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Warning: The instrument can not provide the designed protection for operators who do not follow the right procedures and requirements given by the manufacturer.



Warning: All solutions must be handled with care according to the lab's safety regulation. Please make a reference to the related material safety data sheet. Wear the lab-gown, goggle and rubber gloves all the time. Be care of hot reagents.



Warning: Be aware of the risk of electric shock. Only the trained professionals are permitted to open the face panel or back cover

I. Summary

Hanon SH420F Graphite Digester, adopted with globally advanced high temperature infra red duct radiant heating technology and MPU control platform, is characterized by its accurate temperature control and fast temperature rise. The temperature rise, divided into linear temperature rise mode and curved temperature rise mode, allows storage of 500 groups of digestion solutions. Each digestion solution has 25 temperature spots at most for control of temperature curve and even more provides PID (Proportion-Integration-Differentiation) control for more stable and accurate temperature control. The waste gas disposal system enables absorption of noxious gas, including acid and alkaline smog and the like. The product provides attractive appearance and large screen liquid crystal display. The design, fully incorporated with much hommization and automation, allows safer, easier, faster and more reliable, convenient operation, making the digester ideal device for high temperature digestion.

Definition of digestion: It's also called "wet digestion". It's the decomposition of the organic matter or reducing substances in the sample by the addition of acid or alkaline liquid reagents with heating.

Principles: Put the sample and liquid reagent in the digestion tubes, and the infrared heating pipes send the heat in the form of electromagnetic wave to the graphic block, which further passes on the heat to the digestion tubes. The molecules of the sample and liquid reagent absorb the heat and move faster with increased internal energy, thus generating more heat as the molecules collide with each other. The additional heat coupled with the reagent can accelerate the digestion process and make it more effective and complete digestion.

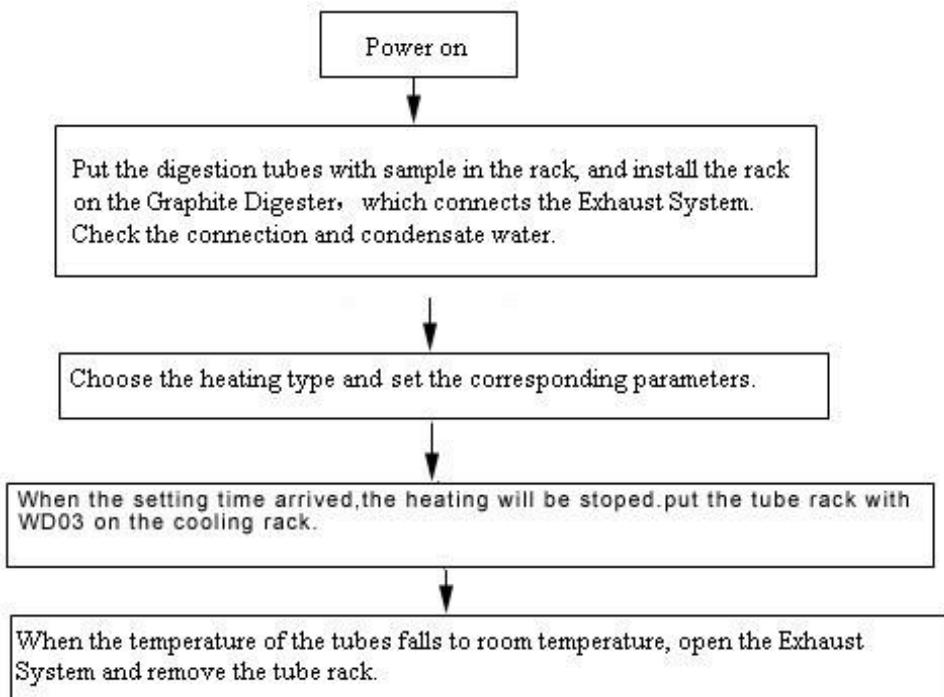
1.1 Features:

- The heating efficiency is greatly improved by the infrared radiation and graphite block, which guarantees uniform temperature.
- Mass storage: 500 groups of digestion solution, each of them has 25 temperature spots at most.
- The uniform temperature across the block can guarantee the consistent result.
- High accurate temperature sensor monitors and records the heating temperature.
- The PID temperature controlling platform improves the accuracy and stability of the temperature.
- Large LCD screen.
- The acidic or alkaline gases generated in the experiment can be eliminated by the environmental-friendly Exhaust System, which can be connected to the Graphite Digester.
- Offers the multiple protections against overvoltage, over current and overheat; the overheating alarm system is incorporated.
- Outstanding anti-corrosion performance.
- Cooling frame with standard configuration

1.2 Operating procedures:

Put the tubes loaded with the sample on the rack; start the exhaust system (selective); connect the exhaust system to the graphite digester and open the condensate water switch.

See Fig. 1 for operation procedure:



II. Main performance

2.1 Technical Specifications

Temperature range: room temperature 5°C to 480°C;

Controllable accuracy: $\pm 0.5^{\circ}\text{C}$

Heating method: infrared radiation heating and graphite conduction

Insulation material: environmental protection fiber and unique duct insulation technology

Digestive tube: 300 mL

Digestion capacity: 20 samples per time

Power supply: 220 VAC $\pm 10\%$ 50Hz

Power: 3.6 KW

Dimension: 515mmX458mmX730mm

Weight: 40 kg

2.2 Use conditions

2.2.1 Input voltage: 220V 50Hz;

2.2.2 The device shall be installed at places adjacent to water source and drain tank and provided with power sockets.

2.2.3 Power supply should meet the requirements of the device to avoid electric over stress; an independent switch, safety device and reliable grounding are required.

2.2.4 The device should be placed away from big electric equipment to avoid strong magnetic field.

2.2.5 Ensure the beneficial ventilation of the laboratory.

III. Structure



Fig. 2

1. Battery main switch 2.Shell 3.Stainless steel decorative sheet
 4.Digestion tube 5.WD03 waste gas collection hood 6.Cooling frame
 7.Waste discharge outlet 8.Digestion tube rack 9.Graphite heating block
 10.Operation panel

3.2 WD03 waste gas collection hood

3.2.1 Operation procedure

Fix WD03 waste gas collection hood prior to digestion: Place the test-tube rack in a proper position, match the digestion tube and the seal cover with one-to-one correspondence, and put WD03 waste gas collection hood on the digestion tube stand (See Fig.3).

After completion of the digestion, hold the grip on both ends of the test tube with hands, and take it out along with the waste discharge cover, then hang them on the cooling frame by the fixing leg on both ends of the test tube (See Fig.4). Hold the grip on both ends of the waste discharge cover after complete cooling and hang the cover on the clamping position of the cooling frame. At the same time, insert the dip tray in case digestion fluid drops down.



Fig. 3



Fig. 4

3.2.2 Dip tray mated for WD03 waste gas collection hood

The mated dip tray is shown in Fig.5



Fig. 5

3.3 Corollary Equipment

There are two solution for waste gas absorption

3.3.1 S402 Exhaust System is selective to the SH420F Graphite Digester

Being environmental-friendly, S402 Exhaust System is used to condensate and neutralize the acidic or alkali waste gas generated in the experiment. SH420F Graphite Digester can reach the best effect with the Exhaust System.



Fig. 6

3.3.2 Direct connection with running water jet vacuum pump

In addition to connection with the waste gas absorption system of S402, SH420F can also be connected to water jet vacuum pump for waste gas disposal. (The waste

discharge outlet is required to be inserted into the PTFE adapter in advance) (See Fig. 7)



Fig. 7

IV. Installation

4.1 Installation

4.1.1 Check before Installation

Open the package and check the device and its parts according to the packing list. If there is any damage, please keep the damaged parts and contact us immediately.

4.1.2 Installation steps

1. The device shall be installed at places adjacent to water source and drain tank and provided with power sockets and grounded line.
2. Connect one side of rubber pipe with the waste air discharge opening, the other side with water jet vacuum.

4.2 Operation

4.2.1 Introduction of the operation panel

a. Picture of the operation panel

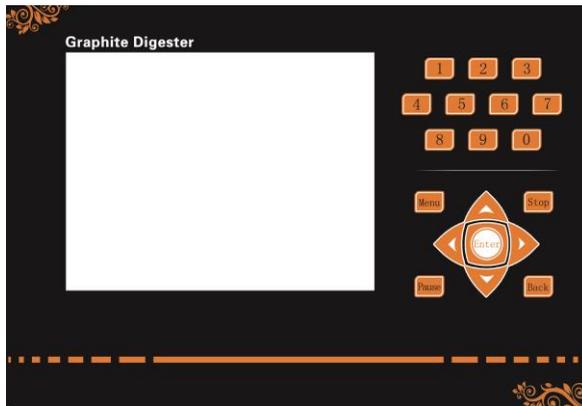


Fig. 8

Operation panel features: Membrane keypads

5.6 inches True-Color screen

b. Function of the Keys:

【Stop】: If an emergent stop is needed due to operation error or system failure, press this key to end heating, and then the system returns to the former interface.

【Enter】: Confirm the task or operation

【Back】: Return to the former interface

【Menu】: Return to the main interface on any condition (except interface of heating)

【←】: Cursor moves leftwards

【→】: Cursor moves rightwards

【↑】: Cursor moves upwards

【↓】: Cursor moves downwards

【0-9】: These keys are used for putting in parameters

【Pause】: Stop the heating process temporarily. Press again to restart.

The additional Function icon indication:

Indication of heating state: enlarging (heating on), normal (heating off).

Indication of the heating duct state.

Indication of timing state: enlarging (timing on), normal (timing off).

Indication of reaching the set temperature: enlarging (already reached), normal (not reached yet).

Indication of the overheating state: enlarging (overheating by 10 degrees), normal (no overheating).

Indication of the heating suspension state: enlarging (heating suspended), normal (heating continued).

4.2.2 Sample Digestion Process

1 Put the sample, chemical catalyst and liquid reagent into the tube; put the tube into the digestion rack.

2. Put the digestion rack on the device; put the exhaust system in the right place and open condensate water valve.

3. Time, heating mode and PID parameters can be set up firstly. If there is no need, choose the saved heating solution.

4. Linear heating for common samples, and curve heating for bubbling samples.

(1) Digestion with little foaming sample, use liner heating.

(2) Digestion with foaming sample, use curve heating.

5. Digestion process will be done automatically according to the selective mode. After digestion, the heating process will follow to stop.

6. After the sample cools down to the room temperature, turn off the condensate water valve, disconnect the exhaust system upper cover and remove the digestion tube rack.

Note: Clean the digestion liquid reagent left on the tap of the tube; get everything ready for the next test.

4.2.3 Detailed Explanation of each interface

4.2.3.1. The waiting interface will be shown on the first page. See Fig.9.

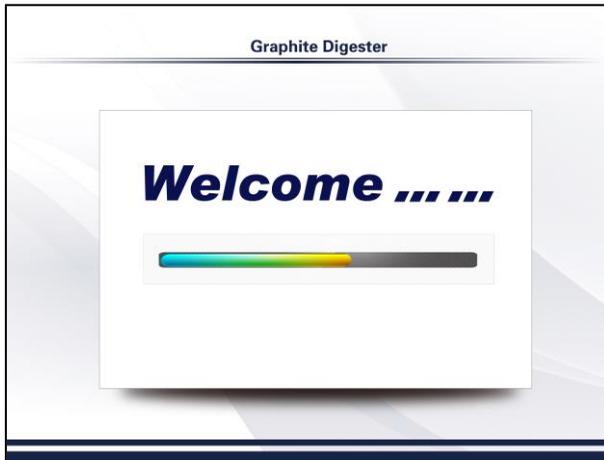


Fig.9

4.2.3.2 Enter the main interface in 5 seconds, include linear heating and curve heating as Fig.10.

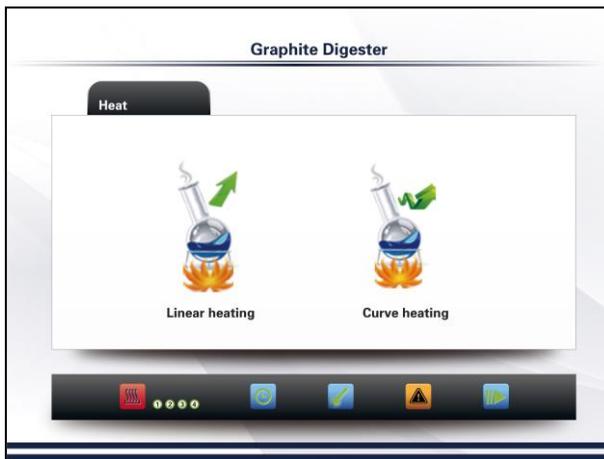


Fig. 10

1) Linear heating:

Press **【Enter】** to enter the setup interface, setting temperature and time and press **【Enter】** start heating and timing.

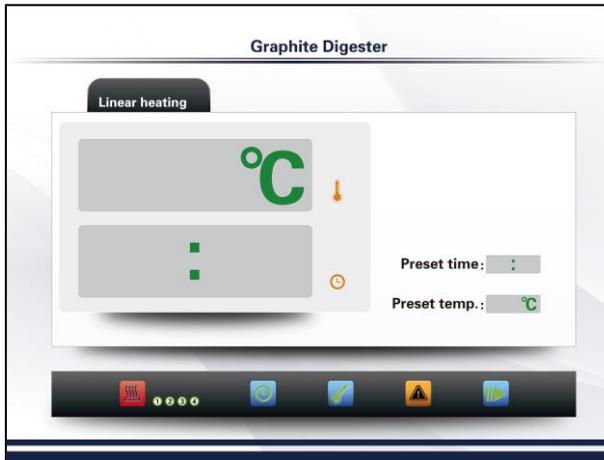


Fig.11

2) Curve heating:

Select curve heating (shown in the figure 12), press Enter key and enter curve heating interface.

The system has automatic memory of the last setting. Press Enter key for heating according to the curve set last time.

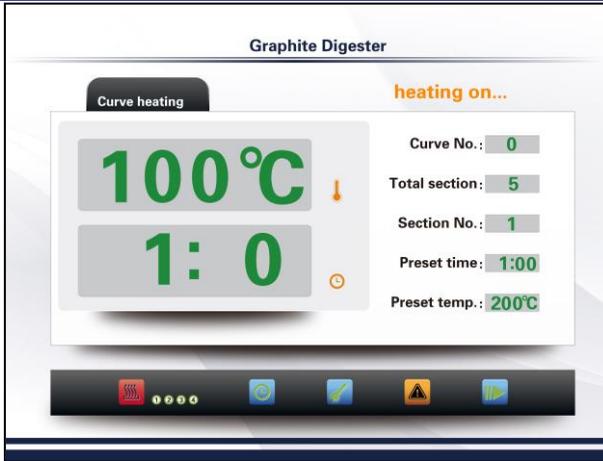


Fig. 12

The interface comes as follows on completion of heating:

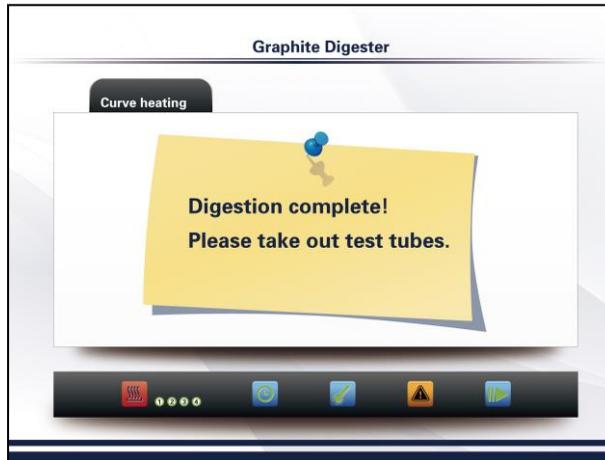


Fig. 13

3) Heating is forced to stop: press stop key when heating is on, and the interface comes as follows:

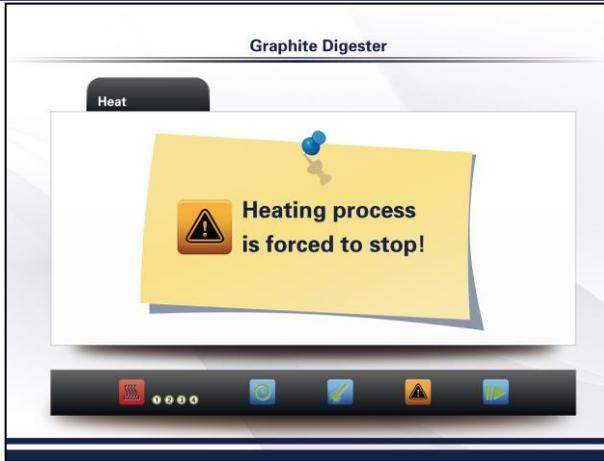


Fig. 14

4.2.3.3 Press the Menu key on the main interface for setting module, including system parameter setting and heating curve setting.



Fig. 15

Press **【←】****【→】** key for selection of system parameter setting or curve setting, and press Enter key for setting interface.

1) Setting for heating curve:

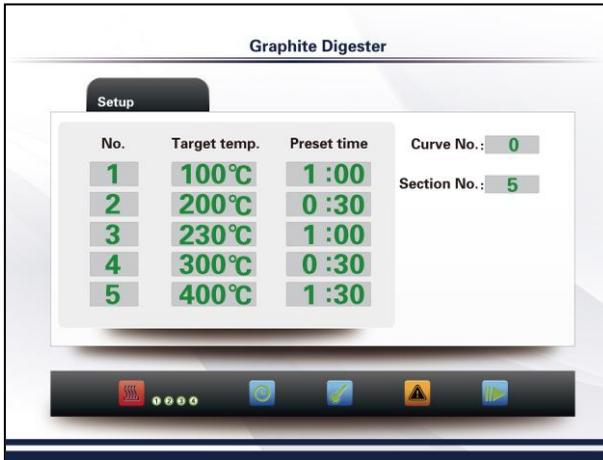


Fig. 16

2) Setting for system parameters:

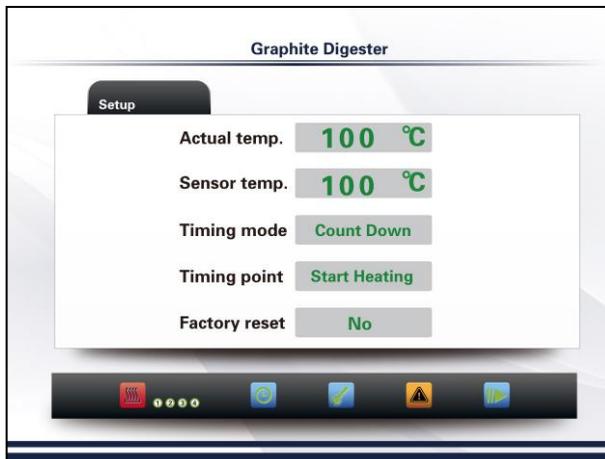


Fig. 17

Function introduction

Actual temperature: input the measured standard temperature (temperature stable).

Sensor temperature: temperature measured by the sensor.

Timing mode: count up timing and count down timing.

Timing point: start of heating and reaching set temperature.

Restore factory setting: restore parameter setting for delivery, wipe customer storage schemes.

4.2.3.4 Press Enter key on the main interface for help module:

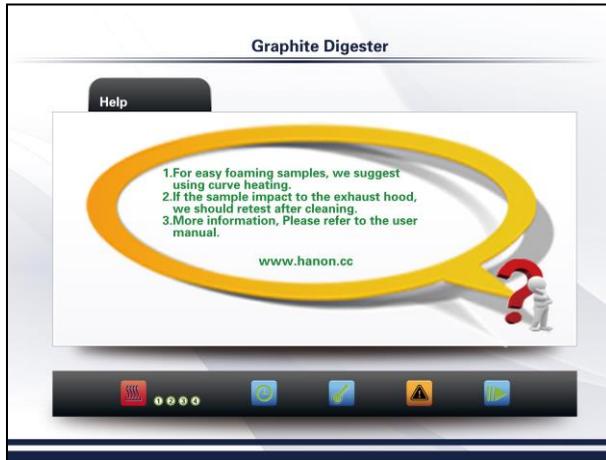


Fig. 18

V. Maintenance and Repair

5.1. Maintenance:

5.1.1. Check the power cord and power supply regularly. Replace the damaged and aging components timely.

5.1.2 Check the air pipelines, valves and connectors regularly. If air leakage or loose connection occur, or any damaged or aging components are found, replace them timely.

5.1.3 Clean the exhaust system upper cover regularly (once a week will be the best).

The specific cleaning steps:

5.1.3.1 Feed about 100ml distilled water into the digestion tube.

5.1.3.2 Put the digestion tube on the rack. Set up the exhaust receiver. Open the

condensed water.

5.1.3.3 Choose the linear heating mode. Set the temperature between 120°C-150°C. (The temperature may vary with the altitude and atmospheric pressure. It should make sure that the water does not boil intensely.)

5.1.3.4 It should distill about 30 minutes. This process may repeat several times according to the degree of contamination.

5.2. Common Faults Treatment

Number	Source of trouble	Causes	Solutions
1	No power	a. The fuse is burnt b. Plug not be properly connected	a. Replace the fuses b. Properly connect the power line
2	Slow heating	a. Low or instable voltage	a. Use stable AC220V voltage
3	Gas leakage	a. The digestion tube orifice is not sealed tight by the annular cover at the bottom of the waste discharge cover. b. Suction of the water jet vacuum pump reduces	a. Adjust the annular cover and seal the digestion tube orifice b. Increase flow of the running water
4	The LCD screen does not work	a. The screen is damaged b. The fuse is burnt	a. call for support b. Replace the fuses
5	Unrecognizable code on the screen	The sensor is interfered or damaged	Professionals to solve

VI. Appendix

6.1. Common Acidic and Alkaline Liquid Reagents

Acidic liquid system: Nitric-Sulphuric acid, Nitric-Perchloric acid, Hydrofluoric acid and Peroxide, etc. These chemicals can completely destroy the organics and reducing substances, such as cyanide, nitrite, sulphide, sulphite, thiosulfate and the thermally labile thiocyanate.

Alkaline liquid system: caustic soda, etc.

6.2. Problems to be noted in the digestion

6.2.1 The component of sample under test should not suffer losses.

6.2.2 Introduce the interfering substance is not allowed.

6.2.3 The process must be safe and fast.

6.2.4 The liquid made from the digestion must suit the selected monitoring method.

VII. Experiment Example

Oxidizing acid and mixed acid are often used in wet digestion, such as concentrated sulfuric acid, nitric-sulphuric acid, nitric-perchloric acid and hydrofluoric acid, etc.

The following example shows how to determine the protein in food with sulphuric acid.

7.1 Measure 0.2-2.00g pre-processed solid sample and put the sample in a tube; add 0.2g CuSO_4 , 3g K_2SO_4 and 20ml concentrated H_2SO_4 .

7.2 Put the digestion rack in the device, cover the exhaust hood and put in the parameters.

7.3 Connect the exhaust System to the device and start the exhaust System or water jet vacuum.

7.4 After finishing the above mentioned steps, choose linear heating or curve heating. The linear heating mode is often used for common samples. Put in the preset temperature at 380 °C and digest for 2 hours.

For sparging samples the curve heating mode is often used. In this case, the following parameters can be a reference.

- 1) 160°C~200°C heating temperature between this interval 20min
- 2) 260°C~300°C heating temperature between this interval 25min
- 3) 380°C~390°C heating temperature between this interval 90min

Different samples also require different parameters.

7.5 The digestion rack rise automatically and the tube falls to room temperature.

7.6 When the samples have cooled down, remove the WD03 and move the samples to the next experiment.

VIII. Announcement and Safety

8.1. Announcement

The one-year warranty for the whole device is valid from the purchase date (the date shown on your receipt), the following cases do not contain:

1. Any damage if the warranty expires.
2. Any damage caused by inappropriate operation.
3. Any damage caused by the unauthorized disassembly.
4. Any damage caused by the improper transportation or storage.

8.2. Safety Tips

This section is about the safe use of the device, including the safe operation and warning.

The following instructions must be read carefully by all persons who have or will have the responsibility for using or serving the device. Any consequence caused by misuse of the device should be taken by the user.

8.2.1 Requirements for the Operator

The shell of the device will be hot during the process and the strong acids and highly-corrosive liquid are dangerous, so the device should only be operated by the professionals in the laboratory or experienced staff with training. The operator must follow the instructions.

8.2.2 Cautions in Operation

1. During digestion, the temperature of the digestion tubes is very high, so be careful not to burn the hand or any parts of the body.
2. Be cautious with the flammable reagents in the tubes.
3. Protective clothing and eye protection must be worn.
4. If there is any problem during the operation, the electricity must be cut off immediately. No further operation.

8.2.3 For the device safety

1. Keep the electric parts of the device (such as electricity socket and main switch) dry.
2. Don't remove the insulation cover on the surface of the device.
3. Don't use damaged or broken digestion tubes.