Alcoholic &Non Alcoholic Beverage Processing
Level-II

Based on October 2019, Version 2 Occupational standards (OS)

Module Title: - Operating Syrup Production Process

LG Code: IND ANP2 M07 LO (1-3) LG (35-37)

TTLM Code: IND ANP2 TTLM 0920v1

September, 2020

Addis Ababa, Ethiopia

Table of Contents

LG #35	LO #1- Prepare the syrup production process for operation

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: • Checking Production requirements • Confirming availability of required materials • Confirming availability of services • Conducting pre-operational equipment checks • Setting syrup production process 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: • Check Production requirements • Confirm availability of required materials • Confirm availability of services • Conduct pre-operational equipment checks • Set syrup production process
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: Checking Production requirements

1. **Checking Production requirements**

1.1. Syrup preparation

Most products are traditionally prepared as a syrup-plus-water mix, in a ratio of some 1 part (volume) syrup to between 3 and 6 parts (volume) water. This allows a concentrated batch of syrup to be made and then proportioned with water to form the final product. For a sugar-based product the syrup would typically consist of 67°Brix sugar, citric acid, flavourings, colourings, preservatives and water. The ingredients are carefully weighed out and added to the mixing vessel. The syrup is pre-prepared and fully tested before being sent to the proportioner for mixing with water and subsequent carbonation. This is carried out in the syrup room as a batch process, allowing the multitude of soft drink flavours to be catered for. Various methods exist to accurately proportion syrup and water, though the most popular current system uses flow meters. The syrup is usually dosed though a mass flow meter and the water is dosed volumetrically using a magnetic induction flow meter. This allows for density variations within the syrup to be accounted for to give the required Brix of the final product, since a mass flow meter works on the same Coriolis principle as a densitometer, although the degree of accuracy of measuring density using a mass flow meter is an order of magnitude less than if a densitometer is employed. (The Coriolis principle is an effect whereby a mass moving relative to a rotating frame of reference is accelerated in a direction perpendicular both to its direction of motion and to the axis of rotation of the frame. It explains why water flows down a plughole clockwise in the northern hemisphere and anticlockwise in the southern hemisphere. The density of water, within the range under consideration, does not vary significantly and hence the simpler volumetric flow meter can be used. The latest adaptations of these **proportioners** allows for the final product either to be collected in large vessels of some 30 000 l capacity or greater or to be fed direct online to the carbonator, with the syrup being individually proportioned as a premix and online metering of sugar, citric acid and other components. The accuracy of mass flow meters ensures the product is produced at the required Brix, thus ensuring conformance to specification, tight cost control and minimum wastage. A typical system is sketched as below .Other systems in use employ volumetric dosing pumps.

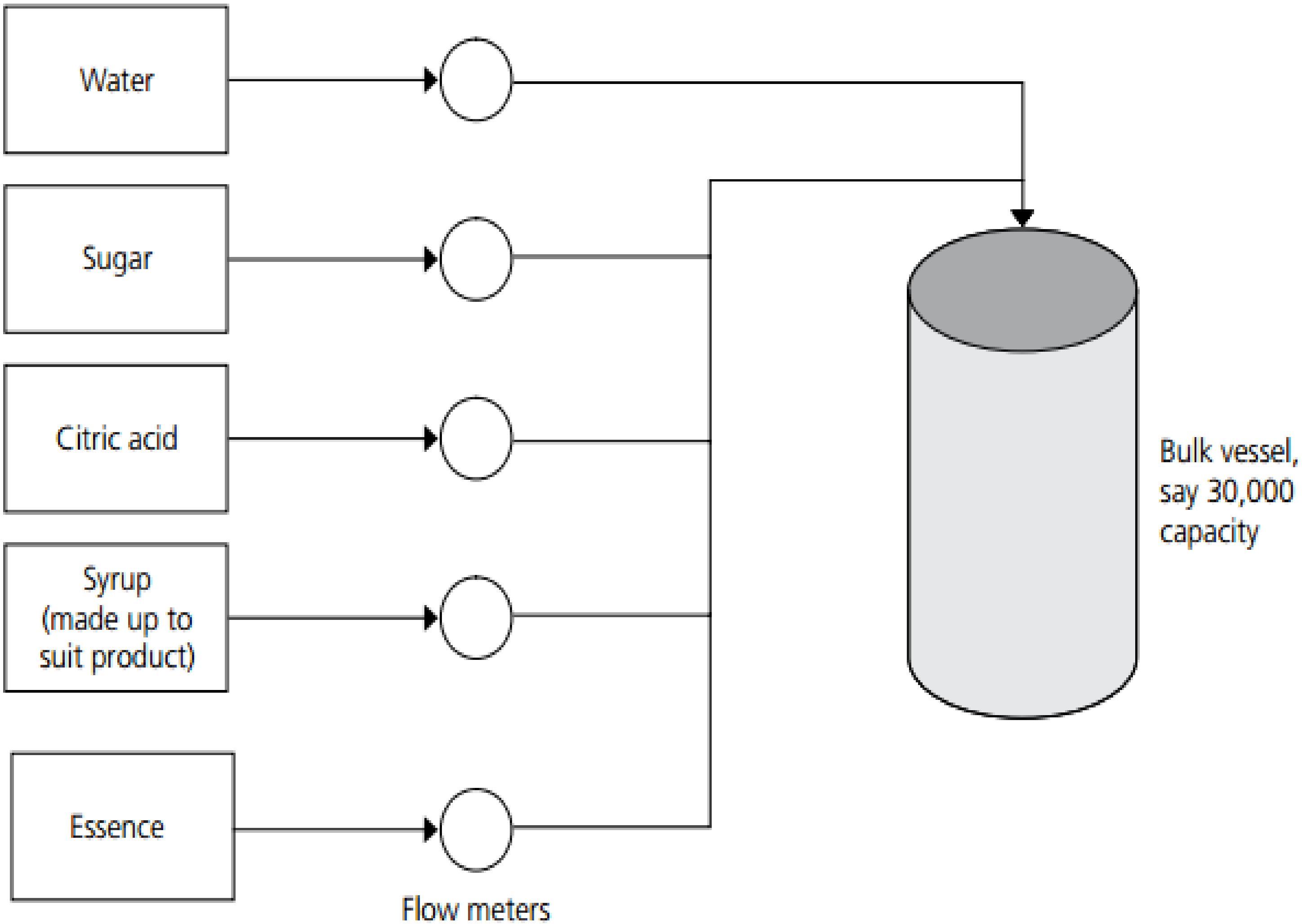


Fig. 1.1: Product preparation using flow meters

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: Choose the best answer (4 point)

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

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

2. Confirming availability of required materials

Required materials for syrup production includes

- Sugar, flavours, additives, activated carbon
- water
- liquid and solid adjuncts such as sugars
- process aid
- citric acid(in liquors)

2.1 Water as an ingredient

Water is the principal component in all soft drinks and reconstituted fruit juices and it can have a fundamental effect on the quality of the end product. If water used in the manufacturing process is supplied by a reputable utility supplier and is fit for drinking as such, its quality is likely to be acceptable for use in beverage manufacture with minimal treatment solely for the purpose of removing chlorine and any other flavour taints. However, many soft drink plants have their own private water supply and the water from such sources may or may not be of suitable quality.

The key factors that particularly need to be considered in relation to water to be used in soft drinks, assuming the water meets the quality requirements of the EU Water Directive for Drinking Water (98/83/EC), are as follows.

a) Chlorine

should always be removed as it sometimes reacts with other flavour or fruit constituents in a way that allows the development of a 'disinfectant' taste due to the formation of complex chlorophenols.

b) Hardness

The level of water hardness will affect the acidity of a soft drink or fruit juice and, in extreme situations, can create a buffering effect that will alter the pH of the product and possibly its microbiological stability and taste.

c) Nitrate levels

may be an important factor if the product is to be provided for babies or young children.

d) Calcium levels,

particularly in products containing high percentages of fruit components, may be important depending on the quality of the fruit constituent. If the pectin content of the fruit material has been degraded (see below), free calcium can react to form stable gels that create an unsightly an unpleasant end product.

e) Iron and other metal ions

can catalyse reactions that can create flavour and colour defects, particularly in products that are fortified with vitamins or
other miscellaneous additives.

f) Sunlight

The use of water that has been subjected to prolonged exposure to sunlight (e.g. in an open reservoir in the summer) when algal blooms have occurred can lead to the formation of white floc in the end product. Such flocs are created by polysaccharides that occur as algal breakdown products.

2.2. Flavourings

The number of different flavourings available for soft drinks is almost infinite. Flavourings fall into three main categories

- natural,
- nature identical
- And artificial –

but in addition there are various sources of flavours for soft drinks that can be seen as part of the natural fruit components where used. Flavours are covered in the United Kingdom by regulations (EC, 2008) which define flavourings as preparations that contain at least one of the following components:

- Flavouring substances
- Flavouring preparations
- Process flavourings
- Smoke flavourings.

For soft drinks the most relevant categories are flavouring substances or flavouring preparations. Flavouring substances are chemical substances with flavouring properties and an established chemical structure. Flavouring preparations are products, other than flavouring substances, with flavouring properties that are obtained by physical, enzymatic or microbiological processes from appropriate vegetable or animal origin. Almost all flavourings for soft drinks use materials from one or both of these categories and the classification of the flavouring depends on the source of the key ingredients. Flavouring components that are derived from natural sources by physical, enzymatic or microbiological processes enable the flavouring to be described as natural. If they are derived by chemical synthesis but are identical to substances found in nature then the term 'nature identical' is applied. Synthetic flavouring materials that do not have any natural counterpart require the flavouring to be called 'artificial'.

2.3. Sugar

The standard carbohydrate used in soft drinks is sugar (sucrose) derived from either sugar cane or sugar beet. This is commercially available as either granulated solid or as a concentrated syrup, usually 67ºBrix. In the EU the production of bulk sugars is rigidly controlled by the Common Agricultural Policy (CAP). At the time of writing the CAP is in the process of being reformed. Sugar is purchased as 'tonnes dry weight'. This allows for minor variations in the Brix value of sugar syrups. Granulated sugar is generally cheaper (per tonne dry weight) than sugar syrup but requires specialised handling and dissolution facilities

2.4. Colourings

The primary consideration in any decision regarding the use of colourings of any origin is whether it is necessary to add colour of any kind to a product. This decision will be driven by the consumer perception of the expectation of a product's appearance. The use of artificial colours in beverage products has diminished significantly in recent years as, although a limited range of artificial colours remain permitted, they are regarded as unacceptable by many consumers. The selection of colour will depend on a number of factors, including the preference for natural or artificial, the cost and availability, the actual colour or shade required, solubility and stability to acidic products, and overall stability in the product. Experienced formulators will usually work from a preferred shortlist but the final selection will depend on the performance of the colour in trial formulations

2.5. Preservatives

Preservatives are used in a wide variety of foods, including soft drinks, to ensure the safety of the food during storage. Preservatives are not permitted in pure fruit juices and either the packaging of these products has to give total protection (in the form of aseptic packaging) or the product should be kept chilled and sold quickly with or without pasteurisation. There is a limited range of permitted chemical preservatives for soft drinks.

2.6. Nutraceutical ingredients

'Nutraceutical' is used to refer to ingredients that are nutrients with possible pharmaceutical effects. They are used as ingredients in drinks that are claimed to have functional benefits in addition to being thirst quenching. They have become more popular as consumers' focus has moved towards drinks perceived to be more healthy. Ingredients in soft drinks and fruit juicesare Vitamins and minerals .The most popular and commonly used ingredients in such drinks are vitamins, minerals and antioxidants. Note that some vitamins are also antioxidants, e.g.Vitamins C and E. A popular combination is known as ACE, i.e. vitamins A, C and E. Vitamin A is added to soft drinks as betacarotene, which is known as provitamin A because it is converted to vitamin A in the body. B vitamins are frequently added to sports drinks as they are associated with carbohydrate metabolism. Vitamin B1 is mandatory for sports drinks in France. The most commonly added mineral is calcium, which is associated with bone and teeth health, but other minerals such as zinc are also used. Sodium is the mineral added to sports drinks as that is the key mineral lost in perspiration. In the EU, addition of nutrients is covered by Regulation (EC) 1925/2006. If any vitamins or minerals are added to a food or drink then full nutritional labelling be used. For any claim regarding addition of a vitamin or mineral to be made, a 'significant amount' must be added. A significant amount is defined as at least 15% of the Recommended Daily Allowance (RDA) per 100 ml, or per portion if a single-serve pack. At the time of writing the RDAs are under review in the EU as part of the revision of the Nutrition Labelling Regulations. Many are to be changed and new RDAs will be established for many minerals, e.g. potassium. The revised list of RDAs for vitamins and minerals is given below. Companies will have a transition period of four years to amend their existing labels and products.

2.7. Antioxidants

It is claimed that oxidising free radicals are damaging to the body and are a cause of ageing. Antioxidants which will remove free radicals are therefore considered to be beneficial for a whole range of age-related diseases. Many botanicals (fruits and berries) are high in antioxidants and are used to manufacture 'healthy' drinks. The most popular ones are pomegranate, blueberries and red (or purple) grape. Green tea and grape seed extract are also reputed to be high in antioxidants. It is claimed that one reason a Mediterraneanstyle diet is healthy is due to the high content of fruits, vegetables and red wine,which are high in antioxidants.

2.8. Sweeteners

After water quality, sweetness is probably the most important feature of a soft drink. In fact, until 1995 in the United Kingdom it was essential that a soft drink contained a minimum level of sugars. This level was set at 45 g/l unless the product was listed as a 'low-calorie' soft and it is now possible to make a soft drink with or without added sugars, if required,provided the product is appropriately labelled. The sweeteners used in soft drinks can be divided into two main categories. These are:

a) **the natural sweeteners**, such as sucrose, invert syrups, corn-derived syrups and honey,
b) **the high-intensity sweeteners** (artificial sweeteners) such as saccharin, aspartame and acesulfame K

2.9. Citric acid:-

Citric acid is used as an additive in different drinks to improve flavour and taste. However; higher concentration may cause damage to tooth enamel. The objective of this study was to determine the citric acid level in different drinks by using titration.

Self-Check – 2	Written test

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

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

Test I: Short Answer Questions

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

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

Information Sheet 3- Confirming availability and readiness of services

3. Confirming availability and readiness of services

Any Chemical Plant requires raw materials in order to produce final products. It also requires various other services called Utilities for smoothly carrying out the processes. Utility is neither a reactant nor a product, but utilities are required for maintaining adequate conditions of a manufacturing unit. Common utilities are air, inert gases, water, steam, fuel, refrigerants (or, coolants) etc. Utilities also include electric power, so power plants are also considered as a part of services. Services that May include but not limited to: Power, water, compressed air and inert gas should be available and meet to the standard.

3.1. Power source (Fuel and electricity):

This is essential utility required for heating, steam generation, burning purpose, etc. It can be solid (coals, etc.), liquid (fuel oils, etc.), and gaseous fuels (natural gas, etc.).

Electricity: It may be purchased or self-generated. Which is a main power source to drive machineries accordingly.

3.2. ***Water****:* It is most widely used process utilities. Water is classified as::

- ***Process water***: Water used by industries to produce a product or affect a process is known as process water.
- ***Potable water:*** Potable water is the drinking water. It contains the impurities that are safe for human health. Any water used in the production of wine, preparation of wine additives, and the washing through of lines and equipment should be of potable standard and meet all legal requirements. Where water is sourced from an 'uncontrolled' source, that is, other than a municipal supply, it should be routinely monitored to ensure compliance with legal requirements
- ***Cooling water***: Water at low temperature used to remove heat from process equipment's like coolers etc.
- ***Hot water:*** Water at high temperature used to heat within process systems is known as hot water.
- ***Fire hydrant:*** Water used for extinguishing fire in emergency fire lines in known as fire water.
- ***Boiler feed water:*** It has fewer amounts of impurities that can cause corrosion within Boiler vessel and Equipment using that water***.*** Some special compounds are also added into it in order to get specific properties e.g. Anti-Foaming Agents.
- ***Waste water:*** It contains a lot of impurities and effluents.

3.3. *Compressed air:* Compressed air is supplied in industrial sites for two main uses.

- ***Plant air:*** For general use
- ***Instrument air:*** for control systems, pneumatic devices, etc.

3.4. *Inert gas:*

Generally used for making system inert or process works under inert condition. The main inert gas used in industry is Nitrogen, but Argon & Carbon-Dioxide are also used. Inert gases are used for Purging and Blanketing**.** Purging is done to exclude air prior to start up, or to drive out hydrocarbons on shutdown etc.

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: Short Answer Questions

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

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

Information Sheet 4- Conducting pre-operational equipment checks

4. Conducting pre-operational equipment checks

A visual "circle check" or pre-operational inspection of equipment prior to every use will reduce the chance of equipment being operated in an unsafe condition. This makes it easier to spot and deal with maintenance issues early before they turn into a problem causing downtime, equipment damage or expensive repairs.

4.1. Pre-operational safety checks

- Locate and ensure you are familiar with all machine operations and controls.
- Ensure all guards are fitted, secure and functional.
- Do not operate if guards are missing or faulty.
- Ensure the engine has operating and maintenance instructions permanently located and clearly visible.
- Ensure the area is clean and clear of grease and oil.
- Check workspaces and walkways to ensure no slip/trip hazards are present.
- Check all safety devices are in good condition.
- Ensure the work area is well ventilated. Start the fume extraction unit before using the machine.
- Ensure all flammable materials are correctly stored before operating.
- Do not use this machine unless you have been instructed in its safe use and operation and have been given permission

4.2. Operational safety checks

- Only one person shall operate the engine at a time.
- Ensure the area is clear of people and equipment before operating.
- During operation and when cooling down, be aware that parts of the plant are hot and/or rotating

4.3. Equipment for syrup production includes:

- Syrup tank with agitator
- Sugar dissolving tank with agitator
- Pumps
- Mixer
- Heat exchanger
- Coiled heaters
- Strainer/ Press filter or other filtration technique
- Mixer for ingredients and flavour

4.3.1. Syrup tank with agitator

Stainless steel tanks are storage devices that are used to hold a range of substances. Many industries use stainless steel tanks to hold substances such as chemicals, gases, food, water, and other bulk materials. Industries that rely heavily on stainless steel tanks.

4.3.2. Sugar dissolving tank with agitator and pump

4.3.3. Pumps

Pumps are divided into dynamic and positive displacement types. The dynamic type operates by increasing the velocity of the fluid as it passes through a rotating impeller. Positive displacement types include pumps where a chamber is filled with liquid, to which pressure is applied, usually by a piston or diaphragm. Before a pump is selected the conditions under which it will be required to operate must be known. This will include the type of liquid, its density, temperature and viscosity. Flow rates will be required as well as inlet and outlet pressures and the presence of any suspended solids, corrosive or erosive materials will need to be accounted for. All pumps used for soft drinks or fruit juices should, as far as possible, be

Constructed to have contact parts of stainless steel (316 grade) or, in the case of diaphragm pumps, other inert material. Most pumps used are of the centrifugal type that are easily cleaned and can be replaced quickly. Some situations will require pumps of the self-priming type. There are other situations that require positive displacement pumps that can deliver at significant pressure. Pumps of the

‘Monopump’ type are often very suitable as they typically have a stainless steel rotor working against an inert flexible stator. Diaphragm pumps offer the attraction of being of the positive displacement type with no rotary moving parts and, as they are invariably driven by compressed air, do not require an electrical supply. This may be a particular benefit if pumps are to be moved around frequently or are to be used in a hazardous atmosphere where zoning of electrical equipment is necessary. Pumps should be inspected regularly and any leaky seals or other worn parts replaced

4.3.4. Mixer

There is no one ideal mixing plant. The design depends upon what is being mixed. All materials used must of course comply with the materials in contact with food regulations. Stainless steel is the preferred material because of its resistance to attack, particularly by cleaning agents such as hypochlorite or ozone. Stainless steel grade 316 is generally considered to be the best material for general use. It is important to achieve thorough mixing without entraining air, which can oxidizes susceptible flavors and cause filling problems, especially for carbonated drinks.

The two main types of stirrers

- Large paddles for slow mixing/ stirring of viscous solutions,
- Rapid ‘propeller’-type stirrers for dissolving powders or rapid stirring of less viscous solutions.

Specialized mixing plant, e.g. homogenizers, may be required for effective dissolution of powders such as gums and stabilizers. Most soft drinks plants operate on a batch mixing principle. A batch of syrup is prepared from the individual ingredients, quality control checked and blended with water to make the finished product. It is essential that the rate of syrup manufacture, mixing and quality control checking is rapid enough to keep pace with the rate of bottling to avoid downtime on the line. In order to simplify the syrup room operation, key components are often pre-blended in the form of a ‘compound’. This would typically include fruit material, colours, flavours and sweeteners (but not aspartame). At its extreme this approach has been developed into a fully automated blending system. The major ingredients – sugar, compound, water and CO2 – are fed into a continuous blender and then directly to the bottling line. This type of process is better suited to long runs of one type of product rather than to those requiring many frequent flavour changes. The syrup is blended with water to the desired finished strength using a continuous blending system such as a ‘’Mojonnier ‘’mixer.

a) Problems during mixing

- Liquid sugar can be considerably more expensive than granulated sugar.
- Dissolving of granulated sugar by simple agitation is a slow process.
- Conventional agitators cannot dissolve high concentrations of sugars at ambient temperatures.

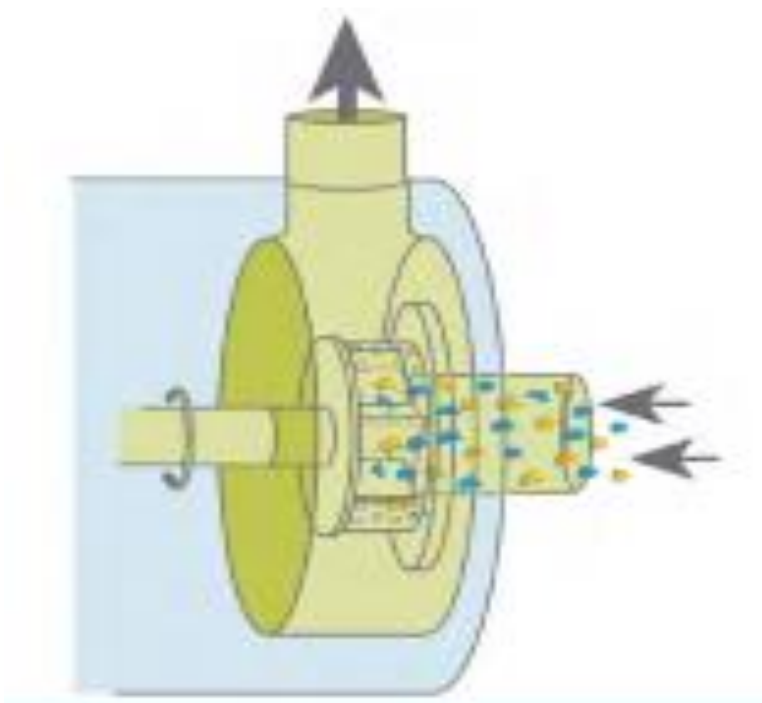
- Heating the water to aid solution adds to costs and is energy inefficient.
- The cooling process further adds to costs and process time.
- Crystallization of the syrup can occur during heating/cooling.
- Incomplete solubilisation can lead to sedimentation or even blocking of vessel outlets.

b) Solutions to tackle during mixing

A Silverson High Shear Mixer can substantially reduce mixing times and eliminate the need for heating the water. This can be achieved with in-tank Batch Mixers or by adding a Silverson In-Line Mixer to the existing process. This operates as follows:

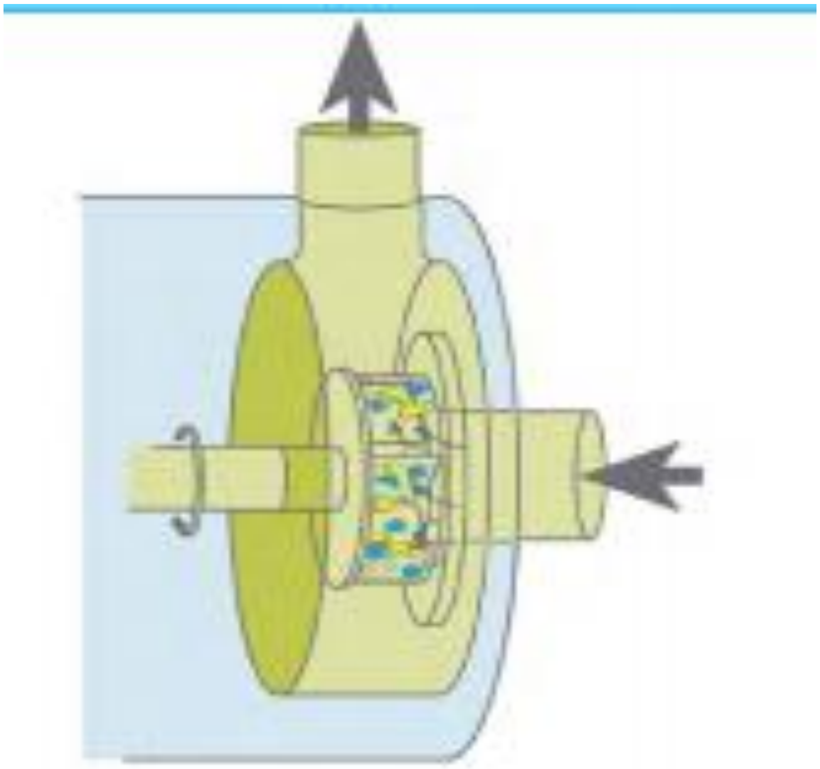
Stage 1:

The high speed rotation of the rotor blades creates a powerful suction which draws the water and sugar granules from the vessel into the work head.



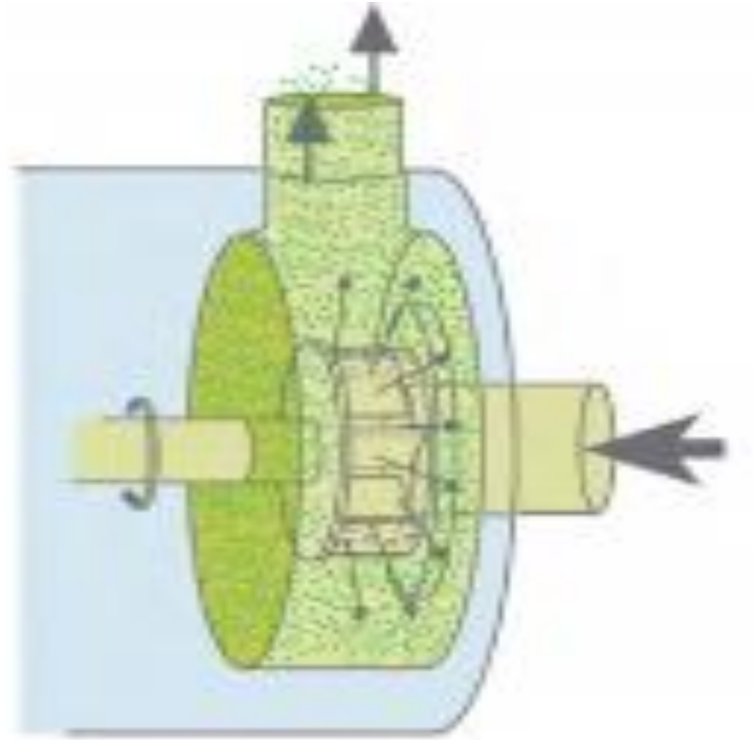
Stage 2:

Centrifugal force drives the materials to the periphery of the work head where they are subjected to a milling action in the gap between the rotor and the stator wall.



Stage 3:

The product is forced out through the stator as fresh materials enter the work head. In a short mixing cycle all the material passes through the work head, progressively reducing particle size and exposing an increasing surface area of sugar to the surrounding liquid, accelerating the dissolving process.



c) The advantage Silverson mixer

- The combination of granule size reduction and vigorous mixing dramatically reduces mixing times.
- A 66% sugar syrup can be produced at ambient temperature.
- Increased versatility allows the manufacturer to use sugar in granulated or syrup form.
- A Silverson mixer can also disperse and hydrate thickening and stabilizing agents such as CMCs and Xanthan gum in a fraction of the time taken by other means.

4.3.5. Mixer:

Types of mixers there are several products in the Silverson range suitable for this application, the selection of which is dictated by individual process requirements including batch size

a) **High Shear Batch Mixers**

- Suitable for batch sizes up to 500 US gallons
- Many units can be used on mobile floor stands
- Small units available for R&D and pilot production

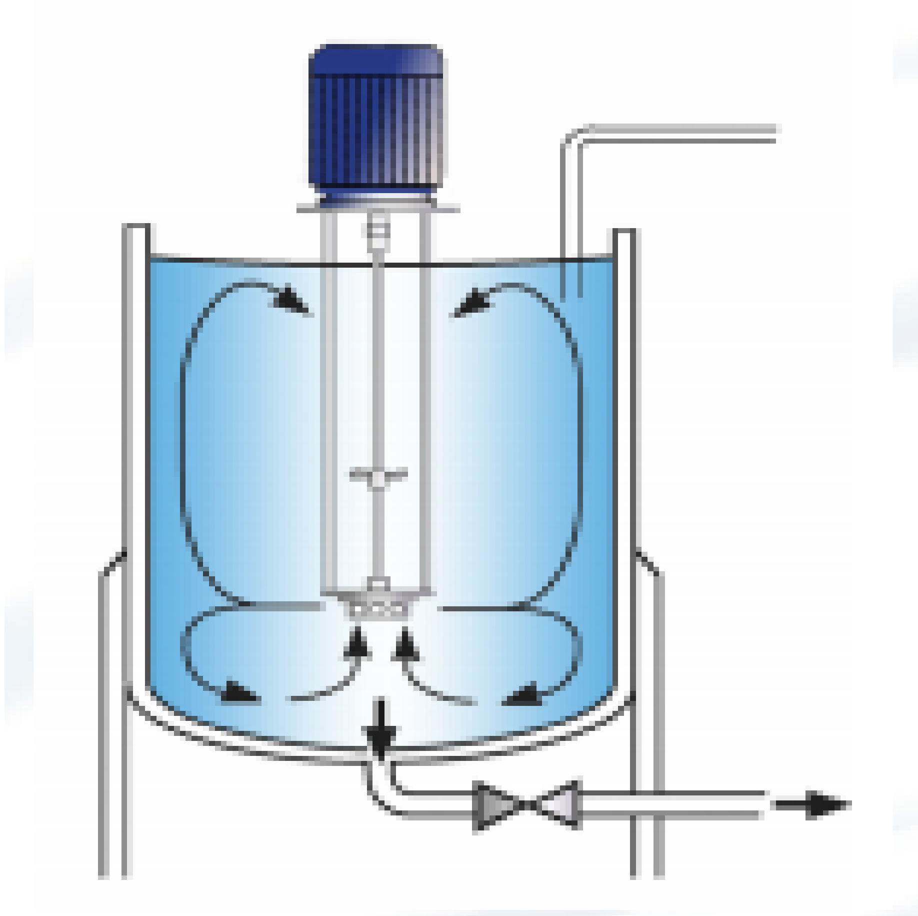


Fig. : High Shear Batch Mixers

b) High Shear In-Line Mixers

- Ideal for larger batches
- Aeration free
- Easily retrofitted to an existing plant
- Self-pumping
- Can be used to discharge vessel
- Ultra Sanitary models available
- High viscosity models available

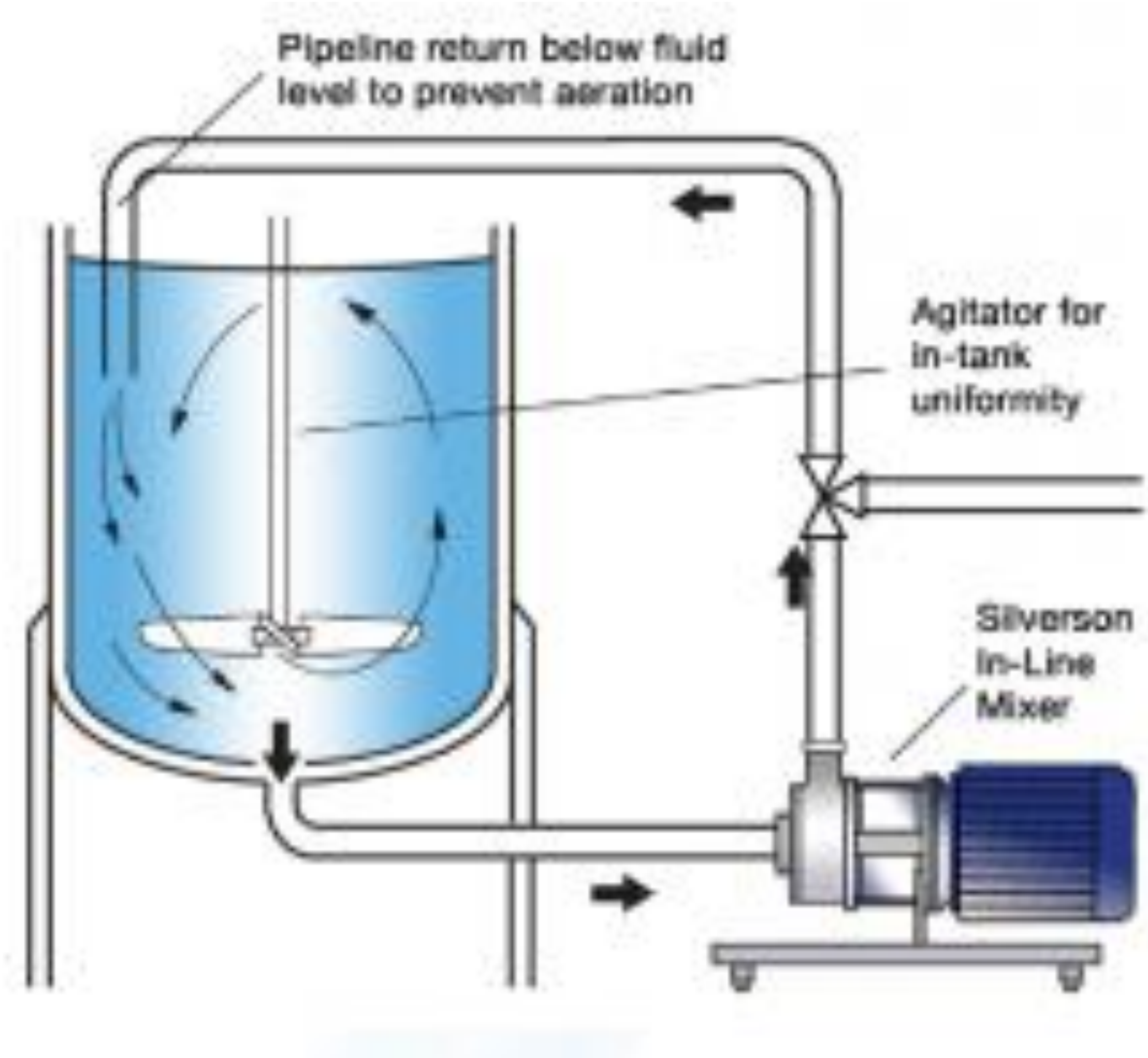


Fig. : High Shear In-Line Mixers

c) Silverson Flashmix

- Ideal for larger batches
- Capable of rapidly incorporating large volumes of powders
- Minimized aeration
- Minimized cleaning requirements
- Suitable for higher viscosity mixes
- Suitable for operation at higher temperatures
- Minimum operator input required

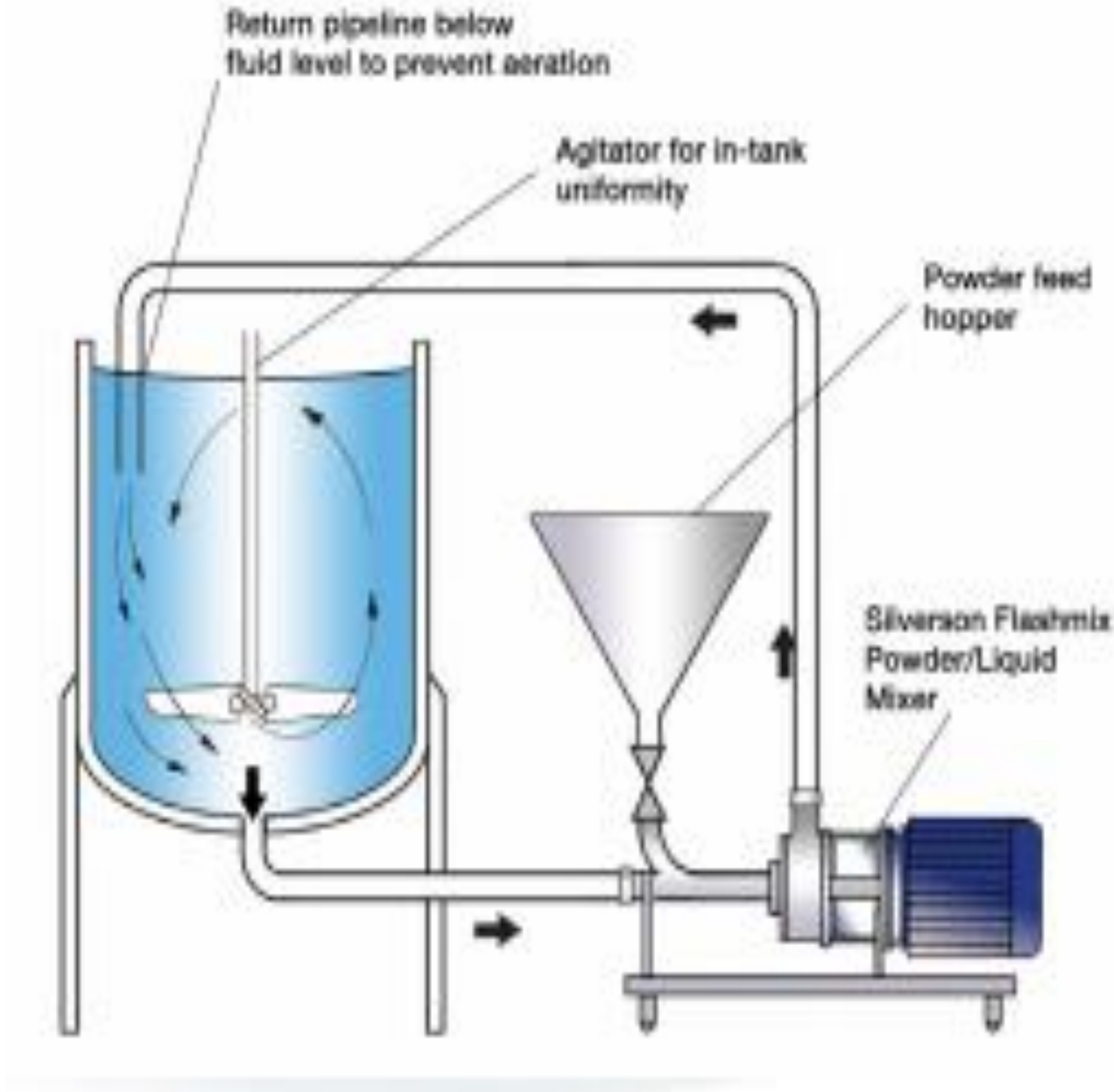


Fig. : Silverson Flashmix

d) Silverson Ultramix

- Ultra Sanitary CIP design
- Excellent in-tank movement
- Capable of rapidly incorporating large volumes of powders
- Ideal for higher viscosity mixes

- Low maintenance

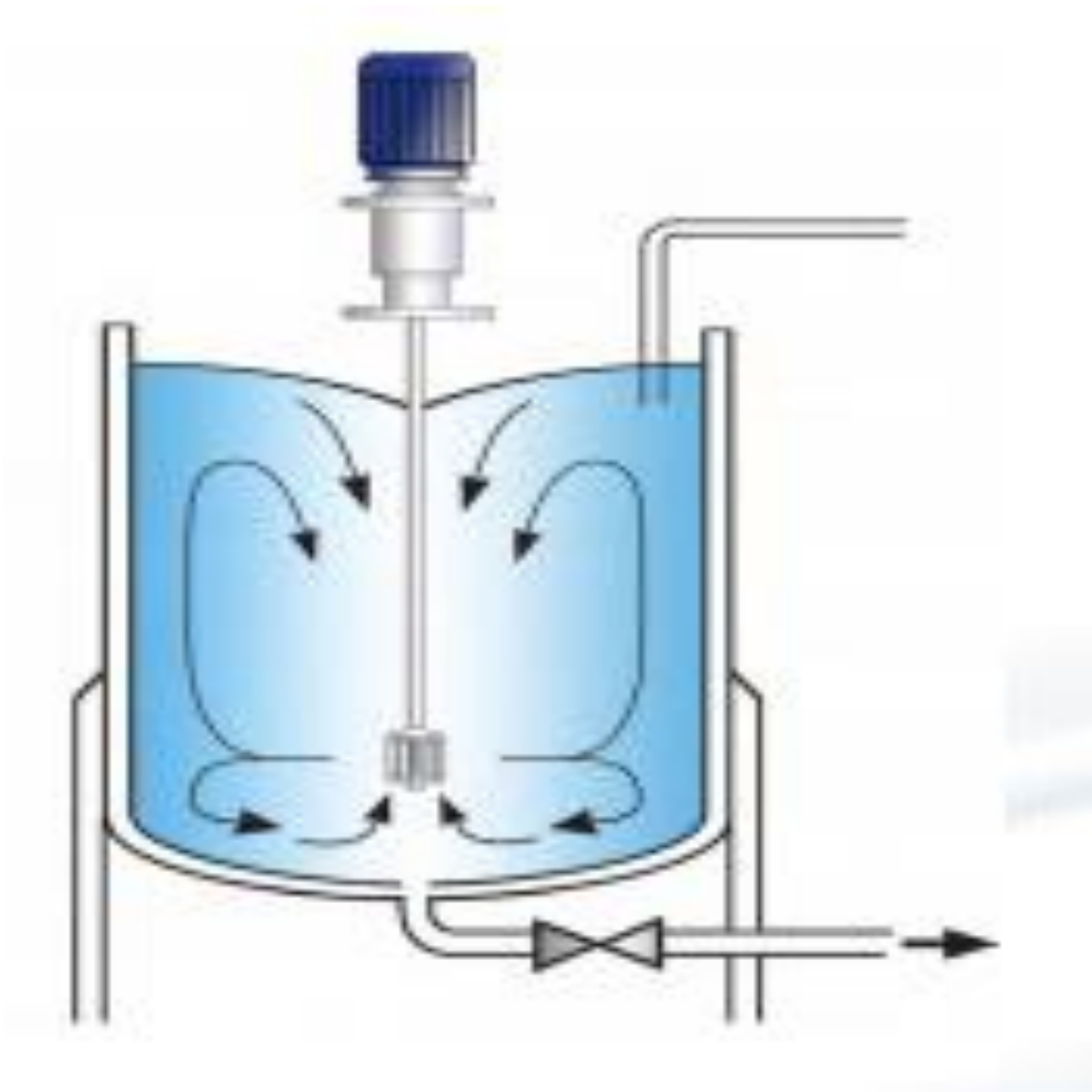


Fig.: Silverson Ultramix

4.4. Coiled heaters

A hot product which emerges is used for pre-heating. Up to 90% of the heat used can be recovered with a recovery heat exchanger. The system which we have developed also ensures hygienic conditions on the outer casing recovery heat exchanger assists in the recovery of heat within continuous processes.

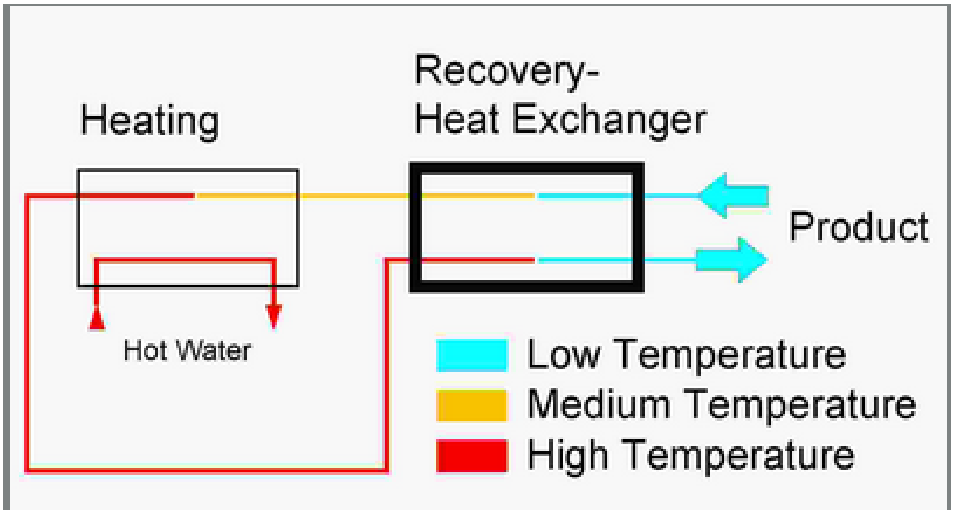


Fig. : Coiled heaters

4.5. Strainer/ Press filter or other filtration technique

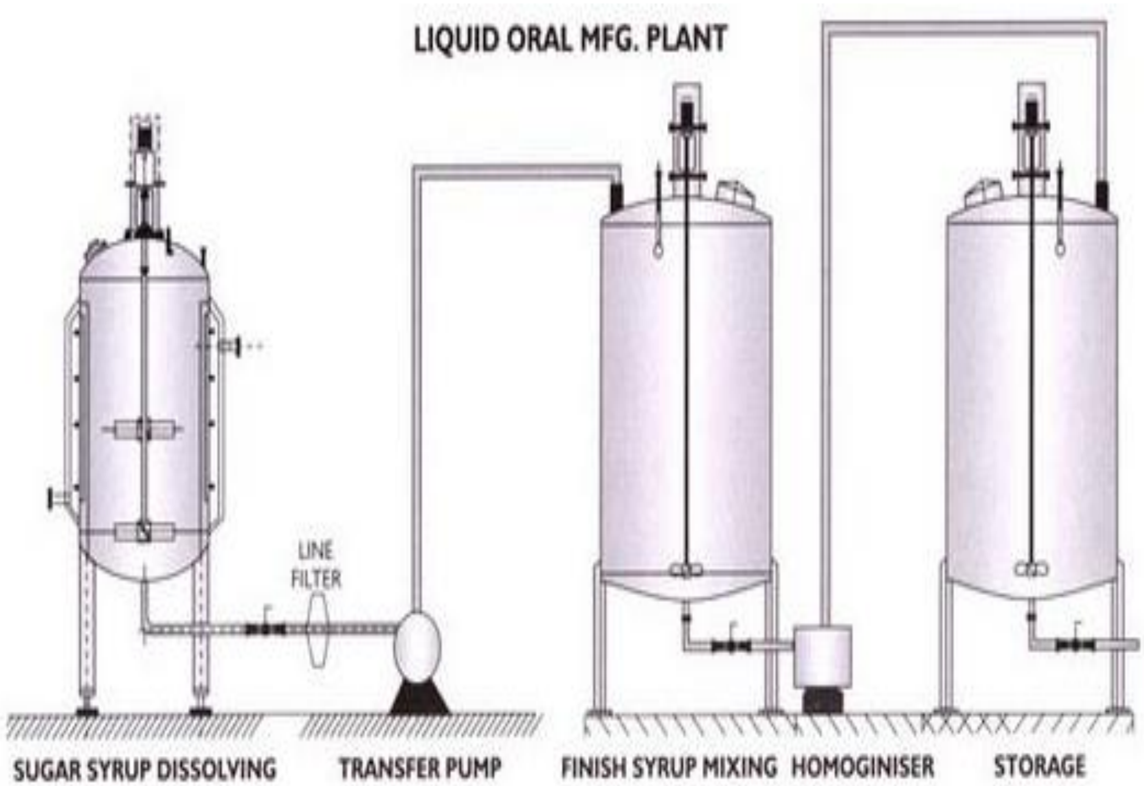
Filtration equipment is a kind of mechanical, physical, or biological equipment that separates solids from fluids (liquids or gases). The fluid passed is called the filtrate.

Fig. : Stainless-Steel-Precision-Filter-Housing

Fig. : Press filter or other filtration technique

4.6. Mixer for ingredients and flavor:

If ingredients are solid, then our dissolver is the optimal choice. Our dissolver is also suitable for to adding small amounts of liquid components. The dissolver unit takes care of a homogeneous mixture prior to in front of dosing into the syrup tank.



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: Short Answer Questions

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

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

Information Sheet 5- Setting syrup production process

5. Setting Syrup Production process

The basis of soft drinks, the syrup, is made up of water, sugar, acid, colouring and flavouring agents. This syrup is prepared by dissolving these ingredients into water to 65°Brix.

Sugar can be dissolved in two ways:

- Warm: dissolving at 70 to 80°C, filtering and cooling to 15°C
- Cold: dissolving by intensive stirring in cold water, filtering, and pasteurizing.

Usually, the sugar is added with a flow meter. With the help of a flow meter with a density measurement (mass flow meter) the sugar content can be measured directly. The density is a measure of the sugar level (also called Brix).

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: Short Answer Questions

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

LG #36	LO#2: Operate and monitor the syrup production system

Instruction sheet

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

Starting up crushing process

- Starting up syrup production system
- Monitoring Control points
- Undertaking required tests
- Implementing system and sub-systems out puts to meet the specification
- Monitoring equipment
- Identifying, rectifying and reporting out of specification
- Recording production data and work place information

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

- Startup syrup production system
- Monitor Control points
- Undertake required tests
- Implement system and sub-systems out puts to meet the specification
- Monitor equipment
- Identify, rectify and report out of specification
- Record production data and work place information

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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 up syrup production system

1. Introduction

Syrups: "Syrups are concentrated aqueous preparations of a sugar or sugar substance with or without flavoring agents and medicinal substances."

1.1. **Preparation of Sugar Syrups**

The sugar content of carbonated and still soft drinks varies considerably according to whether the product is to be supplied ready to drink, or as a concentrate (often referred to as a "syrup"). A typical formulation would also contain flavoring or concentrated fruit juice, acidity regulators, preservatives, stabilizers, antioxidants and coloring. With "Diet," and other "sugar-free" drinks the sugar content is replaced with artificial sweeteners such as Aspartame.

One of the first stages in a typical manufacturing process is preparation of a sugar syrup. Sugar is used in either granulated or liquid form. Liquid sugar simply requires blending with water, however when granulated sugar is used, a number of processing factors must be considered:

- Small scale production of syrups with a low sugar content can be carried out at ambient temperature. However with some concentrated products, sugar solutions at 60% or above are not uncommon, requiring heating of the water to aid dissolving.
- In large scale operations, heating to around 95˚F (35˚C) may be carried out to speed up dissolving.

1.2. Sugar syrup preparation procedures

1. **Simple syrup preparation.**

- A measured amount of treated water is pumped into the tank
- The agitator is started.
- The prescribed amount of sugar is added to the treated water and
- Allowed to mix in the water for some time, until it is completely dispersed and dissolved in the water. The resultant sugar solution is commonly called "simple syrup**"**
- The simple syrup is then pumped through a polishing filter to a second tank
- Filtering the simple syrup through the polishing filter is a standard requirement aimed at removing any foreign matter, such as black carbonized specks that are commonly found in even the best

grades of sugar. The pore size required of the polishing filter depends on the general quality of sugar used and is usually in the 5 to 20 µm range.

1. Adding the beverage base ingredients

To the transferred filtered simple syrup in a second tank, the other beverage formulation ingredients are added in a prescribed manner and sequential order. The total complement of formulation ingredients, excluding the sugar (and the carbon dioxide gas later added at the filling machine), form what will be called the "beverage base" for that particular formulation.

2. Topping up to final volume with treated water.

The beverage base ingredients are mixed well into the simple syrup by the tank agitator until they are completely dissolved or dispersed in the syrup. The agitator is then stopped, and more treated water is added to bring the total liquid quantity in the tank up to the final volume prescribed for the syrup batch. This volume determination can be performed by using a calibrated dipstick or sight glass.

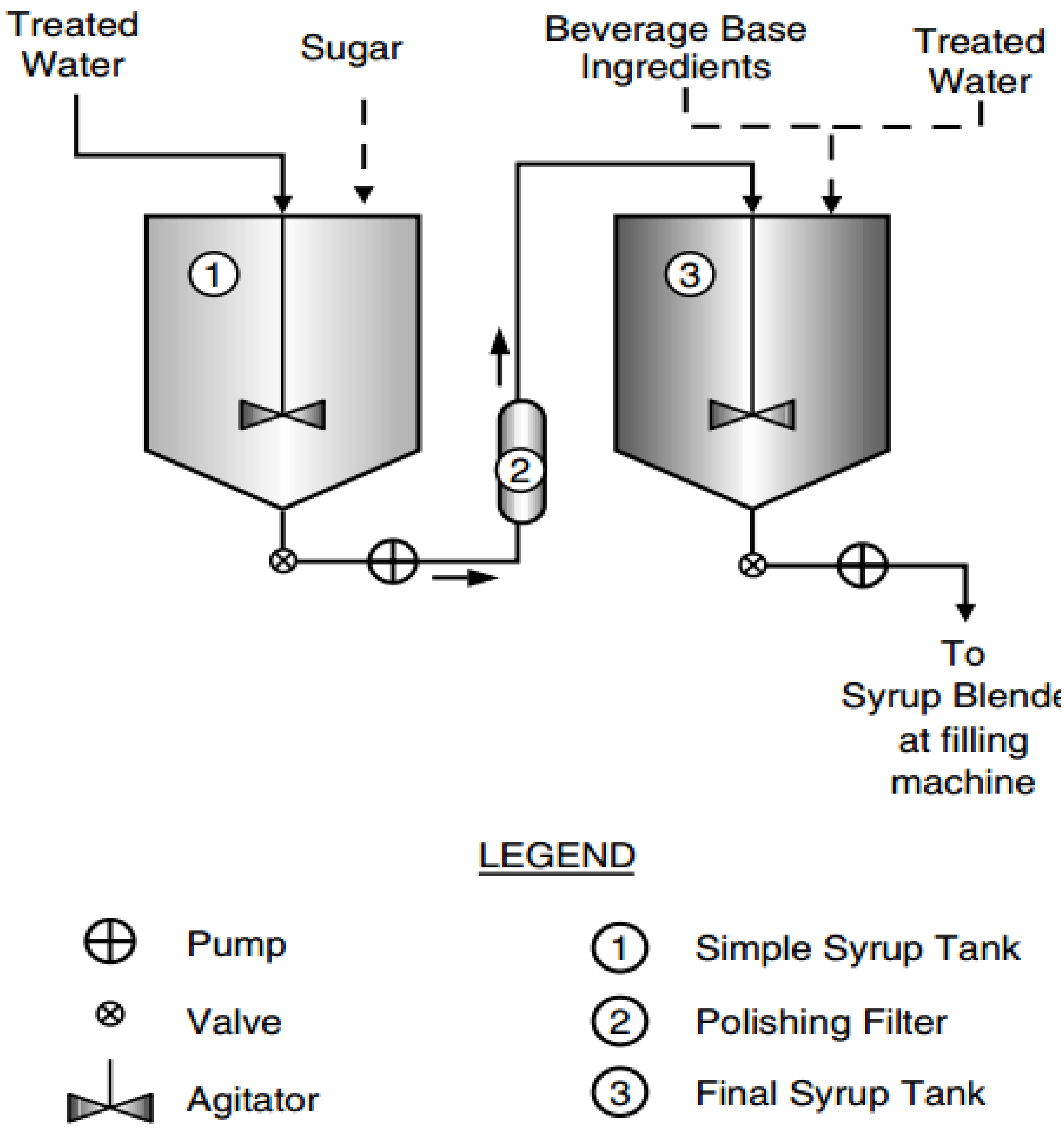

Fig.1.1.: The standard syrup-making process

3. De aeration and final quality control testing are conducted before releasing for filling.

After topping up with the treated water to the final batch size volume,

- The agitator is restarted
- The syrup is mixed for approximately 10 to 15 min.
- The agitator is stopped, and the syrup is allowed to de -aerate for 1 to 2 h.

At this stage, the syrup can be referred to as final syrup, as it now contains all the required components and is at the prescribed volume for the batch. It is ready for use in filling at the bottling line, provided, of course, that it passed all the required quality control (QC) tests

1.5. Syrup production consists the following steps

1. Receiving ingredients and sugar
2. Measuring Sugar and water required
3. Screening Sugar
4. Dissolving and treating sugar at 80 degree centigrade (if hot treatment is applied) in the presence of activated carbon and filter aid.
5. Concentrating dissolved sugar by using steam(in liquors)
6. Filtration through strainers and other filtration equipment, then cooling the dissolved sugar and transfer to final syrup tank.
7. Addition of preservatives, flavors, citric acid and additives.
8. Perform quality check

Self-Check – 1	Written test

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

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

Test I: Short Answer Questions

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

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

Information Sheet 2- Monitoring Control points

2. process control

Process control is the essence of modern factory systems. It is imperative at all times to have the process fully under control and for full records to be kept. Online instrumentation and feedback control is the key to a successful operation. The syrup premix is produced as a batch offline. All the weighed ingredients are logged on a computer-controlled weighing system that can feed back data to the central factory system. The level of de-aeration of the water can be continuously logged using an online probe, and the water quality itself must be regularly analyzed. The treated water is monitored for turbidity problems online, with automatic shut-off should a problem arise. The carbon dioxide and all materials delivered should have a certificate of conformance to an agreed, signed specification. The premix, water, acid and sugar, if required, are fed by flow meter, with online Brix control feedback, either to a bulk vessel or direct to the carbonator and are checked against an agreed recipe within the PLC of the dosing system. At all times, records need to be computerized and backup copies kept. Automatic shutdown occurs should a problem be found by the online instrumentation. The effectiveness of the carbonation process can be detected online by taking regular samples and checking pressure and temperature against the specification. The feedback control system will regulate the process within agreed limits. The filler itself is fully PLC controlled, often using a touch-screen control system. This allows production to be carried out with Brix and carbonation levels controlled.

2.1. Releasing the syrup to production

After topping up to final volume, samples are taken for specified quality testing. It is recommended that two samples be taken:

- one from the top of the tank
- One from the bottom.

This is to confirm that the syrup was mixed homogenously. A Brix test with identical results for both samples will do this. If the Brix results are significantly different, i.e., more than 0.1°B apart, the syrup should be given a 10 min mix with the agitator, and then another two samples should be tested.

If results still differ, then the cause must be found. Many times this difference in results is due to improper sampling of the bottom sample. The sampling point is often at the end of a lengthy piece of piping from the bottom of the tank. It can contain incompletely mixed syrup trapped in the piping on which the agitator had no mixing effect. The solution to this problem is simple. About 20 to 30 liters should be drained out into a vessel before sampling, and the drained syrup must be returned to the tank.

This should be a standard procedure before sampling from the bottom of a tank. Having passed the prescribed QC testing, the final syrup is allowed to stand for approximately 2 h to allow it to de aerate. After de aeration, the final syrup can be released to production for filling final beverage. In general, final syrup may be stored for 24 to 48 h prior to bottling, depending on its “sensitivity” grading. Juice containing syrup, for example, is considered highly sensitive (to microbial growth) and should be used within 24 h after preparation. Lemonade syrup may be kept up to 48 h, but the sooner it is used, as for all final syrups, the better.

Self-Check – 2	Written test

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

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

Test I: Short Answer Questions

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

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

Information Sheet 3: Undertaking required tests

3. Required tests in syrup preparation include

- Brix
- Titrable acidity
- Inverted brix
- Taste, odor, appearance

3.1. Titratable acidity

The acid character of a juice contributes to its flavor type, and is taken into consideration when assessing the value of the juice for inclusion into new beverage product formulations. Acid content (% w/w) is determined by direct titration against a standardized alkali solution (e.g. 0.1 Molar sodium hydroxide), using a pH meter, to an end- point at pH 8.1. Where the juice is naturally clear, or has been clarified, and is of low color intensity, the end-point may be accurately found using phenolphthalein as indicator.

3.2. Ascorbic acid.

Many juices contain ascorbic acid or vitamin C. Quantitatively, this is the most important vitamin in soft fruits, ranging from a negligible level in some whortleberries, to around 200 mg/100 gm in blackcurrants. Ascorbic acid performs a valuable function as an antioxidant in minimizing the degradation of certain flavor principles, and it is often important for it to be included in processed juice or in a soft drink formulation. Levels in the region of 200–400 mg/kg are typical. It should be noted that ascorbic acid is to be added to the natural strength juice, if this is intended for direct use, or to the juice concentrate. Addition to natural strength juice, before its concentration, will result in its own degradation during the heating process, and ultimately cause spoilage of the product, when an intense browning reaction takes place.

3.3. Viscosity:

It is a property of liquid that is directly related to resistance to flow". Viscosity measurement is very important quality control test in case of syrups & elixirs. Viscosity consistency directly relates with stability of solutions.

3.2. Clean& purified vehicle (water):

The water is filtered & purified at the plant to destroy any microorganism & to remove particles from the water. Quality control technicians test the water frequently to ensure that it is clean & pure before the syrups & elixirs made. The syrups & elixirs are also thoroughly filtered before filling in bottles.

3.3. Light Transmittance Meter:

A light transmittance meter is a tool i.e. used to check the syrup's color. In a light transmittance meter a syrup sample is check for color by passing the light to the sample. The percentage of light transmittance is compared to light transmittance rates set for different grades. When using one, you should be sure that there is no finger prints on syrup test bottle, and that the syrup sample has no bubbles or cloudiness. Any of these conditions may diminish the light i.e. transmitted through the sample & therefore lower the grades of sample.

3.4. Visual inspection:

With the visual inspection, the ingredient & the final product are carefully examined for purity for appearance. Physical appearance of product for patient adherence &compliance is critical so that it should be good looking & elegance in appearance.

3.5. pH measurement:

The measurement & maintenance of pH is very important step in quality control testing. Generally there are two different types of methods use in the measurement of PH.

3.5.1. Methods for pH measurement:

a) **PH paper:** The simplest & cheapest method is to dip a piece of pH paper into the sample. The sample is impregnated with chemicals that change the color & color may be compare to a chart supplied with the paper to give the pH of the sample.

b) **PH meter**: If greater accuracy is required a pH meter should be use. A typical pH meter consist of special measuring glass electrode connected to an electronic meter that measures & display the pH reading.

3.6. Physical Stability of Syrups:

- The syrups must be stable physically e.g.
- Its appearance (no crystallization and microbial growth)
- Color must be completely soluble with other ingredients.
- Odor and taste (palatable)
- Solid material is completely miscible in liquid.

3.7. Sucrose concentration/Assay of active ingredient:

The determination of sucrose concentration is also very important in quality control testing of syrups. If the concentration of sucrose in the syrup is very high it may crystallize the syrup & less concentration give favor for the microbial growth. There is no specific method for the determination of sucrose in syrup we use HPLC & U.V spectroscopy for this purpose.

3.7.1. By using HPLC(high pressure liquid chromatography)

HPLC technique is used for both qualitative & quantitative analysis of sucrose. For qualitative analysis or to confirm the presence of sucrose we compare the peaks obtained after running HPLC with standards & specific peaks of sucrose. For quantitative analysis we measure the area under curve (AUC) that will tell us about the concentration of sucrose present in given sample.

3.7.2. By using Ultra violate (U.V)spectrophotometer

It can be used for quantitative analysis, by using Beer's lambert law. The concentration of single absorbing species in a solution can be readily determined. The absorptivity's of many substances at specified wavelength are available in literature. However, if any absorbance is not available it can be determined by measuring the absorbance of a solution of known concentration of the substance concerned, using Beer's lamberts law.

3.8. Refractive Index:

It is measured by refractometer. Refractive index = 1.4608 - 1.4630.

3.8.1. Method:

1. Place the apparatus in front of proper light source.
2. Clean the apparatus using soft cloth and wipe the prism by soft brush, if necessary, moistened with alcohol and then acetone.
3. Place a drop of distilled water and adjust the instrument.
4. Focus the telescope eye piece on the cross section of the instrument and rotate the index arm until a colored band or fringe is seemed through the telescope.
5. Adjust the eye piece on the movable arm to give sharp focus on the scale
6. Record the refractive index to the third place of decimal and for fourth place use a reading lens.
7. Take at least three readings of each sample and its mean used for calculation.
8. Open the prism by turning the lock nut and clean the face of the prism.
9. Put a few drop test solution on prism and close it properly.
10. Take three readings of each sample of liquid

3.9. General appearance :Clear concentrated aqueous solution

3.10. Clarity: Clean & clear with no solid particles

3.11. Sensory evaluation

The sensory assessment of soft drinks and fruit juices is discussed briefly here for completeness. As the flavor and odour of a soft drink or fruit juice are very important elements of a product they should be closely controlled. This is generally carried out by trained panelists who have been screened to ensure that they have an aptitude for this type of assessment; they are often quality assurance personnel or workers from the factory. Sensory assessments should be carried out in surroundings where the panelists can concentrate without distractions. Every batch of finished product, should be checked to ensure that it tastes ‘normal’ (i.e. is free from off-tastes). Although the tasters should be familiar with the product’s flavor and odour they should always be provided with an approval control for reference purposes. Incoming raw materials such as sugar and water should also be assessed to ensure that they will not impart any off tastes to the finished product.

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: Short Answer Questions

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

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

Information Sheet 4- Implementing system and sub-systems out puts to meet the specification

4. Implementing system and sub-systems out puts to meet the specification

4.1. Syrup rooms and proportioning systems

In these systems the syrup is usually prepared in the syrup room in a concentrated form, typically in the ratio 3 parts syrup to 17 parts water. For juice products this is much less down to the order of 1 part syrup to 3 parts water. This includes all the ingredients with just a small amount of water to ensure that the viscosity was low enough to promote reasonable flow conditions. The syrup is prepared normally in batch vessels using water and liquid sugar feed through volumetric flow meter.

Often these are not of very hygienic design, having been installed over 25 years ago. The feed is through a pipe in the top of the vessel often leading down the side of the vessel to the bottom. This was to try and minimize aeration due to feeding liquid into the air rather than under liquid at all times. The ingredients would be pre-mixed in a stainless steel bucket and added to the syrup vessel. High preservative levels were required in the product to ensure product security. Whilst the bucket might have disappeared some time ago, the old-fashioned syrup room still exists in many factories. Often a pre-mix is made up and metered to the syrup tank, using water as the wash through at a metered level. However, the vessels are often open to atmosphere and have rather crude blending arrangement, rather than the more sophisticated mixers used in modern vessels. The state of the syrup room often needs attention, in that risks from overhead beams that are difficult to clean, and similar problems associated with older sites, make product quality an ongoing issue. It is only by very stringent cleaning regimes, including operator hygiene that these systems are still in use today. It is at the proportioner just before the filler that the final product is produced just prior to carbonation. In fact, most such units incorporate the carbonator. In the Mojonnier system a fixed orifice is used to meter the syrup component whilst the water is fed through a variable orifice. They both operate under a constant head of pressure as shown in Figure 4.1. A float valve in the product tank ensures a fixed head feed to the carbonator as well as controlling the water and syrup feeds. The set-up of such a system always meant that the initial product was out of specification, though once set up it remained accurate. Also the last part of the batch would be out of specification which will cause some loss of product. This is due to the fact that the emptying of the syrup tank gives rise to a lower syrup head pressure than that of the water. Another such system used dosing pumps one for water and another for syrup.

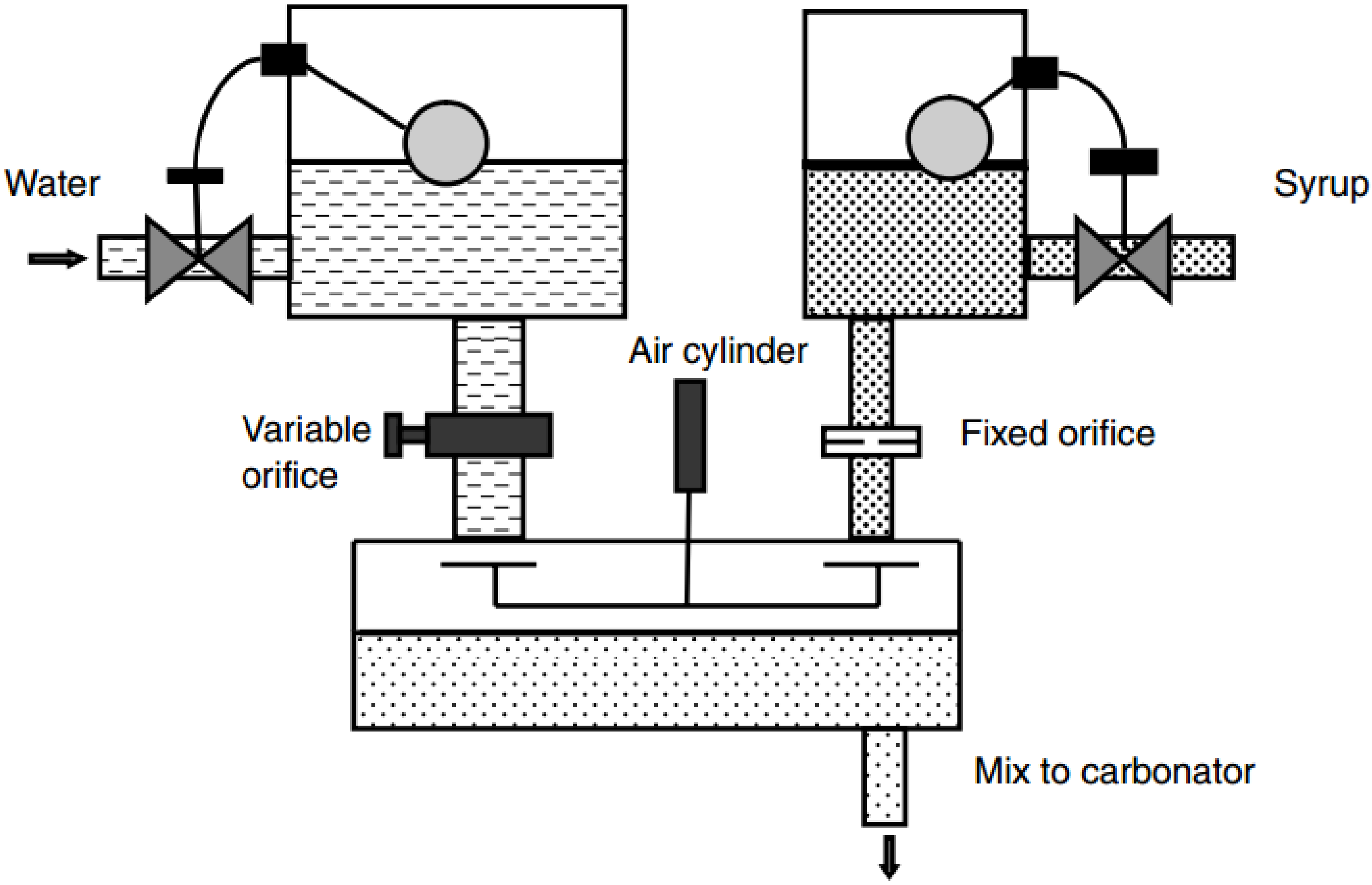

Fig. 4.1: Mojonnier system.

4.2. The modern syrup room

Nowadays these are situated in an air-conditioned specially designed area set to a high standard commensurate with the production of food stuffs. The plant is PLC (program control logic) controlled with in-line clean-in-place (CIP) systems. Banks of valves with a lot of pipelines and stainless steel tanks are in evidence, a far cry from twenty years ago. Meters have now progressed from volumetric to mass flow, where density correction of key ingredients can be incorporated. The key to these systems is that they produce the final beverage on the premise of getting the product right first before carbonating.

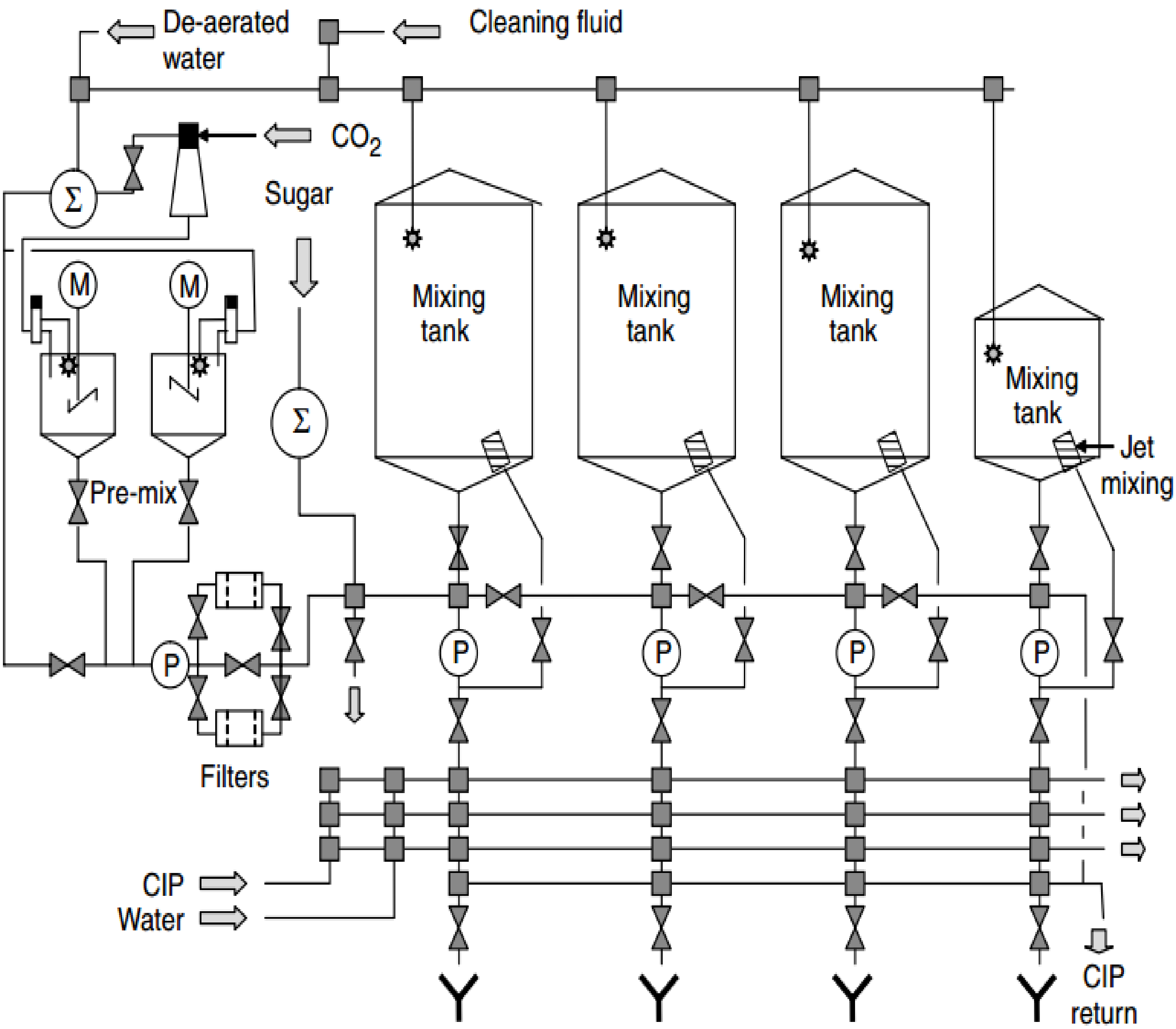

Fig. 4.2.: Volumetric flow meter system.

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: Short Answer Questions

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

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

5. Equipment monitoring

Equipment monitoring involves applying cleaning/sanitizing procedures must be evaluated for adequacy through evaluation and inspection procedures. Adherence to prescribed written procedures (inspection, swab testing, direct observation of personnel) should be continuously monitored, and records maintained to evaluate long-term compliance.

5.1. Cleaning and Sanitizing

The objective of cleaning and sanitizing food contact surfaces is to remove food (nutrients) that bacteria need to grow, and to kill those bacteria that are present. It is important that the clean, sanitized equipment and surfaces drain dry and are stored dry so as to prevent bacteria growth. Necessary equipment (brushes, etc.) must also be clean and stored in a clean, sanitary manner.

The correct order of events for cleaning/sanitizing of food product contact surfaces is as follows:

1. Rinse
2. Clean
3. Rinse
4. Sanitize.

5.2. Definitions

Cleaning

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

Cleaning Methods

Equipment can be categorized with regard to cleaning method as follows:

- Mechanical Cleaning. Often referred to as clean-in-place (CIP). Requires no disassembly or partial disassembly.
- Clean-out-of-Place (COP). Can be partially disassembled and cleaned in specialized COP pressure tanks.
- Manual Cleaning. Requires total disassembly for cleaning and inspection.

Sterilization: refers to the statistical destruction and removal of all living organisms.

Disinfection: refers to inanimate objects and the destruction of all vegetative cells (not spores).

Sanitization: refers to the reduction of microorganisms to levels considered safe from a public health

General types of sanitization include the following:

- **Thermal Sanitization** involves the use of hot water or steam for a specified temperature and contact time
- **Chemical Sanitization** involves the use of an approved chemical sanitizer at a specified concentration and contact time.

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: Short Answer Questions

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

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

Information Sheet 6- Identifying, rectifying and reporting out of specification

6. Identifying, rectifying and reporting out of specification

There is much that can go wrong in a final syrup preparation process that can affect the target of the process, which is a syrup batch at the correct final volume at the right Brix.

6.1. Noticeable nonconformance to be consider while preparing syrup.

- Incorrect indicated weight content of the sugar bags (if these bags are used as the main means of measuring the prescribed sugar weight)
- Faulty flow meter for the treated water measurement
- Calculation error when converting bulk simple syrup to sugar content
- Inaccurately calibrated sight glasses
- Incomplete homogenous syrup due to faulty agitation equipment
- Excessively high or low ambient temperatures affecting tank volumes due to metal expansion or contraction as well as their similar effects on treated water and syrup volumes
- Losses of syrup due to unnoticed leaks in pipe connections and valve seals
- Undrained treated water remnants at the bottom of the tank or in the piping lines after a cleaning operation
- The same as above for remnants of undrained syrup from a previous batch of the same product flavor

Most syrup-room operators and supervisors, especially veterans with years of experience, develop an eye for things that can go wrong with a syrup batch before it is topped up to final volume. Thus, most of the items mentioned above are usually detected early enough to take corrective actions to avoid defective final syrup preparation.

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: Short Answer Questions

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

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

Information Sheet 7- Recording production data and work place information

Self-Check – 7	Written test

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

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

Test I: Short Answer Questions

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

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

LG #37	LO#3: Shut down the syrup production system

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics: • Shutting down syrup production • Cleaning and maintaining equipment • Collecting ,treating and disposing-off or recycling waste 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**: • Shutting down syrup production • Cleaning and maintaining equipment • Collecting ,treating and disposing-off or recycling waste
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- Shutting down the process

1. Shutting down the process

Shutting down plant may require single or multiple energy sources to be shut down, that is,

- electrical,
- air,
- Chemical sometimes in a certain order.

Ensure the plant operator is aware work is being conducted. On many occasion workers are typically injured when plant operators are unaware the plant is being worked on. After cleaning, all equipment should be rinsed with clean potable water. If the equipment is not to be used immediately it should be allowed to drain dry.

1.2. General lockout/ tag out procedure

1.2.1. Purpose

This procedure establishes the minimum requirements for lockout of energy sources that could cause injury to personnel. All employees shall comply with the procedure.

1.2.2. Responsibility

The responsibility for seeing that this procedure is followed is binding upon all employees. All employees shall be instructed in the safety significance of the lockout procedure by (designated individual). Each new or transferred affected employee shall be instructed by (designated individuals) in the purpose and use of the lockout procedure.

1.2.3. Preparation for Lockout

Employees authorized to perform lockout shall be certain as to which switch, valve, or other energy isolating devices apply to the equipment being locked out. More than one energy source (electrical, mechanical, or others) may be involved. Any questionable identification of sources shall be cleared by the employees with their supervisors. Before lockout commences, job authorization should be obtained.

1.2.4. Sequence of Lockout Procedure

- Notify all affected employees that a lockout is required and the reason therefore.

- If the equipment is operating,
- Shut it down by the normal stopping procedure (such as: depress stop button, open toggle switch).
- Operate the switch, valve, or other energy isolating devices so that the energy source(s) (electrical, mechanical, hydraulic, and other) is disconnected or isolated from the equipment.
- Lockout energy isolating devices with an assigned individual lock. Stored energy, such as that in capacitors, springs, elevated machine members, rotating fl y wheels, hydraulic systems, and air, gas, steam or water pressure, must also be dissipated or restrained by methods such as grounding, repositioning, blocking, and bleeding down.
- After ensuring that no personnel are exposed and as a check on having disconnected the energy sources, operate the push button or other normal operating controls to make certain the equipment will not operate.
- Return operating controls to neutral position after the test.
- The equipment is now locked out.

1.2.5. Restoring Equipment to Service

When the job is complete and equipment is ready for testing or normal service, check the equipment area to see that no one is exposed. When equipment is clear, remove all locks. The energy isolating devices may be operated to restore energy to equipment.

1.2.6. Ending operations and cleaning up

- Switch off the machine when work completed.
- Ensure the battery (if fitted) and fuel line are turned off.
- Keep the equipment and work area in a safe, clean and tidy state.

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: Choose the best answer

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

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

Information Sheet 2- Cleaning and maintaining equipment

2. Cleaning and maintaining equipment

Cleaning in place (CIP) is a method of cleaning plant by circulating detergent solutions and thus obviating the need for stripping down and manual cleaning. There are two main types of plant to be cleaned within a drinks plant: Pipelines and vessels. For pipeline cleaning hygienic design is vital and correct CIP velocity is critical. This is typically 1.5 m/s, an empirical value based on achieving turbulent flow to achieve a scouring action. For vessel cleaning, two systems are available depending on the soil to be cleaned: high pressure/low flow, which relies on jet impingement to remove soil, or low pressure/high flow (e.g. spray balls), which relies on there being a continuous film of detergent solution on the vessel walls. Cleaning solution must be continuously removed from the base of the vessel (known as scavenging).

1. A typical CIP cycle consists of:

1. pre-rinse to remove loose soil and reduce the work of detergent;
2. detergent recirculation to remove remaining soil – there are three main variables to be considered: chemical strength, cleaning temperature and exposure time;
3. intermediate rinse to remove detergent with fresh water until a neutral pH is achieved;
4. sanitization to destroy remaining microbial contamination using hot water above 90°C recirculating for more than 20 min.

In addition to internal cleaning of the equipment, effective external cleaning of the plant and environment is required to remove pathogens and spoilage organisms introduced during normal operation. This must include regular cleaning under the equipment and cleaning the drains. Gel cleaning is the only real innovation in plant cleaning since the introduction of foam cleaning in the 1970s. Its main advantage is the prolonged contact time. The detergent increases viscosity on dilution; hence the neat product is easy to handle and contact times of 45 min are possible compared with around 10 min for foams. Additionally, reduced application pressure reduces the production of aerosols on impact with the surface to be cleaned; these can spread contamination over a wide area. Automatic fogging systems are available to disinfect rooms. A dense fog is quickly achieved by atomising disinfectant solution through nozzles. Some construction materials, for example, polyvinylidene fluoride (PVDF), are bacteriologically resistant and it has been shown that simple rinsing without detergent is capable of cleaning them to a state suitable for further drinks production. Such materials are suitable for the production of pipes, coating vessels, etc. and will probably be used more widely in the production of process plant in the future.

Self-Check – 2	Written test

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

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

Test I: Short Answer Questions

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

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

Information Sheet 3- Collecting, treating and disposing-off or recycling waste

3. Collecting, treating and disposing-off or recycling waste

Waste water generated by cleaning may attract trade waste charges or may require treatment before disposal.

3.1. Recycling and reusing water

Recycling and reusing water is one way of increasing water efficiency. Water efficiency is essentially doubled if water is reused once, or from a cost perspective, waster costs are essentially halved every time water is reused.

If purchasing new crushing equipment, consideration should be made for ease of cleaning. Crushers are available that are sealed and easy to clean. This will both reduce water used for cleaning and reduce labor costs in time spent cleaning equipment.

Key metrics for water efficiency include litters of water used per liter of wine produced. This is more challenging to determine at a process level but is easier to calculate at a whole process level.

Processing waste, such as grape skins and lees, should be removed from processing equipment as soon as practicable. Standard Operating Procedures (SOPs) should be thoroughly documented for cleaning procedures and should be strictly adhered to at all times, the equipment checked after cleaning and before reuse. Main waste matter which may be generated during crushing process is collected stem, and can be used for fertilizer in the form of compost for vineyard.

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: Short Answer Questions

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

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

Reference Materials

Book:

WEB ADDRESSES

The trainers who developed the learning guide

No	Name	Qualification	Educational background	Region	E-mail
1.	Mewleddeg girma	B	Food science and post-harvest technology	Sidama	mewegirma@gmail.com
2.	Biruktayt muluneh	B	Chemical engenering (process)	SNNPR	Edenwondimu12@gmail.com/
3.	Alemayehu araya	B	Food science and post-harvest technology	Addis Ababa	alemayohmr@gmail.com
4.	Mamo Abdi	B	BSC in agriculture	Oromiya TVET Bureau dev't Facilitator	Mamoab57@gmail.com
5.	Workneh Asmamaw	B	BSC in agri.economy	FTA dev't Facilitator	workalemaw@gmail.com