



Organic Solvent Spray Dryer

User's manual



★ This machine is dual-purpose, can be used for organic solvent or water solvent spray drying

Catalogue

1、 Purpose	3
2、 Scope	3
3、 Duty	3
4、 Equipment overview	4
4.1 function declaration	4
4.2 operational principle	5
4. 3 Equipment applications:	7
4. 4 Applicable materials:	7
4. 5 Equipment details:	7
5、 Schematic diagram of the equipment	12
6、 Flow of work	14
7、 Standby and preparation	14
7.1 Standby and preparatory work	15
7.2 Operating procedures	15
7.3 Trend chart	20
7.4 Historical data	21
7.5 Alarm Records	21
7.6 Water Solvent Main Working Interface	22
7.7 System Settings	23
7.8 Description of equipment valve components (important parts)	24
8、 Experimental procedure	26
8.1 Material preparation:	26
8.2 Experiment began	27
8.3 Experiment ended	27
8. 4 How to better use small closed cycle spray dryer	27
8.5 Matters need attention	30
9、 Common problems and solutions	31
10、 Addendum	33
1. User Notes	34
2. Three service provisions	35

System update notes.....	34
--------------------------	----

1、 purpose

This manual introduces the IN-OS MINI small spray dryer and provides all the information needed to operate it safely and keep it running properly. The content of this manual is specifically for laboratory personnel.

2、 scope

This manual applies to experimental organic solvent or aqueous solution spray dryer.

3、 duty

This manual outlines the safety features of the equipment, including general operational guidelines and hazard warnings. The safety of users and others can only be ensured through strict adherence to the safety instructions and warnings provided in each chapter. Therefore, this manual must be made available to all personnel involved in the work described herein.

This instrument should only be used by laboratory personnel or by persons with training or professional experience of the risks involved in operating the instrument.

Those who have not received this training or are currently undergoing it require careful guidance. This manual can serve as a basis for providing such guidance.

1.1. Warning signs



Electrical hazard



Hot surface

This instrument is designed and manufactured according to the latest technology. However, if not used correctly, it may cause danger to users, property and the experimental environment.

Instrument manufacturers have identified residual instrument risks in the following situations:

If the instrument is operated by untrained personnel.

If the instrument is not properly operated for its intended use.

When using the instrument, wear personal protective equipment such as goggles, protective clothing and gloves if necessary.

All distribution equipment contains dangerous voltages that can cause death, and the degree of danger is reduced by proper operation and maintenance.

Routine inspections should be conducted for issues displayed on electrical equipment. If the surface becomes overheated or emits a burnt odor, immediately shut down the system and perform checks or corrections. Improper operation of electrical devices creates hazardous conditions. Personnel authorized to operate such equipment must hold relevant certifications and be thoroughly familiar with both operational requirements and all potential risks involved.

Electrical accessories containing dangerous voltage should be kept closed during operation. Many accessories have multiple power sources and must fully understand all contacts of each device so that all power sources can be disconnected before being allowed into the equipment.

Misadjusted equipment can be dangerous. Before adjusting the equipment, the consequences of the change must be estimated to ensure equipment operation and personal safety. During adjustment, refer to the instructions for each special component.

Fuse blowout, circuit breaker trip or overload trip all indicate a potential dangerous situation. The cause of the overload must be identified before the equipment is restarted. Failure to identify or correct the overload may cause equipment damage and personal danger.

If the fuse is blown or the circuit breaker trips, the overload current will cause damage to the equipment. If necessary, check the damage and repair the equipment before restarting.

Fuse, circuit breakers, overload and other electrical devices must replace with devices indicating voltage and current as well as operational performance. Current capacity and tripping performance and breaking performance cannot be changed at will, unless a detailed estimate of current and load changes is made and the changes are guaranteed.

There is a risk of electric shock when working near electrical installations, and the power must be cut off before work. Only qualified professionals who have been trained can work with the correct procedures and tools.

The purpose of maintenance is to keep the equipment in a good state, small problems will not be solved will lead to greater problems. A thorough mechanical inspection should be done at least once a year.

Check the connections of terminals, fuses, wires and ground wires to prevent overheating or loosening. The connections must be clean and loose terminals should be tightened or replaced.

The movable parts should be checked to ensure that they are free to move, without adhesion or damage, and any parts showing problems need to be repaired or replaced.

The vent must be kept open and if the equipment has an auxiliary cooling device, it must be checked periodically.

The electrical cabinet can not be used to store other materials and equipment.

4、Equipment overview

4. 1 function declaration

What is nitrogen closed circuit spray dryer

The nitrogen closed-loop spray dryer, also known as an organic solvent spray dryer, is a closed-loop spray drying process specifically designed for producing suspensions from organic solvents such as ethanol, methanol, acetone, hexane, and gas-oil. To enhance explosion-proof performance, inert gases (such as nitrogen) are used as the drying medium in this system. The entire process ensures oxidation-free product formation, enables medium recovery, and allows for the recycling of inert gases (like nitrogen).

This equipment primarily dries volatile materials containing organic chemical solvents, toxic substances, or hazardous substances that pose risks to human health and the environment when

released. Its key features include a closed-loop system design with recirculating gas media and reusable organic solvents. It is suitable for materials containing organic solvents or those prone to oxidation, flammability, or explosion. Typically, materials requiring this process must be oxygen-free, so inert gases like nitrogen or carbon dioxide are commonly used as heat carriers.

The gas uses inert gas as the circulating gas, which has a protective effect on dry materials. The circulating gas goes through the process of moisture loading and dehumidification, and can be reused. After heating by the heater, the inert gas enters the drying tower. The liquid material is transported to the nozzle by peristaltic pump. The liquid is impacted by high-speed gas and atomized into droplets. In the drying tower, the waste heat medium is fully contacted for drying.

Gases and dried solids undergo gas-solid separation in a cyclone separator and baghouse dust collector, with processed materials collected in storage bins. Exhaust gases are condensed through a condensation system for liquid-gas separation. Recovered organic solvents become reusable resources, while the condensed gases are reheated as drying media to sustain system operations.

Spray drying is extensively used in industrial chemistry and food processing. It produces dry powders, detergents, and dyes, while also serving as a drying agent for materials requiring organic solvents like alcohol. This technology is particularly effective for preserving food products and acts as a rapid drying solution, offering advantages such as weight reduction and volume minimization.

Spray drying is a process that injects a fluid mixture into a hot gas stream. The solvent, typically an aqueous or organic solution, evaporates instantly upon exposure to heated air. This rapid evaporation efficiently removes heat, allowing the product to dry gently without thermal stress. Within seconds, the material transforms into powdered, granular, or chunky forms.

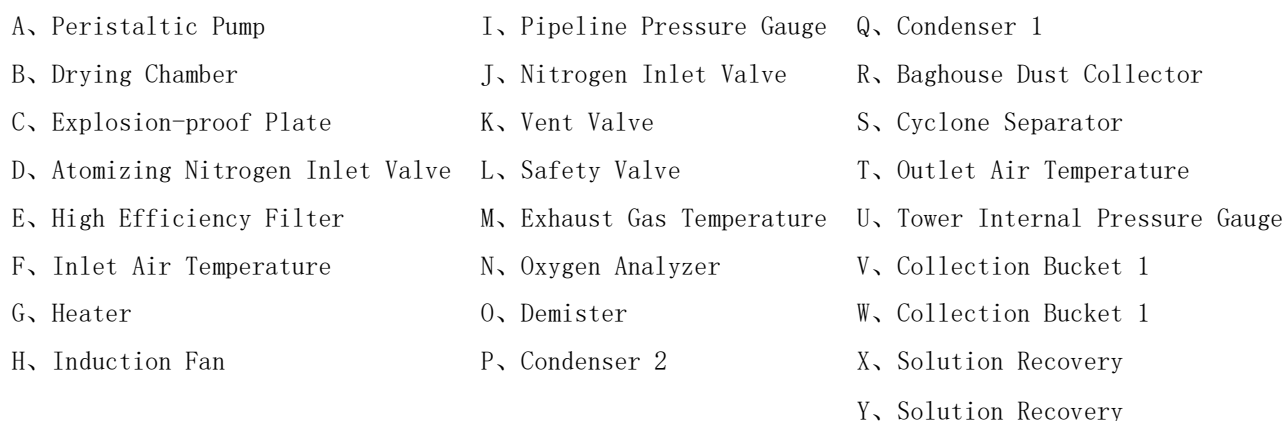
4. 2 operational principle

As required, this equipment has dual functions, closed circuit circulation mode and open mode.

The working principle of closed loop mode is as follows:

- 1、 The system uses inert gas as the circulating gas, which has a protective effect on dry materials. The circulating gas goes through the process of moisture loading and dehumidification, and can be reused;
- 2、 After heating by the heater, inert gas enters the drying tower. The liquid material is transported to the nozzle by peristaltic pump. The liquid is impacted by high-speed gas and atomized into droplets, which fully contact with the hot medium in the drying tower for drying;
- 3、 The gas and the dry solid are separated in the cyclone separator and bag dust collector, and the product material is collected in the bucket;
- 4、 The exhaust gas is condensed and recovered by the condensation system, and the gas-liquid separation is carried out. After the organic solvent is recovered, it can be recycled;
- 5、 The condensed gas is heated and then used as drying medium in the system;

Specifically designed for organic solvents, this system utilizes inert gas (nitrogen) as the drying medium instead of conventional air. In addition to enabling product recovery, it also facilitates solvent recycling. The closed-loop spray drying system was developed based on the unique characteristics of organic solvents.



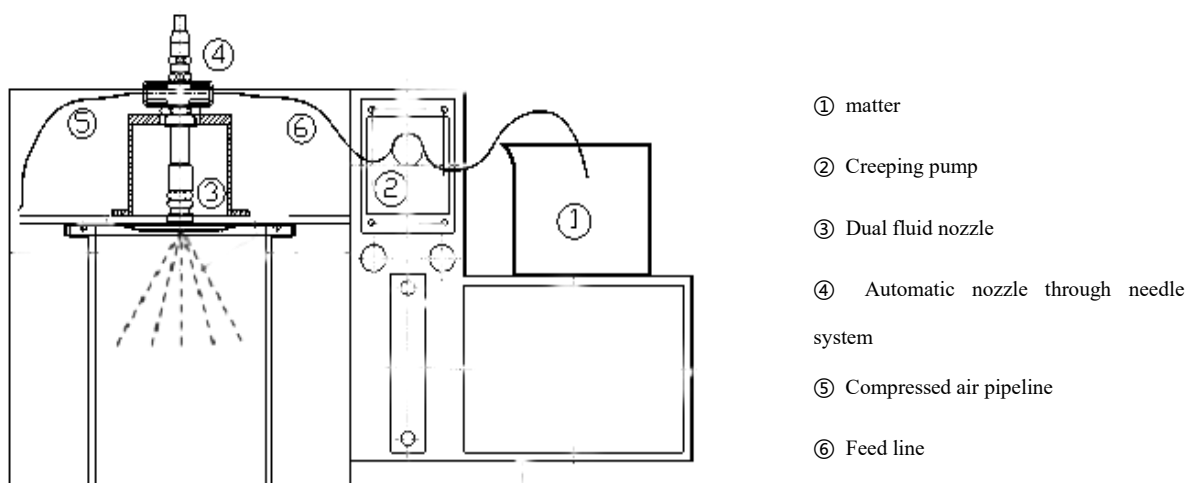
In the open working mode, the function of this equipment is the same as that of a normal spray dryer, that is, the drying air is directly connected as the drying gas. After the drying gas is condensed and the solvent is removed, it is directly discharged into the atmosphere without reuse.

Functional principle of a vacuum furnace

- ① Air inlet (fan supply)
- ② Heating pipes and electric heaters
- ③ The concentric inlet of hot air around the nozzle
- ④ Spray cylinder
- ⑤ Used to separate particles from a gas flow
- ⑥ Product collection containers

6

The sample solution is pumped into a dual-fluid nozzle using a peristaltic pump. Compressed gas atomizes the solution into fine droplets that enter the drying chamber. The hot airflow within the chamber rapidly dries these droplets into solid particles. The processed particles are then separated from the gas stream via a cyclone separator and collected in a collection bottle.



Sample feeding and dispersion working principle

4. 3 Equipment applications:

This equipment can be used for material processing and solvent recovery processes using organic solvents such as alcohol, as well as water-based solutions. It can be configured to establish complete production systems for chemical plants, pharmaceutical factories, medical facilities, schools, and enterprises.

4. 4 Applicable materials:

Non-oxide ceramics, superhard alloys, high-efficiency battery materials, seasonings, health foods, pharmaceuticals, vitamins, organic medicines, synthetic resins, waxes, and related products; pharmaceuticals, dyes, food products, beverages, pigments, dairy and egg products, plant and vegetable products, thermosensitive materials, plastics, polymers, resins, fragrances, ceramics, soaps, detergents, blood products, adhesives, oxides, textiles, bone and dental materials.

4. 5 Equipment details:

4. 5. 1 Electrical connections

Connect the power plug to the instrument and AC power supply.



Power button operation panel

There is a green button 1 on the power operation panel, which is operable. It is used to control the power supply of the instrument, as well as for emergency stop in case of emergency, and also as an indicator of the power status and working status of the instrument.

When the power cable is connected in place and all preparations are ready, press the button to power on the instrument. The indicator light will be green.

Power outage at the facility

When a power failure is required, press the green button (the instrument has been powered on) until the button indicator light flashes, indicating that the power failure is about to occur; when the indicator button is off, the instrument has been powered off.

 **After determining the power failure of the equipment, if the equipment is not used for a short time, for the safety of electricity, the white three-legged plug can be pulled out from the socket**

4. 5. 2 Pipeline linkages

Connect the instrument to the nitrogen cylinder to supply compressed air.

Use the air circuit quick release correctly



The quick-release air circuit can be connected by pressing directly. When inserting, simply press the ① part and insert the ② part in; when removing, press the ① part and pull out the ② part.

4-5-2-1: Quick disassembly of air circuit

Installation and use

This equipment operates on a single-phase 220V/50Hz power supply and should be equipped with an air switch or automatic circuit breaker. Voltage fluctuations may cause startup difficulties or compressor overheating. To ensure proper operation, in areas with unstable voltage conditions, use a single-phase voltage stabilizer with a capacity exceeding 2000VA.

4. 5. 3 Fogging system

This section mainly introduces the performance parameters and advanced features of the instrument dual fluid nozzle.

summarize

The concurrent dual fluid nozzle enables the spray drying of heat sensitive materials at a mild temperature.

American Spray dual fluid nozzle

The Spray dual-fluid nozzle is an excellent high-precision spray nozzle. The instrument uses an external hybrid nozzle, where the compressed gas and liquid flow can be controlled separately, which can effectively spray high viscosity liquids and suspended abrasives.

The dual-fluid nozzle is installed at the center of the top of the gas distributor and sprays directly downward into the tower. The feed enters through a feed pipe inlet of the nozzle at a minimum pressure and is atomized with compressed gas.

Nozzle assembly

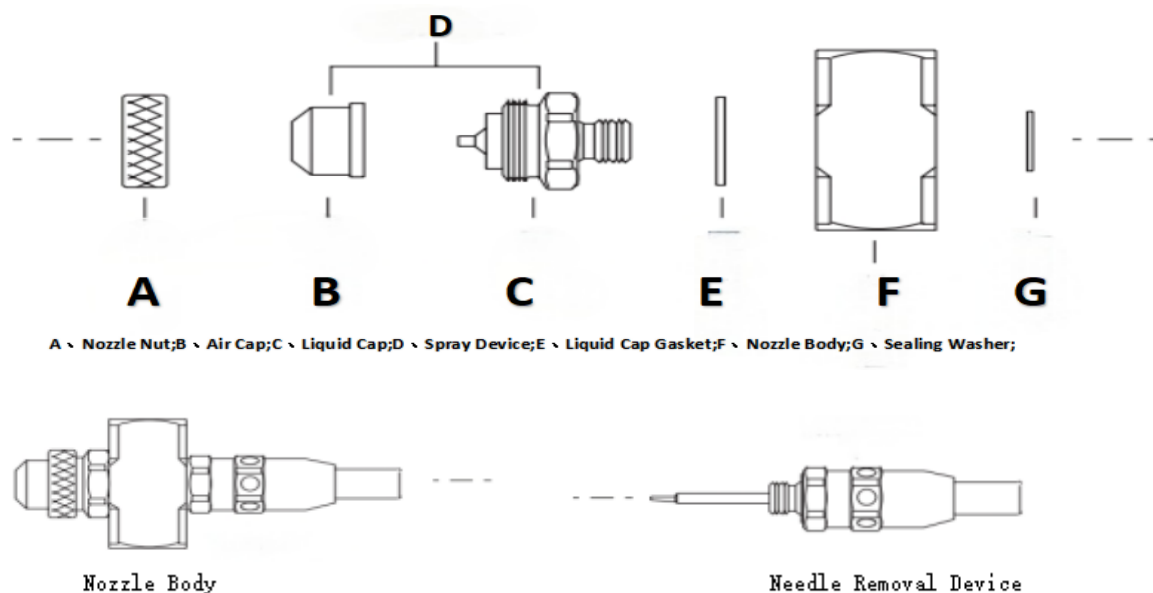


Figure 4-1-3-2.1: Schematic diagram of nozzle body and spray device

Use and maintenance of nozzle

The instrument employs a nozzle that externally mixes liquid flow with compressed gas. Both the compressed gas and liquid flow can be individually controlled. Atomization is achieved by adjusting the gas pressure and liquid pressure within the spray device. Increasing gas pressure and/or decreasing liquid pressure enables finer atomization effects, resulting in a higher gas-to-liquid flow ratio.



Figure 4-1-3-2.2: Spray morphology

The spray system features an automatic needle cleaning mechanism that automatically removes obstructions when the nozzle passes over liquid nozzles, ensuring effective spraying of high-viscosity liquids and suspended abrasives. However, excessively viscous materials or operational errors may still cause nozzle clogging. When manual cleaning is required, simply unscrew the nozzle cap and clean both the air cap and liquid cap separately using a pure solution.



Figure 4-1-3-2.3: Cleaning nozzle

natural parameter

The compressed gas source supply pressure of the nozzle is between 2 and 4 bar.

Gas flow rate is between 15-18L/min.

A flow meter is provided to monitor and control the flow rate.

4. 5. 4 Feed system

This section introduces the components and working performance of the instrument feed system.

peristaltic pump

Transparent protective cover, allowing for easy observation of the pump head and hose operation at any time;

Multiple motor drives are adopted;

Special hygienic-grade hoses are used, with the entire section installed in a snap-in manner;

Standard quick-connect joints, facilitating the connection of different materials of hoses;

No joints, simplified design to avoid leakage and contamination risks. Jointless simplified design to avoid leakage and contamination risks.



1、Stepper motor; 2、Hose; 3、Installation hole; 4、Pump head;

Figure 4-1-4-1: Schematic diagram of peristaltic pump

running mode

The operating control mode of peristaltic pump can be loaded into different applications depending on the selected accessories.

Traffic is autonomous and controllable

The feed rate is controlled by the customer. The feed rate can be adjusted by inputting the value. In the feed rate operation range, the value can be switched at will.

Material return

One-click to recycle the material in the silicone tube.

※ Intelligent expansion

The selected equipment is equipped with feed switching valve, which can switch between manual and automatic operation mode at will. The system can automatically complete the switching of materials and solvents in different stages of working process without manual participation.

Changing hoses



- A、As shown in the figure, tighten the fastening pin to the unlocking position.
- B、Open the transparent cover
- C、Install the hose
- D、Close the transparent cover and tighten the fastening pin to the locked position

Figure 4-1-4-3: Schematic diagram of creep pump hose replacement

First, open the top cover, remove the pipe clamp, gently turn the rotor clockwise, and remove the pipe to be replaced or worn;

Cut a new tube of the same length, and then rotate the wheel clockwise to slowly install the hose into the pump head;

Then, fix the tube card on the card and cover it with a lid.



When you replace the hose, make sure that the total power supply of the instrument is turned off.

Do not turn off the machine to replace the hose or rotate the pump head rotor!

4. 5. 5 heating system

This section introduces the characteristics and use of the instrument heating system.

1.1.1.1. performance index

The instrument uses a special electric heater to provide hot air source for spray drying.

Table 4-1-5-1: Heater performance indicators

metric	parameter
working voltage	AC220V, 50HZ
power rating	3.2KW
heating efficiency	0-250°C
material quality	2520 stainless steel
stability	±1°C

1.1.1.2. Heater maintenance and care

When the electric heater has not been used for a long time (more than 3 weeks), it is difficult to restart because of leakage of electricity caused by condensate and moisture in the insulation material inside or on the surface of the heating element.

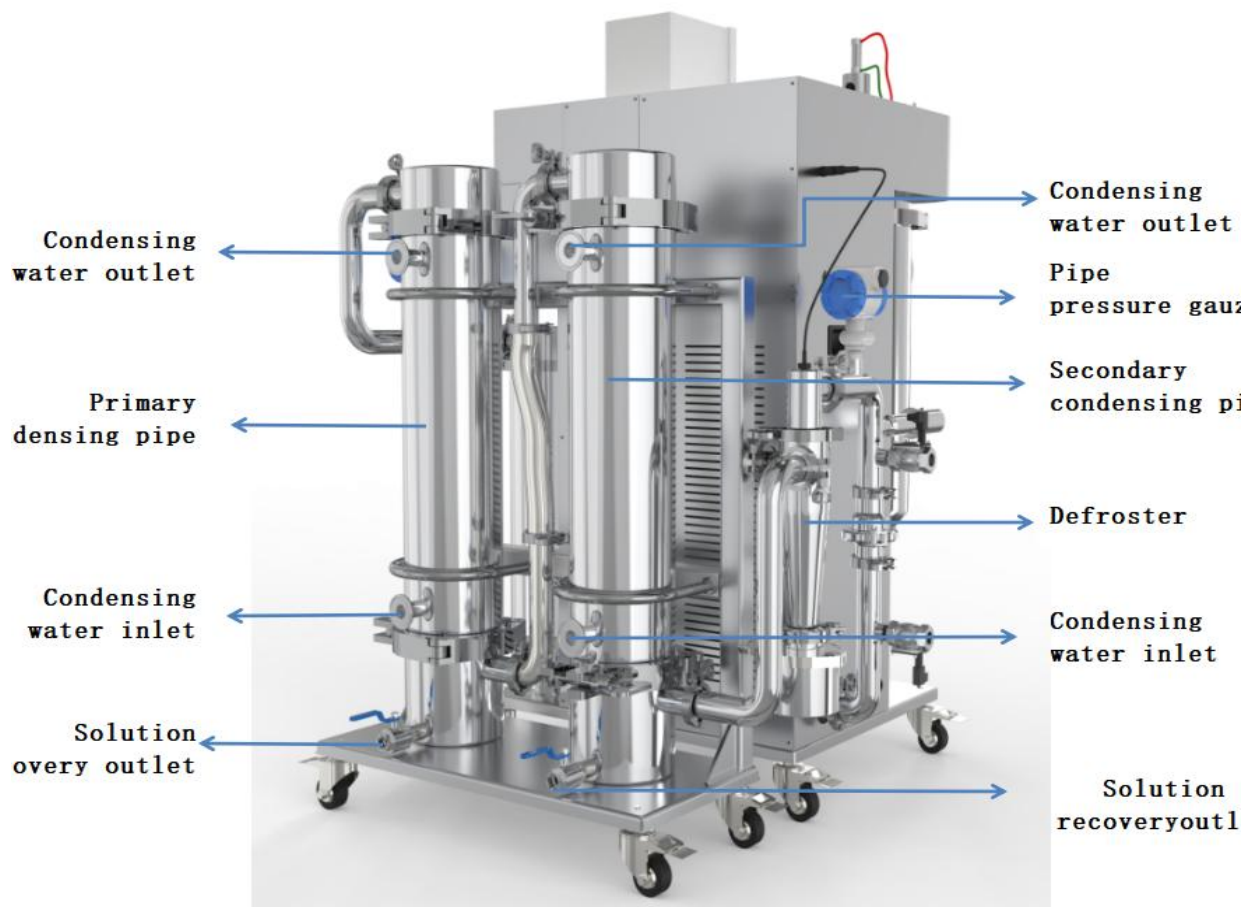
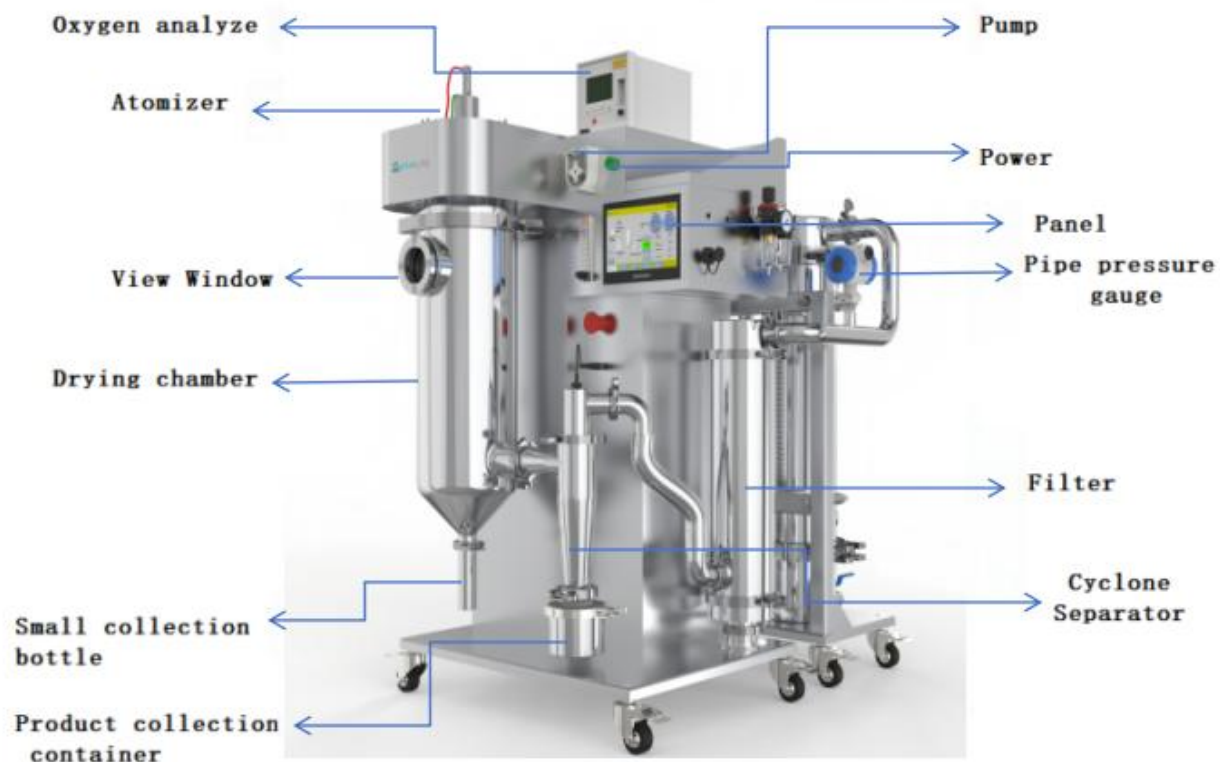
To remove moisture through gradual heating of the element (preventing electrical leakage), follow these reboot procedures: First, turn on the heater switch and wait at least half a minute before turning it off. After approximately one minute, restart the device for half a minute. Repeat this cycle several times based on the duration of inactivity. Gradually extend the on-time while reducing the off-time. After about 30 to 60 minutes, the heater will be ready for continuous operation.

⚠ Because condensate is related to the humidity of gas, attention should be paid to the storage conditions.

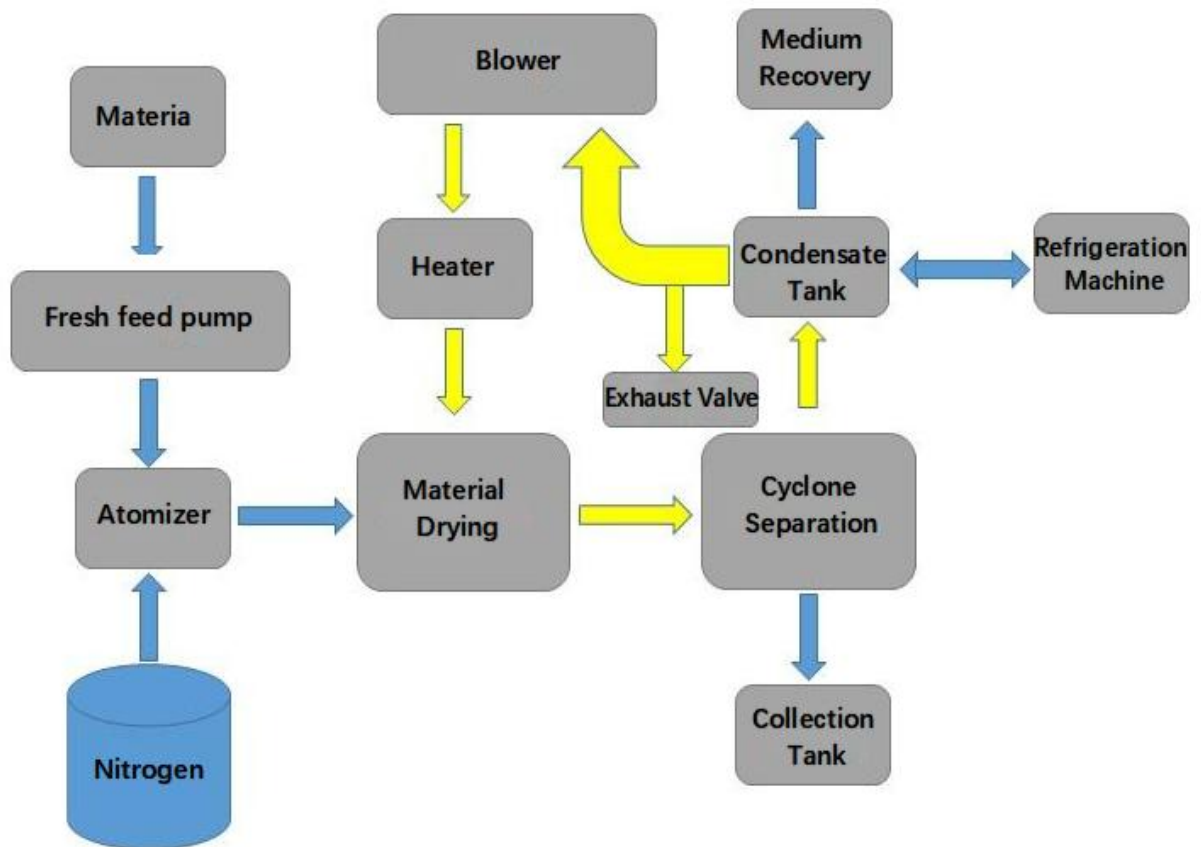
If the heater can not be troubleshooting, please contact our technicians in time.

5、 Schematic diagram of the equipment





6、 flow of work



7、 Standby and preparation

The standby interface is an implicit interface and it is also the initial interface when the instrument is powered on. It automatically jumps to the "main control interface" after 5 seconds.

The system setting interface. When the customer activates the "standby function", the system will automatically jump to the "standby interface".

If any part of the touch screen is touched on the standby interface, the system will again jump to the "main control interface"



Idle screen

1.2. 7.1 Standby and preparatory work

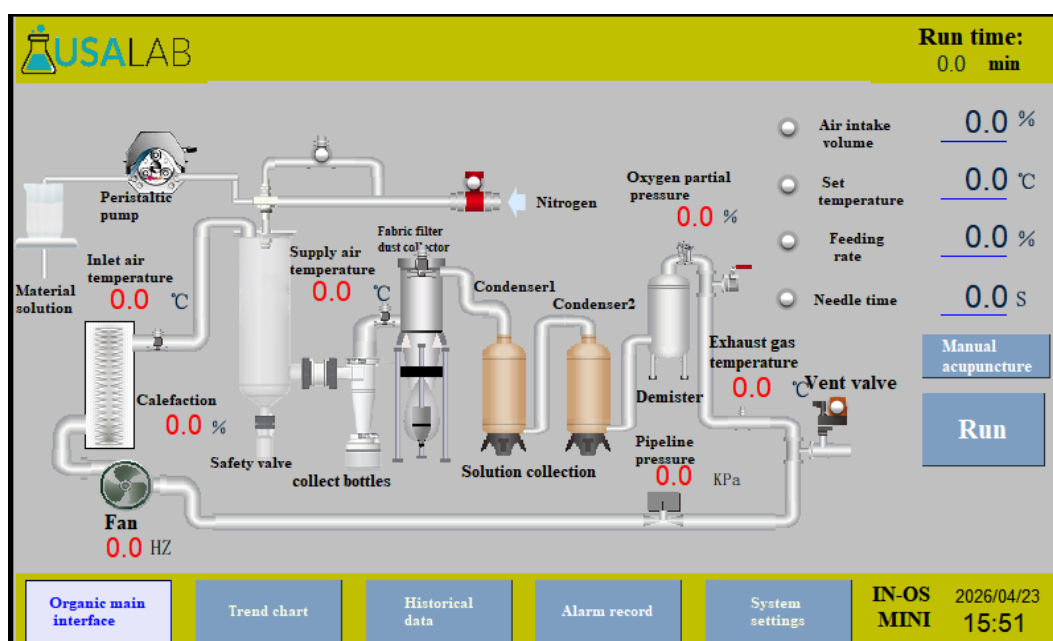
- Before using the equipment, confirm whether the working plane of the dryer is level.
- Keep the equipment in a dry and ventilated environment
- Observe all valves on the machine and keep the necessary valves open and closed.
- Check whether the clamps and components are fastened.
- Confirm whether the casters at the bottom of the equipment are fixed.
- Connect 220V power supply and open the equipment start switch.

1.3. 7.2 Operating procedures

Observe the touch screen and enter the main interface (or operation interface) of the operating system, as shown in the figure below



- Click the organic button to enter the operation interface. As shown in the figure below



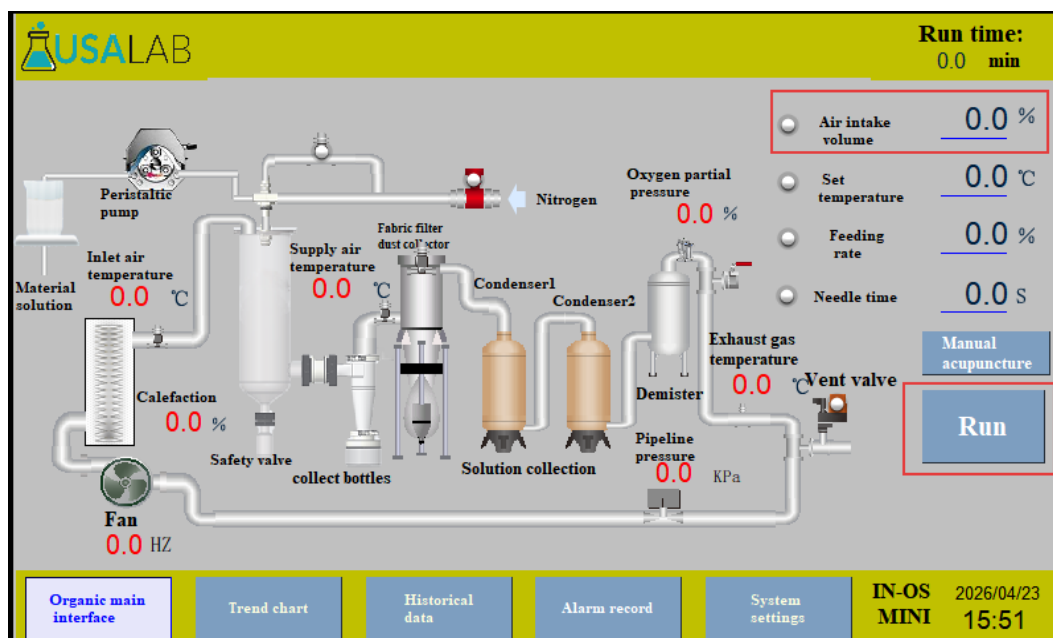
After the initial start-up of the equipment, the system will open the detection mode. In the initial state, the equipment can only carry out other operations when it meets the actual production conditions (the oxygen content of the whole drying system is close to 0, the pressure setting value reaches the set value, and the condensation temperature reaches the specified temperature).

When the organic solution mode is working, the sealing of the pipeline must be tested first, because the pipe parts will be disassembled and assembled during the cleaning process. If the sealing pad is not installed properly, the equipment will not work.

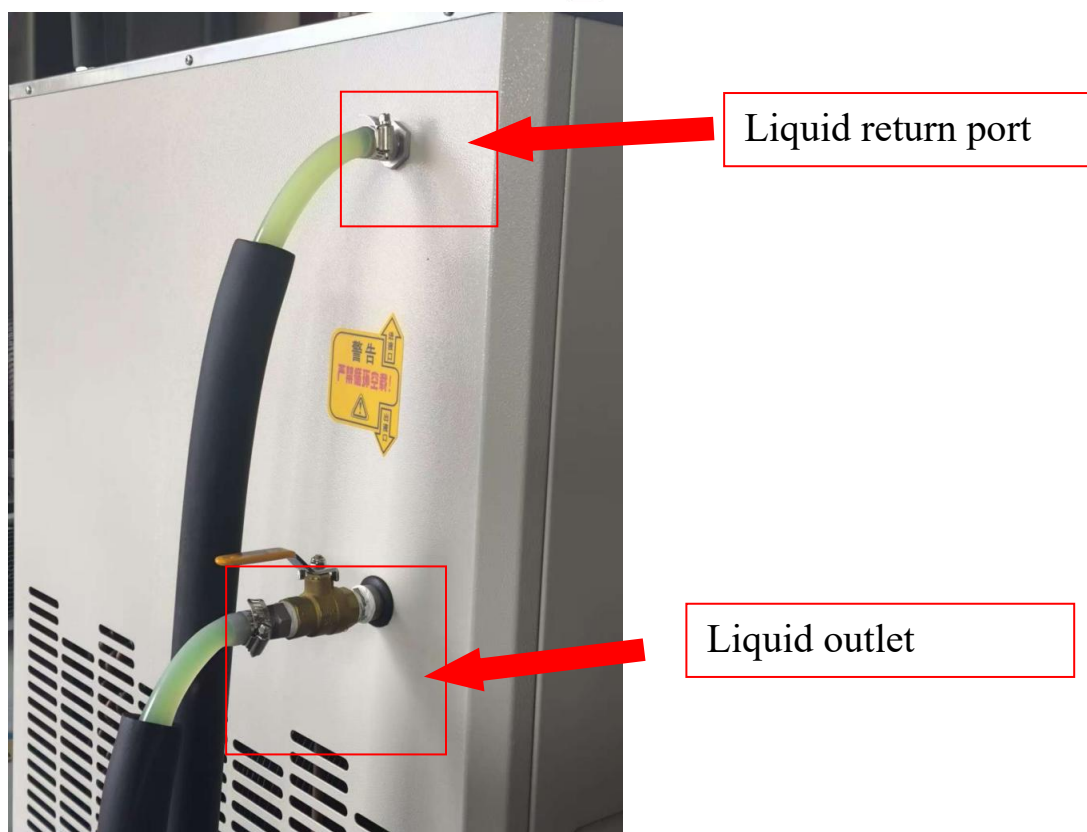
- Water mode: close the peristaltic pump and alarm of oxygen content meter. It can be used for maintenance and debugging.

- In operation mode: when there is an alarm or the oxygen content exceeds the set value, the peristaltic pump does not feed.
- In operation mode: when there is a fault, the heater is closed to ensure safety.
- The heater can only be turned on after the fan is turned on. If the air inlet temperature is greater than 60°C, the fan cannot be closed and the heater is protected.

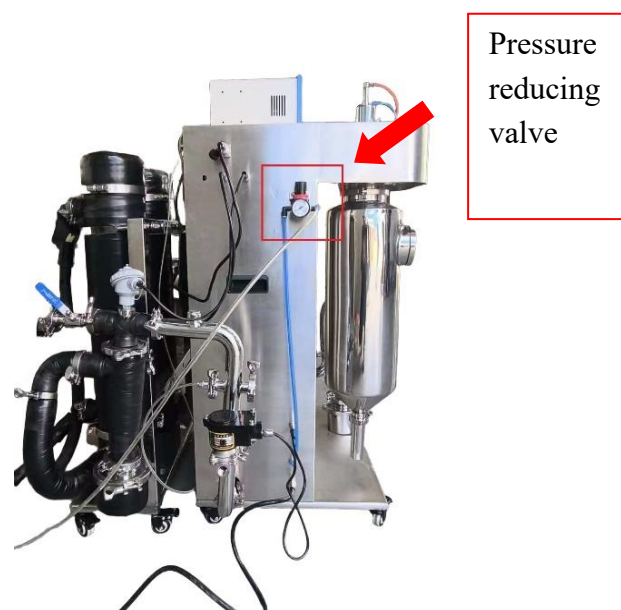
(1) Click the fan frequency setting option to set the fan air volume required by the experiment, and click run to start the fan, as shown in the figure below:



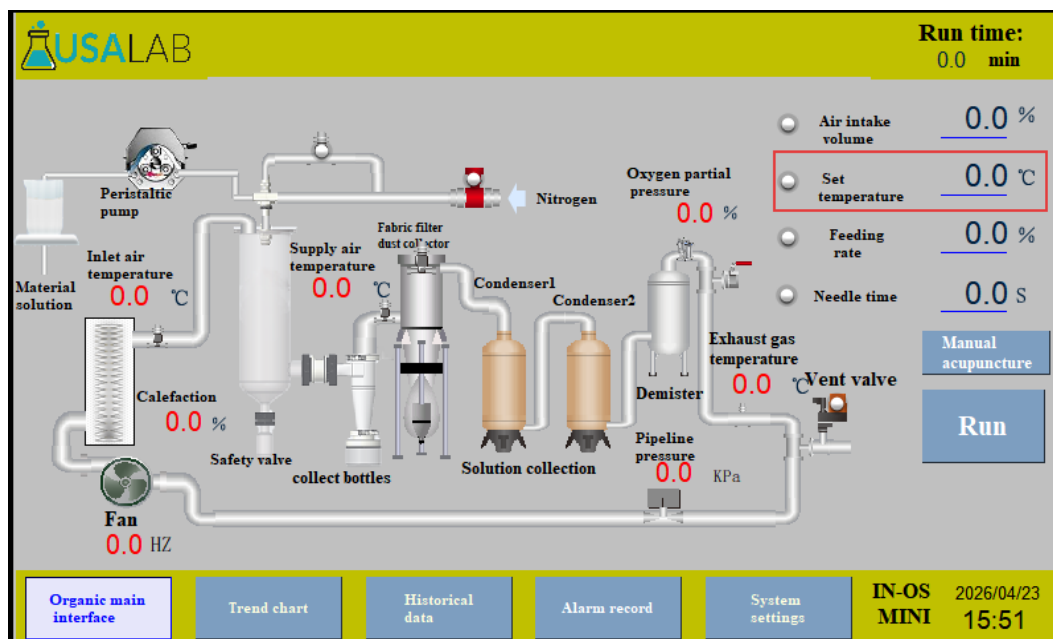
(2) For material storage refrigeration systems, the recommended chiller temperature should be set below -20°C for organic solvent recovery. For water-solvent mixing applications, adjust the temperature according to solvent properties. If water is used as the solvent, chiller operation may not be necessary. Failure to follow instructions and resulting equipment damage will be your own responsibility. Operation guidelines for refrigeration units are detailed in the equipment manual.



(3) Turn on nitrogen, adjust the pressure of the double fluid atomizer and the needle on the left side of the arrow indicated in the figure to the pressure 0.3-0.4mpa, and adjust the gas flow meter in the figure to 15L/min as shown below:



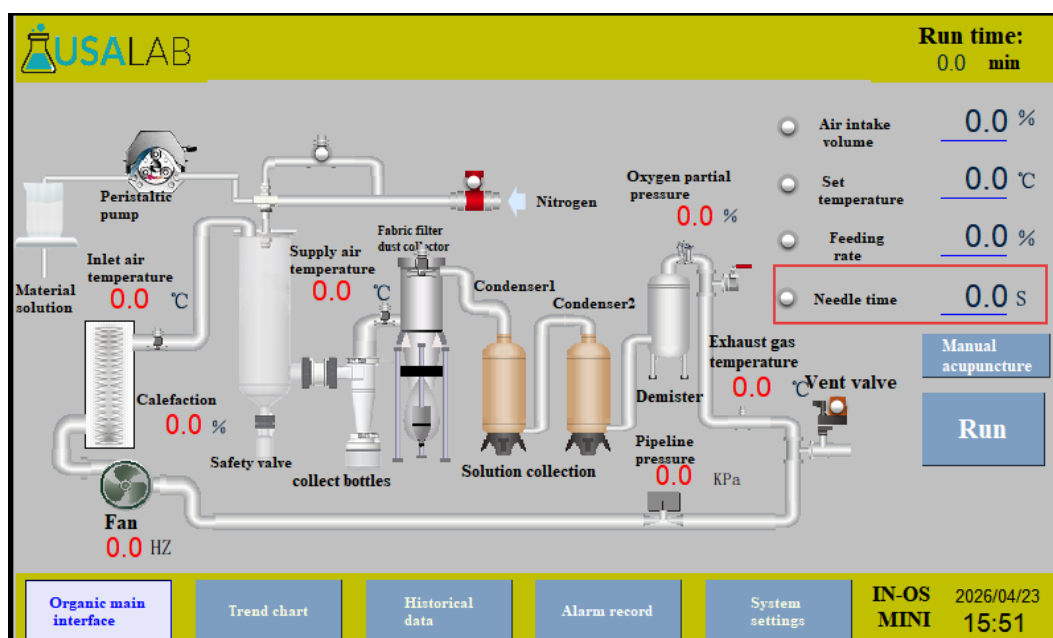
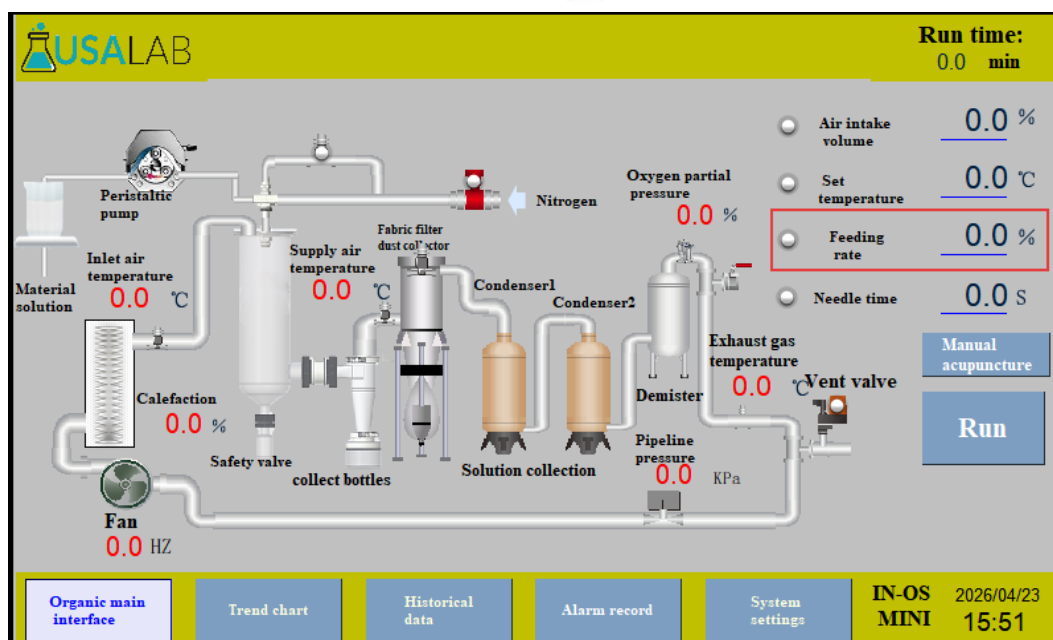
(4) After the inert gas (nitrogen) fills the pipeline, the oxygen content is lower than the set value (3%), and the title bar prompts that the oxygen content is normal. Click the set temperature option, input the actual temperature value required for drying, and start the heater, as shown in the figure below:



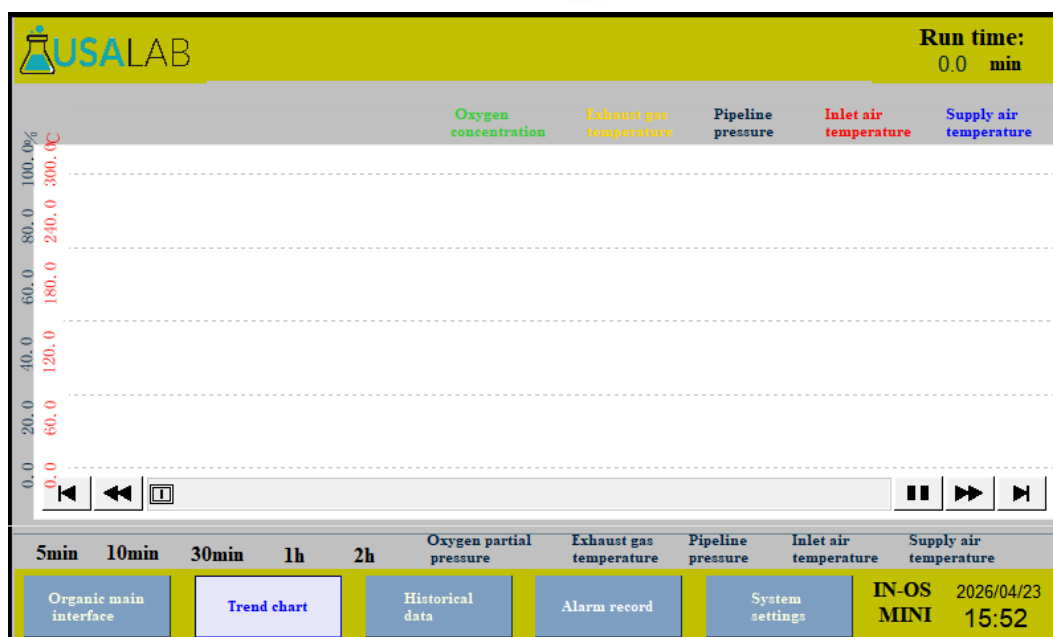
(5) When the temperature reaches the set value, observe the menu bar on the main interface. As shown in the figure below, the feeding can be started only after all the states are normal



Activate the peristaltic pump and needle switches by clicking "Peristaltic Pump Switch" and "Needle Switch". In the settings panel before "RPM", use the numeric keypad to input "0-100" to set the peristaltic pump motor's operating speed between 0-100 RPM. The pump's speed determines the temperature difference between the inlet and outlet temperatures, with actual application parameters influencing this value. The pump's rotational speed directly affects air temperature output: higher speeds result in cooler air, while lower speeds produce warmer airflow.

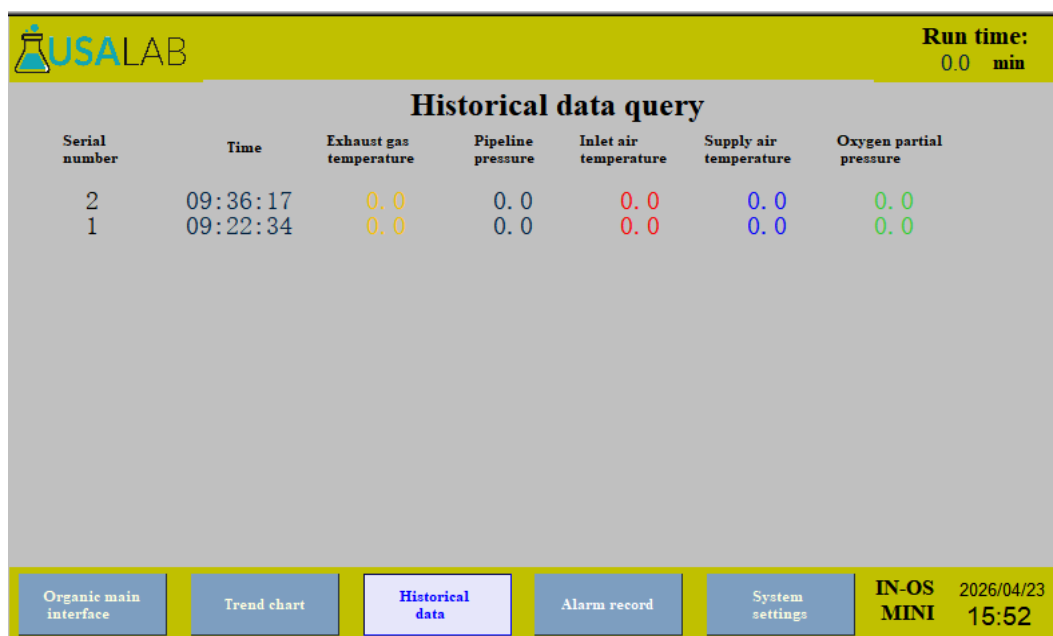


1.4. 7.3 Trend chart



During the work, you can comprehensively observe the data trends of oxygen concentration, exhaust temperature, pipeline pressure, air inlet temperature and air outlet temperature, analyze the rules of products under different parameters, and display them at different times. Click the corresponding menu.

1.5. 7.4 Historical data



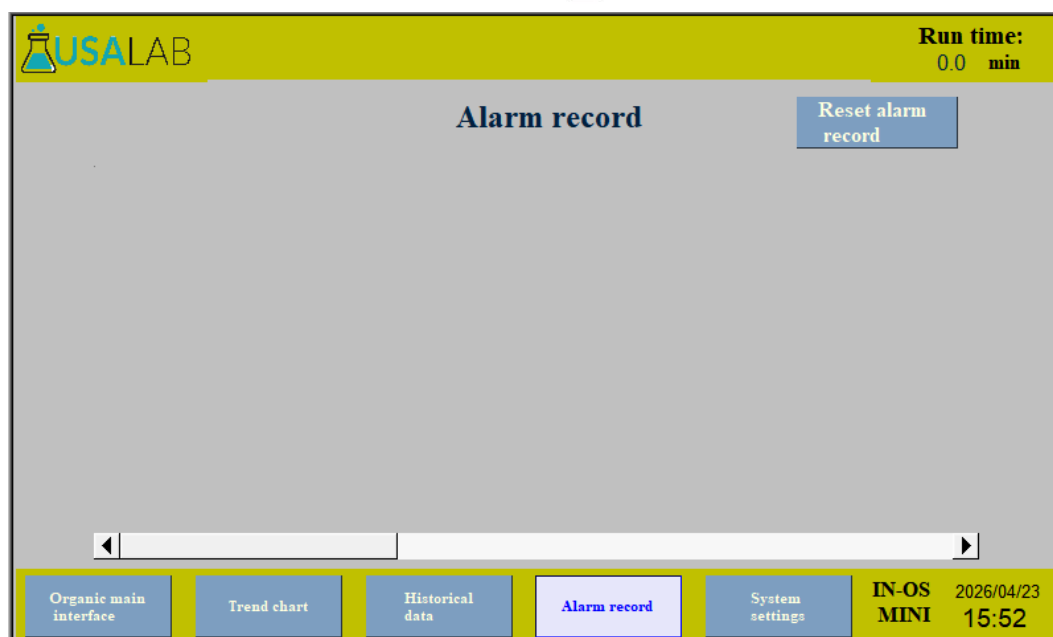
The historical data query interface shows a table with the following data:

Serial number	Time	Exhaust gas temperature	Pipeline pressure	Inlet air temperature	Supply air temperature	Oxygen partial pressure
2	09:36:17	0.0	0.0	0.0	0.0	0.0
1	09:22:34	0.0	0.0	0.0	0.0	0.0

The bottom menu includes buttons for Organic main interface, Trend chart, Historical data, Alarm record, System settings, and system status (IN-OS MINI, 2026/04/23 15:52).

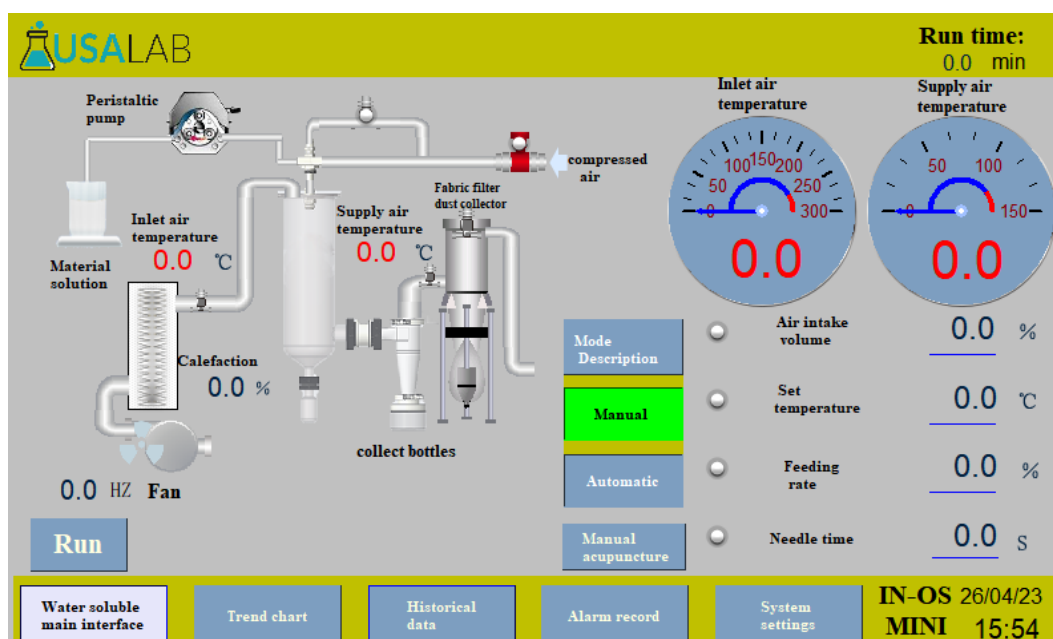
During or after work, the historical data of oxygen concentration, exhaust gas temperature, pipeline pressure, air inlet temperature and air outlet temperature can be comprehensively observed, which can be used for later analysis.

1.6. 7.5 Alarm Records



During the operation, various prompts and alarm information appear. When the alarm prompt bar under the operation host surface has information, you need to switch to the alarm record interface and click confirm. The alarm bar will disappear only after the content of the alarm bar is abnormal.

1.7. 7.6 Water Solvent Main Working Interface



operating steps :

Please set the "air intake" and "air intake temperature", then click the "start" system start/stop function key; the system starts to run, the blower sends air, the heater makes the hot air gradually warm up; at the same time, the touch screen interface also dynamically displays the working condition of the system in real time.

In the process of system heating, we can open the air compressor to prevent the nozzle from being blocked by material due to failure to timely supply compressed air during the later spraying process.

Plug in the air compressor power plug and start the air compressor to deliver pure compressed air to the dual fluid nozzle through the glass rotor flow meter

The glass rotor flowmeter is used to indicate the spray gas flow; the rotary flowmeter knob adjusts the air supply to 600-1000L/H.

When the air inlet temperature reaches the preset spray setting temperature, the peristaltic pump can be activated based on the preset feed rate. During the initial spray drying phase, pure water should be used for trial spraying. The spray volume of pure water can be adjusted according to the preset feed rate value. The feed rate is a critical factor affecting the outlet temperature, as the aqueous solution absorbs heat from the drying chamber through evaporation.

Therefore, the outlet temperature can be adjusted to the desired value by means of the pump speed of the peristaltic pump and the amount of sprayed solution. The outlet temperature can be considered as the thermal load limit of the product, so it is important to ensure that the product is not damaged by excessive outlet temperature.

When the desired operating conditions have been achieved and stabilized, switch the feed pipe from the pure solution to the prepared feed solution.

1.8. 7.7 System Settings

(1) When opening the system configuration interface, sequentially click the settings panel. The pipeline pressure protection is factory-set and should not be adjusted except during maintenance. The exhaust gas temperature monitoring upper limit is preset according to material characteristics and should remain unchanged except during maintenance. The system provides bilingual switching between Chinese and English. Clicking the peristaltic pump enables manual forward/reverse rotation. Data export functions support USB drive transfer. The shutdown temperature is set as the protection threshold, normally 60 °C without modification. System configuration functions should not be operated by non-professionals. The exhaust temperature function serves as auxiliary status indicator and can be customized according to user requirements.

USALAB			Run time: 0.0 min	
Pipeline pressure sensor setting Upper limit exceeded 0.0 KPa Upper limit: 0.0 KPa Lower limit value 0.0 KPa		Exhaust gas temperature sensor setting Upper limit value 0.0 °C Lower limit value 0.0 °C		Pipeline oxygen concentration setting Upper limit: 0.0 %
Mute Export data System settings Peristaltic pump Shutdown temperature Supply air temperature				
Organic main interface	Trend chart	Historical data	Alarm record	System settings IN-OS 2026/04/23 MINI 15:52

(2) When the system setup interface is opened, the system provides two language switching options (Chinese/English). Clicking the peristaltic pump enables manual forward/reverse operation. The data export function allows USB drive data transfer. The shutdown temperature is set to the protection temperature (normal setting: 60 °C) without requiring any adjustments. System configuration functions should not be operated by non-professionals.

USALAB			Run time: 0.0 min	
Mute Export data System settings Peristaltic pump Shutdown temperature Supply air temperature				
Water soluble main interface	Trend chart	Historical data	Alarm record	System settings IN-OS 26/04/23 MINI 15:55

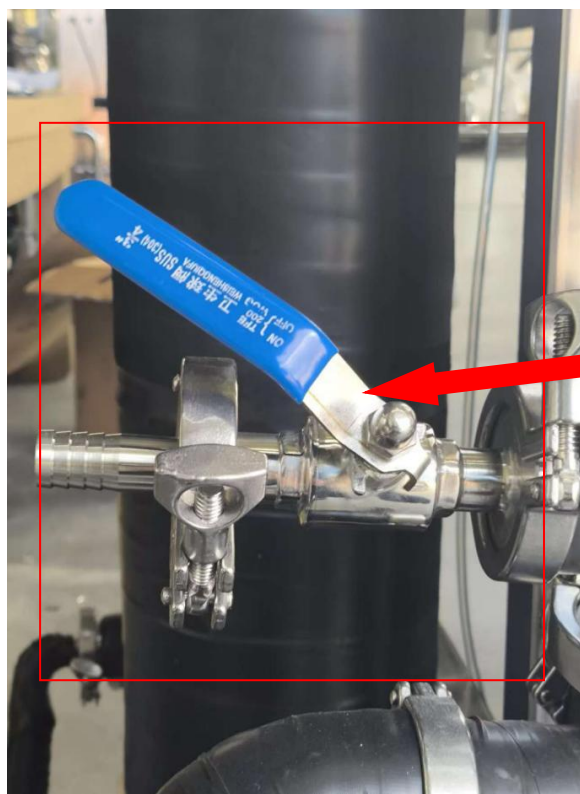
1.9. 7.8 Description of equipment valve components (important parts)



The electromagnetic exhaust valve will automatically work when the pipeline pressure exceeds the upper limit to maintain the system at a proper pressure



Mechanical pressure relief valve, pipeline system pressure exceeds 5KPA will automatically relieve pressure, ensure equipment and personal safety



Exhaust valve: the control system pressure is 2-3pa, generally open the valve to 2/5, a small amount of gas is discharged from the valve port, after setting, it is recommended that there is no need for adjustment later. Check this part carefully before each startup to ensure stable pipeline pressure.

8、 experimental procedure

Input process parameters, the following Settings are for reference only:

Reference parameter settings: input process parameters	
Inflow heating temperature: 50-250°C	Tapping pressure setting: $\text{Mpa} 0.4 \leq \geq 0.2 \text{Mpa}$ (non-essential)
Induction frequency setting: 30-50 HZ (60-100)	Fogging pressure setting: $\text{Mpa} 0.4 \leq \geq 0.1 \text{Mpa}$
Peristaltic pump speed setting: 0-100 RPM	Upper and lower limit of air intake temperature: $250 \leq \geq 50$
Upper and lower limit of outlet temperature: $50 \leq \geq 100$	Upper and lower limit of exhaust gas temperature: $90 \leq -15$
Upper limit of pressure in the tower: ≤ 6000	Maximum oxygen concentration: $\leq 3\%$

8.1 Material preparation:

- (1) Prepare appropriate amount of material, solvent, electronic scale, 500ml beaker
- (2) The solution is prepared in such a way that the material and solvent are completely dispersed or dissolved to avoid clogging the spray gun.

8.2 Experiment began

- (1) Connect the power supply and open the switch button.
- (2) Observe the touch screen and click the "Enter the system" option to enter the operation interface;
- (3) Remove the spray gun, connect the air inlet pipe and feed pipe of the spray gun, and manually adjust the atomization pressure to 0.2Mpa.
- (4) Open the peristaltic pump (set at 15RPM), point the nozzle of the atomizing spray gun towards the space away from the operator and the equipment, and then insert the inlet of the feed pipe into the solvent cup;
- (5) Observe the atomizing nozzle. After the conical material mist appears, close the peristaltic pump and insert the nozzle into the top atomizer installation port.
- (6) Step-by-step operation: 1. Turn on the freezer (-20~-25°C) → Set fan speed to 45Hz → Activate nitrogen supply (15L/min) → Start heater (set to 120°C) → Wait 10-15 minutes until air intake and exhaust temperatures stabilize, with oxygen concentration reduced below 2% → Activate feed pump (cool pure solvent in atomizer for 3-5 minutes before feeding) → Insert needle.
- (7) Expected experimental results: After 5-10 minutes of actual material spraying, a large amount of powder is deposited in the product collection bottle.

8.3 Experiment ended

- (1) After a fixed dose of material is consumed or a specified time of the experiment is reached, we need to collect and statistically analyze the data.
- (2) Close the peristaltic pump in turn (after feeding, 3-5min of pure solvent is added to cold clean the atomizer and pipeline) → Close the heater (when the temperature drops below 60°C) → Close the fan → Close the nitrogen gas source and open the needle → Close the chiller
- (3) We need to open the receiving tank to collect the material. After the experiment, we need to clean the equipment with clean tools in time.

8. 4 How to better use small closed cycle spray dryer

This chapter provides a practical analysis of the operational factors affecting small spray dryers. It is important to recognize that different instrument settings cannot be considered in isolation. All adjustable parameters within the system are interdependent – adjusting one setting will inevitably require changes to another.

1.9.1. The interaction between the parameters

The greater the temperature difference between import and export, the higher the residual moisture content.

The higher the fan speed, the shorter the residence time of hot air in the instrument, resulting in a higher residual moisture content.

The lower the fan speed, the longer the hot air stays in the instrument, the drier the product.

The higher the fan speed, the higher the degree of separation of the rotary separator.

The higher the spray flow rate, the smaller the particles.

The higher the spray concentration, the larger the particles.

Low spray concentration and high spray flow rate can produce very small particles; there is a risk of product loss (low separation degree of cyclone separator).

Assuming that the temperature remains constant, the higher the pump speed, the lower the outlet temperature.

1.9.2. Inlet temperature and outlet temperature

The inlet air temperature refers to the temperature of hot dry air. The dry air is delivered above the heater via fan motor. Its temperature is measured before entering the drying chamber. When spray-drying solutions, emulsions, or dispersions, the solvent is removed through evaporation. The airflow temperature exceeds water's boiling point, enabling rapid droplet evaporation within a short residence time. The final product's temperature remains unaffected by the drying process. Steam envelops the spray droplets, protecting the product from thermal effects.

Before entering the cyclone separator, the temperature of air containing solid particles is designated as the outlet temperature. This temperature does not necessarily correspond to the product's actual temperature. Water evaporation removes heat from the product, keeping it cool. Even with a residence time as short as approximately one second, the solid particles remain below ambient temperature. However, the empirical rule states that the outlet temperature equals the product's maximum temperature. Unlike the intake temperature, the outlet temperature cannot be set through a thermostat.

The air outlet temperature is the result of the following parameters:

Inflow temperature

Fan flow rate (air intake)

Peristaltic pump setup

Concentration of spray material

The optimal selection of temperature differences between imports and exports is the most critical consideration in spray drying processes. While other product-specific factors like melting points or decomposition temperatures must be accounted for, there remains some flexibility in adjustment. The equipment's production capacity and residual moisture content may be affected within this temperature range.

The following table illustrates the interaction between inlet and outlet temperatures in relation to pump gas consumption. These data are provided for guidance purposes only. While they help understand the interplay among the aforementioned factors, the complexity of influencing elements makes absolute values impossible. The following principles can be derived from the data:



For final products with very low residual moisture content, the import temperature must be as high as possible and the temperature difference must be as small as possible.

Increasing the temperature difference while keeping the inlet temperature constant will increase the residual moisture content in the final product and the injection speed of the instrument.

1.9.3. fan

The instrument draws dry gas through a fan. By adjusting the fan speed, the volume of heated dry gas can be increased or decreased. As the gas flow changes, the energy required for evaporation also varies accordingly. Therefore, the fan speed setting significantly impacts the instrument's drying efficiency. The evaporation performance is influenced by multiple factors, including the concentration of the spray solution and the moisture content in the dry gas.



The following principles can be used to determine the best setting through experiments:

The fan speed is high, and the separation degree of the cyclone separator is high;

The fan speed is low, the material stays in the drying range for a long time, and the residual moisture content is low.

1.9.4. Peristaltic pump speed

The peristaltic pump delivers the spray solution to the nozzle.

The speed of the pump determines the temperature difference between the inlet and outlet temperatures. This is completely true, because the temperature of the dry gas and the amount used, i.e. the energy used to evaporate the solvent, is determined by the selected temperature and the speed of the high-pressure fan.

If the amount of liquid sprayed is more or less, the heat consumed by the evaporation process is more or less. In this way, the outlet temperature can be adjusted to a lower or higher value.

The pump rate also depends on a variety of factors, such as the viscosity of the spray solution and the pipe diameter.



The following principles can be derived from the above facts and relate to the rate of the pump:

Increasing the pump rate increases the temperature difference between the inlet and outlet temperatures.

Reducing the pump rate while keeping the inlet temperature constant and the flow rate of the pump constant can improve the dry matter content of the final product.

Flow rate of spray compressed gas

Spray flow rate is the amount of compressed gas required to spray a solution, emulsion or dispersion.

The spray flow rate can be set on the instrument to 100-1000 l/h, but the actual working range is approximately 600-1000 l/h.

The particle size of the final product is affected by the spray flow rate setting.



The principles are:

The higher the spray flow rate, the smaller the particle size of the final product.

Spray material concentration

Spray concentration affects particle size.



The higher the concentration of the spray solution, the larger the particle size and the more pores the drying particles have.

The lower the concentration of the spray solution, the smaller the particle size and the fewer the pores of the dried particles.

Note:

1. Check whether all pipelines are installed and connected. Turn on the chiller (the chiller is connected to the two condensers) and set the temperature to 5-10 degrees (the medium is water). If it is organic solvent recovery, set the temperature to about -20 degrees (the medium is organic solvent) and open the external circulation.
2. Turn on the oxygen meter switch and check whether the oxygen measurement connection is complete
3. Turn on the green switch of the dryer, open the fan, set the air intake air volume and air intake temperature, and connect the pressure reducing valve on the gas outlet machine of the nitrogen cylinder,
4. Observe the percentage of the oxygen meter. Generally, the oxygen concentration is below 3%
5. When the oxygen concentration drops below 3% and the temperature reaches the set value, open the peristaltic switch to feed
6. Keep the exhaust port at the end half open
7. Attention should be paid to the change of nitrogen cylinder. When the nitrogen is consumed, stop the machine and replace the nitrogen cylinder in time

For reference only: it is estimated that one bottle of 40L nitrogen with 13MPa pressure will be consumed after continuous operation for 5 hours

8.5 matters need attention

(1) When unpacking, please prepare the following tools: a pair of crowbars and a pair of screwdrivers. First, use a screwdriver to open the seam and remove the cover part of the wooden box, then use crowbars to pry open the box along the seam;

(2) Please place the equipment in a dry and ventilated environment, and do not use open flame during operation;

(3) Before starting up, please check and confirm whether the power supply meets the 220V voltage stabilization conditions;

(4) Check whether the air switch in the circuit of the distribution box is open (the default button is up to open);

(5) Confirm whether the fuse is placed in the fuse adjacent to the air switch;

(6) During the use of the equipment, the operation should be carried out under the working condition that the drying temperature is limited below 250°C;

(7) Do not touch the full-color touch screen, start knob and glass drying components with sharp or wet objects. Do not remove the body without notifying the manufacturer.

(8) This equipment is an internal quality control product. If you need to make improvements or upgrades to the equipment, please call the after-sales phone for consultation in time;

(9) After the equipment is opened, pay attention to fix the guide wheel at the bottom of the body to avoid vibration or movement of the body affecting the experiment;

(10) During experiments, wear protective equipment such as safety gloves and masks. In high-temperature environments, avoid direct contact between skin and spray guns or glass drying systems to prevent burns. When collecting materials, follow material-specific handling protocols. For products or raw materials that may affect human health, collect or process them in dry, well-ventilated environments.

(11) Do not use strong acid or strong alkali materials, you can consult the manufacturer in advance, so as not to cause unnecessary losses;

(12) When testing the atomization state of the atomizing gun, the nozzle should be directed away from the equipment and personnel;

(13) Do not bend the air pipe when debugging the atomizing spray gun to avoid damage to accessories;

(14) The adjustment of the atomizing spray gun should be adjusted according to the established scope. For details, please consult the official after-sales personnel of Shanghai Qiaofeng Industrial. It is prohibited to pull out or connect the air pipe when the air compressor is on;

(15) When the nozzle is blocked (or the peristaltic tube is blocked), the peristaltic pump and air source should be closed in time, and then the pump pipe should be taken out of the peristaltic pump;

(16) After the end of the experiment, the atomizing spray gun should first remove the nozzle, and then clean. Then install the product collection bottle, waste collection bottle, cyclone separator, drying chamber and other accessories in the order of from bottom to top and from left to right;

(17) Cleaning process: general experiments can be cleaned with dish soap. Peristaltic tubes can be cleaned with alcohol or water. Regular cleaning can effectively avoid the phenomenon of material cross-contamination.

9、Common problems and solutions

fault phenomenon	Possible causes	resolvent
1. The fan is not working	Inverter damaged	Contact the company or replace it yourself
	Fan damage	Contact the company or replace it yourself
	Fan not started	Start fan
2. Electric heater does not work	Solid state relay damaged	Replace solid state relay
	The electric heater is broken	Contact the company
3. No gas supply	Electromagnetic valve damage	Change the solenoid valve
	The gas source is not connected	The gas source upstream device is

	to the equipment	not working
4. No display of air inlet and outlet temperature	PT-100 temperature probe is loose	fastening
	PT-100 damaged	Contact the company or replace it yourself
	PT temperature module damaged	Contact the company or replace it yourself
5. The air inlet temperature cannot reach the set value	The fan air volume is too large	Modify fan parameters
6. The air outlet temperature can not reach the set value	Peristaltic pump feed too fast	Modify peristaltic pump parameters
7. Dripping material at the bottom of the drying chamber	The air intake temperature is too low	Increase the air intake temperature
	The air pressure of the atomized air is too low	Turn the pressure regulating valve in the lower right corner of the fuselage clockwise to 2-3 ar (φ 6 transparent color air pipe)
	Compressed air leakage	Check all connections for leaks
	Too much feed	Modify peristaltic pump parameters
8. The needle does not work	Too little pressure	Adjust the pressure of the relief valve
	The needle parameters are set too large	Modify the piercing parameters
	Electromagnetic valve damage	Change the solenoid valve
9. The oxygen content meter does not work	The oxygen meter is not connected to the system	Connect the air plug
	Oxygen meter damaged	Change oxygen monitor
	The AD module is damaged	Change the AD module
10. Pressure transmitter is not working	The pressure transmitter is	Connect the air plug

	not connected to the system	
	Pressure transmitter damaged	Change the pressure transmitter
	AD module is damaged	Change the AD module

10、 addendum

technical parameter

Experimental closed nitrogen circulation spray dryer	IN-OS MINI
Water evaporation	2000mL/h
Minimum feed	50mL
Drying chamber diameter (mm)	Φ204
Wetting structure	Fogging system (QFN-NZII VER2022-1A)
Electrical control systems	Innova Mini atomization system (IN-OS MINI-1)
Maximum intake air temperature	30-250°C (adjustable)
Heat exposure	blowing-in
heater power	220V; 3KW
Air supply [power (KW), air volume (m ³ /min)]	[0.25,9.5]
power [KW]	8≤
External dimensions (mm) (L×W×H)	1000×1000×1200
Brief description	1. The atomization chamber, cyclone separator, product collection bottle and waste collection bottle are made of 304 stainless steel; 2, the shell is made of 304 stainless steel; 3. The atomization process can be clearly viewed.
Installed weight (reference)	150KG
Power supply	AC220V

Note: Some parts have been assembled. The pictures are for reference only, and the product is subject to the actual object. Our company has the final right to interpret the above information.

Service guide

Dear users:

Thank you very much for choosing Anhui Innuo products series!

Anhui Yingnuo is a rapidly growing high-tech enterprise dedicated to the integrated R&D, production, and sales of spray drying systems and fermentation tank equipment in the fields of biotechnology and chemical engineering. The company provides customers with professional advanced production equipment and comprehensive after-sales services. Since its inception, Anhui Yingnuo has maintained alignment with domestic industry standards, integrating top-tier human resources while adopting a people-first approach and customer-centric philosophy. Committed to delivering more user-friendly and highly reliable products, the company strives to meet evolving market demands through continuous innovation and service excellence.

In order to ensure that the products you buy can be used normally, please be sure to read and implement the requirements in the User Manual carefully, and maintain, use, maintain and adjust correctly, so as to avoid machine damage and other losses caused by improper operation and maintenance. Correct use and maintenance of the machine can achieve the best results.

This manual contains service guidelines, warranty details, and contact information for the IN-OS Mini spray dryer to assist with troubleshooting and maintenance. If you need to update your contact address or contact person, please contact us promptly to update our records. Our service hotline is 0556-5201186 to ensure we can provide ongoing and reliable after-sales support.

After-sales service is an important part of the product, Anhui Innol will adhere to the concept of creating greater value for customers, continue to make progress, constantly improve according to your opinions, to provide you with more and better products and services.

1. User Notes

1.1 In order for you to better use the products of Anhui Innuo Company and give full play to the superior performance of the products, please read the User Manual carefully.

- After you buy the products of Anhui Innuo Company, please fill in the "User Purchase Information Form" in time after purchasing the machine, leaving your accurate name, address and telephone number, so that we can provide you with long-term high-quality and timely service.
- This certificate must be stamped with the official seal of Anhui Innuo Company and the user's seal or signature before it can take effect.
- When you need the three guarantees service, please present the three guarantees service certificate at the same time: user purchase information sheet, purchase invoice and product identification.
- This certificate is one machine and one book, and shall not be lent or altered, otherwise it may affect your normal three guarantees service!

2. Three service provisions

1.10. 2.1 Basis for the preparation of these provisions

Product Quality Law of the People's Republic of China.

Anhui Inno Company service policy.

2. 1 The principle of three package services

If the equipment has problems, the maintenance is the main thing. If the maintenance plan is not feasible, the goods will be replaced.

Special provisions shall be implemented in accordance with the agreement between the two parties, but shall not be lower than the standards set by the state.

2. 2 Three types of service provisions

Provisions on the three-term guarantee.

The warranty period of the machine is one year.

Normal wear parts and vulnerable parts are not covered by the three guarantees.

Special agreements shall be implemented in accordance with the agreement between the parties.

2. 3 Calculation of three guarantee periods

The three-year warranty period starts from the date when the user buys the machine.

If the time of purchase cannot be proved by valid certificate, it shall be calculated from the factory date of the machine.

Special agreements shall be implemented in accordance with the agreement between the parties.

2. 4 Product quality three guarantees scope

For the products produced by the factory, if the user strictly operates, maintains and maintains the products according to the requirements in the user manual during the valid three guarantees period, and the damage of parts and components is confirmed to be caused by the quality of the products after technical appraisal, the three guarantees shall be handled according to the regulations.

If the buyer and the seller have special agreement, the agreement shall be executed.

2. 5 According to the relevant state regulations, the following cases shall not be subject to the three guarantees and may be subject to appropriate fee repair

Early wear and failure caused by improper use, maintenance or care of the user or beyond the scope of use specified in the user manual.

The fault caused by the user's own disassembly, adjustment and modification of parts that are not allowed by the User's Manual.

No three guarantees certificate, and can not prove that their products are within the validity period of three guarantees.

The product specification and model on the three guarantees certificate are inconsistent with the product specification and model required by the three guarantees, or the relevant certificate is altered.

After the occurrence of a fault, the damage is not maintained in its original state, or the fault is disposed of without the consent of the seller or the repairer, so that the technical appraisal of the cause of the fault cannot be made.

Secondary faults caused by failure to be handled in time and continued use.

The fault is caused by the use of non-original parts.

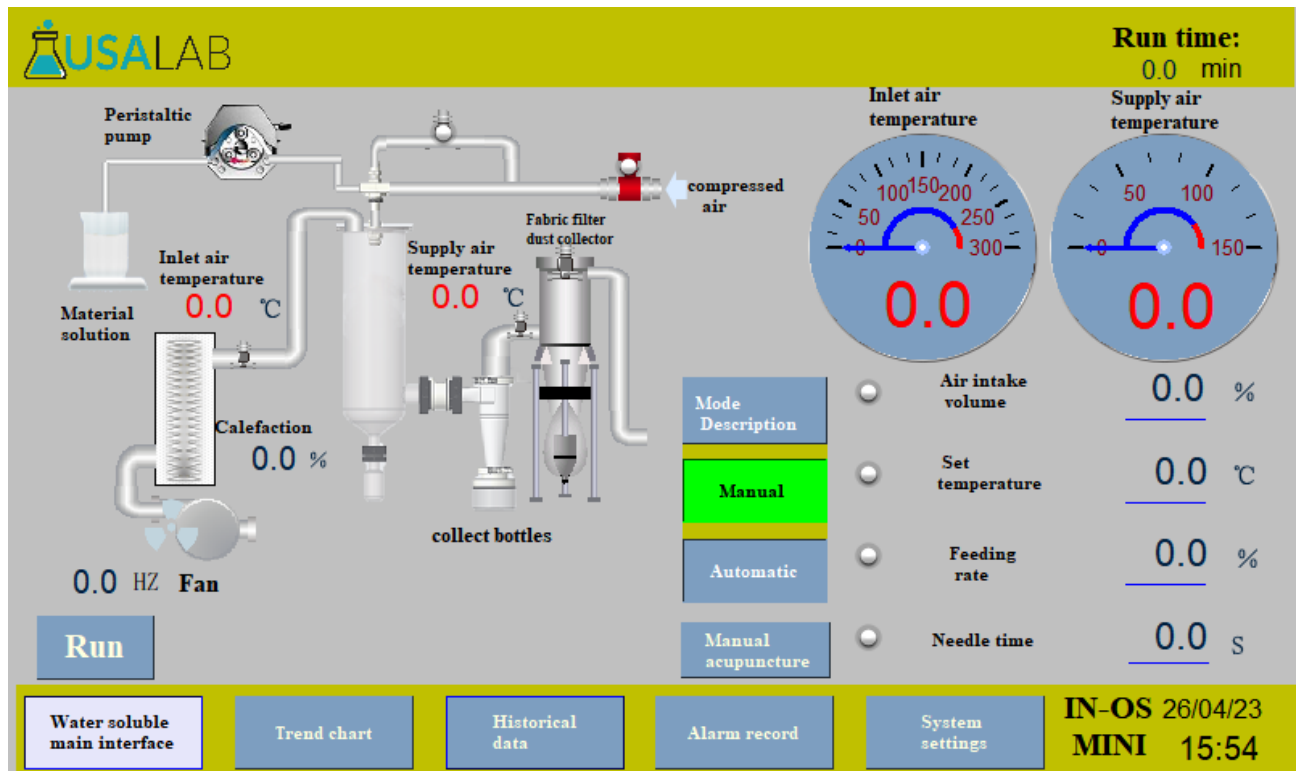
Damage caused by force majeure.

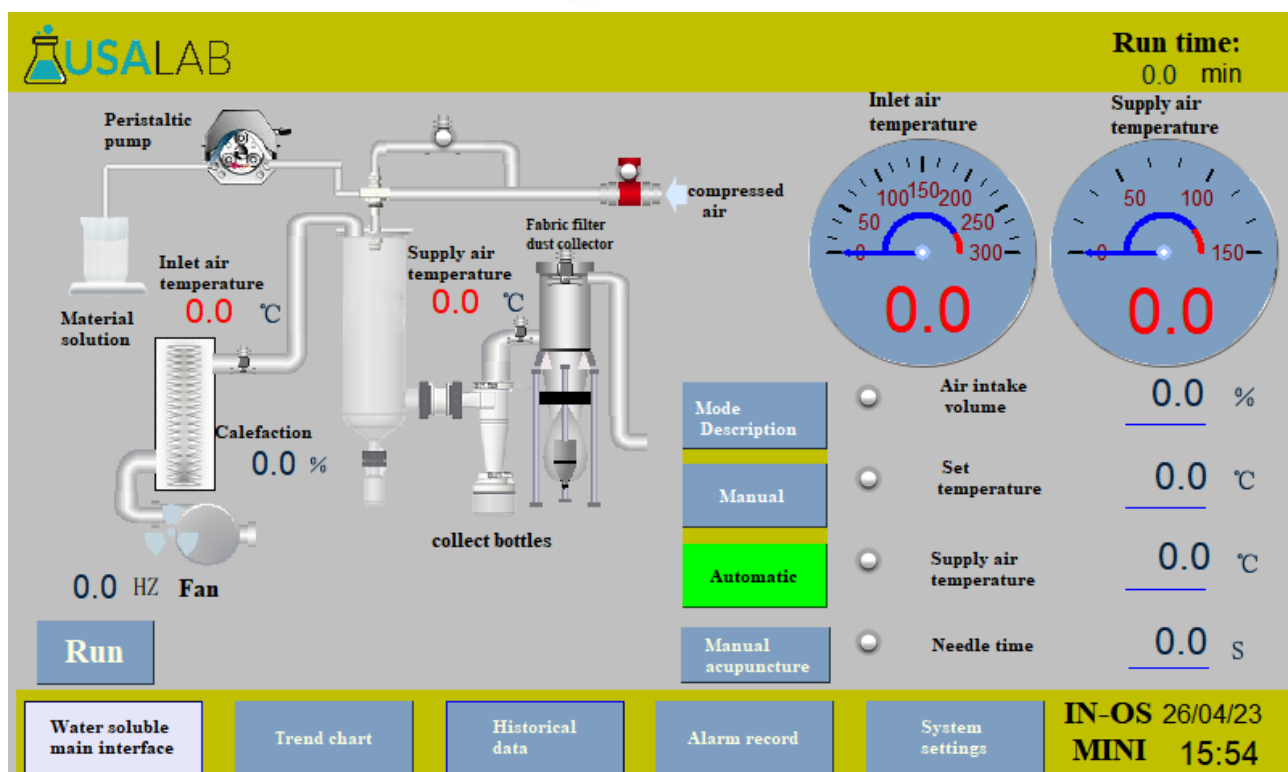
System update notes:

According to the user feedback information, add nitrogen intake valve and pressure detection prompt.

Nitrogen intake valve control Nitrogen must be opened after the fan starts to enter nitrogen to avoid users forgetting to close the gas source after operation, resulting in long-term waste and high pipeline pressure.

Nitrogen gas source pressure detection. When the gas source is lower than 10KPA, the operation screen will prompt the gas source pressure is insufficient and remind the user to replace the gas source, so as to avoid the interruption of the experiment when the gas source is used up without being found during the operation.





According to the user requirements, this product has updated the software and interface in the water solution mode for the peristaltic pump feeding method. The manual and automatic feeding functions of the peristaltic pump have been added. The interface update is as shown in the above figure.

The updated content is described as follows:

- In the manual mode, when the peristaltic pump feeding is for testing, the input feeding speed of the peristaltic pump is displayed. After observing the temperature of the outlet, the speed can be gradually adjusted manually.
- In the automatic mode, when the peristaltic pump feeding is for testing, the input temperature of the outlet (default 80) is displayed. The feeding speed of the peristaltic pump is automatically adjusted by the system program to match the outlet temperature.
- The default state upon startup is manual, which is the same as before the update.