Bamboo Product processing

Level-II

Based on November 2021, Version 1

Occupational standards

Module Title: - Producing bamboo derivatives

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LG #20	LO #1- Prepare for work

Instruction sheet

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

- Checking tools and equipment and following OHS procedures.
- Identifying and setting out materials, tools and equipment's
- Understand mixing ratio
- Establishing communication with others

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 tools and equipment for functionality following OHS procedures.
- Identify required materials, tools and equipment's properly
- Set out tools and equipment's to facilitate effective work practices.
- Establish Communication with others

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,

If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information sheet #1 Checking tools and equipment and following OHS procedures.

1.1 Introduction

- **Tools** are any physical item that is used to achieve a goal but is not consumed during this process can be defined as a tool. Informally speaking, it can also be used to describe a specific procedure with a specific purpose as well..

- **Equipment** is designed for a specific task. The idea of equipment represents all sorts of machinery, functional devices or accessories which serve an individual, household or a community purpose. Usually, a set of tools that are designated for a specific task is known as equipment.

- **Safety** is the first essential requirement and every personnel must learn the safety measures even before he starts working on a machine or on equipments.
  Safety is an attitude, a form of mind of worker. If the attitude of worker towards safety is good and he is safety conscious, then he himself will develop the safe working habits. **It** is a precaution to avoid accident.
- **Care** is a technique of properly handling tools, equipments & materials.

1.1.1 General Safety Rule

General safety rule is very important to reduce the accident while you working in workshop.

- Always dress properly: - Dress properly for your work. While you must wear your aprons are provided so that you can work on the machines. Remove any jeweler, neckties, chains, bracelets, and rings. Roll up your sleeves and tie any hair back in a ponytail before beginning any work
- Follow directions:-understanding the procedures of using by hand tools & machines.
- Keep the shop clean: - Put your tools back where they belong when you are finished. Keep the floor clear of debris and sawdust the floor should be clear of scrap blocks, excessive material, and sawdust. Keep projects, sawhorses, and other equipment and materials you are using out of travel lanes. Wipe up any spilled liquids immediately.
- Learn to use the tools correctly
- Understanding using of hand tools in proper ways.
- Avoid house play
- Report all accidents

- Practice lending a cheerful helping hand when requested by someone.
- Be thoughtful and helpful toward other students in the class.

1.1.2 Safety Sign

Safety signs are figure which introduces the standard system & given a meaningful information about safety rules with a minimum words. Example:-Written materials in the machine.

1.1.3 Personal Safety

- **Stay alert.** Watch what you are doing, and use common sense when operating a power tool. Do not use a power tool while tired or under the influence of drugs, alcohol, or medication. A moment of inattention while operating power tools may result in serious personal injury.

- **Dress properly.** Do not wear loose clothing or jewelry. Contain long hair. Keep your hair, clothing, and gloves away from moving parts. Loose clothes, jewelry, or long hair can be caught in moving parts.

- Avoid accidental starting. Be sure the Power Switch is off before plugging in. Carrying power tools with your finger on the Power Switch, or plugging in power tools with the Power Switch on, invites accidents.

- Use safety equipment. Always wear eye protection. Dust mask, non-skid safety shoes, hard hat, or hearing protection must be used for appropriate conditions.

Figure1. Personal protective safety equipments

1.1.4 Tools and equipment's safety

- Do not force the tool. Use the correct tool for your application. The correct tool will do the job better and safer at the rate for which it is designed.

- Do not use the power tool if the Power Switch does not turn it on or off. Any tool that cannot be controlled with the Power Switch is dangerous and must be replaced.

- Disconnect the Power Cord Plug from the power source before making any adjustments, changing accessories, or storing the tool. Such preventive safety measures reduce the risk of starting the tool accidentally.

- Maintain tools with care. Keep cutting tools sharp and clean. Properly maintained tools with a sharp cutting edge are less likely to bind and are easier to control. Do not use a damaged tool. Tag damaged tools "Do not use" until repaired.

- Use only accessories that are recommended by the manufacturer for your model. Accessories that may be suitable for one tool may become hazardous when used on another tool.

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (2points)

1. Which one of the following is **not** personal safety? 1pnt.

A. Dress properly B. Do not force the tool. C. Use safety equipment. D. None

2. What are the causes of accidents in workshop? 1pnt.

A. Due to carelessness

B. Lack of cleanliness

C. wearing ear protection

D. A&B

E. all

Test II: Short Answer Questions (8points)

1. List at list three Causes of Accidents. 3pnts

1._____

2._____

3._____

2. Write at list five personal protective safety equipments. 5pnts

1._____

2._____

3._____

4._____

5._____

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

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

Information sheet #2	Identifying and setting out materials, tools and equipment's

2.1 Identifying and setting out materials, tools and equipment's

- **Charcoal grinding machine**

The charcoal maker machine takes advantages of the agriculture wastes or forestry wastes that are rich in lignin, cellulose, hemicelluloses, such as straw, sawdust, rice husk, fruit hush, coconut shell, palm shell, tree bark, logs, etc. In the high-temperature oxygen-free paralysis process, the carbon and hydrogen elements in the raw materials are converted into high-calorie mixed combustible gas, charcoal and by-products: wood vinegar and tar.

- **The Grinder**

The charcoal which is produced in the drum needs to be crushed into small particles for filling into the mould. This can be done by using grinding stones or by a special grinder. The grinding stones follow the same principle as for the grinding of flour and produce a very fine dust.

- **Hammer mill**

Hammer mill is the most widely used grinding mill and among the oldest. Hammer mills consist of a series of hammers (usually four or more) hinged on a central shaft and enclosed within a rigid metal case. It produces size reduction by impact.

The materials to be milled are struck by these rectangular pieces of hardened steel (ganged hammer) which rotates at high speed inside the chamber. Hammer mills crush materials into two (2) stages. Size reduction which occurs by dynamic impact and sizing which occurs by attrition and shear in the second zone where small clearance exists between the hammer and the screen bar producing a particle range of 15-50 μm.

- **Hand operated briquette unit**

A briquette machine is used to turn the waste powder to a regular shape block, which can help to improve the conditions for those powder, make them easy for transportation, storage, and more useful for further usage. The briquette system is able to deal with all kinds of materials with suitable size and moisture.

- **Beehive briquette machine**

Coal charcoal briquette making machine makes coal briquette with honeycomb/beehive shape which is very popular in home usage. The machine is easy to set up and operate. It is the most popular coal briquette machine in developing countries with a small investment.

- **Hand saw or power saw**

Figure 2. hand saw and power saw

2.2 The difference between hand tools and power tools

Hand tools are exactly what they sound like – tools that require manual labor to use. Power tools have a power source that allows them to operate automatically and without human intervention. That power source may be a battery, air compressor or electricity.

Power tools also have motors and other mechanisms that allow them to run more efficiently and more powerfully than their manual counter parts. Manual tools have fewer moving parts, and their designs are simple in nature.

Power tools use a source of power (i.e. battery or electricity) to run, while hand tools rely on human power to operate. Another big advantage of using a handsaw is that it is much safer than a power saw. There have been many fewer accidents when using a handsaw as opposed to power saws. A power saw is very powerful and moves at a very high rate of speed. Therefore, it is very easy to cut your finger or hand or some other part of your body while using them.

- **Shovel**

Shovel is a tool used to dig as well as to move loose, granular materials (like dirt, gravel, grain, or snow) from one spot to another. Spade is a tool used for digging straight-edged holes or trenches, slicing and lifting sod, and edging flower beds or lawns. However, in North America, the term shovel tends to be used for both shovels and spades.

Figure 3. shoval

A shovel is a tool for digging, lifting, and moving bulk materials, such as soil, charcoal, gravel, snow, sand, or ore. Most shovels are hand tools consisting of a broad blade fixed to a medium-length handle. Shovel blades are usually made of sheet steel or hard plastics and are very strong. Shovel handles are usually made of wood (especially specific varieties such as ash or maple) or glass-reinforced plastic (fiberglass).

- **Wheel barrow**

A wheelbarrow is a small hand-propelled vehicle, usually with just one wheel, designed to be pushed and guided by a single person using two handles at the rear or by a sail to push the ancient wheelbarrow by wind. The term "wheelbarrow" is made of two words: "wheel" and "barrow." "Barrow" is a derivation of the Old English "barew" which was a device used for carrying loads.

Figure 4. Wheel barrow

The wheelbarrow is designed to distribute the weight of its load between the wheel and the operator, so enabling the convenient carriage of heavier and bulkier loads than would be possible were the weight carried entirely by the operator.

- **Bucket**

A bucket is typically a watertight, vertical cylinder or truncated cone or square, with an open top and a flat bottom, attached to a semicircular carrying handle called the bail. A bucket is usually an open-top container. In contrast, a pail can have a top or lid and is a shipping container. In common usage, the two terms are often used interchangeably.

Figure 5. **Bucket**

- **Cutting tools**

  Power saws are an electric saw or similar tool with a fine-tooth blade is an excellent tool for cutting back large amounts of bamboo. It requires little effort on your part and can cut through thick foliage and stalks in a fraction of the time it'd take you to cut with a hand saw.

- **Bamboo splitter Machine**

  Turns out it is used to **hand-split bamboo**. What the splitter offers that simple blades and froes do not is the ability to split a culm (the woody stem of bamboo) into equal width pieces. This one splits the material into sixths, though models are available for different numbers of pieces

Figure 6. Bamboo splitter machine

- **Slicer Machine**

  The bamboo slicing machines are used for getting thinner slats of bamboo in various thickness dimensions**.**

  It is concluded that design and fabrication of bamboo slicing machine is a good choice to slice's the bamboo in to different slices. This is used for bamboo decorative works**,** It is used in light weight bamboo cutting industries, different design can make It is the useful project. It is used in many verities decorative things. The project is fabricated successfully

Self check # 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Match the questions under **"A"** with the answer shown under **"B"** (10 points)

No	A	B
1	Slicer Machine _____	Used to turn the waste powder to a regular shape block
2	Bucket _____	An electric saw
3	Shovel _____	Used for getting thinner slats of bamboo in various thickness dimensions.
4	Hand operated briquette unit __	Open-top container.
5	Cutting tools _____	Their blades are usually made of sheet steel or hard plastics and are very strong.

Test II: Short Answer Questions (5 points)

1. Write the two stages of hammer milling crush materials.
   I. _____
   II. _____

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

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

Information sheet #3	Understand mixing ratio

3.1.1 Understand Mixing Ratio

The mix ratio for a two component epoxy is the correlation between the resin and catalyst, also known as the hardener or curing agent, required to realize a full cure of the system. Mix ratios are typically expressed by either weight or volume.

3.1.2 Making a Vinegar Cleaning Solution

There are two types of method making a vinegar cleaning Solution. Those are: - making liquid cleaners method and creating vinegar scrubs and pastes method

3.1.3 Making liquid cleaner's method

- **Mix equal parts water and vinegar in a spray bottle.**

Use distilled white vinegar and, if possible, distilled or filtered water.[1] If you don't have those on hand, tap water will work fine. Put them in an empty spray bottle, attach the nozzle and shake briefly to combine them.

Spray this mixture on kitchen and bathroom countertops, stovetops, backsplashes, toilet surfaces, tile, flooring and almost any smooth surface you wish. Wipe it up with a paper towel or sponge. Vinegar and water solutions can help eliminate dirt, soap scum, sticky spills and hard water.

- **Add lemon juice to disinfect surfaces.** Mix one part lemon juice, one part white vinegar and two parts water in a spray bottle. Replace the nozzle and give it a shake. Spray the solution on smooth surfaces you want to disinfect, such as in the kitchen or bathroom. This mixture can typically eliminate 99% of bacteria from surfaces, making it ideal for Sanitization

- **Add dish soap for persistent stains on carpet. If the vinegar and water solution isn't** getting rid of a carpet stain, add a teaspoon of mild dish soap to the spray bottle. Give it a shake, then spray it directly onto the stain. Allow it to soak for about two minutes, then gently blot at the spill with a clean towel or sponge

- **Tackle tough stains and grime with undiluted vinegar.** To clean heavy soap scum and mineral deposits, skip the water and pour white distilled vinegar into a spray bottle, straight

from the jug. Replace the nozzle. Spray the solution onto the affected area, scrub with a brush or sponge and rinse with water.

- **Put vinegar and water in a bowl to clean microwaves and ovens. Mix equal parts white** vinegar and water, then pour them into a heat-safe bowl. Place the bowl in your microwave or conventional oven. Microwave or heat the solution long enough to bring it to a boil. Let it cool down a bit before you open the door.

- **Mix vinegar, rubbing alcohol and water to create a glass cleaner.** Measure out 1 cup (240 mL) of rubbing alcohol, 1 cup (240 mL) of water and 1 tablespoon of white vinegar. Pour them into a spray bottle. Spray the mixture onto glass, mirrors, ceramic tiles and chrome finishes, then wipe with a paper towel or microfiber cloth.

- **This mixture is effective for cleaning and polishing glass surfaces.**
  For a pleasant citrus scent, add one or two drops of orange essential oil to the mixture

  - **Method 2 Creating vinegar wash and attach**

- **Use equal parts vinegar, salt and Borax to remove carpet stains.** For tough carpet or fabric stains, mix equal parts vinegar, table salt and Borax in a large bowl until a paste forms. Apply the paste directly to the stained area. Allow the paste to sit for several minutes before wiping it up with a clean towel. Rinse the area with water.

- **Unclog a drain with baking soda and vinegar.** Baking soda is a mild abrasive. Combined with vinegar's acidic properties, the duo can effectively unclog kitchen drains. Pour ½ cup (125 g) of baking soda down the drain. Follow it up with a ½ cup (120 mL) of white vinegar. The combination of the two will create fizz. Once it stops fizzing, pour warm or hot water down the drain.

- **Clean brass with a table salt and vinegar scrub.** Immerse a sponge in white vinegar, then wring out the excess liquid. Sprinkle table salt evenly over one side of the sponge. Gently scrub brass surfaces with the mixture. Rinse the area thoroughly with clean water, then dry it with a soft towel

- **Clean metal surfaces with a vinegar, salt and flour paste.** Use this paste on silver, pewter, copper, or brass. Combine 1 teaspoon salt with 1 cup (240 mL) of vinegar. Add ¼ cup (30 g) of flour and stir until a paste forms. Apply the paste to the metal surface and let it sit for about 15 minutes. Rinse it off with warm water and then polish the surface with a clean cloth.

Generally, mixing ratio is the ways of mixing two binary solutions of different compositions or even two pure components can be mixed with various mixing ratios by masses, moles, or volumes. The mass fraction of the resulting solution from mixing solutions with masses m1 and m2 and mass fractions w1 and w2 is given by:

where m1 can be simplified from numerator and denominator

Self check #3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Give short answer (6 points)

1) What is a mixing ratio?

2) What is the purpose of understanding mixing ratio?

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

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

Information sheet #4	Establishing communication with others

4.1.1 Establishing communication with others

Communication is not just about talking to someone.

Communication is any verbal or non-verbal behavior which gives people an opportunity to send their thoughts and feelings, and to have these thoughts and feelings received by someone else. There are numerous benefits of effective communication.

4.1.2 To communicate with people effectively you need to:

- make sure it is not too noisy to hear what is being said sit or stand so that you directly face the person who you are talking or listening to maintain eye contact
- use polite opening and closing greetings
- speak clearly and at a medium pace
- speak in an open and neutral tone
- be straight forward and to the point
- keep the message simple
- be patient
- show interest
- use the words that the people you are talking to can understand
- listen carefully to the conversation so that you get the right message

4.1.3 In the workplace, effective listening helps you to:

- understand instructions clearly
- learn from others
- convey clear messages
- understand the ideas and suggestions of others
- respond in an appropriate manner

4.1.4 Elements of Communication

- listening
- seeking clarification
- body language
- blocking and barriers
- general attitude

4.1.5 The need to communicate

In the work environment, you need to communicate with:

- people who belong to your organization
- People who belong outside your organization and wish to do business with you.

You communicate with people at work for several reasons, example to:

- take a part in friendly conversations
- assist customers
- receive or pass on information and instructions
- discuss problems
- ask for information or ask questions
- get help

4.1.6 The Communication Process

- a sender who has a message or idea which they wish to send
- a message which is sent between the sender and the receiver

- a method (face-to-face, telephone, letter, form) by which the message is sent
- a receiver who receives and understands the message
- Feedback passed from the receiver to the sender showing that the message has been received and understood.

Communication needs to be clear and effective in order to achieve its aim. When it is not, all kinds of problems can result

Self check #4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Give short answer (10 points)

1. Write at list five elements of communication. 5pnts

I. _____

II. _____

III. _____

IV. _____

V. _____

2. Explain the two types of communication behavior.5pnts

I. _____

_____

_____.

II. _____

_____

_____.

3. Write the four ccommunications process step by step.

I. _____

II. _____

III. _____

IV. _____

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

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

Operation Sheet 1	understand vinegar mixing ratio

1.1.1. Determine methods of vinegar mixing ratio

1.1.2. Tools and Equipments needed:

- a spray bottle
- lemon
- spoon
- jar
- sponge
- dish soap
- table salt
- salt
- barox
- bowl
- rubbing alcohol
- olive oil

1.1.3. Procedures

- Wear appropriate PPE's.
- Mix equal parts water and vinegar in a spray bottle.
- Add lemon juice to disinfect surfaces.
- Add dish soap for persistent stains on carpet.
- Tackle tough stains and grime with undiluted vinegar.
- Vinegar and water in a bowl to clean microwaves and ovens.
- Mix vinegar, rubbing alcohol and water to create a glass cleaner.
- Measure out 1 cup (240 mL) of rubbing alcohol, 1 cup (240 mL) of water and 1 tablespoon of white vinegar. Pour them into a spray bottle.
- Clean work area

LAP TEST	Performance Test

Name……. ID…… Date……

Time started: _____ Time finished: _____

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

Instructions: Given necessary workshop, tools and materials you are required to perform the following tasks within the specified **2hours.**

Task-1 Perform methods of making liquid cleaners

Task-2 Select chemical and materials. 30min

Task-3 Mix necessary chemicals with water in clean container. 30min

Task-4 Put produced chemical in clean and pure bottle.30min

Task-5 Pack and store it in cool place. 30min

LG #21	LO.2 Produce bamboo charcoal

Instruction sheet

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

- Sizing and staking bamboo to chamber
- Closing chamber and Observing Carbonization process
- Removing charcoal procedure
- Cleaning chamber

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:

- Size bamboos according to the size of chamber
- Stack bamboos into the chambers in accordance with stacking procedures
- Close chamber with insulation materials to prevent heat loss or leakage
- Observe carbonization process properly
- Maintain chamber by regulating the openings
- Remove charcoal according to the specified procedure
- Clean chamber of fines and residues for the next operations.

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,

If your performance is unsatisfactory, see your trainer for further instructions**/**“Operation sheets”

Information sheet #1	Sizing and staking bamboo to chamber

2.1 Sizing and staking bamboo to chamber

The requirement for bamboo size is no more than 2cm.

The larger bamboo pieces need crushing by crushing machine.

The space size between bamboo pieces has a close relationship to the quality of bamboo botcher.

Then, small bamboo pieces enter into drying system.

The excess water content will be removed.

Bamboo to charcoal process.

Heat the chamber.

Ant-occupation of bamboo culms was affected by culm size.

Bamboo culms had 5.4 ± 1.2 m in length (mean ± standard deviation, N = 900) and 21.9 ± 4.4 cm in circumference (N = 900), and there was no difference in culm mean length (GLM effect: F 3, 52 = 3.8, p = 0.15) or mean circumference (GLM effect: F 3, 52 = 2.06, p = 0.28) between areas

2.2 staking bamboo to chamber

Figure 7. **Staking bamboo to chamber**

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (4 points)

1. Which one of the following is **not** personal safety?

A. Dress properly B. Do not force the tool. C. Use safety equipment. D. None

2. What are the causes of accidents in workshop?

A. Due to carelessness B. Lack of cleanliness C. wearing ear protection D. A&B E. all

Test II: Short Answer Questions (6points)

1. List at list three Causes of Accidents

I. _____

II. _____

III. _____

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

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

Information sheet #2	Closing chamber

2.1 Closing chamber and observing Carbonization process

Closing chamber is used to remove pollutants from the atmosphere in and around entire orchards. Air pollution can be caused by

- Particulate matter, such as dust;
- Vapor or gas, such as organic solvent vapors; or
- A combination of vapor and particles, such as smoke. Activated charcoal may be used to remove the vapor component of polluted air. Ad-

Closing the top vents a little. This way more air will get into the smoker. Therefore, the temperature will start rising. And your electric smoker will get hotter. Final words. now, that's all on smoker vents open or closed. By the way, if the heat is too much and adjusting the vents is difficult-Try using a water pan above the charcoal chamber.

No.1 Carbonization process

Bamboo → pass through belt conveyor → sealed feeding device → fall into the inner tank of high temperature carbonization machine (medium temperature zone) → fall into high temperature zone for "high temperature hydrolysis, flue gas volatilization, sulfur release, carbon enrichment" → the process of carbonization finished → three-stage sealed and water-cooling discharging.

No.2 Treatment process of combustible gas

A large amount of flue gas (combustible gas) produced in the carbonization process → piped to the first-stage cyclone dust collector for duct removal → the flue gas after purification is converted into combustible fuel gas and then introduced into the auxiliary furnace as the heating source (the combustible flue gas is ignited with automatic ignition), the exhaust gas after heating source utilization → go through the cyclone dust collector for dust removal → exhaust gas dust collector for discharging.

Figure 8. Closing chamber

Self check #2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I. Give short answer (5points)

1. Write the two process of making bamboo charcoal.

I._____

II._____

1. What are the three-ways sealing devices?

I. _____

II. _____

III. _____

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

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

Information sheet #3	Observing Carbonization process

3.1 Observing Carbonization process

Carbonization is the process by which complex carbonaceous substances, such as bamboo or agricultural residues, are broken down into elemental carbon and chemical compounds by heating. Carbonization (or complete paralysis) occurs when “bamboo is heated in a closed vessel of some kind, away from the oxygen of the air which otherwise would allow it to ignite and burn away to ashes.” Without oxygen, the wood decomposes into a variety of substances; the main one of being charcoal, which itself consists mainly of elemental carbon.

We **observe** that bamboo has traditionally not been valued as firewood as the material burns hot and reduces quickly to ash. Compared to other desirable types of fuel wood, larger volumes of bamboo are needed for meal preparation. Therefore, the wood is only used as a supplemental fuel. Until his organization’s recent efforts, he had never encountered bamboo charcoal.

The first advantage is high output. It is because the furnace has big effective volume and used advanced carbonization technology. So the carbonization cycle is cut down. One furnace charcoal only need two days. The second advantage is environmental friendly. It is because the carbonization furnace has the device to collect and recycle the emission.

Self check #3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Fill the blank space. 6pnts

1. _____is the process by which complex carbonaceous substances, such as bamboo or agricultural residues, is broken down into elemental carbon and chemical compounds by heating.
2. The first advantage observing carbonization process is_____-.

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

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

Information sheet #4	Removing charcoal procedure

4.1 Removing charcoal procedure

Once your bamboo is ready to go, it's time to get your metal container. A large steel drum, like the Bay Tec 55-gallon Steel Drum, is a good option. Make sure it comes with a lid since you will need this to seal the bamboo in once you have it burning properly.

The metal container should be clean, with no residue from oils or other chemicals inside since this could be transferred to the bamboo you're using to create your charcoal. It is has been used for any dangerous liquids or materials, it is best to burn all of those contaminants off of the interior before you start making your charcoal. Using a clean unused barrel allows you to avoid this step.

- **Remove the piece coal**

Figure 9. **Removing the pieces of coal**

Once the fire is out and the wood has stopped flaming, wait for it to cool completely. The barrel should also be cooled to prevent burns when you try to remove the charcoal from it. If the lid is still hot, leave it for a few more hours.

When you're sure the charcoal has cooled, remove it from your metal barrel. You should have some sort of container ready for it, like a plastic tote or a large pail. You may need a few containers, depending on how much charcoal you plan to create. You can also leave the charcoal in the barrel, though this prevents you from using it again until the charcoal has been used up.

Self check #4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (4 points)

1. How you remove charcoal from container or metal barrel?

A. When the fire is out

B. When the Bamboo/wood has stopped flaming.

C. When you're sure the charcoal has cooled

D. All

2. One of the following is best to removing charcoal from container?

A. Due to carelessness B. Lack of cleanliness C. wearing ear safety shoes D. none

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

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

Information sheet #5	Cleaning chamber

5.1 Cleaning chamber

When bamboo is changed into charcoal, there are waste gas and waste smoke in the reactor. The waste gas enters into cyclone dust collector and two condensers by induced draft fan. The two procedures guarantee the cleanness of combustible gas. Accordingly, the combustible gas is able to provide heat for the reactor instead of other fuel

Over time, unwanted deposition build-up on chamber surfaces leads to particulates and potential contamination, negatively impacting wafer yield.

In order to reduce particulates stemming from chamber wall deposition, chambers must be cleaned periodically to remove build up.

Removal of chamber deposition is achieved through introduction of reactive gas. The best possible clean time for a given chamber is a complex function of number variables including thickness of the deposited material, temperature, pressure, reactive gas delivery and material chemical composition.

5.2 Water cleaning challenges

- Contamination free surfaces for highly sensitive devices
- Surface preparation and activation for better for adhesion
- High throughput, ensuring minimal cycle time for higher overall productivity.

Self check #5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: short answer question (10 points)

1. Write the best possible clean time for a given chamber?
2. Write at list 4 cleaning challenges.
   I. _____
   II. _____
   III. _____
   IV. _____

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

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

LG #22	LO.3 Produce charcoal briquette

Instruction sheet

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

- Sorting charcoal from impurities
- Crushing charcoal
- preparing and mixing binder with charcoal powder
- Producing and drying charcoal briquettes

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:

- Sort charcoal from impurities
- Crush charcoal according to the specified operation
- Prepare and mix binder with charcoal powder in appropriate proportion with water.
- Produce charcoal briquettes by using appropriate equipment.
- Dry charcoal briquettes

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
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation.
8. If your performance is satisfactory proceed to the next learning guide,

If your performance is unsatisfactory, see your trainer for further instructions.

Information sheet #1	Charcoal is sorted from impurities

1.1 Charcoal is sorted from impurities

- The purpose of sorting is to segregate possible bamboo materials with similar drying characteristics.
- Remove all items from the workplace that are not needed for current production or administrative operation.
- Keep “only what is needed, only in the amount needed, and only when it is needed”.

1.2 The purposes of charcoal sorting from impurities are:-

- To place or arrange according to class, kind, or size; classify
- To separate from others
- To be or become arranged in a certain way

1.3 Important of sorting

- Space, time, money, energy and other resources can be managed and used most effectively
- Problem and annoyances in the work flow are reduced.
- Communication between employees is improved.
- Product quality and Productivity is enhanced.


Figure10. Sorting charcoal from impurities

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (10points)

1. What is sorting?

A. Keeping only what is needed

B. Removing all unwanted materials from work place.

C. Sorting is to segregate possible bamboo materials with similar drying characteristics.

D. None

2. What is the Important of sorting?

A. Space, time, money and energy.

B. Problem and annoyances in the work flow are reduced.

C. Communication between employees is improved.

D. Product quality and Productivity is enhanced.

E. All

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

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

Information sheet #2	Crushing charcoal

2.1 Crushing charcoal

The charcoal grinder is one of the main equipment widely used in mineral processing equipment, which can be used for coal, charcoal, limestone, cement clinker, mixture and other materials.

Crushing is also one of the most common equipment is used in the fertilizer industry
Charcoal & coal crusher is suitable for crushing raw materials and returned materials, especially for materials with high moisture content, strong adaptability, not easy to block, smooth feeding.

The material enters from the inlet and collides with the high-speed rotating hammer inside the housing. In the process of falling, the material becomes powder after several times of impact, or particles below 3mm are discharged from the lower outlet.

Crushing and drying: Crush the bamboo into small particles with a crusher. And, drying the small bamboo particles with a dryer.

Use a hammer crusher or roller crusher to crush the carbonized wood. Although different types of wood such as bark, dry wood chips, wet wood and so on should be crushed to different sizes, generally they can be crushed into pieces of charcoal to 5mm below to make high-quality charcoal briquettes.

2.2 Charcoal crusher machine features

- The entire equipment is driven by only one motor, simple structure, compact layout, cheap price, stable work, less energy consumption, high output, good quality of finished products, low processing cost.
- It has the advantages of less investment, low energy consumption, high productivity, good economic benefits, and convenient operation and maintenance.
- Charcoal crusher is mainly used for the charcoal production line.

Charcoal crushers can crush charcoal fragments and make full use of charcoal resources again. Crushed charcoal, after further grinding and mixing in the wheel grinding machine, and then into the pulverized charcoal molding machine into finished charcoal, can improve the output of charcoal and save resources.

- The large-size bearing has a higher bearing capacity and longer service life.

- The discharge port is equipped with an adjustment device, which is easier to adjust, safe, and fast to operate.
- High hardness alloy wear-resistant material is adopted in the housing, with small wear and high working efficiency.
- It can greatly reduce the labor intensity of workers, reduce production costs and improve economic benefits.

The crushed powder is affected by the centrifugal pressure of the rotor and the suction force of the fan. It passes through the sieve hole and is discharged from the bottom outlet.
The powder that cannot pass through the sieve hole will continue to repeat the above process until it passes through the sieve hole and is sent out of the machine.
Coal crusher is a kind of non-sieve and adjustable crusher which is optimized and designed on the basis of absorbing the advanced fine crushing equipment at home and abroad.

- **Crusher**

This vertical complex crusher is developed by our technical staff team with the improved structure design based on the foreign and domestic technologies, it is a new type of crush equipment for rough gridding and fine crushing, which is commonly used in the crushing of briquettes' raw materials like wood chips, wood shavers, etc, it also can crush slag, iron ore, gypsum , sandstone, and other hard materials.

- **Crusher advantages:**
  - Stable running;
  - High crushing ratio;
  - Energy consumption is low;
  - Compact structure and easy to operate and maintain;

  - Applications of the charcoal powder grinder machine

Charcoal & coal crusher is suitable for crushing raw materials and returned materials, especially for materials with high moisture content, strong adaptability, not easy to block, smooth feeding.

The material enters from the inlet and collides with the high-speed rotating hammer inside the housing. In the process of falling, the material becomes powder after several times of impact, or particles below 3mm are discharged from the lower outlet.

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (10points)

1. What is the advantage of crusher?

A. Stable running;

B. High crushing ratio;

C. Energy consumption is low;

D. All

2. What is the Important of sorting?

A. Space, time, money and energy.

B. Problem and annoyances in the work flow are reduced.

C. Communication between employees is improved.

D. Product quality and Productivity is enhanced.

E. All

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

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

Information sheet #3	Preparing and mixing binder with charcoal powder

3.1 Preparing and mixing binder with charcoal powder

A binder is used for strengthening the briquettes. The carbonized char powder can be mixed with different binders such as commercial starch, rice powder, rice starch (rice boiled water) and other cost effective mate- rials like clay soil and mixed in different proportions and shaped with thehelp of briquetting machine.

Figure 11. Preparing and mixing binder with charcoal powder

For preparation of binding material add starch to water in the ratio of 10:1 and allow it to disperse without any clumps. Then heat the solution for 10 min and do not allow it to boil (the final stage can be identified by the stickiness of the solution.

After boiling, pour the liquid solution onto the char powderand mix to ensure that every particle of carbonized char is coated with the binder. This process enhances charcoal adhesion and produce identicalcal briquettes.

Charcoal fines are mixed with binder which could be any of gelatinized starch of pastry consistency, liquid tar, molasses, or heated asphalt. Mixing usually use a kneader type, double-shaft mixer. This process is one of the most critical operations in the manufacture of charcoal briquettes. Efficient mixing is essential to obtain a strong product.

Self check #2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (4 points)

1. For preparation of binding material add starch to water in the ratio of_____,

A. 10:1 B. 5:1. C. !0:10 D. 1:1

2. What is use of binder?

A. It is used for strengthening the briquettes.

B. It is used to crushing the carbonized wood.

C. A&B

D. None

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

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

Information sheet #4	Producing and drying charcoal briquettes

4.1 Introduction

Charcoal briquette is a kind of fuel made by charcoal powder. Compared with traditional fuels, charcoal briquettes can not only generate heat continuously but also produce no smoke and odor during combustion.

4.2 Composition of charcoal briquettes

The charcoal briquette is mainly composed of two parts, the charcoal which is used to provide heat and the minor ingredients. Charcoal is the product of incomplete combustion of wood or wood raw materials or paralysis under the condition of air isolation.

Its main component is carbon, so it can be used as fuel. The minor ingredients include accelerants, white ash and briquette binder. There are four components of charcoal briquettes.

- **Component 1: charcoal**

Charcoal accounts for more than 70% of the entire charcoal briquettes. As the combustion material providing heat, the raw materials for charcoal can be various woods, such as beech, birch, hard maple, pecan and oak.

The charcoal is mainly processed by the kiln. In general, the charcoal produced and extinguished in the kiln is called black wood charcoal. It has the advantage of being easy to ignite, but it is easy to explode during burning with a short burning time and much smoke.

- **Component 2: accelerants (spreading of fire a fire)**

The charcoal briquette cannot fully contact with oxygen during the combustion process, so the accelerator is needed to accelerate the combustion. The most suitable accelerator is the nitrate, which can not only provide oxygen to accelerate combustion but also heat during combustion.

However, it is too expensive. As an excellent accelerator with lower cost, 10% -20% of sawdust can be added to effectively increase the burning speed.

- **Component 3: white ash**

As one of the minor ingredients, white ash accounts for only 2% -3% of the charcoal briquette. But it plays a very important role in the burning process of charcoal briquettes.

By observing the degree of turning white, we can judge the burning degree of the charcoal briquette. In addition, because the white ash is not combustible, it can effectively extend the burning time.

- **Component 4: briquette binder**

Due to the lack of plasticity, the binder needs to be added in the process of charcoal briquettes. The proportion of binder in the charcoal briquettes is about 5% - 7%.

Numerous facts show that starch has the best performance as a binding material. After it's gelatinized, a thick paste can be formed so that the charcoal powder is stuck together to facilitate the later briquette.

With different composition ratios, the final material produced will be different. The following are several appropriate recipes for making charcoal briquettes:

4.3 Advantages of charcoal briquettes

- High combustion value (more than 80% of biomass mass)
- Longer burning time as well as more uniform and stable burning process
- Smokeless and tasteless
- Lighter (only 1/5 to 1/3 of the original weight)
- Cheaper than lumpy charcoal
- Easy to handle, pack, transport and use

4.4 Process of making charcoal briquettes

How to produce charcoal briquettes is a question that people generally care about. The process of making charcoal briquettes can be divided into five steps:

Step 1: carbonization

Firstly, fire the raw materials in a rotary kiln. During the one-week combustion process, the temperature needs to be maintained at approximately 840-950 °F (450-510 °C). After the end of combustion, close the air inlet, and after one to two hours of exhaust, close the exhaust hole. After a two-week cooling period, empty the kiln and crush the carbonized wood (charcoal).

Step 2: crushing

Use a hammer crusher or roller crusher to crush the carbonized wood. Although different types of wood such as bark, dry wood chips, wet wood and so on should be crushed to

different sizes, generally they can be crushed into pieces of charcoal to 5mm below to make high-quality charcoal briquettes.

Step 3: drying

Then a drying process is needed. If the water content exceeds the empirical upper limit, the temperature will rise and the volume will expand suddenly, which is easy to cause an explosion. If the moisture content is too low, it will be difficult to mold. Use a dryer to reduce its moisture content to the level required for briquettes formation by about half (to about 15%).

Step 4: briquetting

Briquetting is a key step in charcoal molding. After the raw materials enter the ball press, they will be subjected to three kinds of forces, namely the main driving force of the briquette machine, the friction force and the centripetal force of the wall.

Due to moisture, adhesives, temperature (about 105 °F or 40 °C) and pressure of the rollers of the briquetting machine, the charcoal briquettes can maintain their shape when they fall from the bottom of the machine.

The process of making charcoal briquettes can be divided into five steps:

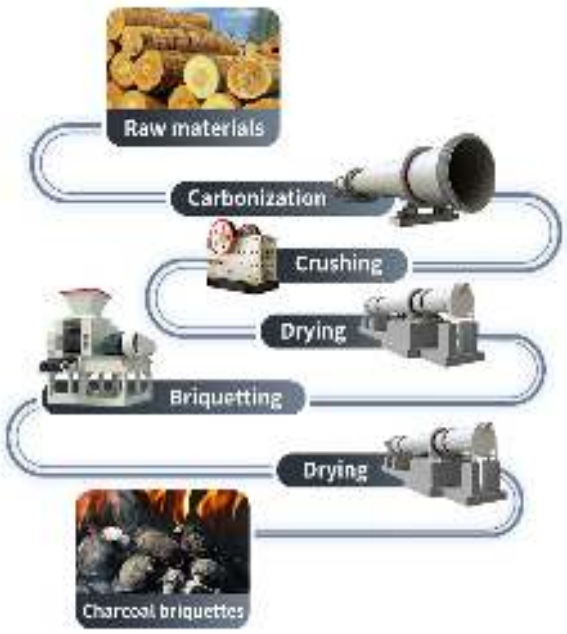
Step 1: carbonization. Firstly, fire the raw materials in a rotary kiln. ...

Step 2: crushing. Use a hammer crusher or roller crusher to crush the carbonized wood. ...

Step 3: drying. Then a drying process is needed. ...

Step 4: briquetting. ...

Step 5: drying.



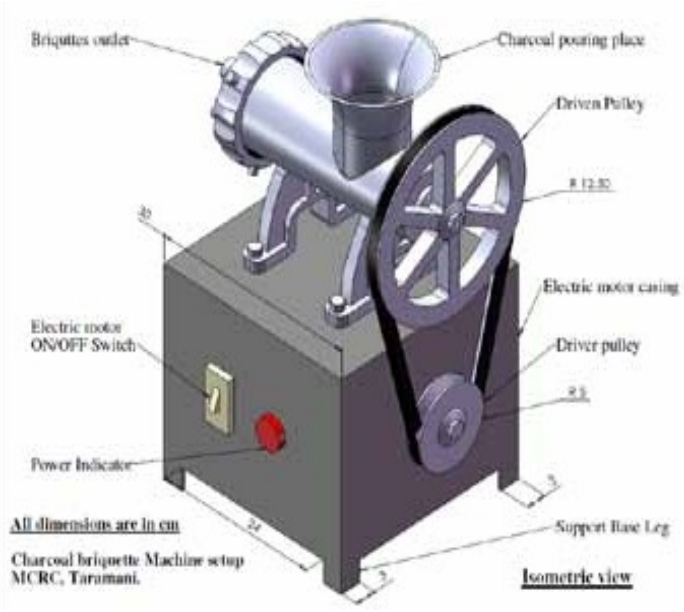


Figure 12. Steps for making charcoal briquettes Figure 13.Charcoal briquetting machine.

The charcoal mixture with binder can be made into briquettes either manually or using machines. For the mechanical operation, load the mixture directly into the briquetting mould / machine to form uniform-sized cylindrical briquettes

- **Drying and Packing**

Collect the briquettes in a tray dry them in sunlight for 2 or 3days and pack them in sealed plastic bags for sale.

Figure 14. Drying briquettes

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (10 points)

1. Which one of the following is an advantages of charcoal briquettes?

A. Smokeless and tasteless

B. Cheaper than lumpy charcoal

C. Easy to handle, pack, transport and use

D. All

2. What are the components of charcoal briquettes?

A. Charcoal

B. White ash

C. charcoal briquettes

D. All

3. Which one of the following is **no**t the process of making charcoal briquettes?

A. Crushing

B. Drying

C. Preparing raw material

D. None

4. Which one of the following is used to molding charcoal?

A. Crushing

B. Drying

C. Briquetting

D. A and B

5. How many days needed to drying charcoal briquettes?

A. 1 day

B. 2 or 3 days

C. 5 days

D. 6 up to 8 days

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

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

LG #23	LO.4 Produce bamboo vinegar

Instruction sheet

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

- Cleaning and drying container.
- Attaching Condenser to carbonize chamber
- Mounting container and checking for stability.
- Labeling collected vinegar

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:

- Clean and dry container
- Attach condenser in the bamboo carbonize chambers.
- Mount container in the condenser spout and checked for stability.
- Label collected vinegar in accordance to workplace procedure

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,

Information sheet #1	Cleaning and drying container.

1.1 Steps of cleaning and drying container are:-

When it comes to keeping your left over's fresh, plastic vinegar containers are a lifesaver.

- **Remove the lid from the container.** After you pop it open, check to make sure there are no remnants of food left inside. Give the container a quick preliminary rinse with hot water. Drain and shake out the excess water and place the container on the kitchen counter.

  If there's any dried or sticky residue inside the container, it may help to wipe it out with a paper towel before you begin cleaning.

- **Fill the container with vinegar.** For best results, use pure distilled white vinegar. If most of the stains are concentrating around the bottom, you'll only need to add in an inch or two; if they reach up the sides, fill it to the top. Place the lid back on the container to keep the vinegar from spilling. Vinegar is strong enough to make an effective cleaner and disinfectant, but not so strong that it needs to be cut it with water.

  If you don't happen to have any vinegar handy, try using a little diluted rubbing alcohol or hand sanitizer. The alcohol in these products will produce an effect similar to the vinegar

- **Let the vinegar soak for 30 minutes.** As it soaks, the acidity of the vinegar will help break down any discoloration present while neutralizing persistent odors. It will also help clear away hard water deposits from previous washings. For heavier messes, you can leave the vinegar in the container for an hour or longer before cleaning it out by hand.

  Vinegar is naturally antimicrobial, which makes it useful for killing the bacteria that's had time to begin growing on old food.

  Adding a squeeze of fresh lemon juice can help brighten dull, discolored plastic and leave it smelling more pleasant

- **Rinse with hot water.** Remove the lid and clear the container, using the corner of a washcloth to scrape out the rest of the baking soda. The container should now be stain and odor-free. If you want, you can go one step further and wash it out with soapy water.

  Keep rinsing the container until the water runs clear

  Use baking soda periodically to restore old and heavily-used containers.

- **Dry the container completely.** After cleaning, drain all water from the container and wipe it down inside and out with an absorbent towel. You can also simply leave it sitting with the lid off and allow it to air dry. Whichever method you choose, the lid should stay off until all moisture has evaporated from inside.

  Replacing the lid on a plastic container while it's still wet can cause mold and mildew to develop.

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (5 points)

1. How many days needed to drying container? 2.5 pnts

A. 3days B. 3weeks C. 13 days. D. 3months

2. Which one of the following is the step of cleaning and drying of container? 2.5 pnts

A. Dry the container completely**.**

B. Rinse with hot water**.**

C. Fill the container with vinegar**.**

D. Remove the lid from the container**.**

E. all

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

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

Information sheet #2	Attaching Condenser to carbonize chamber

1.1 Attaching Condenser to carbonize chamber

In chemistry, a condenser is laboratory apparatus used to condense vapors that is, turn them into liquids by cooling them down. Condensers are routinely used in laboratory operations such as distillation, reflux, and extraction.

The function of the condenser in a refrigeration system is to transfer heat from the refrigerant to another medium, such as air and/or water. By rejecting heat, the gaseous refrigerant condenses to liquid inside the condenser.

The major types of condensers used are (1) water-cooled, (2) air-cooled, and (3) evaporative. In evaporative condensers, both air and water are used.

Three common types of water-cooled condensers are (1) double pipe, (2) shell and tube and (3) shell and coil.

In systems involving heat transfer**,** a **condenser** is a heat exchanger used to condense a gaseous substance into a liquid state through cooling. In so doing, the latent heat is released by the substance and transferred to the surrounding environment. Condensers are used for efficient heat rejection in many industrial systems. Condensers can be made according to numerous designs, and come in many sizes ranging from rather small (hand-held) to very large (industrial-scale units used in plant processes). For example, a refrigerator uses a condenser to get rid of heat extracted from the interior of the unit to the outside air.

Condensers are used in air conditioning, industrial chemical processes such as distillation, steam power plants and other heat-exchange systems. Use of cooling water or surrounding air as the coolant is common in many condensers Carbon source

Charcoal may be used as a source of carbon in chemical reactions. One example of this is the production of carbon disulphide through the reaction of sulfur vapors with hot charcoal. In that case the wood should be charred at high temperature to reduce the residual amounts of hydrogen and oxygen that lead to side reactions.

The process of making charcoal involves large amounts of volatile matter to be released from the bio mass during the carbonization stage

The condensation of the emitted volatiles during charcoal making from bamboo yields bamboo vinegar. The raw bamboo 3-4 years old is cut to around 80cm length and placed into the oil drum. The oil drum is placed horizontally and covered with 1 feet of earth insulation.

The combustion chamber for the production of heated gases is built adjacent to the drum orifice opening, with bricks that are mud plastered to build the combustion chamber
The mixture of steam and gas emerges in the process of carbonization is condensed and separated to produce crude vinegar liquid.

The liquid is divided in to 2 layers after deposit.
The upper layer is clean bamboo vinegar liquid; the lower layer is sediment bamboo tar. The clean bamboo vinegar liquid is smells smoky, contains acetic acid, methyl alcohol and other chemical compounds. The sediment bamboo tar is a kind of black oily glutinous liquid; it contains a great deal of phenol matter, including organic matters. Its composition is very complicated and the techniques of its utilization are to be studied.

- **Bamboo charcoal heater**

The carbonizing heater of charcoal manufacturing equipment is the most important part in operation process, which decides the working efficiency as well as the quality of end products. Thus, for the design of this part, we have introduced double layer design, which can make the lower part of the machine contact with the hot air as much as possible; meanwhile, this design is helpful to raise the heat utilization efficiency from the beginning. There are three times to make the maximum full use of heating in the whole process of operation, so the temperature of the emission gas is below 100 centigrade and the heat use ratio of our bamboo carbonization equipment is over 85%

Figure 15. Bamboo charcoal heater

Self check #8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (12 points)

1. What are the major types of condensers?
   A. Water-cooled**.**
   B. air-cooled,
   C. Evaporative.
   D. All**.**
2. What is a condenser?
   A. Condenser is a heat exchanger
   B. Condenser is used in air conditioning
   C. Used to condense a gaseous substance into a liquid state through cooling.
   D. Used for efficient heat rejection in many industrial systems.
   E .All

Test II: Short Answer Questions. 6points

1. Write down at list three uses of condenser.
   I. _____
   II. _____
   III. _____

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

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

Information sheet #3	Mounting container and checking for stability.

1.1 Mounting container and checking for stability.

Use the right container. Vinegar is acidic. As such, it should not be stored in containers made from brass, copper, iron or tin or corrosion and leaching will set in, creating reactions between the metals and the vinegar and therefore damaging the food. The safest container for storing vinegar in is glass**.**

Store the vinegar in a cool, dark place. You can even put it into the refrigerator. Although vinegar is the product of wine having gone bad, vinegar can also go bad after a while and it tends to lose flavor after it is opened. Store for around 6 months; after a year you will probably find that the vinegar doesn't taste as good as it did when first purchased

Figure 16. Mounting container and checking for stability.

Self check #8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (12 points)

1. What is the purpose of burning incense stick?
2. List down at list four were the places Incense sticks are commonly used.
   IV. _____
   V. _____
   VI. _____
   VII. _____
3. What is the other name of Incense sticks?

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

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

Information sheet #4	Labeling collected vinegar

1.1 Labeling collected vinegar

Manufacturers are required to indicate the common or usual name of each type of vinegar used as an ingredient**.** If a blend of several types of vinegars is used, all types used should be listed with the product names appearing in order of predominance.

Labeling is used to identify a company name, direction of use and place of storing.

1.2 Bamboo vinegar liquid and its utilization.

Figure 17. Labeled bamboo vinegar

- **The main content of bamboo vinegar**

Bamboo vinegar liquid is a kind of by-product of bamboo carbonization. It contains many organic compounds. The quantity depends on the species and quality of bamboo material, and carbonization conditions. The content of liquid varies with the methods of its collection and storage.

Along with a great deal of water content, the liquid contains a lot of chemical compounds, such as acetic acid, formic acid, butyric acid, phenol, aldehyde, saturated alcohol and unsaturated alcohol. Its pH value id 2.20 ~ 3.01, and the specific gravity is about 1.02.

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (12 points)

1. Write two format layers of Incense sticks.
   I. _____
   II _____

2. List down at list four were the places Incense sticks are commonly used.
   II. _____
   III. _____
   IV. _____
   V. _____

3. What is the other name of Incense sticks?

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

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

LG #24	LO.5 Produce incense stick

Instruction sheet

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

- Preparing bamboo sticks
- Preparing and mixing Ingredients
- Bing ingredient with the stick
- Drying incense stick under sunlight and perfuming
- Packing and storing perfumed incense sticks

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:

- Bamboo sticks with required perfection
- Prepare and mix ingredient in appropriate proportion and ratio
- Bind ingredient with the stick
- Dry incense stick under sunlight
- Perfume dried incense sticks
- Pack and store perfumed incense sticks properly

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-
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation
8. If your performance is satisfactory proceed to the next learning guide,

If your performance is unsatisfactory, see your trainer for further instructions

Information sheet #1	Preparing bamboo sticks

1.1 Introduction

Incense sticks also called agarbattis are fragranced sticks used from ancient period by all over the world. The evolutionof incense stick could be from the burning of aromatic woods in the primitiveperiod.

Incense sticks are used by many communities in the world daily for performing worships and for special occasion. You require only low technology for manufacturing. Basically sticks are rolled by hands. If you can invest much money you can buy machines also. There are many different types of incense sticks used for different purposes or on different festive days.

1.2 Steps to made sticks

Step 1: You'll need following things to made sticks

- Bamboo sticks - There are two difference sizes 7" and 10"
- Wood glue
- Charcoal powder - burning wood powder
- Unburned Wood powder –sawdust's
- Sandalwood powder
- Paint
- Perfumes - fragrance oils most used fragrance oils are (Perfumes)

Step 2: Supplying of Raw Materials

Figure18. Supplying of Raw Materials

Supplying of raw materials also good small business you can start in small investment. The new generation always tries to earn money online without doing anything, but my suggestion is you have to do work to earn money yourself.

- **To make bamboo sticks.**

  You need following materials to make bamboo sticks

Bamboo tree

Hand saw

large knife

Small knife and blades

Step 3: Bamboo Nodes

First you have to cross cut bamboo to7” to 10” inches’ size leaving out nodes as follows

Figure 19. Bamboo Nodes

Step 4: Split to Slats

Figure20. Using a knife the pieces are split in to slats.

Step 5: Sliver

The slates are slivered using small knives or blades as this.

Figure 21. Sliver

Step 6: Ready

Figure 22. Now you have to put sticks to sun-dried and ready to make incense sticks.

Step 7: Hand Ralls

Figure 23. Now you need little experience to roll sticks to bamboo sticks

First mixed the above materials to following ratio.

Wood glue + Charcoal powder +sawdust's + Sandalwood powder = **1:2:1:.5**

mixed this all together and used water to prepare glue.

Handrall - Photo attached

2.1. Materials:

Incense sticks of different colors, fragrance and brands, glass beaker, Grinder, Sieve sets, mortar-pestle

2.2. Method:

Incense sticks of different brands and color and fragrance were procured from the local market The powder of incense sticks was separated from the incense sticks. The powder was collected while the bamboo sticks were discarded. The incense stick powders, which were collected, firstly, grounded in a grinder and later on, it was through a sieve. The powders were analyzed for their color, size and other properties.

BAMBOO STICK MAKING MACHINE - YouTube.mp4

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (12 points)

1. Write two format layers of Incense sticks.
   I. _____
   II. _____

2. List down at list four were the places Incense sticks are commonly used.
   I. _____
   II. _____
   III. _____
   IV. _____

3. What is the other name of Incense sticks?

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

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

Information sheet #2	Preparing & mixing ingredients

1.1 Incense Ingredients

The starting ground for making fine aromatic incense mixtures is using high quality natural ingredients. Start with some of your favorite woods and spices. Experiment with new substances as you become more comfortable and intrigued with the process. Try to always use at least one resin or wood in your mixture as a base. Visit local herb shops, incense stores, nurseries, etc. to uncover hidden aromatic treasures. Here is a partial list of popular incense ingredients from around the world. Wine, honey, dried fruits and fragrant hydrosols are often used as well. Recipes and suggestions are listed later in this article. All ingredients should be stored in a dark, cool space

The basic ingredients of an incense stick are bamboo sticks, paste (generally made of charcoal dust or sawdust and powder – an adhesive made from the bark of wood and other trees), and the perfume ingredients – which traditionally would be a powder of ground ingredients, though more commonly is a solvent of perfumes and/or essential oils

Depending on its makers and local custom, incense sticks have several physical characteristics of these incenses, such as length and diameter of the bamboo stick (average 39.5 and 0.4 cm, respectively), length and diameter of the incense coated part (average 28.5 and 2.7 cm, respectively), and weight of the whole stick (average 1.3 gm), are very similar . While the exact content of incense sticks is a commercial secret, most incense is made from a combination of fragrant gums, resins, wood powders, herbs and spices.

A typical composition of stick incense consists of 21% (by weight) of herbal and bamboo powder, 35% of fragrance material, 11% of adhesive powder, and 33% of bamboo stick To make incenses, one end of a bamboo stick is first soaked in adhesive materials before it is coated with a mixture of fragrance, herbal and wood powders. This coating process is repeated two more times. Incenses are then dried under the sun.

Mix all your dry ingredients together first (herbs & bamboo), separately mix all your resins together then add your resins mixture to your dry mixture and mix together thoroughly.

Stick Incense: When you start to mix your base, incense and paste, add more paste to the mix until rather wet, but still thick. You need it to cling to the stick, but be thin enough to dip the stick in. You can use bamboo splints, broom straws, very thin twigs. Have a brick or two of floral foam or a slab of clay beside where you are working, to poke the sticks into to dry upright. Dip the sticks into the paste mixture, turn them upright in your hand for a few minutes and then dip again. When sticks have been covered with enough incense, stick them into the foam or clay to dry upright. Let dry as above. Empower your incense and store in zip-lock bags or air-tight containers. Label with name and date.

1.2 Rules of flammable Incense

- Do not use more than 10 percent saltpeter, **ever**!
- Keep woods (sandalwood, cedar, juniper...) and gum resins in the proper proportions: at least twice as much wood as resins. If there is more resin, the incense won't burn.
- Depending on the type of incense being added to the base, the proportions may need to be altered. Make sure that resins do not make up more than 1/3 of the final mixture.

Incense Papers

Incense papers are made using white blotter paper, potassium nitrate (saltpeter) and a tincture made from gums or resins.

Cut a piece of white blotter paper into 6 inch strips about 1 inch wide. Add 1 &1/2 teaspoons saltpeter to 1/2 cup very warm water. Stir very well until the saltpeter is completely dissolved.

These are paper versions of the self-igniting charcoal disks you probably use right now.

To cover the smell of burning paper, tinctures should be used to odor the strips of paper. Empower the tincture with your magical need, and pour a few drops on the paper.

Spread the tincture over the strip and keep adding more drops until the paper is coated on one side. Hang the strips up to dry.

Empower your strips and store in zip-lock bags or in air-tight jars.

Label with name and date.

To use incense papers, light the tip of one paper above censer, and after it is completely alight, blow it out. Set the glowing paper in the censer and let it smolder during your ritual or magical workings. Light the paper and place in censer.

To keep the paper lit, place it on a heat proof object in the censer, or fill the censer with salt or sand and stick one end into it. It should burn all the way to the end.

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (12 points)

1. Write the rules of flammable Incense. 6pnts
   I. _____
   II. _____
   III. _____
   IV. _____
2. What are the basic ingredients of an incense stick? 6pnts
   I. _____
   II. _____
   III. _____
   IV. _____

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

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

Information sheet #3	Bind ingredients with the stick

1.1 Bind ingredients with the stick

Incense is typically made up of an aromatic material that produces a scent and a combustible binding material that holds it together in a particular shape.

The aromatic materials used for making incense are typically plant-based and can include a variety of resins, barks, seeds, roots, and flowers.

The specific ingredients used in incense can vary by region and manufacturer. Some specific examples of aromatic ingredients that you may recognize include:

The combustible binding material found in incense is what ignites, allowing the incense to burn and produce smoke. The materials used vary, but can include things like charcoal or bamboo powders.

Incense has been used for creating aromatic spaces both indoors and out. Incense making is a meditative and enjoyable way to exercise your creativity. It's simple, inexpensive and awakens us to the pleasures of earth's aromatic treasures and our interconnection with nature.

The basic ingredients of an incense stick are bamboo sticks, paste (generally made of charcoal dust or sawdust and powder – an adhesive made from the bark of wood and other trees), and the perfume ingredients – which traditionally would be a powder of ground ingredients, though more commonly is a solvent of perfumes and/or essential oils

The binding is often a type of wood powder the incense paste is formed into a stick shape, and allowed to dry

How To Make Incense Sticks – Powerful And Long Lasting - YouTube.mp4

Ingredients

The basic ingredients are bamboo sticks, paste (generally made of charcoal dust and joss/jiggit/gum/tabu powder - an adhesive made from the bark of litsea glutinosaand other trees and the perfume ingredients.

The bamboo stick is rolled into the masala, or is sometimes rolled into a perfume liquid consisting of synthetic ingredients.

Stick machines are sometimes used, which coat the sticks with paste and perfume, though the bulk of production is done by hand-rolling at home.

1.2 Tools / Supplies

- Natural incense ingredients - resins, woods and herbs
- pincers - to hold charcoal while lighting it
- Coffee grinder - to pulverize our ingredients into powders or you can omit this by starting with powdered substances
- Notebook - to record your recipes
- drying cloth or wax paper - for drying some recipes
- gram scale, measuring cup or spoons - to measure the ingredients in our recipes
- mixing bowls -to hold our pulverized ingredients until final mixing

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (12 points)

1. Write two format layers of Incense sticks.
   I. _____
   II. _____

2. List down at list four were the places Incense sticks are commonly used.
   I. _____
   II. _____
   III. _____
   IV. _____

3. What is the other name of Incense sticks?

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

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

Information sheet #4	Drying incense stick under sun light & perfuming

1.1 Dry incense stick (agarbatti):

- Air-dry the sticks on a cooling rack for approximately 24 hours. Wear rubber gloves and carefully remove each incense stick from the dish. Spread the sticks out on a cooling rack and leave them to dry, which may take up to a few days depending on the humidity.

  Don't tightly pack the incense sticks on the cooling rack as there needs to be room around each one for the air to circulate.

- Repeat the soaking and drying process to make 2 more batches. Soak the next 10 incense sticks in the liquid for 24 hours. There should be enough liquid left in the dish to use, however, add more DPG and oil if there isn't. Then dry the incense sticks and repeat the process with the final batch.

- You can put them under sunlight in day and inside storage that is low- moisture! This is natural drying
- Or you can put all incense sticks into drying room, with fan and heater using electric

  This step usually takes 24 hours at least!


Figure 24. Drying bamboo incense stick

Manipuri incense sticks being dried in the sun - YouTube.mp4

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (12 points)

1. Write two format layers of Incense sticks.
   I. _____
   II. _____

2. List down at list four were the places Incense sticks are commonly used.
   I. _____
   II. _____
   III. _____
   IV. _____

3. What is the other name of Incense sticks?

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

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

Information sheet #4	Packing and storing Perfumed Incense sticks

1.1. Packing Incense sticks

The packaging design of incense sticks should not cluster with its messaging, and it must communicate a clear value proposition of the product. Type of box should be finalized, which can be a tray, circular cardboard or pouch with zip-lock.

Incense stick packaging is having 2 layer formats. Wherein there is outer packaging which is core packaging, and then there is inner packaging inside where actual product lays. Sometimes there is only primary outer packaging which treasures the fragrance of sticks by zip-locks majorly.

Make sure whenever you get done your designing prefer professional creative agency. Who is versatile in designing and have a modern approach which is trending and upgraded.

The packaging design of incense sticks should not cluster with its messaging, and it must communicate a clear value proposition of the product. Type of box should be finalized, which can be a tray, circular cardboard or pouch with zip-lock.

The line art, symbolic and abstract images are encouraged in incense stick packaging designs. Scenic background with a combination of relevant colours will entice the overall look and feel of packaging design. Space available on the packaging is not too wide, and hence the role of creativity is very challenging. The aesthetic look is the heart of packaging, and it makes the product stand out on the display shelf.

In case of incense sticks box should be very pleasing and with soothing colour. Pastel colours and golden finish enhances the luxurious and classic look of sticks. Gold foil is always an option for heading text. Creative tagline, brand name and logo will help to increase brand identity and awareness.

The packaging design should reflect with storytelling, where in people in temple or festivals, the process of ritual, whatever should communicate through storytelling. Everyone loves stories, and anything expressed in the form of stories has a high tendency to stay back in memory.

The brand should carry its unique value proposition which can be hand-made or organic should communicate its USP. If natural then the earthy look is rendered on the packaging along with images which stand for organic in nature. With well brand strategy, a positioning statement is

constructed productively. Positioning is establishing either creative tagline or emblem form on the packaging.

1.2. Storing perfumed incense sticks

No matter what type or scent of incense sticks you own, they should be stored in a cool, dry place out of direct sunlight and away from heat sources such as the stove or a heater. Wax paper, thick paper and rice paper all help the sticks maintain their fragrance, although paper wrapping may absorb some of the scented oils from time to time.

Store perfumed incense sticks at a somewhat warm place to keep the oil from solidifying.

The oil needs soaking a bit longer than the alcohol (at least two months), but check every now and then to see how you like it.

Stored properly, incense sticks may keep their scent for a few years or even longer. Since the sticks contain essential oils or fragrance oils, storing them in plastic bags is not a good idea, as the chemicals in the oils and plastic affect one another. Instead, store them in wax paper, craft paper or a cotton fabric wrapping.

1.3. Incense Storage Tips

- Storing your incense far away from moisture and light. A cool and dark location would be optimal. This could be a location such as drawer or cabinet.
- Storing your incense in an airtight container typically allows the incense to store longer without losing scent.
- It is best if you store each type of incense stick you have separately. Otherwise they may pickup nearby scent.
- Incense that contains less volatile oil is less prone to degradation and will likely last quite a while longer.

Self check #1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (12 points)

1. Write two format layers of Incense sticks.
   I. _____
   II. _____

2. List down at list four were the places Incense sticks are commonly used.
   I. _____
   II. _____
   III. _____
   IV. _____

3. What is the other name of Incense sticks?
4. What are the types of packaging materials?
5. How long does it take to design packaging?

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

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

Operation Sheet 1	Make incense sticks

Name of operation: making incense sticks

1.1 Tools and Equipments needed:

- Bamboo sticks –
- Wood glue
- Charcoal powder
- Unburned Wood powder
- Sandalwood powder
- Paint
- Perfumes
- Machete/knife

1.2 Procedures

1st step Use appropriate PPE's			
2st step Supplying of Raw Materials		**5th step** Using a knife the pieces are split in to slats.	
3nd step **Split bamboos to slat**		**6th step** The slates are slivered using small knives	
4rd step Select bamboo nodes		**7th step** Put sticks to sun-dried and ready to make incense sticks.	

LAP TEST	Performance Test

Name……. ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary workshop, tools and materials you are required to perform the following tasks within the specified **5hours.**

Task-1 Prepare bamboo nodes split it to slat and square edges of slats.1hr

Task-2 Slide slates using small knives.1hr

Task-3 Put sticks to sun-dried and ready to make incense sticks.2hrs

Task-4 complete attaching ingredients of incense to stick.1hr