DEPARTMENT OF BIOTECHNOLOGY

CHEMICAL ENGINEERING LABORATORY

Lab Code: 17BTCC86

STANDARD OPERATING PROCEDURE

STANDARD OPERATING PROCEDURE

HEATING MANTLE

Name of the Lab./facility	Chemical Engineering Lab
Purpose	To describe the procedure for the operation and maintenance of the Heating mantle
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using the heating mantle in the Chemical Engineering lab, Vinayaka Missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR HEATING MANTLE

- Switch ON the Power button
- Set up flask and condenser as required.
- Connect hose to tap and turn on to give a gentle flow of water
- Switch on heating mantle and set to required temperature setting. Monitor temperature. Do not use a mercury thermometer.
- Place HOT warning sign near the heating mantle.
- Monitor system during heating procedure.
- When procedure complete, carefully remove glassware, using heat proof gloves.

Switch off heating mantle and leave HOT warning sign in place until everything is cool.

PRECAUTIONS TO BE FOLLOWED

- Know where the nearest firefighting equipment
- Know the emergency phone number 33#
- Refer to the SDS for any chemicals being used
- Place a HOT warning sign at the heating mantle
- Read and understand the procedure
- Check that the equipment is electrically compliant

HOD

STANDARD OPERATING PROCEDURE

FUMEHOOD

Name of the Lab./facility	Chemical Engineering Lab
Purpose	To describe the procedure for the operation and maintenance of the Fumehood
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using the Fumehood in the Chemical Engineering laboratory, Vinayaka missions Research foundation
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR FUMEHOOD

- A chemical fume hood must be used for any chemical procedures that have the potential of creating:
  - ✓ Airborne chemical concentrations that might approach Permissible Exposure Limits (PELs) for an Occupational Safety and Health Administration (OSHA) regulated substance. These substances include carcinogens, mutagens, teratogens, and other toxics.
  - ✓ Flammable/combustible vapors approaching one tenth the lower explosive limit (LEL). The LEL is the minimum concentration (percent by volume) of the fuel (vapor) in air at which a flame is propagated when an ignition source is present.
  - ✓ Explosion or fire hazards.
  - ✓ Odors that are annoying to personnel within the laboratory or adjacent laboratory/office units.
- Vertical fume hood sashes can be used in three positions: 1) closed, 2) the operating height (or half open), and 3) the set-up position (or fully open).
- Hoods must be closed when unattended.
- The sash opening must be positioned no higher than the operating height (or half open) when the hood is being used with chemicals present or when chemical manipulations are performed. Place the sash in front of the face to protect the persons breathing zone near the nose and mouth from chemical contaminants released within the fume hood. When working with hazardous chemicals, the hood sash should always be positioned so that it acts as a protective barrier between laboratory personnel and the chemicals.
- The set-up position (fully open) is only used to place equipment in the hood when no chemicals are present. Do not fully open the sash when chemicals are present.
- Sliding horizontal sash panels are used with one panel placed in front of the face and arms

reaching around the sides to perform manipulations.

- Sliding horizontal sash panels are used with one panel placed in front of the face and arms reaching around the sides to perform manipulations. Do not slide the panels laterally exposing the face to the interior of the hood with chemicals present.
- Hood baffles or slots should be positioned properly if available. The top baffle/slot should be opened when chemicals with a vapor density of less than 1 (lighter than air) are used. The bottom baffle/slot (if available) should be opened when chemicals with vapor densities greater than 1 (heavier than air) are used.
- Chemicals and equipment (apparatus, instruments, etc.) should be placed at least 6 inches (15 cm) from the front edge of the hood.
- Equipment should be placed in the center of the working surface in the hood.
- Do not place materials at the front of the working surface because it will block the slot under the air foil sill at the front. Do not place materials at the back of the working surface because it will block airflow to the lower slot under the baffle in the back. Separate and elevate equipment by using blocks or lab jacks to ensure that air can flow easily around and under the equipment.
- Chemical fume hoods must be kept clean and free from unnecessary items and debris at all times. Solid material (paper, tissue, aluminum foil, etc.) must be kept from obstructing the rear baffles and from entering the exhaust ducts of the hood.
- Minimize the amount of bottles, beakers and equipment used and stored inside the hood because these items interfere with the airflow across the work surface of the hood.

PRECAUTIONS TO BE FOLLOWED

- Chemicals should not be stored in a hood because they will likely become involved if there is an accidental spill, fire or explosion in the hood, thus creating a more serious problem.
- Fume hoods are not flammable cabinets and do not offer fire protection for materials stored inside.
- Sliding horizontal sash windows must not be removed from the hood sash.
- Laboratory personnel must not extend their head inside the hood when operations are in progress.
- The hood must not be used for waste disposal (evaporation).
- Hoods must be monitored by the user to ensure that air is moving into the hood. A small piece of thread, yarn can be taped to the hood sash as a visual indicator that the hood is pulling air. Any hoods that are not working properly must be taken out of service and reported to Facility Services/Physical Plant (FS/PP) and University Environmental Health and Safety for your respective campus.

HOD

STANDARD OPERATING PROCEDURE

MAGNETIC STIRRER

Name of the Lab./facility	Chemical Engineering Lab
Purpose	To describe the procedure for the operation and maintenance of the Magnetic Stirrer
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using the Magnetic Stirrer in the Chemical Engineering Lab , Vinayaka missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR MAGNETIC STIRRER

- Place the magnetic stirrer on a stable well-levelled surface.
- Place the stir bar at the bottom of a glass container.
- Fill the glass container with the liquid to be stirred.
- Plug the mains cable into a suitably earthed socket.
- Check that the speed control knob is completely turned anticlockwise.
- Place the glass container on the centre of the magnetic stirrer.
- Press the On/Off switch to turn the magnetic stirrer On. The switch will light green.
- Adjust the speed control knob to a low stirring rate.
- Continue to adjust the speed control knob until the desired stirring speed is achieved.
- Wait until the liquid is properly mixed.
- Completely turn the speed control knob anticlockwise.
- Press the On/Off switch to turn the magnetic stirrer Off
- Manipulate another stir bar from the outside of the glass container to remove the immersed stir bar

PRECAUTIONS TO BE FOLLOWED

- Thoroughly wash the stir bar with distilled water after each application.
- Store stir bars in pairs to maintain their magnetic strength and increase their life span.

HOD

STANDARD OPERATING PROCEDURE

VACCUM PUMP

Name of the Lab./facility	Chemical Engineering Lab
Purpose	To describe the procedure for the operation and maintenance of the Vacuum Pump
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using the Vacuum Pump in the Chemical Engineering Lab Bio organic chemistry laboratory, Vinayaka missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR VACUUM PUMP

- Make sure pump has an up to date PAT certificate
- Check that the pump oil-level is between the MAX and MIN marks on the bezel of the oil-level sight-glass; if it is not, DO NOT USE.
- Ensure that vessel to be evacuated is appropriately set up. **If unsure ALWAYS ASK.** Never set up a new vacuum system (especial glass) on your own unless experienced.
- Ideally use a suitable inlet-valve to isolate the pump from your vacuum system, important:
    - if you need to allow the pump to warm up before you pump condensable vapours,
    - if you need to maintain vacuum when the pump is switched off.
- Avoid high levels of heat input to the pump from the process gases.
- Ensure that any heating of the pump body will not affect any other equipment or cause a danger to others.
- Make sure that the exhaust pipeline is either vented to a safe location or filtered. Also ensure that it cannot become blocked. **Check expiry date on filter, if it has expired DO NOT USE.**
- Make sure pump is on a firm, level platform and it is located so that the oil-level sight-glass is

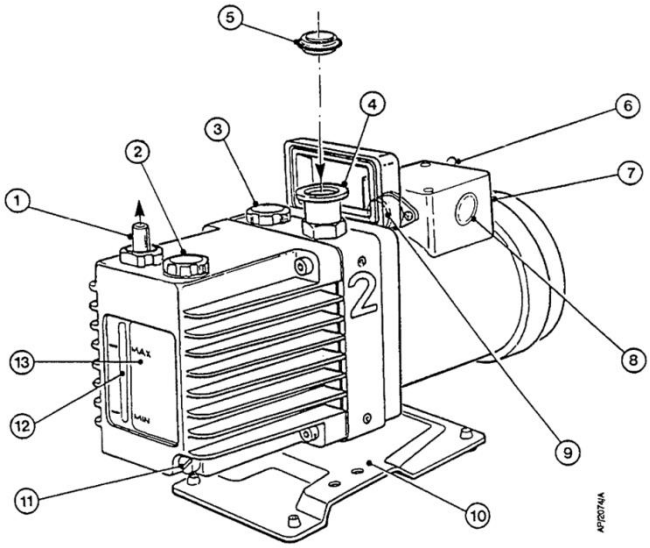
Replace oil

Oil should be change minimum once a year unless pump is used heavily or for very dirty work.

- Allow the pump to cool to a safe temperature before you start maintenance work.
- Ensure that the pump is decontaminated before maintenance and that you take adequate precautions to protect people from the effects of dangerous substances if contamination has occurred – this may include an additional risk assessment.
- Operate the pump for approximately ten minutes to warm the oil, then switch off the pump. (This

lowers the viscosity of the oil and allows the oil to be drained from the pump more easily).

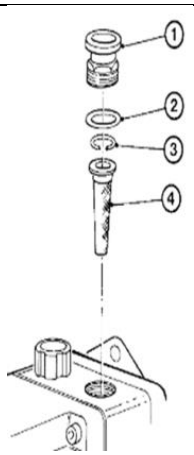
- Isolate the pump from your electrical supply and disconnect it from your vacuum system.
- Remove the oil filler-plug (1).
- Place a suitable block under the pump-motor to tilt the pump and place a suitable container under the oil drain-plug (gravity drain). **CAUTION-HEAVY.**
- Remove the oil drain-plug and allow the oil to drain into the container. Oil should be disposed of through chemical waste disposal route.
- If oil is very dirty (water can be seen as "threads" in oil container.
    - Refit the oil drain-plug and pour clean oil into the pump (up to MIN level).
    - Reconnect the pump to the electrical supply and operate the pump for about 5 to 10 minutes.
    - Disconnect the pump from the electrical supply, remove the oil drain-plug and allow the oil to drain out of the pump.
    - Repeat this step until the oil reservoir is clean
- Refit the oil drain-plug pour clean oil into the filler hole until the oil-level reaches the halfway level on the bezel of the oil sight-glass (12). This is normally sufficient for laboratory use. Heavier use may require filling to MAX.
- Allow a few minutes for the oil to drain into the pump. If necessary, add more oil.
- Refit the oil filler-plug.
- Place gloved hand over inlet (4) and startup vacuum pump (see above).
- Check that the oil-level in the sight-glass drops slightly (by 3 to 5 mm) after start-up. This shows that the pump has primed with oil.
- If the pump fails to prime, operate the pump with the inlet open to atmosphere for approximately 30 seconds. Then isolate the inlet and check that the oil-level drops by 3 to 5 mm.
- If the pump is working reconnect to the vacuum system.



1. Outlet nozzle
2. Oil filler-plug
3. Gas-ballast control
4. Inlet-port (adaptor flange)
5. Centering-ring and 'O' ring (supplied)
6. Inlet-On/Off switch
7. Motor terminal box
8. Cable-gland
9. Overload reset button
10. Baseplate
11. Oil drain-plug (gravity drain)
12. Oil sight-glass
13. Pump identification label

Inspect and clean inlet-filter

1) Unscrew the inlet adaptor (1) and remove the 'O' ring (2), circlip (3) and inlet-filter (4).
2) Wash the filter in a suitable cleaning solution. Allow the filter to dry.
3) Refit the inlet-filter (4), circlip (3), 'O' ring (2) and inlet adaptor (1).



HOD

DEPARTMENT BIOTECHNOLOGY

STANDARD OPERATING PROCEDURE

MUFFLE FURNACE

Name of the Lab./facility	Chemical Engineering Lab
Purpose	To describe the procedure for the operation and maintenance of the Muffle Furnace
Scope	This Standard Operating Procedure (SOP) Chemical Engineering Lab applies to the staff and students using the Muffle Furnace in the Bio organic chemistry laboratory, Vinayaka missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR MUFFLE FURNACE

- Connect the unit to 230 volts a/c power supply.
- Switch on the equipment.
- The digital temperature controller will be displayed indicating the ambient temperature.

Note: ensure that no chemicals or solvents shall be near to the equipment.

- Press push button of digital controller and set the required temperature by rotating the set knob.
- Set the required temperature with set knob and release the push button
  actual temperature will be displayed on the controller monitor.
- Set the rate of temperature by using the tune knob.
- Temperature will increases up to set temperature and heater bulb will be on.

Note: once the required temperature reached, the heater shall cut off automatically and heater bulb is off.

- Change in to the on/off cycle will continue to maintain the constant temperature.
- Now the equipment is ready for the ignition of sample.
- After completion of the analysis enter the data in to a muffle furnace logbook.

Note: while placing the samples in the furnace use large tongues and asbestos hand gloves

HOD

DEPARTMENT BIOTECHNOLOGY

STANDARD OPERATING PROCEDURE

ELECTRONIC WEIGH BALANCE

Name of the Lab./facility	Chemical Engineering Lab
Purpose	To describe the procedure for the operation and maintenance of the Electronic Weigh balance
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using the weigh balance in the Chemical Engineering Lab , Vinayaka missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR ELECTRONIC WEIGH BALANCE

- Switch ON the Power button
- Keep the butter sheet or aluminum foil, Press TARE to equivalence the weight
- Add the chemicals on to the butter sheet and weigh it accurately
- Wear clean cotton gloves (supplied with reference weights) or use forceps while handling reference weights. To avoid depositing oil and dirt onto the surface of the weight, do not touch weights with bare hands.
- Store reference weights in cases provided by the manufacturer.
- For optimal performance, place balance on a stable, even, horizontal surface with minimal vibration. Avoid areas with excessive heat and moisture, direct sunlight, aggressive chemical vapors, and drafts.
- If a balance is transferred to a different location, perform the accuracy check prior to use in the new location.
- Switch OFF the power button

PRECAUTIONS TO BE FOLLOWED

- Short circuit of the battery terminals or any source terminals has to be avoided.
- Avoid spilling of chemicals

- Clean the spilled chemicals/powders immediately to avoid deposition.
- Avoid over weighing, above the limit
- As it is air sensitive, handle with care
- Perform annual calibration of weigh balances at approximately the same time each year

RECORD TO BE MAINTAINED

- Laboratory Manual containing the experiments that can be performed with the equipment
- Maintenance Record

HOD

STANDARD OPERATING PROCEDURE

HOT PLATE

Name of the Lab./facility	Chemical Engineering Lab
Purpose	To describe the procedure for the operation and maintenance of the HOT PLATE
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using the hot plate in the Chemical Engineering Lab Vinayaka Missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR HOT PLATE

- Plug in power cable and switch on the Hot Plate
- Keep the Glassware on the hot plate and set the temperature using knob
- Red light glow indicates the Hot plate is ON
- Once the appropriate time is over, turn the knob to zero
- Switch off the power switch, after use.

PRECAUTIONS TO BE FOLLOWED

- Short circuit of the battery terminals or any source terminals has to be avoided.
- Avoid spilling of chemicals
- Clean the spilled chemicals/powders after the usage to avoid deposition.
- As the plate is hot avoid touching with bare hands
- Always wear gloves and lab coats.

RECORD TO BE MAINTAINED

- Laboratory Manual containing the experiments that can be performed with the equipment
- Maintenance Record

HOD

STANDARD OPERATING PROCEDURE

FLOW THROUGH ORIFICEMETER

Name of the Lab./facility	Chemical Engineering Lab
Purpose	To describe the procedure for the operation and maintenance of the Flow measurement through Orifice meter set up
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using flow measurement through orificiemeter set up in the Chemical engineering lab, Vinayaka missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR ORIFICE METER

Check all the clamps for tightness.

2. Check whether the water level in the main tank is sufficient for the suction pipe of pump to be completely immersed.

3. For measurement through venturi, open the outlet valve of the venturi meter line and close the valve of the orifice meter line.

4. For a good amount of variation in discharge, close the by-pass valve of pump also.

5. Now switch on the pump.

6. Open the gate valve and start the flow.

7. Remove any bubbles present in the U-tube manometer through air cock valve. Operate the air cock valve slowly and cautiously to avoid mercury run-away through water.

8. Wait till the flow attains a steady state.

9. Close the gate valve of the measuring tank and note the initial water level in the tank. Measure the time taken for the water level in the tank to reach a certain level and then Calculate the flow rate. Also note the manometer difference. Before taking any

Measurements, make sure the flow is stable.

10. Repeat the procedure by changing the discharge by slowly opening the by-pass valve and take the six readings.

11. Repeat the same procedure for orifice meter.

PRECAUTIONS TO BE FOLLOWED

RECORD TO BE MAINTAINED

- Laboratory Manual containing the experiments that can be performed with the equipment
- Maintenance Record

HOD

DEPARTMENT BIOTECHNOLOGY

STANDARD OPERATING PROCEDURE

FLOW THROUGH VENTURIMETER

Name of the Lab./facility	Chemical Engineering Lab
Purpose	To describe the procedure for the operation and maintenance of the Flow measurement through Venturimeter set up
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using flow measurement through Venturimeter set up in the Chemical engineering lab, Vinayaka missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR ORIFICE METER

Check all the clamps for tightness.

2. Check whether the water level in the main tank is sufficient for the suction pipe of pump to be completely immersed.

3. For measurement through venturi, open the outlet valve of the venturi meter line and close the valve of the orifice meter line.

4. For a good amount of variation in discharge, close the by-pass valve of pump also.

5. Now switch on the pump.

6. Open the gate valve and start the flow.

7. Remove any bubbles present in the U-tube manometer through air cock valve. Operate the air cock valve slowly and cautiously to avoid mercury run-away through water.

8. Wait till the flow attains a steady state.

Close the gate valve of the measuring tank and note the initial water level in the tank. Measure the time taken for the water level in the tank to reach a certain level and then calculate the flow rate. Also note the manometer difference. Before taking any measurements, make sure the flow is stable.

10. Repeat the procedure by changing the discharge by slowly opening the by-pass valve and take the six readings.
11. Repeat the same procedure for orifice meter.

PRECAUTIONS TO BE FOLLOWED

RECORD TO BE MAINTAINED

- Laboratory Manual containing the experiments that can be performed with the equipment
- Maintenance Record

HOD

DEPARTMENT BIOTECHNOLOGY

STANDARD OPERATING PROCEDURE

SIMPLE DISTILLATION SET UP

Name of the Lab./facility	Chemical Engineering lab
Purpose	To describe the procedure for the operation and maintenance of the Simple distillation set up
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using Simple distillation process in the Chemical Engineering lab, Vinayaka missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR SIMPLE DISTILLATION SET UP

This SOP applies to distillation. Distillation is the traditional method of purifying a chemical liquid. It is also used to separate one component in a liquid mixture from another.

Distillation in most laboratories involves refluxing volatile liquids at atmospheric or normal air pressure from a distilling flask through a "simple" or short path still head, or a longer "fractional" vertically held column, into a slightly downward angled condenser with a water-cooled jacket into receiving flasks

Many different sizes and shapes of distillation heads and columns exist in chemical laboratories, but all adhere to the same basic principles of safe use.

Trouble can arise mainly from excess pressure build-up due to too rapid heating and unsafe use of flammable solvents, resulting in fires.

• In general, common high-boiling or nontoxic solvents can be distilled on lab benches, with efficient condenser jacket water-cooling. Very low-boiling or more toxic compounds should be distilled only in a fume hood

. • Begin by attaching the water inlet hose on the lower water jacket inlet on the condensing column. The thermometer bulb should be placed just below the level of the roughly horizontal side arm of the distillation head. Just enough heat should be added to the distillation flask to raise the level of reflux only as high as the side arm. Additional heat is not needed.

• Do not completely fill the flask with liquid. A half-full or, at most, two-thirds full level is safer. • Be sure all joints are tight, with grease if needed, and that the entire apparatus is well clamped and supported by ring stands. Fumes leaking through loose joints could come into contact with the heat source and cause a fire.

• Add boiling stones for atmospheric pressure distillations. More even boiling can be achieved with use of magnetic stir-bars. You should certainly use stirring for high boiling or very toxic compounds. Add boiling stones and stir bars to cool solutions, before you begin heating. Dropping cold boiling chips through a condenser into hot solutions will result in very rapid boiling and has been known to cause boil-over of liquid through the top of the condenser. • Ordinarily, you should raise the heating mantel on a platform, or "lab jack" so that you may quickly remove the source of heat if the liquid "bumps" uncontrollably or loss of vapor occurs through the top of the condenser. Heat sources ordinarily used in undergraduate organic labs include bare corning stirrer/hotplates, on low thermostat settings of about "3", with distilling flasks just touching or just above the surface and surrounded in a funnel of aluminum foil. Research labs make use of various types of heat sources, including heating mantels attached to variable transformers and oil baths on hotplates. When using oil baths, do not overheat the oil.

• The receiving flask should be of such design as to efficiently receive the condensed liquid through the receiving adapter. Vacuum adapters can be used for water-aspirator vacuum distillations or inert atmosphere applications. Gas cylinders of nitrogen or argon are commonly attached via hoses to reaction stills with appropriate regulators and fittings.

• Never heat a closed vessel. Always have some means of venting heated gasses through distillation setups. One could also attach a hose to the vacuum adapter and direct it into a hood for more effective removal of any uncondensed vapors which may escape from normal atmospheric pressure distillation. Purging of distillation apparatus with inert gasses while distilling is sometimes employed in research laboratories. Make sure to include some sort of "safety valve".

• Surround the receiving flask in an ice bath to further condense very volatile organic

compounds.

• Make sure coolant is running through the condenser before you start heating the liquid. The rate of distillation, as determined by the number of condensed drops falling into the receiving flasks, should be relatively low, a few drops per second.

• Potentially reactive or explosive solvents should be distilled behind transparent explosion shields

• Refill liquid in the receiving flask or disassemble the entire setup only when the glassware has cooled down from the previous distillation

PRECAUTIONS TO BE FOLLOWED

Excess pressure build-up due to too rapid heating and unsafe use of flammable solvents, may result in fires.

• Very low-boiling or more toxic compounds should be distilled only in a fume hood.

• Fumes leaking through loose joints could come into contact with the heat source and cause a fire. • Dropping cold boiling chips through a condenser into hot solutions will result in very rapid boiling and has been known to cause boil-over of liquid through the top of the condenser.

• When using oil baths, do not overheat the oil. • Never heat a closed vessel. • Do not distill to dryness or "superheating" of the flask will occur, either cracking the glass or leaving a "tarry" residue which may be very flammable or even explosive.

• Potentially reactive or explosive solvents should be distilled behind transparent explosion shields

EYE PROTECTION • Safety glasses, goggles or face shields shall be worn during DISTILLATION operations. • Ordinary (street) prescription glasses do not provide adequate protection. Adequate safety glasses must meet the requirements of the Practice for Occupational Education Eye and Face Protection (ANSI Z87.1-1989) and must be equipped with side shields. HAND PROTECTION • Use disposable nitrile gloves when working with chemicals. Check chemical compatibility chart for breakthrough time when using • Laboratory personnel should thoroughly wash hands with soap and water before and immediately upon removal of gloves. LAB COATS, ETC. • Button lab coats, closed toed shoes, long pants and long sleeved clothing

shall be worn when PERFORMING DISTILLATIONS.

Protective clothing shall be worn to prevent any possibility of skin contact with CHEMICALS DURING DISTILLATION

RECORD TO BE MAINTAINED

- Laboratory Manual containing the experiments that can be performed with the equipment
- Maintenance Record

HOD

DEPARTMENT BIOTECHNOLOGY

STANDARD OPERATING PROCEDURE

STEAM DISTILLATION SET UP

Name of the Lab./facility	Chemical Engineering lab
Purpose	To describe the procedure for the operation and maintenance of the Steam Distillation set up
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using steam distillation in the Chemical Engineering lab , Vinayaka missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

TANDARD OPERATING PROCEDURE FOR STEAM DISTILLATION DISTILLATION SET UP

- An all-glass, vertical steam distillation unit, consisting of a hot plate, boiling flask, biomass flask, still head, condenser and receiver, is used for "dry steam" distillation of plant material. Steam produced in the boiling flask travels upward into the biomass flask where essential oils and water-soluble compounds are removed into the vapor stream. This vapor stream travels through the still head, condenses in the water-cooled condenser, and collects in the receiver, where the essential oil layer phase separates.
- Health and safety information for materials used: The glassware must be handled with care during assembly, dismantling and cleaning to prevent breaks and cuts. The hot plate and boiling water/steam can cause burns. Hazard Control Measures: • safety glasses • lab coat • latex or nitrile gloves for handling biomass • heat resistant gloves for handling hot equipment
- Waste Disposal Procedures: Biomass can be put into regular, non-hazardous garbage Decontamination Procedures: none Spill containment and clean up procedures: Biomass can be swept up or wiped up with a wet cloth and disposed of in the garbage.

Distiller Set-Up 1. Check all glassware for chips or cracks and discard any broken pieces in broken glass container. Even small cracks can become big problems when heated. See lab

supervisors for replacements. 2. Fill boiling flask with approximately 1.25 L of distilled water such that flask is between 1/2 and 2/3 full.

Place boiling flask on top of hot plate and secure in place with tube clamp around the neck of the flask. (Tube clamps should already be in the correct orientations and therefore should not need to be adjusted much aside from closing and opening the "pincher".)

3. Coat boiling flask stopper ground glass joint with thin layer of silicon lubricant and place in boiling flask. (Keeping ground glass joints lubricated is critical to preventing joints from "freezing" and breaking during disassembly.)

4. Secure condenser in place using second metal tube clamp such that the male end is facing downwards and tube clamp is attached slightly above water inlet connection (water tubes will likely already be connected to inlet and outlet). Coat male end of condenser with thin layer of silicon lubricant.

5. Attach receiver to bottom of condenser and secure in place with green plastic connector clamp. (Condenser height may need to be adjusted to accommodate receiver).

6. Make sure stopcock on receiver is in closed position and fill receiver with distilled water such that the water level is at least as high as the top of the lower outlet (see above diagram of how receiver works). The metal heat shield should be between receiver and hot plate.

7. Carefully insert metal screen (folded part ups) into the male end of the biomass flask such that bottom (open part) of screen is flush with the bottom of the ground glass joint.

8. Fill biomass flask through the top with prepared biomass. Coat male end ground glass joint of biomass flask with thin layer of silicon lubricant and set flask into top of boiling flask.

. Coat both ground glass joints of still head with thin layer of silicon lubricant. Simultaneously connect still head to top of biomass flask and condenser. If the height/orientation of the condenser needs be adjusted, set the still head on the counter before making the adjustments to prevent dropping or knocking over any of the glassware (another set of hands is useful here). Secure still head to condenser using red plastic glassware connection clamp. 1

0. Verify that condenser tubing is connected. Cold water should enter in the bottom and exit out of the top.

11. Connect inlet condenser tubing to sink cold water tap using cream-colored faucet adapter.

Make sure that outlet condenser tubing is drained into the sink, or connected to inlet of second condenser if running multiple distillations in a daisy-chain set-up.

12. Turn on cold water such that there is a gentle flow of water through the condenser. The outlet temperature of this water will be monitored throughout the distillation to make adjustments to the flow rate.

13. Place beaker (400 ml or larger) underneath overflow spout on receiver to catch hydrosol.

Distillation Procedure

1. Double-check all ground glass connections to make sure there is a good seal and that joints are lubricated.

2. Plug in hot plate and turn on to high (this setting will be used throughout the distillation). 3. Water in boiling flask should gradually begin to boil and travel upward into biomass flask. Steam will appear and start to condense in the still head after about 30 minutes of heating. Some water will also condense in biomass flask and flow back down into boiling flask which may cause the water in the boiling flask to change color; this is normal (think tea-making).

4. Make note of the time when the first drops run down the condenser and into the receiver. 5. Begin periodically checking the temperature of the water draining out of the condenser outlet tube into the sink. Water should be cool and at most, lukewarm; if water is warm, gradually increase the flow rate of the cold water until the outlet water is cool.

6. Watch liquid continue to collect in the receiver. An oil layer should begin to form on top of the hydrosol. Most of essential oil will collect in the first 10-20 minutes, but more will come off in the next 1-2 hour

To stop the distillation, turn off and unplug the hot plate. Let the entire set-up cool until the biomass flask is cool enough to handle (takes about 30-40 minutes).

Disconnect receiver from condenser and use stopcock to carefully drain remaining hydrosol into overflow beaker, leaving the essential oil layer. If desired, save a sample of the hydrosol in a labeled vial. 10. Wait about 5 minutes and then drain out the essential oil layer into a vial. Close and label vial.

If the essential oil has a slightly “burnt” smell, it contains some hydrophobic phenolic compounds. This smell can be removed by letting the essential oil vial sit uncovered for a day or

two; during this time, the phenolic compounds should evaporate off and the essential oil should smell better.

PRECAUTIONS TO BE FOLLOWED

Pre-Distillation Checklist The following checklist is to be performed each time before setting up the distillation.

• Cold water for the condenser(s) is available at the sink and the proper faucet adapter is installed. • Hot plate surface is clean and dry. Power cord is in good condition.

• Biomass is available and prepared. Essential oils are best extracted from fresh biomass shortly after harvesting. If fresh biomass needs to be stored between harvest and extraction, store in a labeled plastic bag or sealed container in the refrigerator.

Dried biomass can also be used. To prepare, remove as much of the non-oil containing plant parts as possible (steams, fruit pieces, etc.) and break/cut biomass to be extracted into ~1" wide pieces. In general, the smaller and thinner the biomass pieces (as long as it is not powder), the more efficient the extraction is.

• All the distiller pieces (boiling flask, boiling flask stopper, biomass flask, metal screen, still head, condenser, condenser tubing, receiver, large (red) and small (green) plastic glassware connector clamps, metal vertical support rod, beaker to collect hydrosol, and two metal tube clamps) are present and clean. • Silicon joint lubricant is on hand for distiller assembly.

Distiller Set-Up 1. Check all glassware for chips or cracks and discard any broken pieces in broken glass container. Even small cracks can become big problems when heated. See lab supervisors for replacements

RECORD TO BE MAINTAINED

- Laboratory Manual containing the experiments that can be performed with the equipment
- Maintenance Record

HOD

STANDARD OPERATING PROCEDURE

HEAT EXCHANGER

Name of the Lab./facility	Chemical Engineering lab
Purpose	To provide training for students, in Heat Exchanger apparatus using both experimental training set-up and Basic knowledge about Heat Transfer.
Scope	This Standard Operating Procedure (SOP) applies to the staff and students using Heat exchanger in the Chemical Engineering lab, Vinayaka missions' Research foundation to carry out research works and experimental purpose.
Responsibility	Faculty i/c of the facility, HOD/Biotechnology Lab technicians, students

STANDARD OPERATING PROCEDURE FOR HEAT EXCHANGER APPARATUS

- Switch on the heater and allow the water to heat.
- Open the valves V_2 and V_4 and arrange for parallel flow and open the valves V_1 and V_3 and arrange for counter flow.
- The gate valves of the geyser are opened and allow the hot water to flow through it.
- Adjust the flow rate of hot water in the range of 1.5 to 3 lit per min and the cold water in the range of 3 to 5 lit per min.
- Observe the thermocouple temperature at different points until it reaches steady state
- Measure the flow rate of hot and cold water.

PRECAUTIONS TO BE FOLLOWED

- Do not conduct an experiment without the complete knowledge of its operating procedure.
- Wear tight fitting clothes and thick leather shoes.
- In case of any injury, use the FIRST AID KIT.
- Report any fault (or) damage in the equipment to inform the lab in charge.
- Use stop watches, thermometers and accessories carefully.
- Do not wear watches (or) bracelets while working in the equipments.
- Do not remove safety guards or parts of any equipment

RECORD TO BE MAINTAINED

- Laboratory Manual containing the experiments that can be performed with the equipment
- Maintenance Record

HOD