at least to the next increment higher, i.e., 15 ppm.

b. The precision of the method must be considered. A test strip responds to the amount of chlorine presented to it, the time that the strip is left in the water, how the drop at the end of the strip is allowed to dry or is shaken off, and how long the technician waits before reading the color. All can contribute to the final color reading. This precision, or lack thereof, can contribute from 5 to 10 ppm of additional error in the reading of chlorine. If an additional ±5 ppm is assumed, coupled with the accuracy error, it is then necessary to have an operational limit of at least 20 ppm to assure that the system does not fall below a real value of 10 ppm.

c. Another important consideration is pH. Test strips respond to any form of free chlorine, including hypochlorite ion, which has poor antimicrobial effectiveness. The pH of the water must be determined to ensure that the predominant chlorine species are the active ones.

The maximum allowable level for non rinse application is 200ppm available chlorine but recommended usage level vary.

The FDA analysis is evaluation of preventive control measures for the control reduction/eliminations of microbial hazards on fresh cut produce. It is well established with whole or fresh cut produce can cause diseas out breaks

Determining how much total chlorine to start with in your wash and flume water will depend on what type of product you are washing, the amount of organic matter that collects in the wash water and how often you change the water. For example, field tomatoes will have more soil than greenhouse tomatoes and the chlorine will be used up faster. we will need to determine the initial amount of total chlorine to add to wash or flume water, the frequency at which you need to check chlorine levels, how much chlorine we need to add throughout a typical day and how often we need to change water:

Choose a total chlorine level between 50-150 ppm and, using the chorine conversion below,add the required amount of chlorine to your wash water.

Check the chlorine level after a few minutes to ensure that you have added the correct amount (using total chlorine test strips or probe) or that free chlorine levels are between 2-7ppm (using free chlorine test strips or probe).

For the first several days (go through several water changes), continue to check the free chlorine levels at a relatively high frequency (every hour or every product load) to ensure levels do not drop below 2-7 ppm.

As chlorine levels start to drop below 2-7 ppm add more chlorine as required.

If you can no longer maintain free chlorine levels between 2-7 ppm, empty and rinse out the wash or flume tank and refill. Adding a filtration system or scooping out organic matter with a net can also help to maintain the potability of the water.

Table 2. chemical conversion

Target ppm	ml/L	tsp/5 gal	cup/50 gal
Sodium Hypochlorite 5.25%			
50	0.95	3 ⅔	¾
75	1.43	5 ½	1 1/10
100	1.90	7 ¼	1 ½
125	2.40	9 1/10	1 ⅞
150	2.90	10 ⅞	2 ¼
Sodium Hypochlorite 12.75%			
50	0.39	1 ½	⅓
75	0.59	2 ¼	½
100	0.78	3	3/5
125	0.98	3 ¾	4/5
150	1.18	4 ½	9/10

4.2. Chlorine Conversion

These calculations are to be used to determine the amount of chlorine required to treat fluming and cleaning water and control microbial growth. Refer to Section 1: Water Treatment (above) to determine the level of chlorine required for the produce we will be fluming or cleaning. Carefully read the ingredient label to ensure there are no other chemical additives.

1. Determine pH of fluming or cleaning water using a pH test strip. Add organic acids as necessary to adjust the pH.

2. Determine the concentration of chlorine required. Convert the concentration to parts per million (ppm).

Example – if a chlorine concentration of 5.25% (standard household bleach) is used: 5.25/100 = 0.0525

Parts per million = 0.0525 X 1 000 000 = 52 500 ppm

1. Calculate the dilution factor.

   Example – if a chlorine level of 125 ppm is required:

   Dilution factor = 52500ppm/125ppm = 420

2. Determine the amount of chlorine needed.

   Example – if the volume of water is 1000 L: 420/1 = 1000/X Then X = 2.38

   Thus, 2.38 L of chlorine is required per 1000 L of water; or 2.38 ml of chlorine per 1 L of water.

4.3. Purpose of adding chemical during washing fruit and vegetables

The purpose of adding chlorine to wash and flume water is to keep the water potable, not to sanitize the product. Chlorine can be used effectively to kill microorganisms present in wash and flume water, but the effectiveness of chlorination depends on the following factors:pH of Water, Organic Matter,Contact Time and Water temperature

https:// measuring and adding chemical dose

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 the short Answer Questions

1. Write at least three ways of measure free chlorine ?(5pts)
2. Write purpose of adding chemical during washing fruit & vegetables? (5pts)

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

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

Score = _____

Rating: _____

Answer sheet

Test I

1_____

2_____

Information Sheet- 5 :checking performance of chemical dosing equipment

5.1. introduction

5.2. performance of chemical dosing equipment

There are many chemical dosing equipment used for chemical wash fresh produce. These are water tanks, hoses, pumps and flumes and other equipment**.**

5.2.1. features of chemical dosing pump

- Easy installation and opertation
- It has high precision, adjustable out put
- Strong chemical corrosion resistance; economical and practical
- Metal reinforced diaphragm and long use

5.2.2. hose assembly feature

- Fully tested
- Statically bonded
- braided
- Textile
- Choose from 4m, 6m or long assembly use stainless steel adaptor to make hose endes 3/4

Figure -6. hoses

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 the short answer questions

1. Write at least three chemical dosing equipment? (3pts)
2. List at least two features of chemical dosing pump?(4)

Note: Satisfactory rating - 4 points Unsatisfactory - below 4 points

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

Score = _____

Rating:

Answer Sheet

Name: _____ Date: _____

1. _____
2. _____

Information Sheet 6- checking and confirming water quality

6.1. water quality of washing fruit and vegetables

Water can be a carrier of microorganisms including pathogens. Adequate quality water is critical in a fresh-cut processing facility because of the absence of a step lethal to pathogens (kill step) in processing the product as well as the presence of factors such as the high degree of product handling, the damage to product during cutting, shredding, etc., and the potential for temperature abuse in processing and storage.

We recommend that the water supply in a fruit and vegetable washing processing plant be sufficient for the operations intended and be derived from an adequate source.

We recommend that water for operations in the processing facility, such as cleaning and sanitizing the facility and equipment as well as preparing the product for processing, processing the product, and manufacturing ice, be of adequate quality.

Where water does not become a component of the fresh-cut produce, we recommend that water be safe and sanitary, at suitable temperatures, and under pressure as needed for all uses

6.2. Confirm water quality parameter depends on

- clarity
- solids (total solvents, total suspended solids, total dissolved solids, turibidity)
- nutrients (total phosphate, dissolved phosphorus, total kjeldahl nitrogen, ammonium/ammonia, nitrate/nitrite, potassium and chloride

- others (regulated metal, biological oxygen demand, dissolved oxygen, PH, Temperature, electrical conductivity, total organic carbon

6.3. Maintaining Water Quality

When used appropriately with adequate quality water, antimicrobial chemicals help minimize the potential for microbial contamination of processing water and subsequent cross contamination of the product.

The effectiveness of an antimicrobial agent, as well as the amount that should be used, depends on the treatment conditions, such as water temperature, acidity [pH], water hardness, contact time, amount and rate of product throughput, type of product, water to product ratio, amount of organic material, and the resistance of pathogens to the particular antimicrobial agent.

6.4. Checking water quality and testing procedures

Commonly conducted water quality tests include:

- Temperature testing
- pH testing
- Chloride test
- Salinity testing
- Dissolved Oxygen Test
- Turbidity test
- Nitrate and Phosphate
- Pesticides

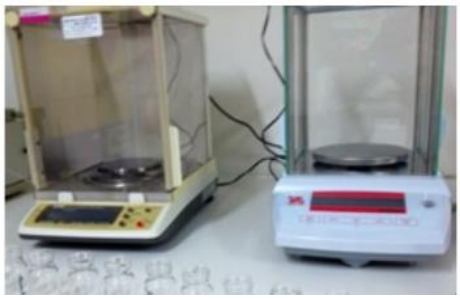

Figure 7. water quality testing equipment

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 the short Answer Questions

1. Mention at least three effectiveness of an antimicrobial agent?(5pts)
2. Write at least four water quality test instruments?(5pts)

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

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

1._____

2. _____

LG #17	LO #3- Operate and monitor the washing process

Instruction sheet

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

- starting and operating washing process and work place information
- inspecting and washing raw materials
- checking water to confirm correct levels of chemicals
- transferring washed materials
- identifying variation in equipment operation and reporting maintenance requirements
- identifying, rectifying and reporting out of specification product or process out comes
- maintaining work area
- Conducting work with workplace environmental guidelines.
- Maintaining workplace records

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

- starts and operate washing process and work place information
- inspects and washe raw materials
- checks water to confirm correct levels of chemicals
- transfer washed materials
- identifies variation in equipment operation and report maintenance requirements
- identifies, rectifies and reports out of specification product or process out comes
- maintains work area
- Conduct work with workplace environmental guidelines
- maintains workplace records

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- starting and operating washing process and work place information

1.1. Introduction

Starting and operating the washing process means checking and making available all necessary equipments and the coming raw-materials. the operation may require making adjustment, maintenance and taking corrective action when and where necessary.

Washing fresh produce with potable water treated with a sanitizing agent can reduce microorganisms and pathogens that may be on the surfaced of the produce. These potential problems include post-harvest rot and decay microorganisms such as spoliage bacteria and yeast, Botrytis, penicillium and mucor as well as foodborne pathogens such as E.coli, cyclospora, Listeria,

and salmonella .Chlorine can be used in wash water for apples,

nectarines, plums, cherries, grapes (or muscadines), leafy greens, peppers, tomatoes, peas, melons, cabbage, green onions, cucumbers and zucchini squash.

Do not wash or disinfect berries such as strawberries, blueberries, blackberries or raspberries. While peaches and pears can be washed and sanitized,

care must be taken because these fruits easily bruise and the washing process can damage the fruit and increase the chances of post-harvest decay.

1.2. Starting chemical washing process of fruit and vegetable

In small- to medium-scale farms, produce can be washed using the immersion type of triple-wash system with circulating or non-circulating water. In either case, sanitizer is essential to reduce the risk of cross-contamination between produce during washing.

The triple-wash system of produce includes successively washing the produce in three dump tanks containing sanitizing solutions. Briefly, the produce is dumped in the first wash tank to remove the excess soil and debris from produce and then transferred to the second dump tank for further cleaning and then to the third dump tank for the final wash. When

produce is dumped in the first tank, it should be in contact with the sanitizing solution for at least one minute.

Depending on the type of produce it should be dipped, re-dipped, agitated or any suitable procedure necessary to remove soil from produce. The first two dump tanks should have higher chlorine concentrations (depending on the crop type) because organic matter, like soil, coming off the produce depletes the free chlorine rapidly. For final rinsing, potable water is generally used; however, adding a small amount of chlorine (target 5-10 parts per million free chlorine) in the final, i.e., third wash tank, will prevent buildup and cross-contamination of pathogens to produce.

There are several wash processes that can be combined to wash vegetables and fruits. Water from the initial wash removes the heaviest loads. The quality and quantity of washwater depends on the complexity of the washing process and the produce being washed.

Dump Tanks Dump tanks create a soft landing for emptying crates of produce and provide an initial wash. When used, they are usually the first step in the washing process. Produce is loaded through conveyor, tipped, dumped or submerged. The tank can be aerated to help remove solids from the produce before further processing. Accumulated solids can be removed from the bottom of the tank.

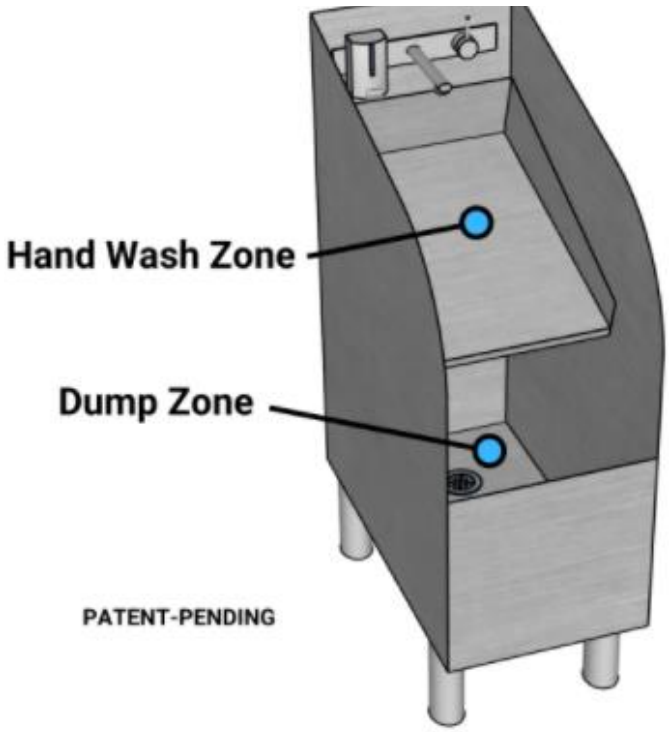

Figure -8 Diagram of dump

Fluming

Flumes move product from one place to another place using water (Figure 6) and provide a gentle way to move produce and provide a passive wash. Flumes can be located at any stage of the washing process.

Figure-9. Diagram of fluming **figure-10. Apples in flume**

Figure -11. Spray chemical wash of tomato

washing process of carrot in conveyer belt(vedio)

Washing raw fruits and vegetables can remove soil and other contaminants. Many fruit & vegetable establishments use soaking or submersion as an approved, effective technique for washing produce. This method is often preferred for a variety of reasons, including:

- The contact time is better controlled
- All surfaces come in direct contact with the water
- It reduces the amount of waste water
- It allows for simultaneous washing and re-hydrating
- It helps minimize shrink and extends shelf life
- It improves the appearance of the product
- And, when chemicals are added, can provide an antimicrobial treatment for the reduction/prevention of cross-contamination.

Using chemically treated water to wash and/or process fresh produce can impact public health by minimizing the risk of cross-contamination and reducing pathogens if they are present.

"All fresh produce, except commercially washed, pre-cut, and bagged produce, must be thoroughly washed under running, potable water or with chemicals.

The use of chemicals is equivalent, if not better, than rinsing under running water. Further, the use of chemicals will minimize pathogens in the water. Concerns about cross-

contamination have led some experts to question the potential risk when soaking produce in untreated water. However, treated water has been shown to be very effective in minimizing/preventing cross-contamination

Best Practices Guide for Retailers" advising retailers to use sanitizers when soaking/submerging fresh produce. The following guidance was provided to retailers regarding crisping fresh produce:

- If a bath is used, follow sanitizer recommendations
- If using a bath, an appropriate sanitizer should be used in compliance with label directions

water and may reduce microbial load on the surface of produce. Thus, antimicrobial chemicals may provide some assurance in minimizing the potential for microbial contamination."

1.3. Operate washing with chemicals

Step 1. Remove soil and other types of organic debris from the surface of the produce before treating the product. Soil and organic debris reduce the effectiveness of chlorine. Before treating the produce with chlorine, rinse with potable water.

Step 2. **Measure the temperature of our wash water**.

Wash water should be cool but not cold. Chlorine is most effective when water temperatures are between 55 and 120 degrees Fahrenheit. When washing tomatoes, peppers, melons or other produce with large stem scars the water temperature should be at least 50 degrees Fahrenheit higher than interior temperature of the produce. If the water is colder than the produce, plant and human pathogens can be sucked into the fruit. Chlorine cannot kill pathogens that

are inside the fruit. Holding produce with large stem scars for four to five hours before washing will allow

The chlorine concentration can be verified using chlorine test strips or kits. These strips estimate the amount of chlorine (hypochlorite and hypochlorous acid) in water treated with

chlorine bleach. Test strips or kits can be purchased at most pool supply stores, online or at other stores that sell food-use sanitizers.

Step 3. Monitor the pH,

Oxidation reduction potential (ORP) and sanitizer levels. pH: Chlorine is most effective when the pH of water is maintained between 6 and 7. Always check the pH of our water before adding the chlorine

Step 4. **Rinse produce with clean potable water**

Step 5. Change the water frequently.

The wash water should be changed when it becomes dirty and when a new crop is added. The wastewater can be poured down a drain or onto an area that does not contain edible crops.

Step 6. Record all our practices.

Maintain a log sheet with the date, time,chlorine concentration (ppm), pH, ORP (mV), water temperature and contact times

(amount of time produce was exposed to the chlorine solution). All records must be kept on the farm and be readily available within 24 hours of a formal request by an auditor or inspector.

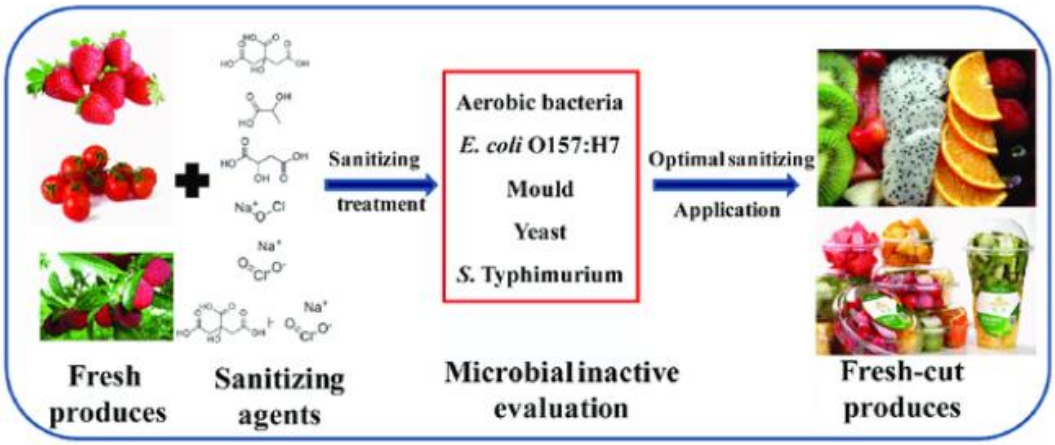

Figure 12. flow chart showing the washing process steps for fresh produce

1.4. Work place information

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

Standard Operating Procedures (SOPs)specifications

An SOP is a procedure specific to our operation that describes the activities necessary to complete tasks in accordance with industry regulations, provincial laws or even just our own standards for running our business.

Any document that is a “how to” falls into the category of procedures. In a manufacturing environment, the most obvious example of an SOP is the step by step production line procedures used to make products as well train staff

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 the short answer questions

1. write steps of operate of washing with chlorine?(5pts)
2. write at least three workplace information? 5(pts)

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

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____

Information Sheet 2- inspecting and washing raw materials

1.1. Inspection and washing raw materials

fresh fruit and vegetables, the inspector must also be aware of the pesticides and other chemicals used in the production of the raw materials. Necessary laboratory analyses can then be arranged to ensure residue levels in the final product do not exceed tolerances adopted by importing countries.

The inspector should pay attention to the state of raw materials, the preparation of raw materials for washing fruit and vegetable with chemicals. After washing fresh produce, the inspector should check the final washed product and chemical effectiviness :

- pH of washed water
- the concentration of chemicals like (chlorine, potassium permanagate)
- quality of water
- level of used chemical

1.2. purpose of inspecting of raw materials

The main purpose of inspection is to provide the client with objective, independent, and impartial information regarding the condition and safeness of the raw materials suitable for further processing. To ensure uniformity of inspection: inspectors are trained to apply the standards, visual aids, determining quality and level of chemical and good working environments with proper lighting are provided

1.3. washing raw materials

1.3.1. Method of washing

There are two common methods used for washing produce. Softer produce or leafy greens should be cleaned using a soaking method, while firmer-skinned vegetables can be cleaned using a spray solution. We'll outline these two methods of cleaning fruits and vegetables.

1.3.1.1. Soaking of fruit and vegetables

Using the soak method to wash produce is ideal for tightly packaged fruits like berries and vegetables with crevices, like broccoli. Not only does soaking produce rid it of harmful germs or chemicals, but it can also be used to revitalize produce for a better taste and longer life. If we purchase local, organic fruits and vegetables that contain no chemicals or harmful preservatives.

Figure -13. Soaking (immersing) of fruit product (guava and kale)

The soaking method works best with these types of fruits and vegetables

- Lettuce
- Spinach
- Kale
- Cauliflower
- Cabbage
- Grapes
- Raspberries
- Strawberries

1.3.2. spray washing for fruit and vegetables

Produce with firmer skin such as eggplant, potatoes, or cucumbers may benefit from using a spray and scrub to thoroughly clean away dirt and pesticides. This

method is also ideal for larger, smooth fruits and vegetables without crevices or cracks.

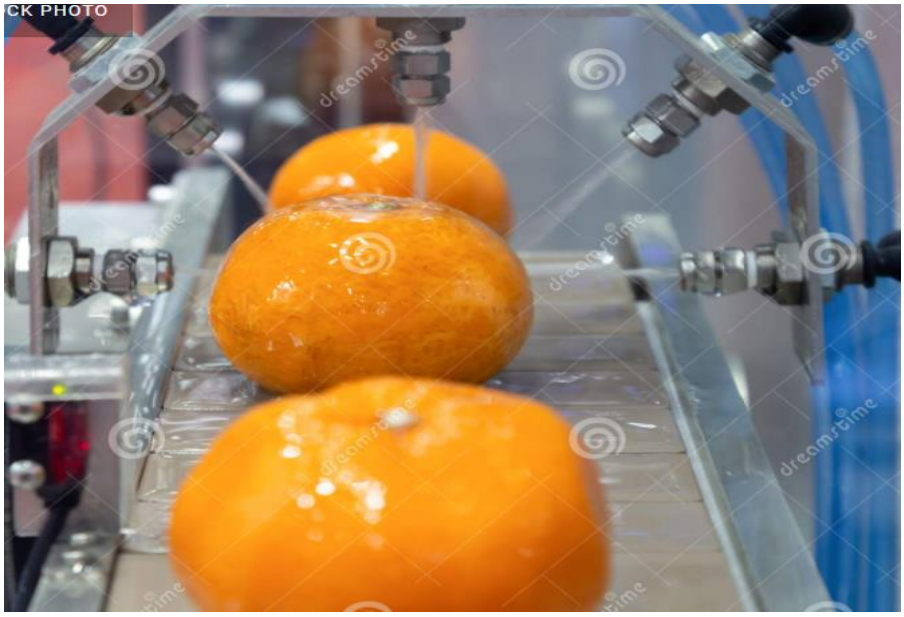

Figure-14 . Spray wash of orange

The spray method works best with these types of fruits and vegetables

- Tomato
- Potato
- Cucumbers
- peppers
- apples
- oranges
- lemons
- limes

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 the short answer questions

1. write at least two purpose of inspecting of raw materials?(5pts)
2. write the two common methods methods of used for washing produce? (5pts)

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

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1.....

2. ----------

Information Sheet 3- checking water to confirm correct levels of chemicals

3.1. Checking water to confirm correct levels of chemicals

During operate and monitor washing process check the following parameters of water during washing fruit and vegetable with chemicals

- Amount of water
- PH of process water
- Amount of Water temperature
- Water mineral hardness
- Product of water ratio
- Types water(tape, bore, spring water)

Dilution Rate

Agar Bleach with 5% available (free) chlorine can be diluted using the table below to achieve a 100 ppm concentration of available chlorine.

Table -3. Dilution ratio

Volume of water	Plus Agar Bleach (5% av chlorine)
1 litre	2ml
5 litres	10ml
10 litres	20ml
50 litres	100ml

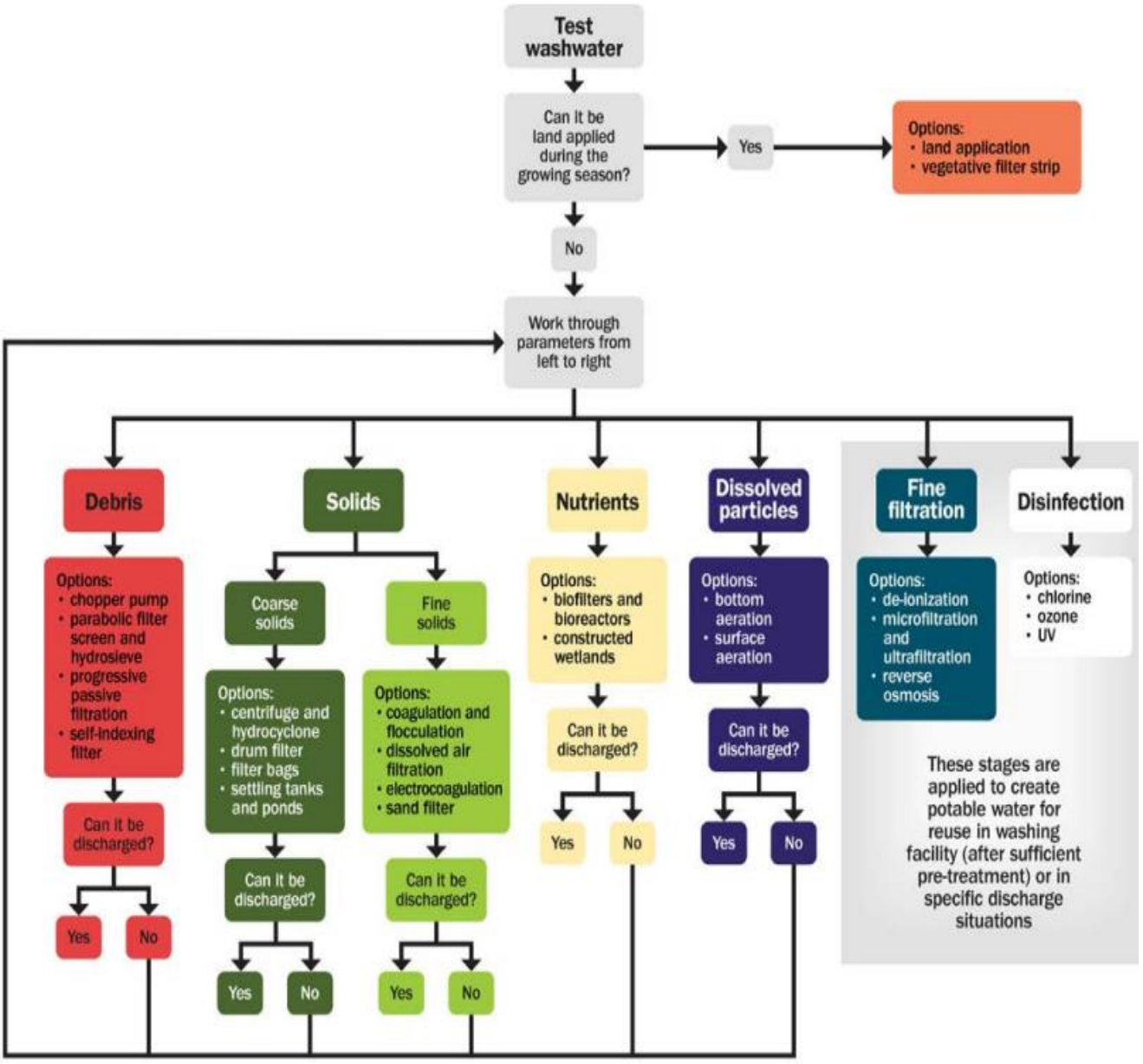

Figure -15. Flow chart for treatment technology selection

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 the short answer questions

3. Write at least three checking water parameteters? (5pts)
4. Mention at least two measurement equipment? (5pts)

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

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____
3. _____

Information Sheet- 4: transferring washed materials for further processing

4.1. Transfer washed materials

Keeping produce chilled at the right temperature is one of the most important steps in the entire process. The entire process of shipping fresh produce means juggles many variables like weather conditions.

The refrigerated truck, known in the industry as a reefer, is the workhorse for shipping sensitive freight. If the shipment spends even a few minutes either too cold or too warm it could damage much of the produce or ruin it all together.

Depending on what part of the country is the point of origin or destination, the weather may play a role in how cool the reefer unit needs to be. If transporting during winter months the interior of the trailer may only need a small adjustment to reach freezing range to transport apples or grapes.

In reverse, cold weather outside can make it necessary to warm up the reefer to keep other freight at a balmy 50-60 degrees for bananas and some crops of potatoes. A number of situations can occur such as traffic congestion keeping a truck in a warm climate longer than anticipated. A late truck arriving at the dock can also affect the fragile balance of produce if it's loaded in the heat of the day versus before sunrise.

As required whenever shipping freight, a bill of lading or BOL, is attached to specify information such as temperature requirements. The driver will need to pay close attention to all gauges and adjust as needed to maintain proper temperatures. If this step is missed and the produce is damaged upon arrival, the delivery can be refused. Ultimately, it could be a costly mistake if temperatures are off by just a degree or two.

Shippers will avoid contracting with trucking companies that fail to make on-time deliveries or disregard instructions regarding temperature ranges. Refrigerated companies with the capacity to handle time-sensitive loads of produce are in high demand.

4.2. moving product through Packaging Containers

- Containers must be food grade quality.
- Must protect integrity of the product.
- Disposable containers should not be re-used.
- Take precautions to minimize risk of microbial contamination during transit.

❖ during transferring washed product Attention to:

- Fruit and vegetable contact surfaces.
- Time and temperature abuse.
- Product integrity
- potential or opportunity for unintentional or intentional contamination.
- Other uses of the vehicle

Figure-16. Transfer guava

4.3. Transportation product Ownership of product until transferred.

Take precautions to minimize risk of microbial contamination during transit.

Attention to:

- Fresh produce contact surfaces.
- Time and temperature abuse.
- Product integrity
- potential or opportunity for unintentional or intentional contamination.
- Other uses of the vehicle

4.4. Equipment used in transferring fruit and vegetable

After the raw materials has been thoroughly inspected they will then be brought to the processing location using **conveyors or flumes pumped** system.

4.4.1. conveyor

Conveyor is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials.

Figure 17. transport apple in Conveyor

Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Some of basic characteristics of conveying equipment's are:-

- Transporting material from one place to another over stationary structure.
  - Caries material in continuous stream with its distinct feature such as endless chain or belt.
  - Can be done horizontally, vertically or inclined.
  - When the equipment does horizontal conveying, it is known as conveyor and when it does vertical, it is known as elevator.
  - Conveying are mainly used in mining, construction and in some of the industries.

  The Advantage of using conveyors are as follows:-

- It increases the output.
- It facilitates continuity in operation.
- It results in time saving.
- There are no waiting periods

4.4.2. Flumes pumped system

Conveying foods in water using shallow inclined troughs (or flumes) and pipes finds application for the simultaneous washing and transporting of small particulate foods, such as peas, sweet corn, etc. The main advantage is reduced power consumption as water flows under gravity, especially at factory sites located on hillsides. Water is re-circulated to reduce costs and is filtered and chlorinated to prevent a buildup of micro-organisms.

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 choice

1. Which of the following are moving product through packaging containers? (1.5pts)
   a. Disposable containers should not be re used b. containers must be food grade quality c. protect integrity of the product d. all

Test –II. Write the short answer question

1.. list out at least three attention to during transferring washed product? (5pts)

Note: Satisfactory rating – above 4 points Unsatisfactory - below 4 points

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1_____

2_____

Information Sheet- 5: identifying variation in equipment operation and reporting maintenance requirements

5.1. **Identifying variation in equipment operation**

Variations in equipment operations can be happen due to many factors. Such as lack of maintenance or poor maintenance, sensor defects, equipment component problem, difference in applied pressure, and power shortages.

These variations may cause different damages to a machine, process, products, and environments.

To minimize these variations we have to conduct pre-start checks on all components of equipment, sensors, and perform maintenance before we are going to operate equipment

5.2. Variables to be monitored to minimize variations in equipment operations include:

- Production capacity
- Equipment durability
- Equipment performance (e.g. speed, output, variations)
- equipment component performance
- sequences and timing of operation
- materials changes (desired and not desired)

5.3. Reporting maintenance requirement

Maintenance recommendations are based on industry standards and experience in Reclamation facilities. However, equipment and situations vary greatly, and sound engineering and management judgment must be exercised when applying these recommendations. Other sources of information must be consulted (e.g., manufacturers recommendations, unusual operating conditions, personal experience with the equipment, etc.) in conjunction with these maintenance recommendations.

5.3.1. Maintenance requirements status include

- take corrective action in response to out-of-specification results
- respond to and/or report equipment failure within level of responsibility
- locate emergency stop functions on equipment
- stop operate equipment during maintenance

5.3.2. MAINTENANCE FEATURES

Maintenance requirements chemical washing equipment maintenance falls into the following categories. Operational checks to simulate automatic start-up, shut-down and emergency shutdown.

Inspection and maintenance:-Drive train, Rotor, including tip flaps, Hardware control systems, Hydraulics, Electrical control signals and power system, Braking system, Tower. The operational checks are carried out every seven days or 100 hours of operation; inspection and lubrication every 40 days or 1000 hours of operation. This is supplemented by an annual or 9,000 hours of operation check, when a more detailed examination and overhaul is carried out.

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. Choice

1. Which one the following are variables to be monitored to minimize variations in equipment operation?(1.5pts)

   a. Equipment b. production capacity c. equipment component performance d.all

2.. which one of the following are maintenance requirement? (1.5)

   a. take corrective action in response to out of specification

   b.locate emergency stop functions on equipment

   c.report equipment failure within level of responsibility

   d. all

Note: Satisfactory rating above 2 points Unsatisfactory - below 2 points

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____
3. _____

Information Sheet- 6: identifying, rectifying and reporting out of specification process out comes

6.1. Identifying out-of-specification of product

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

Out-of specification of a product means a condition in which the product did not fall in a specified condition, like chemical composition, physical appearance, recommended quality and so on.

There are many factors that lead a product in to out-of specification such as;

6.2. Out of specification product/process out comes are:

- Change washed product physical appearance(like texture, firmness, color, odour)
- production/processing temperature and Pressure
- variation chemical washing concentration level
- types of Washing materials used
- Efficiency of a washed chemical
- Improper Product handling system or mechanisms
- Occur shrinkage for washed product
- Malfunction of washing equipment

6.3. Cause of out specification product are:

- Variation level PH
- Vary Temperature of washing materials
- Improper contact time.
- Improper chemical dosage level

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 the short answer question

1. Write at least three out of specification product process? (4pts)
2. Mention at least three reason of out of product/process out comes?(4pts)

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

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____
3. _____

Information Sheet- 7: maintaining work area

7.1. Maintaining work area according to housekeeping standards

When working with dangerous chemicals, a proper housekeeping is essential. Storage areas must be well organized and kept in order. The transport of chemicals within the industrial premises should be planned and the transport routes kept clear. Maintenance of premises and equipment should also be planned. These tasks should be dedicated to persons/work groups/departments. Workers using the equipment should know the person responsible for repairing faulty equipment.

Monitoring the efficiency of housekeeping and inspections should be carried out regularly; this should involve the workers themselves, who are experts in their own work.

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

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

When considering how to provide and maintain facilities that are adequate and accessible, a person conducting washing process undertaking must consider all relevant matters including

- The nature of the work being carried out at the workplace
- The nature of the chemicals at the workplace
- The types and dose of chemical during wash fresh produce
- Handling and storage and disposing chemical residues
- The size, location and nature of the workplace
- The number and composition of the workers at the workplace.

During Conducting work in accordance with workplace guideline a person should ensure the following requirements

7.2. Housekeeping standards

Untidy workplaces may lead to injuries e.g. slips and trips, therefore good housekeeping practices are essential for all workplaces.

For example:

- Washing area free from any hazards
- Chemical dosing equipment should be kept clear of obstructions
- Work materials should be neatly stored
- Any waste should be regularly removed
- Any toxic chemical removed from washing area
- Suitable containers for waste should be conveniently located and regularly emptied.

Washing Areas

The layout of the washing area should be designed to provide sufficient clear space between equipment, fixtures and fittings so workers can move freely without strain or injury also evacuate quickly in case of an emergency.

The washing equipment to be handled and the personal protective equipment that may be worn to perform the work.

Floors and Other Surfaces

Floor surfaces shall be suitable for the wash area and be chosen based on the type of work being carried out at the workplace, as well as the materials used during the work process, the likelihood of spills and other contaminants, including dust, chemicals, and the need for cleaning.

✓ Floors shall be free from slip or trip hazards e.g. cables, uneven edges, broken surfaces

Lighting: Sufficient lighting is required to allow safe movement around the workplace and to allow workers to perform their job without having to strain their eyes to see.

7.3. Purpose of maintaining work area

- Increased efficiency.
- The reduction of accident hazards.
- The reduction of fire hazards.
- Improved morale.
- Compliance with the law.
- Creating a favorable impression to people outside the Company.

Workshop should be kept neat and tidy. Good housekeeping can significantly reduce the risk of an accident and injury, failure to maintain a clean and tidy Workshop can result in accident and injury. Work areas and equipment are to be thoroughly cleaned after use

Cleaning and hygiene is super important in every workplace. But before we can talk about that safety must come first. Keeping people safe is our highest priority. Sure, your cleaning chemicals might say they are safe and natural

Store and stack chemicals safely: Stacking chemical drums and boxes too high is unsafe and may cause damage. It is advisable to store powders above liquids. Ensure chemicals are stored in a cool, well ventilated area away from direct sunlight and out of the reach of children..

Ventilation:Ensure there is good ventilation in the store room and when you are using chemicals. Extra caution should always be exercised when using any kind of spray in a confined space (eg. bathroom).

No smoking:Do not smoke anywhere near chemicals or whilst you are using chemicals.

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 -1. Write short answer questions

1. Write a at least four purpose of maintaining work area practices which are essential for all workplaces? (4 points)
2. List out at least tthe importance of monitoring work area? (4pts)

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

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____
3. _____

Information Sheet- 8: Conducting work with workplace environmental guidelines

8.1. **introduction**

Conducting work is procedure sets out the steps to be followed for work activities.we must consult with affected workers when developing procedures for resolving work health and safety issues, consulting with workers on work health and safety, monitoring worker health and work place conditions, and providing information and training Work is carried out: loading vehicles is transport material, equipment and carry heavy machine equipment product in the fruit and vegetable processing industry.

8.2. work place environmental guidelines

8.2.1.. Environmental Considerations

Detergents can be significant contributors to the waste discharge (effluent). Of primary concern is pH. Many publicly owned treatment works limit effluent pH to the range of 5 to 8.5. So it is recommended that in applications where highly alkaline cleaners are used, that the effluent be mixed with rinse water (or some other method be used) to reduce the pH. Recycling of caustic soda cleaners is also becoming a common practice in larger operations. Other concerns are phosphates, which are not tolerated in some regions of the U.S., and the overall soil load in the waste stream that contributes to the chemical oxygen demand (COD) and biological oxygen demand (BOD).

8.2.2. Environment regulation

The regulatory concerns involved with chemical sanitizers are antimicrobial activity or efficacy, safety of residues on food contact surfaces, and environmental safety. It is important to follow regulations that apply for each chemical usage situation. The registration of chemical sanitizers and antimicrobial agents for use on food and food product contact surfaces and on nonproduct contact surfaces is through the U.S.

Environmental Protection Agency (EPA). (Prior to approval and registration, the EPA reviews efficacy and safety data, and product labeling information.)

The U.S. Food and Drug Administration (FDA) is primarily involved in evaluating residues form sanitizer use that may enter the food supply. Thus, any antimicrobial agent and its maximum usage level for direct use on food or on food product contact surfaces must be approved by the FDA. Approved no-rinse food contact sanitizers and nonproduct contact sanitzers, their formulations and usage levels are listed in the *Code of Federal Regulations* (21 CFR 178.1010). The U.S. Department of Agriculture (USDA) also maintains lists of antimicrobial compounds (i.e., *USDA List of Proprietary Substances and Non Food Product Contact Compounds*), which are primarily used in the regulation of meats, poultry, and related products by USDA's Food Safety and Inspection Service (FSIS).

Self-Check – 8	Written test

Name…… ID……

Date…….

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

Test –I. choice

1. Which one of the following is procedure sets out the steps to be followed for work activities? (2pts)

a. Maintenance b. workplace records c. conducting d. all

Test –II. Write short answer question

1. List out at two work place environmental guidelines? (5pts)

Note: Satisfactory rating above 4 points Unsatisfactory - below 4 points

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____
3. _____

Information Sheet- 9: maintaining workplace records

9.1. Maintain workplace records

Records are observations, measurements, and other data recorded manually or by means of monitoring equipment, to document the devotion to critical limits or other processes requires. Records are the collected information produced by the industry in the process of performing and reporting industry operation**.** Maintenance is work that is carried out in order to enable its continued use and function, above a minimum acceptable level of performance, over its design service life, without unforeseen renewal or major repair activities.

The maintenance concept is a brief description of the maintenance considerations, constraints and plans for operational support of the system/equipment under development

9.2. Importance of workplace record

- Gives the information you need to run your business and help it grow
- Helps identify the strengths and weaknesses in your coffee packaging process
- helps manage changes and improvements in your packaging process

9.3. Types of workplace maintenance records include:

- Records chemical addition date
- Record added time
- Record chlorine orchemical concentration
- Record any faults occur during wash fruit and vegetable
- Reagent chemical Name
- Manufacturer
- U.O.M Unit of measurement of chemical quantity
- Minimum chemical level
- Maximum chemical Level
- Re-order Level

- Location at storage
- MSDS – Material Safety Data sheet available or not
- Test certificate of chemical with all the chemical composition – TC available or not
- Disposal Method
- Safety equipment requirement for the material handing, storage and movement.
- General information about reagent chemical

Table 18. reagent chemical records

SR. No.	Reagent chemical name	Manufacturere	Monthly QTY cons.	Min chem.level	Max. chemical	Re-order level	Location at storage	Msds available	Disposal method	information

Self-Check – 9	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below

Test –I. Write the short answer questions

1. Write at least two importance of workplace records?(4pts)
2. Mention at least three types of workplace maintenance records?(4pts)

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

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____
3. _____

Operation sheet 1: starting and operating washing process and work place information

Objective

To get quality product for further process water must be cleaned with appropriate level chemical.

Chemical wash play vital role for cleaning fruit and vegetable rather than water wash fresh produce.

List of materials used for wash fresh produce

- Fresh fruit and vegetable product(like carrot, tomato, apple, grapes and cabbages end etc.

Washing equipment	**required chemicals**
✓ Water tank with nozzle	a. free chlorine
✓ Flumes	b. combined chlorine(optional)
✓ Pumps	c. total chlorine(optional)
✓ Hoses	d. potassium permanganate
✓ Conveyor and spray brush	

The following procedures should be taken into account to monitor the process

Procedure

Step: 1 use appropriate personal protective equipment

Step: 2 clean all fresh produce product in a wash tank

Step: 3 measure temperature of wash water

Step: 4. Measure and mix chlorine into potable water.

Step: 5. Draining the tank

Step 6. Submerge fresh produce product for 2min

Step: 7.spray rinse vegetables with the sanitizing solution

Step 8: Rinse fruit with potable water only

Step 9. Test chlorine residue after rinse by using of test strip

Step 10: packing for further processing

Step11. Ready for the next process

LAP Test	Performance Test

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 3 hours.

Task -1. Monitor washing process

LG#18	LO #4- Shut down the washing process

Instruction sheet

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

- implementing shutdown procedures
- handling, storing and disposing chemicals
- identifying and reporting maintenance requirements

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

- implement shutdown procedures
- handle, store and dispose chemicals
- identifies and reports maintenance requirements

Learning Instructions:

Read the specific objectives of this Learning Guide.

Follow the instructions described below.

1. Read the information written in the “Information Sheets”. Try to understand what are being discussed.
2. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work.
5. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,

Information Sheet- 1: implementing shutdown procedures

1.1. Introduction

Normal shutdown includes steps to render the systems safe, such as removal of hazardous process materials and inert gases. The systems might be cleaned as part of the shutdown; cleaning is often a process unto itself requiring its own set of startup, operation, and shutdown procedures

1.2. Shut down procedures

- Cleans external and internal parts of washing equipment
- Inspect the hoses
- Don't overload it
- Use the right type of detergent
- Use the right amount of detergent
- Clean the interior and dispensers
- Wipe down the drum, door and gasket
- Leave the door ajar after a load
- Transfer clean **laundry** to the dryer as soon as it's done.

1.3. Implement shut down procedures

Shut down procedures are implemented to ensure that all energy sources to the relevant equipment are isolated, disconnected or discharged, in order to prevent an inadvertent activation or energisation. Lock-out procedures must be established and implemented for the

- Inspection
- ,cleaning

- repair or maintenance of any equipment that may cause injury to any person
- and if started inadvertently.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test –I. Choices

1. which one of the following is shut down procedures? (2pts)
   a. use the right amount of detergent b.inspect the hoses c. clean the interior and dispensers d. all.
2. Which one of the following are lock out procedures must be established and implemented for the.....?(3pts)
   a.inspection b. cleaning c.cutting d. ‘’a’’ and ‘’b’’ are answers

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

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____
3. _____

Information Sheet- 2: handling, storing and disposing chemicals

2.1. Handling and storing Chemical waste

Storage of volatile liquids requires vapour recovery and air pollution control. In addition to this, you should also ensure that you follow the requirements stipulated within the Dangerous Goods (Storage and Handling) Regulations 2012 and Occupational Health and Safety Regulations 2017 for dangerous goods and hazardous substances respectively. Dangerous goods regulations include provision for prevention of ignition sources (reg. 43) and ventilation (reg. 44). Measures to reduce the risks of air pollution occurring are also addressed in Preventing and monitoring of spills segment of this guidance.

Separation distances for particular chemicals are set out in Australian Standards and Dangerous Goods (Storage and Handling) Regulations 2012 (Reg. 35) requires management of incompatible materials. It is important to ensure that incompatible chemicals will not come into contact during spills, leaks or fires.

It is important to ensure that the storage container and the secondary containment materials are impermeable to the substance being stored and will not react with the substance being stored.

Pollution incidents can occur as a result of vandalism or unauthorised tampering. Indoor storage, the use of fences, locks and/or alarms may be necessary.

2.1. Method of dispose chemical waste in fruit and vegetable

Chemical waste is regulated by the Environmental Protection Agency (EPA) through the Resource Conservation and Recovery Act (RCRA). It cannot be disposed of in regular trash or in the sewer system. Most chemical wastes must be disposed of through the EHS Hazardous Waste Program. To have hazardous waste removed from your laboratory, do the following:

1. Store chemical wastes in appropriate containers; plastic bottles are preferred over glass for storing hazardous waste when compatibility is not an issue. Segregate chemical waste by compatibility, and not alphabetically.
2. Chemical waste containers must be labeled with the following information:
   Full chemical name and quantity of the waste. For mixtures, each chemical must be listed. Abbreviations, acronyms and ditto marks ("") to replace words are not allowed, as this does not comply with The Hazard Communication Standard;Date of waste generation; Place of origin (department, room number);PI's name and telephone number;Bottle number assigned on corresponding waste sheet; and The tag or label must have the words: "Hazardous Waste."
3. A completed Hazardous Waste Information Form must be submitted to the EHS office (Instructions are on the back of the form). On this form, please include: Full chemical name and quantity of the waste. For mixtures, each chemical and its volume or weight must listed. Abbreviations, acronyms and ditto marks ("") to replace words are not allowed, as this does not comply with The Hazard Communication Standard; Date of waste generation; Place of origin (department, room number);PI's name and telephone number; A contact name is required to answer any questions or open the door; Bottle number (in numerical order) assigned on bottle; and A speedtype or account number.
4. The disposal of chemicals by sanitary sewer is only possible with written permission from EHS. Contact the Director or Chemical Waste Manager for more information.
   - Submit a complete list of all chemicals to be disposed of to EHS.
   - EHS will review and provide written approval on a case by case basis.
   - Any change in formulation (volume of chemical, new chemical), will require a fresh review by EHS.
   - Disposal of any chemical into the solid waste disposal system is not allowed.

Required precondition to dispose waste chemical resdues to environment check:

- Chemical oxygen demand (COD)
- Biological oxygen demand (BOD)

- Dissolved oxygen (DO)
- PH level
- Total suspended solids (TSS)
- Total dissolved solvent (TDS)

Chemical oxygen demand:

COD is a measure of the oxygen equivalent of the organic matter in a water sample that is susceptible to oxidation by a strong chemical oxidant. COD is widely used as a measure of the susceptibility to oxidation of the organic and inorganic materials present in water bodies and in the municipal and industrial wastes.

Biological oxygen demand (BOD):-

Biochemical oxygen demand is the amount of oxygen consumed by bacteria and other microorganisms while they decompose organic matter under aerobic conditions.

The common lake or stream contains small amounts of oxygen in the form of dissolved oxygen (DO). Dissolved oxygen is a crucial component of natural water bodies, maintaining the aquatic life and quality aesthetic of streams and lakes.

Dissolved oxygen :

Dissolved oxygen (DO) is the amount of oxygen that is present in water. Water bodies receive oxygen from the atmosphere and from aquatic plants. Running water, such as that of a swift moving stream, dissolves more oxygen than the still water of a pond or lake

PH level :

The pH of the environment has a profound effect on the rate of microbial growth. pH affects the function of metabolic enzymes. Acidic conditions (low pH) or basic conditions (high pH) alter the structure of the enzyme and stop growth. Most microorganisms do well within a pH range of 6.5 to 8.5.

Total suspended solids(TSS):

Total suspended solids (TSS)

It is the dry-weight of suspended particles, that are not dissolved, in a sample of water that can be trapped by a filter that is analyzed using a filtration apparatus. It is a water quality parameter used to assess the quality of a specimen of any type of water or water body, ocean water for example, or wastewater after treatment in a wastewater treatment plant.

Total dissolved solvent(TDS):

Total Dissolved Solids (TDS) are the total amount of mobile charged ions, including minerals, salts or metals dissolved in a given volume of water, expressed in units of mg per unit volume of water (mg/L)

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 the true or false

1. Chemical waste is regulated by the environmental protection agency through the resource conservation and recovery act?(3pts)
2. Storage of volatile liquids requires vapour recovery and air pollution control? (3pts?

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

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____
3. _____

Information Sheet- 3: identifying and reporting maintenance requirements

3.1. Maintenance requirements

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

Maintenance is a general upkeep and repair of washing equipment, washing land and grounds, heating and air-conditioning; removing washed wastes; parking; and perhaps security

Food premises and equipment that are not kept in good repair and condition are a potential source of microbiological and physical contamination of food. Poorly maintained premises and equipment cannot be cleaned effectively. Poor maintenance may allow the entry of other sources of physical, microbiological and chemical contaminants such as water, pests,chemical wastes and dust. Poor maintenance can have health and safety implications for workers.

3.2. Identifying and reporting maintenance requirements

To minimize the hazards that might be happen during equipment operation, you have to check that the equipment was in a good operating condition or not. If there is a defects on it, report and undertake maintenance before starting operate equipment.

The maintenance that needed may be adjusting thermocouple, pressure sensors, chemical levels and some components of a machine or equipment and etc

3.3. Report maintenance requirements

Careful and complete details of all emergencies should be recorded in the appropriate log book, i.e., Property Log Book or Fire Log Book, with each entry giving at least the following information:

- date of incident
- item of equipment
- details of emergency
- details of immediately previous maintenance work carried out to the plant / equipment,
- previous evidence or warnings of trouble
- any special circumstances or other relevant details
- action taken to affect both temporary and permanent repairs.

3.4. Purposes of Maintenance Requirement

Maintenance requirement requires that: all washing and chemical dosing equipment be maintained in an efficient state, in efficient order and in good repair. Where any machinery has a maintenance log, the log is kept up to date; and that maintenance operations on work equipment can be carried out safely

Table 6. maintenance schedule

Maintenance schedule

Date ----------

Prepared by:----------

Submitted to: ----------

Approved by: ----------

No.	Task description	Task duration	Due date	Target date	Washed equipment names	Person responsible	Information
1							
2							
3							
4							

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 the short answer question

1. mention at least two purposes of maintenance requirement?(5pts)
2. list out at leat three poor maintenance sources? (3pts)

Note: Satisfactory rating above 4 points Unsatisfactory - below 4 points

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

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Test I

1. _____
2. _____
3. _____

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