User manual

★ Only for aqueous materials

A message of respect:

- All personnel involved in operation and maintenance should read this manual carefully before using the machine;
- This manual can help users to operate and maintain the machine conveniently and safely;
- Failure to operate according to this manual may cause damage to the equipment or even safety accidents.

Catalogue

Note: The attached ※ is optional

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Chapter 1 User notification

1 User notes

This manual describes the pilot-scale 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.

1.1 introduction

This manual contains essential documentation covering instrumentation systems, process design specifications, operational protocols, maintenance requirements, emergency response procedures, and other occupational safety and health-related information. As the facility undergoes modifications or upgrades during its operational life, it is imperative to maintain up-to-date instrument specifications to ensure this manual remains a reliable reference resource.

1.2 customer service

Our customer service is all the technical data and system engineering application software of the instruments and equipment in your custody. If you have any difficulties, please contact the local representative office or Innolux.

If you have any questions or want to order replacement parts, please contact us in time. This will ensure that you receive the correct information or replacement parts needed.

1.3 Copyright notice

Note: The attached ※ is optional

Technology Co., Ltd., no reproduction (in whole or in part) of such drawings and documents shall be permitted, nor shall they be used to manufacture new components.

1.4 Liability guarantee

The information, data and instructions in this instruction manual regarding the installation, operation and maintenance of the instrument are based on the best current knowledge based on our experience and expertise at the time of printing.

This instruction manual contains all important information, and the user must be fully familiar with it before operation.

We shall not be liable for damages or losses resulting from failure to strictly follow the instructions in this manual, including interruptions to production operations. Within the scope of our liability coverage, upon discovering defects, we require immediate reporting through a detailed written statement with contract number attached. The company must provide all relevant operational and maintenance data, along with opportunities for comprehensive factory inspections.

This warranty shall not apply to defects, damage or loss caused by improper handling, inadequate maintenance, failure to use as required, unauthorized modification or abuse, corrosion and wear, operations outside of production or process specifications (including the use of materials or utilities not specified in the component contract), or improper installation or maintenance.

The installation and use of third-party equipment may negatively impact the production characteristics of products processed by the factory, potentially endanger personnel safety and cause material damage. Prior written approval from our company is mandatory before installing third-party equipment or security systems. We shall not be liable for any damages or losses resulting from unauthorized use of third-party equipment or arbitrary modifications to factory facilities and equipment.

The Company does not make any express or implied warranty regarding the subject matter and does not expressly disclaim any warranties of merchantability or fitness for a particular purpose. The Company's warranty obligations are limited by the terms and limitations of the component contract and are not intended to impose any rights on the Company's users.

Any software described in this instruction manual is sold "as is". Anhui Innol Engineering Technology Co., Ltd. reserves the right to modify this instruction manual and change the content.

Note: The attached ※ is optional

2 security information

This chapter outlines the safety protocols for the instrument, 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 section. Therefore, this manual must be made available to all personnel involved in the work described herein.

2. 1 User eligibility

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

Those who have not undergone or are currently undergoing such training require careful guidance, and this manual serves as a basis for providing that guidance.

2. 2 Use correctly

This instrument belongs to the laboratory pilot instrument. It is only used for drying aqueous solution or safe suspension, solution in one operation process.

2. 3 Incorrect use

It cannot be used to treat materials that are inflammable, explosive or prone to producing large quantities of gas. In particular, it cannot release gases whose chemical composition is unknown.

The following applications are also explicitly prohibited:

Do not spray dry organic solvents at will.

- Use this instrument in the room where explosion-proof instruments are required.
- Handling samples that may explode or burn due to shock, friction, heat or spark.
- Process substances that produce oxygen.

The operator is solely liable for the risk of accidents arising from such improper use.

If you have any questions, please call our company for details.

2. 4 Warning signs

Electrical hazard

Hot surface

Note: The attached ※ is optional

2.5 Instrument safety

This instrument is designed and manufactured according to the latest technology. However, careless or improper use of the instrument may cause danger to the user, property and environment.

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

If the instrument is operated by untrained personnel.

If the instrument is not operated in accordance with its intended use.

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

2.6 electrical safety

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

Routine inspection should be carried out on the problems displayed on the electrical device. Usually, if the surface is hot or there is a burnt smell, it should be checked and corrected immediately.

Mistakes in the operation of electrical equipment create unsafe conditions and the personnel authorized to operate such equipment shall be certified and familiar with the equipment and all hazards contained therein.

2.6.1 dangerous voltage

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

2.6.2 regulate

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

2.6.3 hitch

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 it will cause equipment damage and personal danger.

Note: The attached ※ is optional

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

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

2.6.4 maintenance

There is a risk of electric shock when working near electrical installations. 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 condition. If small problems are not solved, they will lead to bigger problems. A thorough mechanical inspection should be done at least once a year.

Check connections of terminals, fuses, wires and ground wires for overheating or looseness. Connections must be clean and loose terminals must be tightened or replaced.

Check the movable parts to ensure that they move freely, without adhesion and damage. Any parts showing problems need to be repaired and replaced.

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

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

2.7 high-tension apparatus

The following safety precautions should be observed when using a medical oil-free air compressor. The safety matters must be strictly observed to prevent fire, electric shock, personal injury and other accidents.

① Keep the workplace clean: Messiness can lead to accidents.

② Pay attention to the workplace environment: air compressor should not be exposed to wind and rain, do not work in damp and dark places, do not work in places where flammable and explosive liquids and gases and dust are stored.

③ Beware of electric shock: when using the air compressor, do not let the machine itself touch the grounded objects (such as pipes, heating pipes, refrigerators, etc.).

Note: The attached ※ is optional

④ Outsiders/children do not approach: Do not allow children to approach the air compressor with people unrelated to the work, so as to avoid electric shock and other injuries.

⑤ Proper storage of machinery: unused air compressors should be emptied of air and sewage in the gas storage tank, and stored in a dry environment.

⑥ Do not force the use of this machine: according to the rated voltage, frequency or do not overload operation, the effect will be better and safer. (Continuous operation time should not exceed one hour, otherwise it will affect the service life).

⑦ Protect the cable: Do not pull the cable from the power supply plug, the cable should be far away from heat source and oil, and avoid contact with sharp objects.

⑧ Proper maintenance of the machine: The filter should be cleaned in time according to the use, and accessories and cables should be checked regularly. If damaged, replace them immediately. The machine should be kept clean and dry without oil stains, so as to give full play to its performance.

⑨ Cut off the power supply in time: when you are not using it after work, develop the habit of cutting off the power supply in time. When moving the air compressor, the power switch must be cut off.

⑩ Overpressure protection: Overpressure use is strictly prohibited. The maximum pressure of air compressor is set to 8 Bar when it leaves the factory, and the safety pressure relief is 8.8 Bar. Otherwise, the gas storage tank will be in danger of explosion.

⑪ Warning: Using non-pure original accessories, it is easy to cause damage to the air compressor, or even personal injury.

⑫ Power supply voltage: attention should be paid to the power supply voltage and the voltage on the air compressor nameplate. If the power supply voltage is higher than the applicable voltage of the air compressor, it may cause personal accidents and damage the air compressor. If the power supply voltage is lower than the applicable voltage of the air compressor, it will cause poor starting, or even damage the motor.

⑬ Compressors can only be used to pressurize air and under no circumstances can they handle other gases, suck in liquids, particles, solids and anything that may cause explosive or flammable substances.

⑭ Do not aspirate flammable and explosive gases or operate in an environment containing these gases.

Note: The attached ※ is optional

2.8 General safety rules

Responsibility of the operator

The laboratory director is responsible for training laboratory personnel.

Operators shall notify the manufacturer without delay of any safety-related accidents that may occur during the operation of the instrument. The laws and regulations applicable to the instrument, such as local, provincial and national laws, must be strictly observed.

Maintenance responsibilities

Operators are responsible for ensuring that the equipment is operated only under correct conditions and that maintenance and repairs are performed responsibly and on time by authorized personnel only.

Spare parts used

Only the original consumables and spare parts of the instrument should be used during maintenance to ensure good system performance and reliability. Only with the prior written permission of the manufacturer can the spare parts used be modified.

change

Any modification of the instrument shall be made only with prior consultation and approval of the manufacturer. Modifications and upgrades shall be performed only by authorized INNO technology engineers. The manufacturer shall not accept any claims arising from unauthorized modifications.

Note: The attached ※ is optional

Chapter 2 Overview of equipment

1. technical data

This chapter introduces the technical specifications of the instrument. The content includes delivery scope, technical data, requirements and performance data.

1.1 Delivery scope

Please check the delivery scope according to the order contract.

For details about the products listed, visit www.ahinuo.com or contact your local distributor.

1.1.1 reference instrument

Table 3-1: Standard instruments

product	model
Pilot spray dryer	IN-SD 5N

1.1.2 standard accessory

Table 3-2: Standard annex

product
user's manual
Glass collection bottles
Silicone tube 3.5 meters
Power cord, 2 meters with quick release head, complete set
Compressed air pipe, 4 meters with quick release head, complete set
Pt100 temperature sensor, quick release

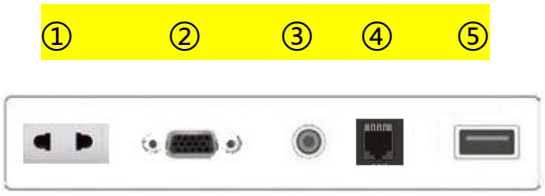
Note: The attached ※ is optional

Peristaltic pump, 1 unit
Quick installation butterfly valve, 1
Electrical control box, 1

1. 1. 3* Optional annex

Table 3-3: Optional annexes
product
Feed switching valve
Industrial Ethernet module
wireless router
Remote PC monitoring system (software)
Silent oil-free air compressor

1. 1. 3. 1※ Connect the optional attachment to the IN-SD 5N



① Routing power supply ② PLC debugging interface

③ Connect to the feed switching valve interface

④ Connect to the remote control panel/upper computer, Ethernet interface

⑤ Touch screen optimization interface

1. 1. 3. 2※ Automatic feed switching valve and wireless remote PC monitoring

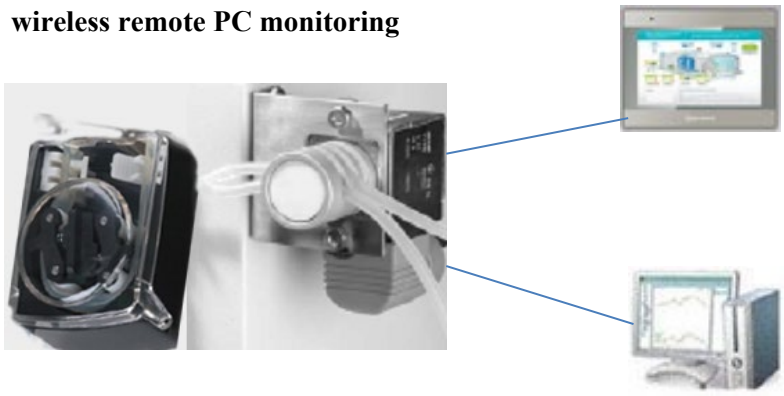


Figure 3-1-3.2: Feed switching valve and remote operation monitoring system

Note: The attached ※ is optional

The pilot-scale spray dryer in the laboratory can be easily operated from a remote control, even in the office. The flow rate of the spray air is the only parameter that cannot be adjusted by the remote control panel.

The feed switching valve serves as a practical tool integrated with the remote control panel. During the start and stop phases of the spray process, it is essential to transfer the feed line from pure solvent to product solution or vice versa. This operation can be automatically executed through the feed switching valve. A three-way pipe is installed between the peristaltic pump and the feed switching valve.

1.2 Overview of technical data

Medium trial spray dryer IN-SD 5N	
power dissipation	AC380V/16KW
supply voltage	AC380V/50HZ
evaporative power	5000ml/h, aqueous solution
Fan power	1.5KW/220V, frequency conversion control
Inlet air temperature	30-250℃ ±3℃
Air outlet temperature	30-100℃ ±3℃
heating efficiency	10KW/380V
heating control	PT-100 temperature measurement, PID control, control accuracy is ±3℃
air compressor	3KW, maximum gas production 10m3/H, working pressure 2-6bar
Spray system	Electric centrifugal atomizer & American original imported atomizing nozzle, 0.7mm diameter dual fluid nozzle
Average drying time	1.0-1.5s
Automatic drainage function	Automatic needle penetration, the action frequency can be adjusted 1-60s
navar	Germany Siemens S7-200Smart PLC with 10-inch imported touch screen INS-Control main control
Product material	Contact material 304&316L stainless steel
Electrical standards	Made to Schneider Electric standards
Instrument dimensions	1850mm×1200mm×2100mm
instruments weight	450KG

Note: The attached ※ is optional

1. 3 Materials used

Table 3-5: Materials used	
component	**Name of material**
Stainless steel collection bottle	304&316L
Nozzle/heater	304 & 316L stainless steel
Product feed pipe	silastic
Exhaust pipe	polyurethane

2. function declaration

This chapter introduces the basic principle and structure of the instrument, and explains the function of each component.

2. 1 What is spray drying

Spray drying is a process method for drying aqueous solutions and emulsions, widely used in industrial chemistry and food processing. Dry milk powder, detergents, and dyes are just a few product categories currently processed through spray drying. This technique can be employed to preserve food or serve as a rapid drying solution. Additionally, it offers advantages such as weight reduction and volume minimization.

Spray drying is a process where a fluid mixture is ejected into hot dry air. The solvent, typically water, evaporates immediately upon contact with the heated air. This rapid evaporation process efficiently removes heat, allowing the product to be gently dried without thermal stress. Within seconds, the material transforms into powder, granules, or lumps.

2.1.1 The superiority of IN-SD 5N

IN-SD 5N pilot spray dryer can quickly and directly obtain the powder particle samples with good shape, which are natural spherical particles. It has the following significant performance characteristics:

① Fast drying speed, after the material is atomized, the surface area is greatly increased, in the hot air flow, 95%-98% of the water can be evaporated instantly, the drying time is only a few seconds, especially suitable for the drying of heat-sensitive materials;

Note: The attached ※ is optional

② Heating pipes and auxiliary mechanical parts are made of high strength stainless steel, high corrosion resistance and durability;

③ High precision imported dual fluid nozzle to ensure accurate atomization performance;

④ The product has good uniformity, fluidity and solubility, high purity and good quality.

⑤ The control system of this equipment takes Siemens PLC and HMI touch screen as the development platform in Germany. Based on the design principle of energy saving and high efficiency, it makes the temperature rise faster and more stable, and the temperature control accuracy is up to 1℃;

⑥ The production process is simplified with user-friendly operation and control. Liquids containing 40-60% moisture content (up to 90% for special materials) can be directly dried into granular powder without subsequent crushing or sieving, reducing production steps and enhancing product purity. Within specified ranges, parameters such as particle size, bulk density, and moisture content can be easily adjusted by modifying operational conditions, ensuring convenient control and management.

⑦ Intelligent remote upper computer operation and monitoring system, which can easily complete the spray drying work in the laboratory at the computer in the office.

2.1.2 Applicability of IN-SD 5N

The IN-SD 5N pilot-scale spray dryer is designed for drying aqueous solutions and suspensions, making it ideal for experiments and industrial production requiring uniform powder products. Applications include pharmaceuticals, dyes, food and beverages, pigments, dairy products, plant-based and vegetable products, heat-sensitive materials, plastics, polymers, resins, fragrances, ceramics, soaps, detergents, blood products, adhesives, oxides, textiles, bones, and dental materials.

This instrument is especially suitable for the laboratory to directly convert liquid materials into trace powder, without the need to filter, concentrate and crush the material before drying, and has a wide spectrum of applicability to all solutions such as emulsions and suspensions.

It cannot be used to treat materials that are inflammable, explosive or prone to producing large quantities of gas. In particular, it cannot release gases whose chemical composition is unknown.

Note: The attached ※ is optional

2. 2 The functional principle of dry air

The IN-SD 5N pilot-scale spray dryer operates on the principle of coexisting air and product flow, where the sprayed product and hot air share the same direction. A peristaltic pump introduces sample solution into a dual-fluid/centrifugal nozzle, which compresses the solution into fine droplets through compressed air that enter the drying chamber. The hot air rapidly dries these droplets into solid particles within the chamber. The dried particles are separated from exhaust gases via a cyclone separator before being collected in a collection bottle, while the exhaust is either discharged directly into the atmosphere or directed to an air filtration system.

Chapter 3 Put into use

This chapter describes how to get the equipment up and running quickly

1. Installation site preparation

1.1 Instrument placement: Place the instrument on a stable horizontal base surface in the room.

1.2 Air supply (air): When the equipment is in a relatively cloudy air condition, please do air filtration and purification first, and then use it for drying; if necessary, please contact Inno Company.

1.3 Power Supply: The instrument operates at 380V AC power frequency with a power of 12KW; the air compressor operates at 220V AC power frequency with a power of 3KW. The site requires one standard 4-pin 32A socket and one standard 3-pin 16A socket. The socket power supply must be provided by an independent air switch, with the power cable current load not less than 16A and a reliable grounding.

1.4 Exhaust emission: During the operation of the instrument, a small amount of fine particles are discharged with the exhaust gas. The exhaust pipe should be placed outside the window or in the ventilation kitchen. The standard high temperature resistant exhaust pipe of the equipment is 3 meters.

1.5 Working noise: In the operation of the instrument and air compressor, there are fans and air pumps running continuously respectively, and some decibel noise is inevitably generated.

Note: The attached ※ is optional

1.6 Cleaning the sink: After spraying, the glass collection bottle needs to be cleaned.

2. Install instrument accessories correctly

After all the standard accessories are correctly installed, as shown in the figure below

5-2: Physical analysis of standard instruments

3. Overview of the operation process

This section introduces a complete and simple spray drying operation process, so that customers can quickly get started and independently complete the spray drying test.

3. 1 Power on the device

After checking the correct connection of the power supply, press the power control button. The indicator light is on and the power supply is completed.

Note: The attached ※ is optional

3. 2 Set parameters and run the system

After power on, the touch screen operation interface is automatically opened; the touch screen is a detailed experimental operation platform provided by this system for you: "air intake", "feed", "air temperature" and other parameters are completely open.

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

3. 3 Start the air compressor and adjust the ventilation

During the heating process of the system, 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 power plug of the air compressor and start the air compressor. Deliver pure compressed air to the dual fluid nozzle through the glass rotor flowmeter
- The glass rotor flowmeter is used to indicate the spray gas flow; the rotary flowmeter knob adjusts the air supply to 1000-3000L/H.

3. 4 Temperature balance, pure solvent test spray

When the air inlet temperature reaches the preset spray temperature, the peristaltic pump can be activated based on the preset feed rate. During the initial 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. Feed rate is a critical factor affecting outlet temperature, as the aqueous solution absorbs heat from the air 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 spray solution. The outlet temperature can be considered as the thermal load limit of the product, so it is necessary to ensure that the product will not be damaged due to excessive outlet temperature.

Note: The attached ※ is optional

3. 5 After debugging, the material is fed in

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

3. 6 After spraying the material, clean the nozzle

After complete spray drying of the solution, continue spraying purified water for a period of time while using the nozzle cleaning system to remove product deposits from the hose and nozzle. Finally, remove the tube from the pure solvent. The pump will continue working to evacuate the hose, then shut down the peristaltic pump, nozzle cleaning system, air compressor, and stop heating the heater. Keep the fan running continuously.

3. 7 When the temperature drops, stop the fan

When the heater stops heating, once the air inlet temperature in the instrument shows down to 100° C, the fan can be turned off.

3. 8 Turn off the power supply and collect the material

Press the power button again, the indicator light is off, and the instrument is powered off. Open the clamp, remove the product container, collect and save the material.

Do not remove the product collection container when the fan is running to avoid the product being blown away.

3. 9 At the end of work, clean the instrument

- If the spray work has been completed, you can clean and wipe the glass collection bottle under the condition that the instrument is powered off for the next use.
- After the spray drying work is finished, disconnect the power supply of the instrument and air compressor. Pay attention to electrical safety.

Note: The attached ※ is optional

Chapter 4 Details of equipment

1. come into service

1. 1 Electrical connections

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

1. 1. 1 Power up the device

Figure 5-4: Power operation panel

There are two blue power button lights and red emergency control button on the power operation panel. The blue button is operable and used to control the power supply of the instrument, while the red button is used for emergency stop in case of emergency.

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 blue.

1. 1. 2 The device is powered off

When there is a need for power failure, press the button again (the instrument has been powered on); at this time, the indicator light will flash, indicating that the power failure is about to occur; when the indicator light 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, the white three-prong plug can be pulled out from the socket for the sake of electrical safety; the quick-release head at the end of the cabinet does not need to be removed.**

1. 2 Air connection

Connect the instrument and air compressor to supply compressed air.

Note: The attached ※ is optional

1.2.1 Use the air line quick release correctly

Connect the 10mmPE pipe from the compressed air to the inlet of the three-way gas source of the gas circuit.

⚠Please confirm that the control switch or power supply of the air compressor is off, and the air outlet valve of the air compressor is closed, then install the air line.

1.2.2 air compressor

The air compressor selected for the IN-SD 5N pilot-scale spray dryer is a multi-purpose energy-efficient electromechanical integrated product developed using advanced American compressor technology. It truly boasts advantages such as low noise, compact size, attractive design, energy efficiency, easy maintenance, and safe durability. Widely applicable in medical devices, analytical instruments, educational research, national defense, environmental protection, light industry, food processing, pharmaceutical machinery, daily life, and other fields, it serves as an ideal air source for various equipment and stands as a high-performance import replacement product.

1.2.2.1 operational principle

The oil-free air compressor is a miniature reciprocating piston compressor featuring a single-shaft motor driving symmetrical crank-rocker mechanisms. The primary motion component is the piston ring, while the secondary motion element is an aluminum alloy cylinder surface. These components operate through self-lubrication between the rings without requiring external lubricants. The compressor achieves periodic volume changes in the cylinder through the reciprocating motion of the crank-rocker. During each full rotation of the motor, the cylinder undergoes two directional reversals: when expanding, the cylinder becomes vacuum with atmospheric pressure exceeding internal pressure, allowing air to enter through intake valves during suction; when contracting, the gas is compressed, causing rapid pressure buildup that triggers exhaust valve opening during discharge. This dual-cylinder design at single-shaft configuration doubles the rated flow rate compared to single-cylinder models while effectively reducing vibration and noise, resulting in a more compact overall structure.

1.2.2.2 Main accessories and functions

Note: The attached ※ is optional

Function of the pressure switch: Its main function is to control the motor's start and stop by sensing the pressure inside the gas storage tank. The machine is set to stop at 8bar and restart at 5 bar. Rotate the switch to the "-" position (connected position); rotate the switch to the "0" position (disconnected position).

Safety valve: when the pressure switch fails or for other reasons, the compressor does not stop, and the working pressure is greater than 8.8 bar, the safety valve will open automatically to reduce the exhaust pressure.

Overload protector: When the compressor is faulty and the current is too large, the protector will automatically disconnect to protect the motor from damage. This machine uses manual overload protection. After the fault is removed, the protector button should be manually reset before the compressor can run normally.

Sewage ball valve: when the gas storage tank has a certain pressure, open the sewage valve handle to discharge the accumulated water in the gas storage tank.

The filter pressure regulator serves two primary functions. First, it filters compressed gas by separating moisture from air before connecting to external equipment. The water flows out through a visible cup connected via an external hose (accessory) at the bottom. Second, it regulates pressure: By lifting the pressure adjustment lever and turning it clockwise, the pressure gauge displays the required exhaust pressure (0.1-0.8 MPa). Turning the lever clockwise increases pressure while counterclockwise decreases it. Pressing the pressure adjustment lever locks the pressure setting.

1. 2. 2. 3 **Install and use**

operating requirement ：

Air compressors should be used in indoor rooms not lower than 5 degrees Celsius, not higher than 40 degrees Celsius, and the relative humidity is not greater than 80%. The surrounding environment must be kept clean, dry, ventilated, and avoid direct sunlight.

This machine should be placed on a flat and firm ground to prevent the machine from moving during operation.

This machine uses a single-phase 220V/50Hz power supply and should be equipped with a 15A fuse or automatic circuit breaker. Abnormal voltage may cause difficult startup or compressor overheating. To ensure

Note: The attached ※ is optional

normal operation of this machine, in areas with abnormal power supply voltage, please use a single-phase power voltage stabilizer. The power of the voltage stabilizer must be greater than 3500VA.

Preparation before startup:

① Check whether the drain valve is closed, whether the pressure control switch is in the "0" position (open position), whether the exhaust port ball valve is closed, and check whether the power supply voltage is normal.

② Remove the air intake plug and screw on the air filter so that the PU pipe is directly downward.

③ Unscrew the quick screw clamp of the exhaust port and put it on one end of the gas pipe. Insert the gas pipe into the quick screw and tighten the clamp, and connect the other end of the gas pipe to the external equipment.

④ Insert the power plug of this machine into the power socket, and the installation is complete.

shakedown test ：

When the pressure switch is set to the on position (start position), the air compressor should immediately activate and begin supplying air to the storage tank. The pressure gauge needle will gradually rise. When it reaches 8 bar, the pressure control switch will automatically cut off the power supply to the air compressor, causing it to stop working immediately. Once the storage tank pressure equals 5 bar, the pressure control switch will reset to its closed position, restarting the air compression system. This cycle repeats continuously, achieving precise pressure regulation.

After debugging, the machine can be put into normal work.

Check that the air inlet is not blocked before starting the compressor.

The top surface of the cylinder may be hot, especially after the motor has been running for some time. Do not touch those parts during operation.

1. 2. 2. 4 Drain the gas tank

During operation, the air compressor compresses moisture in the air and condenses it into the storage tank. Excessive moisture accumulation can degrade the air quality in the tank, directly affecting the normal

Note: The attached ※ is optional

operation of pneumatic equipment. Therefore, it is essential to promptly drain accumulated water from the storage tank. The drainage cycle depends on environmental conditions and usage duration, typically requiring drainage every three days.

Drainage method: When the gas storage tank is not under pressure, open the ball valve to make the water outflow from the drain valve, and discharge through the drain hose until the water is drained. After the water is drained, close the ball valve and ensure no leakage.

1. 2. 2. 5 Change the filter element

The air compressor's intake port is equipped with an air filter to prevent dust from entering and to reduce noise. Over time, the filter element may become clogged, which can affect the compressor's suction capacity. Therefore, it is essential to replace the filter element regularly. To replace it, open the intake silencer cover, remove the old filter element, install a new one, and then reassemble the unit.

1. 2. 2. 6 routine inspection

Please check and replace the air intake filter regularly and appropriately. We recommend that you check the air intake filter once after 300 hours of operation, and users can decide the frequency of inspection according to their own use. Keeping the filter and muffler clean can avoid most faults, and unclean filter can reduce the performance and service life of the compressor.

1. 3 Fogging system

This section mainly introduces the performance parameters and advanced features of the instrument's dual fluid atomizer/centrifugal atomizer.

1. 3. 1 summarize

The dual fluid atomizer/centrifugal atomizer enables spray drying of heat sensitive materials at mild temperatures.

1. 3. 2 Bifluid atomizer/centrifugal atomizer

The dual-fluid atomizer is an exceptional high-precision spray atomizer. This device employs an external mixing-type atomizer where air and liquid flow can be independently controlled, effectively spraying high-viscosity liquids and suspended abrasives. The centrifugal atomizer features rapid drying capabilities, with

Note: The attached ※ is optional

95%-98% of moisture evaporating instantly in hot airflow. The drying process takes merely 10-10 seconds, making it particularly suitable for drying heat-sensitive materials. All products are spherical particles characterized by uniform size, excellent flowability, good solubility, high purity, superior quality, and broad applicability.

The atomizer is installed at the center of the air distributor's top, spraying downward directly into the tower body. The dual-fluid atomizer feed enters through a nozzle inlet with minimal pressure and is atomized using compressed air. The centrifugal atomizer feed undergoes one or two liquid distribution stages before being rapidly directed to the high-speed rotating atomizing disk. Under centrifugal force, the liquid spreads into a thin film on the disk's rotating surface and continuously moves toward the edge at increasing speed. Upon exiting the disk's edge, the liquid atomizes. The centrifugal atomizer requires external cooling water for temperature regulation.

1. 3. 2. 1 Nozzle assembly

Bifluid atomizer electric centrifugal atomizer

1. 3. 2. 2 natural parameter

The compressed air supply pressure of the nozzle is between 3 and 6 bar.

Air flow rate is between 800-3000L/h.

Equipped with a flow meter to monitor and control the flow rate.

1. 4 Feed system

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

Note: The attached ※ is optional

1.4.1 peristaltic pump

The instrument uses a spring type peristaltic pump head, which can automatically adapt to the change of hose wall thickness. When there is a large difference in hose wall thickness, manual adjustment can be made.

The peristaltic pump uses a stepper motor as the driving force and precise pulse control to further reduce the pulsation. (It is recommended that the size of the silicone tube be #14~#18)

1.4.2※ Feed switching valve

Figure 5-6.2: Feed Switching Valve (Optional)

The feed switching valve is an optional accessory. The switching valve is driven by an electromagnetic solenoid and controlled by squeezing or releasing the hose. The medium only passes through the hose, and other components in the valve body do not come into contact with the chemical corrosive medium. Simply replace the silicone hose.

The three tubes are connected to the peristaltic pump feeding silicone tube, and then the pumping of materials and solvents is automatically switched.

1.4.3 running mode

The operation control mode of peristaltic pump can be loaded into different applications according to the different accessories.

1.4.3.1 Traffic is autonomous and controllable

The customer can grasp the feeding rate, and the input data can be used to pump the material accurately. Within the running range of the feeding amount, the numerical operation can be switched arbitrarily.

1.4.3.2 Material reflux

One-click recovery of material in silicone tube.

1.4.3.3※ Intelligent expansion

Note: The attached ※ is optional

The selected equipment is equipped with a feed switching valve, which can be switched 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.

1.5 heating system

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

1.5.1 performance index

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

Table 5-7: Heater performance index

metric	parameter
working voltage	AC380V，50HZ
power rating	10KW
heating efficiency	0-300℃
material quality	316L stainless steel
stability	±3℃

1.5.2 Maintenance and care of heaters

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 inside or on the surface of the insulation material of the heating element.

To remove moisture through gradual heating element warming (preventing electrical leakage), follow these steps for restarting the heater: First, turn on the heater switch and wait at least half a minute before turning it off. After approximately one minute, restart the system for another half-minute. Repeat this cycle several times based on the duration of previous shutdowns, gradually extending the on-time while shortening the off-time. After about 30 to 60 minutes, the heater is ready for continuous operation.

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

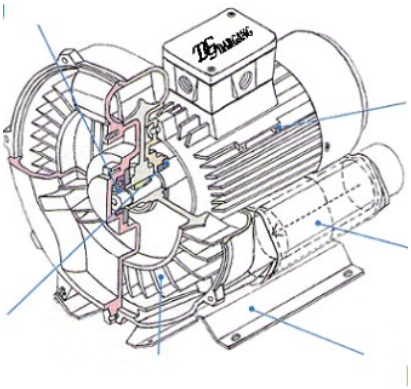
Note: The attached ※ is optional

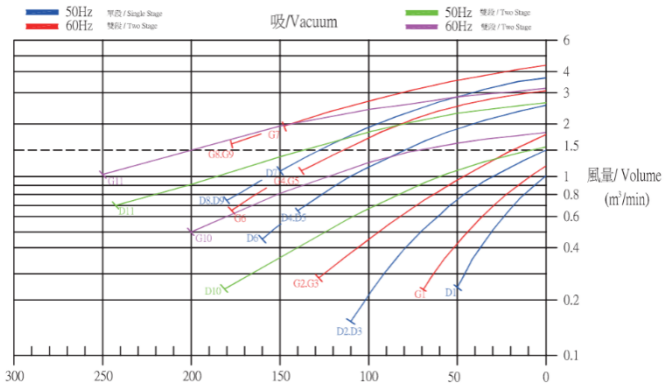
If the heater cannot be troubleshooting, please contact our technical staff in time.

1. 6 Supply air system

This section mainly introduces the relevant performance indicators of the instrument exhaust system.

1.6.1 Taiwan original medium voltage induced fan





The fan is a rotary internal mechanical structure, do not disassemble by non-professionals!

1.6.2 Control mode

The instrument air supply system adopts frequency conversion control to achieve infinitely adjustable air volume, so as to better adapt to the needs of different process spray drying experiments.

If your experiment requires very high purity of the air source, please add an air filter.

1.6.3 Exhaust emissions

In the process of spray drying, a small amount of extremely fine dust will be discharged with the hot air. The exhaust pipe at the end of the instrument should be put into the ventilation kitchen or outdoors. If there is certain pollution, please do a good job of filtration.

During the experiment, the exhaust gas is hot air with high temperature. Be careful not to burn!

2. operate

This chapter describes how to correctly and safely identify and recognize the operation of the instrument.

Note: The attached ※ is optional

2.1 General operating system steps

After the instrument is powered on, the touch screen starts up and the initial drawing is the standby interface; this picture stays for 5 seconds and then automatically jumps to the main operation interface. The key data setting of spray drying experiment and system start/stop are all operated in this interface.

- Set the air intake and target air temperature, then touch the start/stop button of the system (main control section), the system starts, the induced fan runs, the heater works, and the heating air is started.
- When the air inlet temperature reaches, the system will automatically use an audible warning (not effective in silent state);
- Then, the feed rate is set, and the test spray is made with pure water. By adjusting the feed rate, the outlet temperature reaches the target temperature until the temperature balance is stable.
- Replace the pure water with a pre-prepared material solution, and keep the preset feed rate and air inlet temperature unchanged.
- When the material is relatively viscous and easy to block the nozzle, the automatic unblocking function should be opened. At this time, the needle frequency can be set from 0 to 60. When it is 0, it will not work by default; when it is greater than 0, the needle will be intermittently unblocked.
- After completing the material spray drying, spray with pure water for approximately 5 minutes to clean the nozzle. Remove the silicone tube from the pure water and allow it to pump naturally until the solution is completely drained. Set the feed rate to zero, stop the peristaltic pump, and disable the needle discharge function. Adjust the air inlet temperature to 0°C and shut down the heater.
- Adjust the glass rotor flowmeter (the float is at the bottom), stop conveying compressed air; turn off the power switch on the air compressor.
- Keep the fan running until the air inlet temperature drops to 60℃; touch the system start/stop button again, or set the air inlet volume to 0 and turn off the fan. After the tower surface is cooled, other follow-up work can be carried out.

Note: The attached ※ is optional

2.2※ Steps of automated integrated operating system

- Prepare a solution of pure water and a solution of the material to be sprayed.
- After the system is officially started, the preset parameters "air intake", "air intake temperature" and "feed quantity" are preset once.
- Click the system start/stop control button, and the system starts to run automatically.
- The instrument is equipped with troubleshooting and information monitoring system, which can report the working status of the stage in real time; or the upper computer can remotely monitor and interfere with the experimental process.
- The instrument sprays itself to end, and the system informs that the material is collected.

3. Detailed explanation of touch screen system

The system includes six human-computer interaction interfaces: main control, curve, data, system, suggestion and standby. It is easy to operate and powerful.

3. 1 Master interface

This interface is the IN-SD 5N control system center. Customers can easily control the important experimental data such as "inlet temperature", "feed quantity" and "inlet air quantity", and can visually monitor the "inlet temperature" and "outlet temperature" in real time. Moreover, by observing the "heating amount", the working condition of the heater can be controlled in real time.

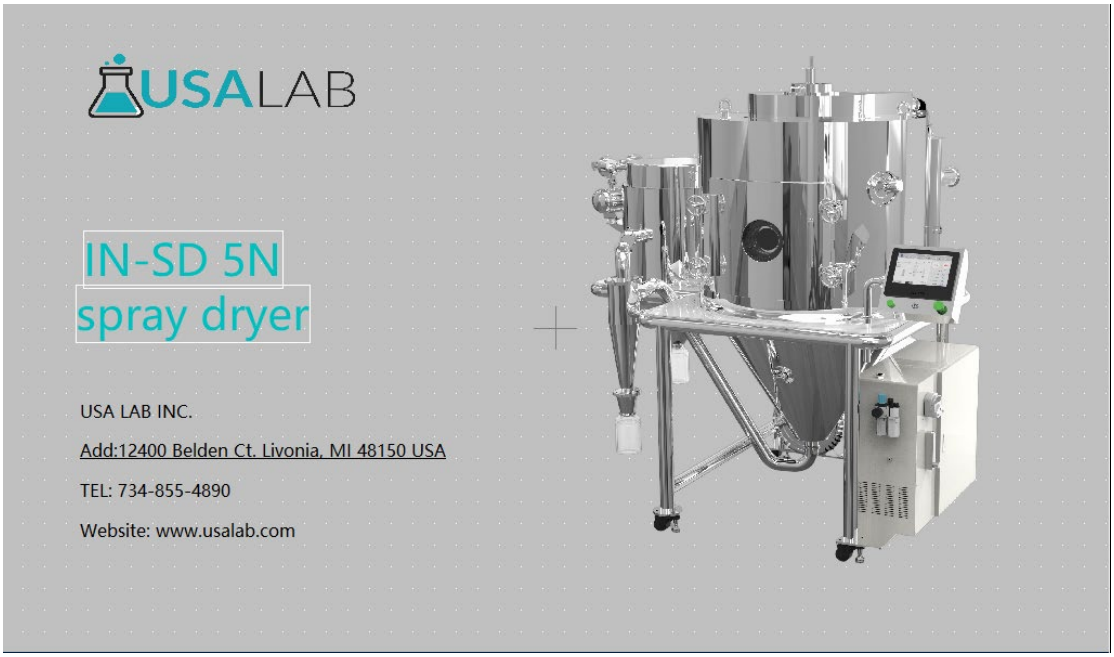
- Interface Switching In the title bar, customers can switch between interfaces by touching buttons.

Take the "Curve" button as an example:

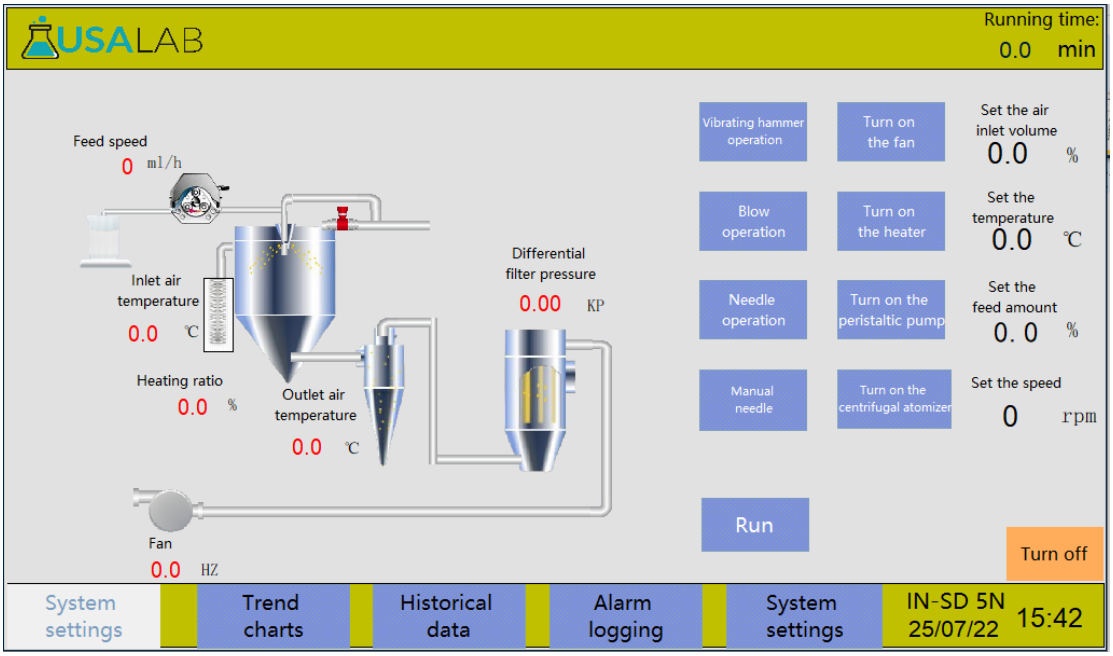
When in another interface, the "Curve" button is gray

Turn on the display screen interface

Note: The attached ※ is optional

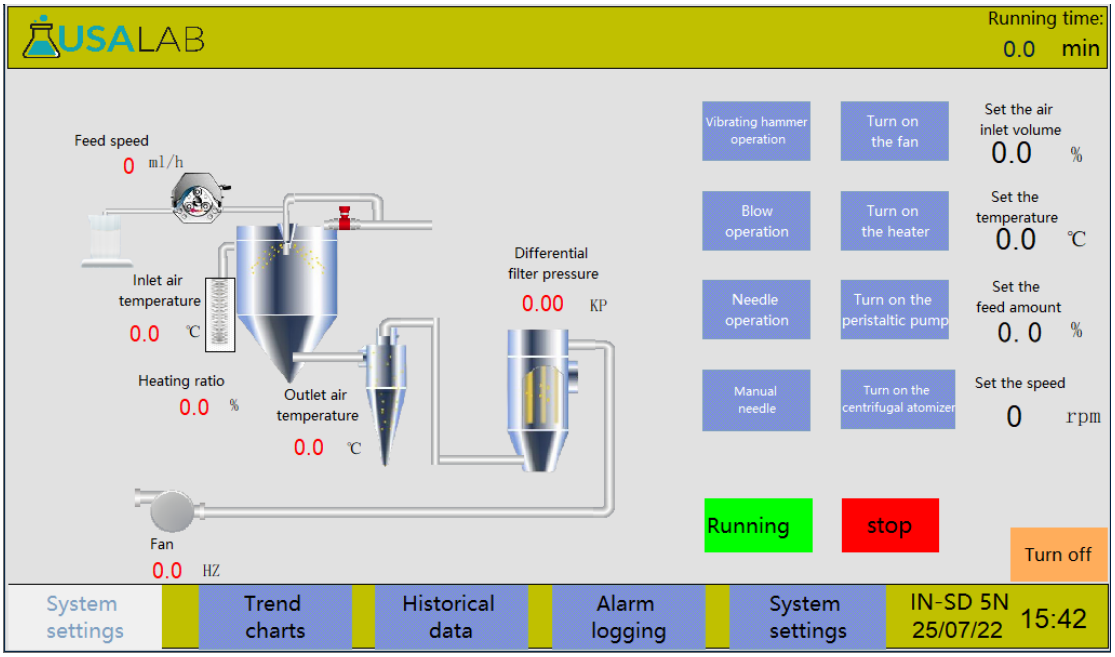


working interface as follows:

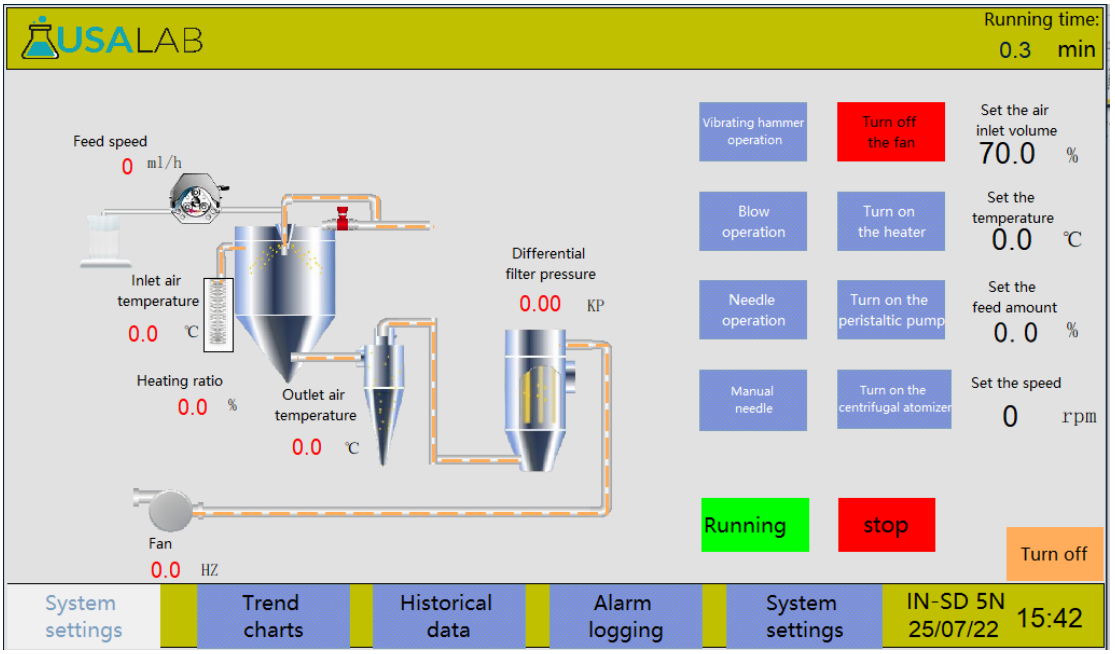


Note: The attached ※ is optional

Click run and the display is as follows

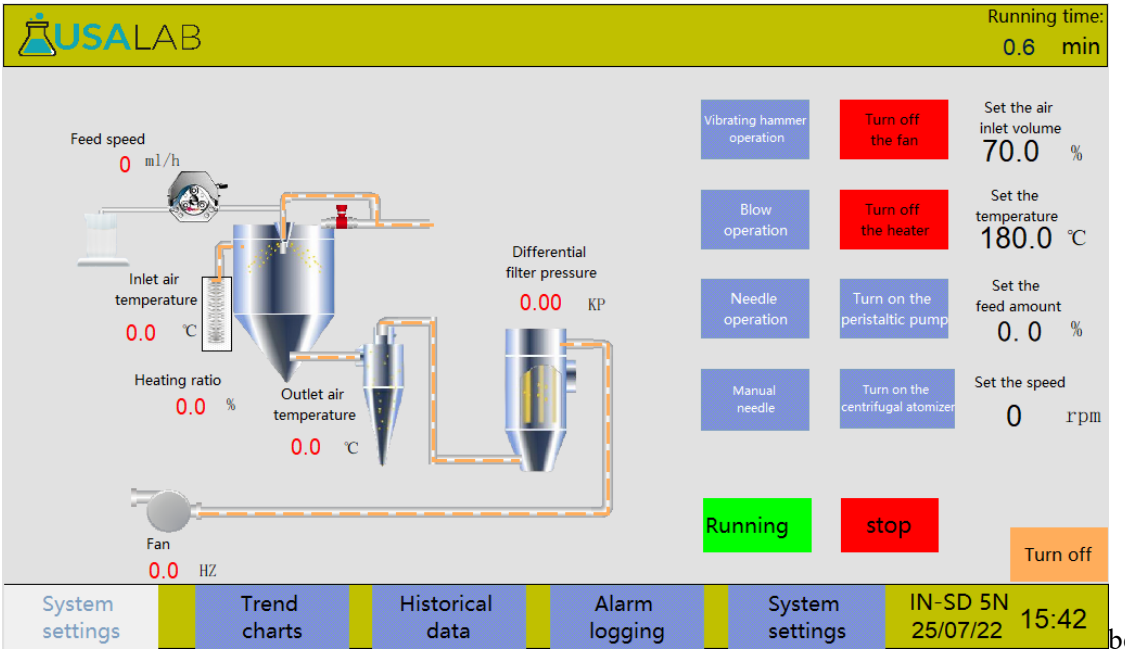


After setting the fan air volume, Click to turn on the fan. The following will be displayed:



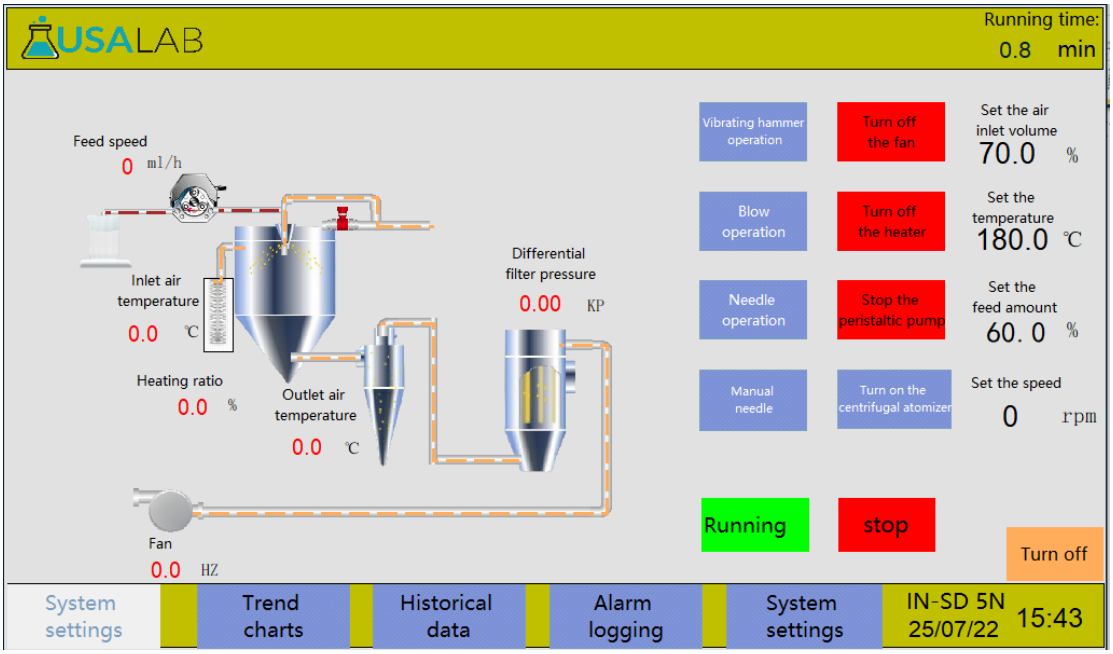
Note: The attached ※ is optional

After setting the heating temperature, Click to Turn on the heater The following will



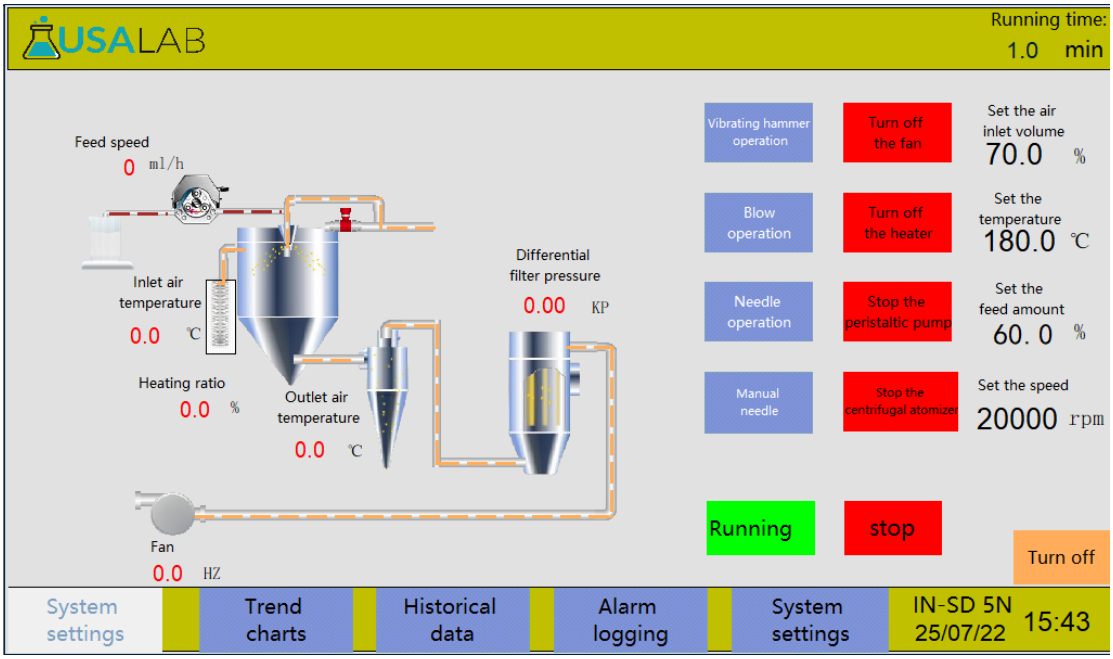
be displayed：

After heating to the appropriate temperature, set the feed rate of the peristaltic pump. Click to Turn on the peristaltic pump The following will be displayed:

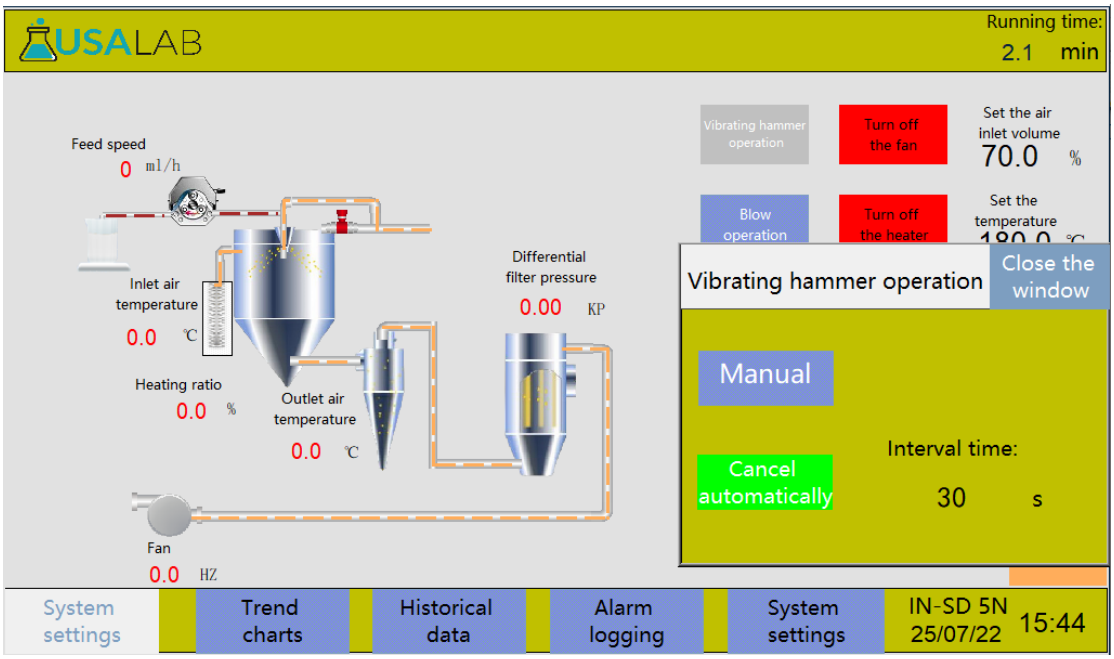


Note: The attached ※ is optional

If dual-flow atomizer is used, the gas flow meter needs to be adjusted. If an electric centrifugal atomizer is used, the rotation speed needs to be set. Click to Turn on the centrifugal atomizer as shown below:

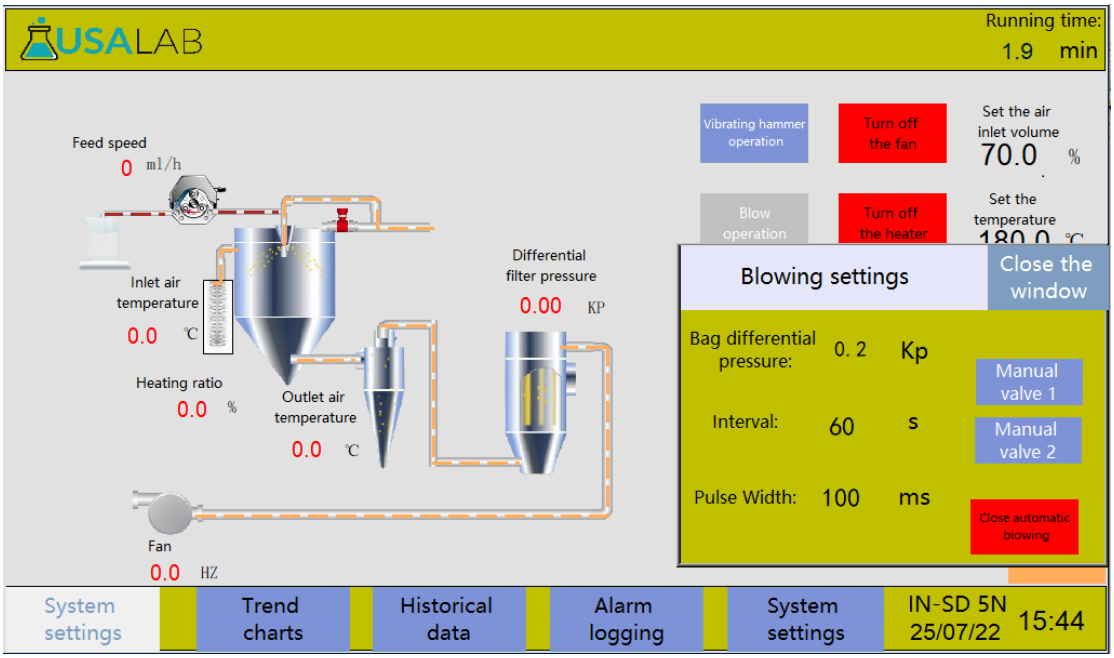


During the operation of the machine, If the vibrating hammer operation needs to work, you can open the small page and set it as automatically. According to the set time, it will work automatically interval time . You can also Manual click and operate, as shown below:



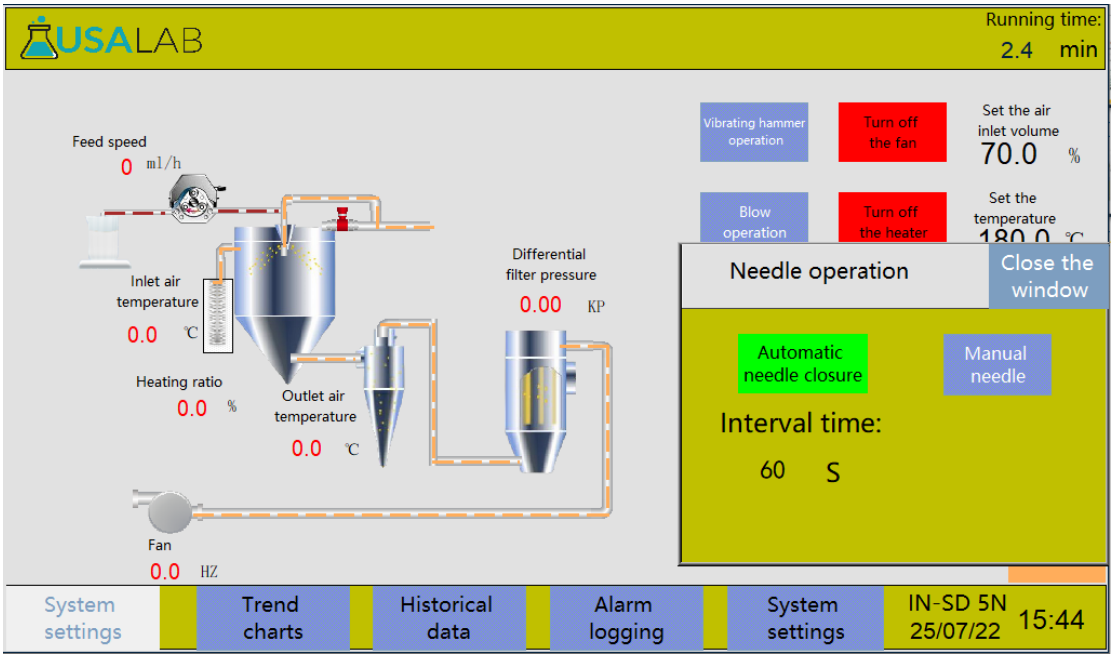
Note: The attached ※ is optional

During the operation of the machine, If the pulse blowing setting is used, you can open the small page and set it as automatically. According to the set time, it will work automatically interval time . You can also Manual click and operate, as shown below:

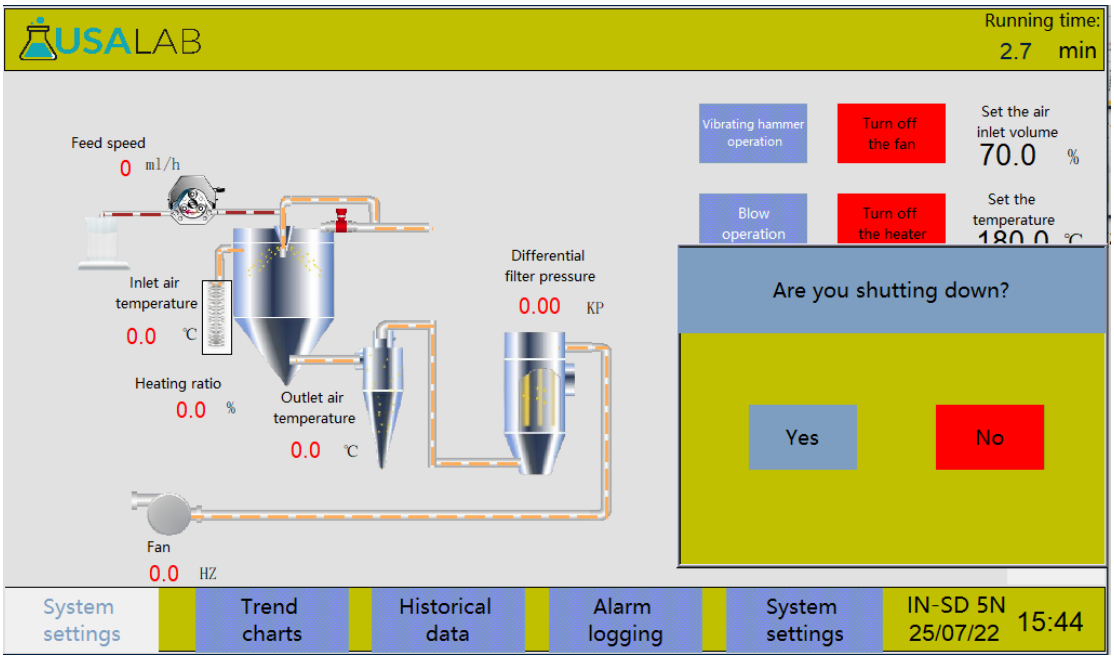


During the operation of the machine, when using dual-flow atomizer, If gas needle operation is required, you can open the small page and set it as automatically. According to the set time, it will work automatically interval time . You can also Manual click and operate, as shown below:

Note: The attached ※ is optional



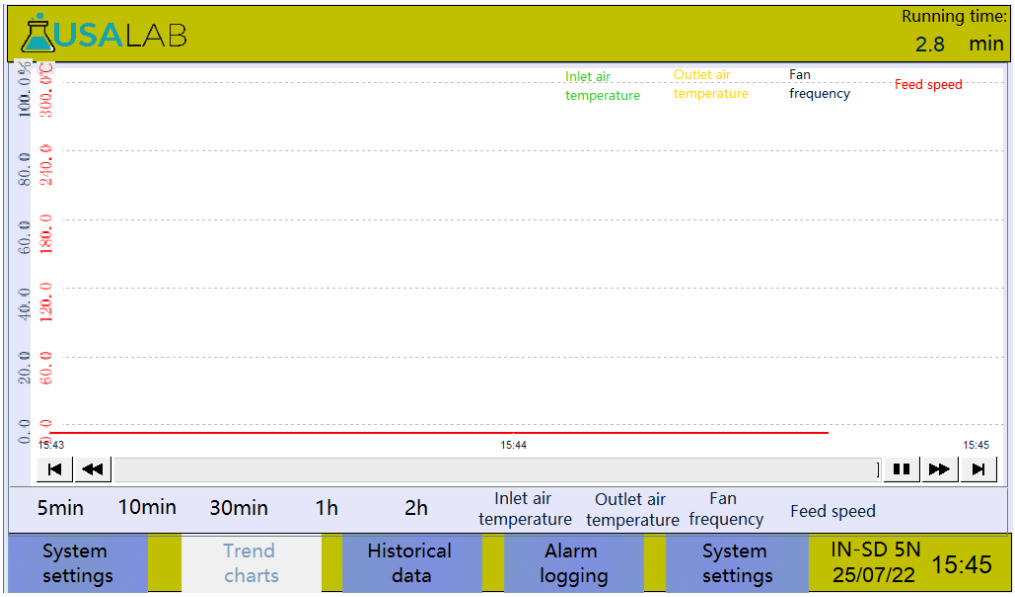
At the end of machine operation, in order to protect the heater, when the fan is above set the temperature (Inlet air temperature above 60 degrees), the fan will not stop. The machine will stop only when the temperature is lower than the set value. To shut down the machine, click shut down. After confirmation, the power supply will be turned off as shown below:



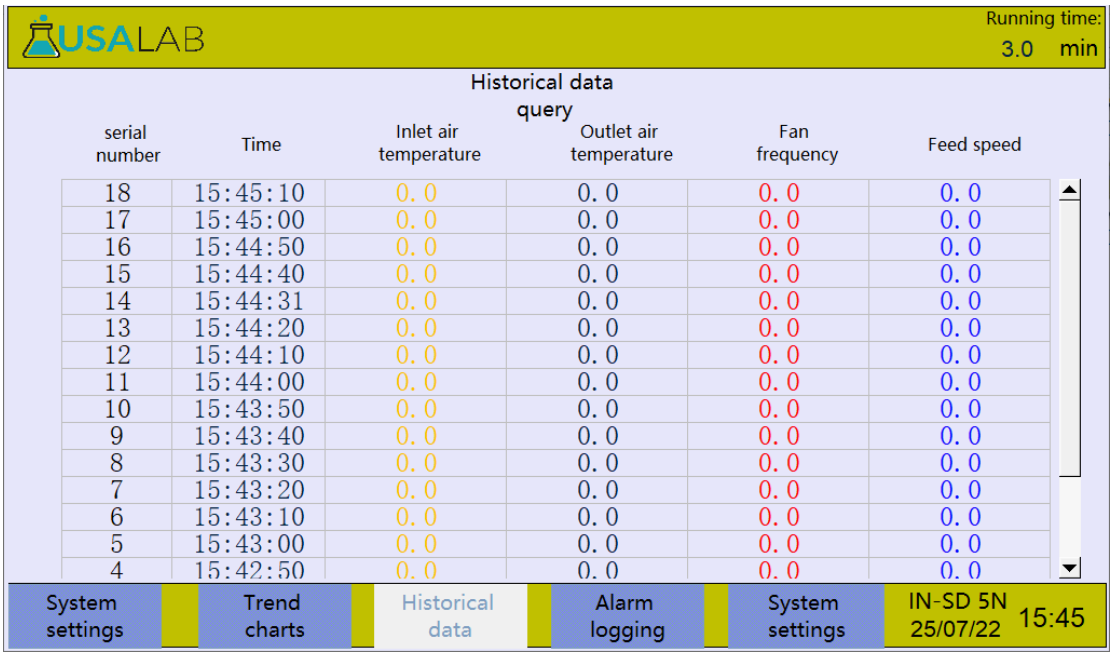
The auxiliary functions provided by this machine are as follows:

Note: The attached ※ is optional

When the machine is running, You can observe the curves of parameters such as temperature and air volume in real time, as shown below:



When the machine is running, the temperature, air volume and other parameter values can be displayed in real time as shown below:



When the machine runs, Operation prompts and alarm are displayed as follows

Note: The attached ※ is optional

The machine system settings interface is described as follows

Click mute to turn off the button sound on the operation screen

System Settings are set for the internal system of the operating system and used by the manufacturer for system upgrade and update

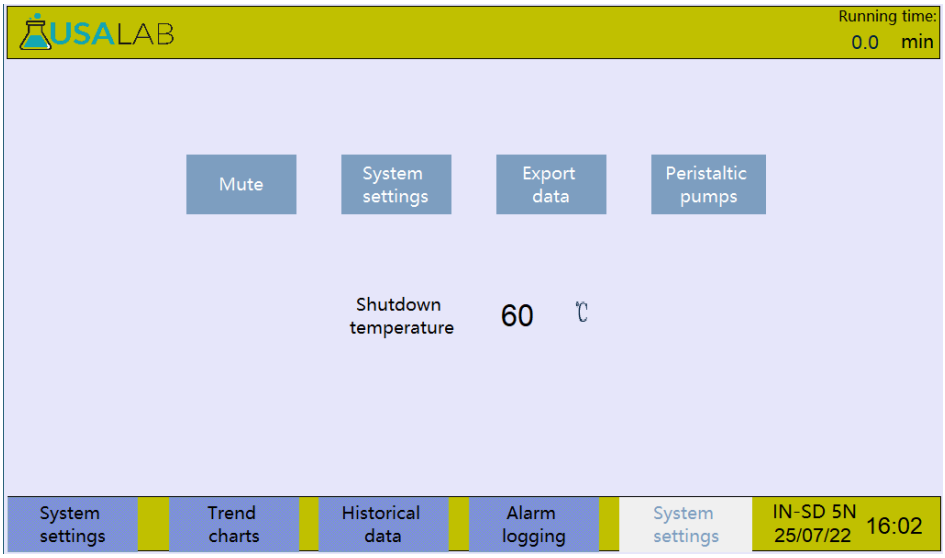
Export data. The data displayed on the historical data page can be exported to a U disk and archived for analysis by using this operation key.

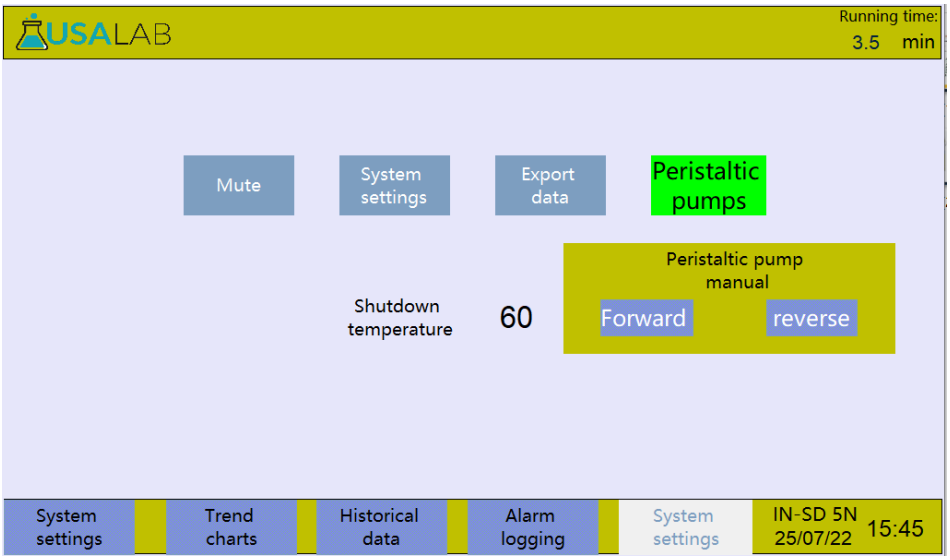
Peristaltic pump, click to appear a small page, can manually operate the peristaltic pump forward and reverse.

The shutdown temperature setting is for the protection of the heater. The normal default value is 60° and does not need to be changed.

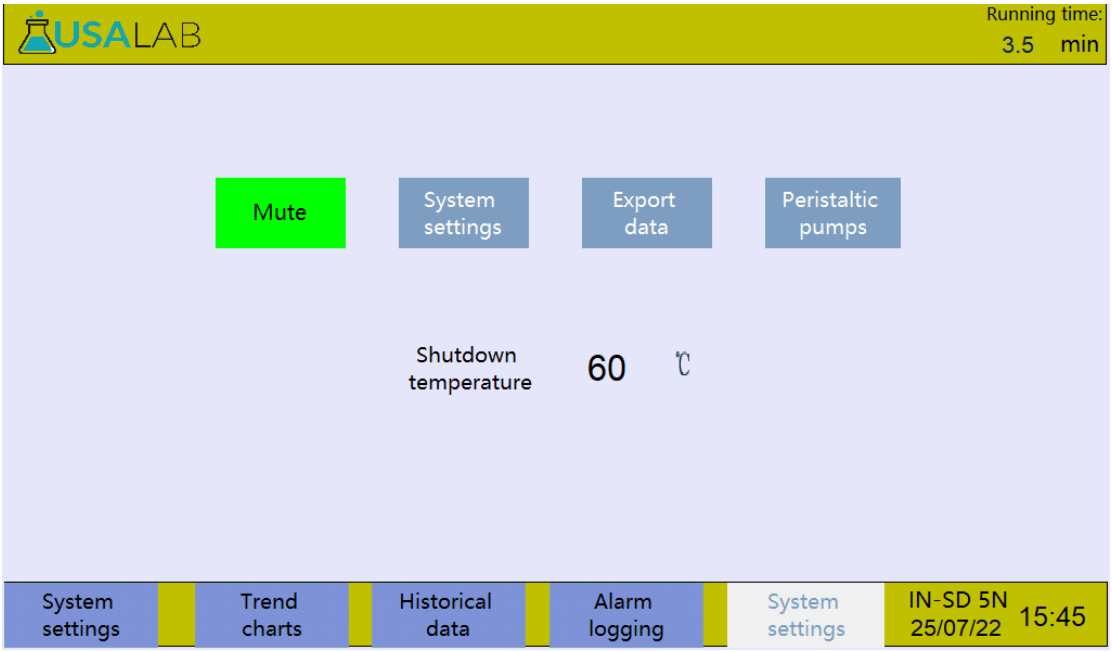
It is shown below

Note: The attached ※ is optional





Note: The attached ※ is optional



The improvement of IN-SD 5N pilot spray dryer needs your support and suggestions.

4. Reference table of fault information

Customers can refer to the following general fault information and possible causes and remedial measures to quickly determine the fault and resume operation.

4. 1 General fault information

fault message	Possible causes	corrective measure
The instrument cannot be powered on	Power outage in the interior	Waiting for a call
	The power plug is not plugged in	Plug in the power plug
	The power cable is damaged	Change the power cable
	electrical accident	Contact Innol
The touchscreen is not working	The instrument was out of power	Refer to the solution for the inability to power on the instrument
	Touch screen damaged	Replace the touch screen
The fan is not working	Fan is damaged	Change the fan
	electrical accident	Contact Innos
	The heater is broken	Replace the heater

Note: The attached ※ is optional

The electric heater cannot be heated	electrical accident	Contact Innol
The feed pump is not working	Stepping or drive damage The pump head is stuck or loose	Change the stepper or driver Retie the hose
The needle doesn't work	Low air pressure The electromagnetic valve is damaged	Refer to air compressor troubleshooting Replace the solenoid valve
The touch screen is not working	Communication failure	Contact Innol
The temperature display value is too large	Pt100 is damaged or not connected Temperature transmitter fault	Replace Pt100 or reconnect Change the temperature transmitter
The temperature can't go up	The heater is broken Thermometer sensor fault	Replace the heater Replace Pt100 or check the connection
The air compressor is not working	The air compressor is not powered on Air compressor failure	plug in Replace the air compressor
Low end drop liquid of drying chamber	The air intake temperature is too low The air pressure of the atomizer is too low The compressed air is leaking Excessive feed	Low preset temperature / Heater failure Adjust ventilation Check the air lines Reduce feed
Compressed air cannot be regulated	The nozzle is blocked No gas source	washing nozzle Check the air compressor working condition

Figure 4-1: Comparison table of general fault information

4. 2 Implicit fault information

Considering the safety and reliability of customer's use of the instrument, HS-Control 1.0 control system has a number of automatic protection functions implied.

Note: The attached ※ is optional

When the equipment is in an abnormal state, these specific functions will be activated and automatically make corresponding corrective and protective measures.

Implicit functional failure	**System processing method**	**Customer response measures**
The intake air test cannot be heated	The system automatically turns off the heater	Temperature sensor and transmitter are faulty The fan is not running The heater is not working
The air intake temperature is too high	The system automatically turns off the heater	Temperature sensor and transmitter are faulty
	The system automatically cuts off power	Other unexpected failures
The system displays password protection	Access is granted after password verification	Contact Inno

Figure 4-2: Correspondence table of implied fault information

After the implicit functional fault alarm appears (the alarm will be displayed on the touch screen interface of the upper computer), the customer can make some fault judgment and troubleshoot immediately according to their own experience, then try to run the instrument safely, or directly contact with the engineer of INNO.

5. How to better use IN-SD 5N pilot-scale spray dryer

This chapter objectively analyzes the working factors affecting pilot-scale spray dryers from a practical perspective. It should be understood that different settings of the instrument cannot be considered in isolation. All parameters that can be adjusted on the instrument are interdependent, and adjusting one setting will also require changes to another parameter.

Note: The attached ※ is optional

5. 1 The interaction between the parameters

- The greater the temperature difference between import and export, the higher the residual moisture content.
- The higher the speed of the medium voltage induced fan, the shorter the residence time of hot air in the instrument, resulting in a higher residual moisture content.
- The lower the speed of the medium voltage induced fan, the longer the residence time of hot air in the instrument, and the drier the product.
- The higher the speed of the medium voltage induced fan, 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 particle.
- Low spray concentration and high spray flow rate can produce very small particles; and there is a risk of product loss.
- Assuming the temperature remains constant, the higher the pump speed, the lower the outlet temperature.

5. 2 Inlet temperature and outlet temperature

- The inlet air temperature refers to the temperature of hot dry air. Dry air is conveyed above the heater via a medium-pressure induced draft fan motor. Its temperature is measured before entering the drying chamber. During spray drying of solutions, emulsions, or dispersions, solvents are 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. A vapor cloud envelops the spray droplets, protecting the product from thermal effects.
- Before entering the cyclone separator, the temperature of air containing solid particles is referred to as the outlet air temperature. This temperature does not necessarily match the product's actual temperature. Water evaporation removes heat from the product, keeping it cool. Even with a residence time as short as

Note: The attached ※ is optional

approximately 1 second, solid particles won't be heated to their ambient temperature. However, the empirical rule is that the outlet temperature equals the product's maximum temperature. Unlike inlet temperature, the outlet temperature cannot be set through a thermostat.

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

- Air intake temperature
- Air velocity of medium voltage induced fan (air intake)
- Setting of the creeping pump
- Concentration of material to be sprayed

The optimal selection of the temperature difference between imports and exports is the most critical factor to consider when implementing spray drying. While other specific product parameters such as melting points or decomposition temperatures must be accounted for, there remains considerable flexibility in adjustment. The equipment's production capacity and residual water content may be affected within this temperature range.

The table below illustrates the interaction between inlet and outlet temperatures, which are related to the pump's air consumption. These data are intended for guidance only. While they help clarify the interrelationships among the aforementioned factors, the number of influencing variables makes absolute values impossible. The following principles can be derived from the data:

For the final product with very low residual moisture content, the inlet 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.

5. 3 Medium pressure induced draft fan

The instrument draws dry air through a medium-pressure induced draft fan. By adjusting the fan speed, the volume of hot dry air can be increased or decreased. As the dry air supply changes, the energy required for evaporation also varies accordingly. Therefore, the fan speed setting significantly impacts the instrument's

Note: The attached ※ is optional

drying performance. The evaporation efficiency is influenced by multiple factors, including the concentration of the spray solution and the moisture content in the dry air.

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

- **The speed of the medium voltage induced fan is high, and the separation degree of the cyclone separator is high;**
- The speed of the medium voltage induced fan is low, the material stays in the drying zone for a long time, and the residual moisture content is low.

5.4 Pump speed of peristaltic pump

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 entirely true, because the temperature of dry air and the amount used, i.e. the energy used to evaporate the solvent, are determined by the selected temperature and the speed of the medium pressure fan.

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

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

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

- **Increasing the pump rate increases the temperature difference between the inlet and outlet temperatures.**
- **The drying material content of the final product can be increased by reducing the pump rate while keeping the inlet temperature and the flow rate of the ejector constant.**

5.5 Flow rate of compressed air for spray

Spray flow rate is the amount of compressed air 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 about 600-1000 l/h.

Note: The attached ※ is optional

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

The principle is: • The higher the spray flow rate, the smaller the particle size of the final product.

5. 6 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 of the dried particles.***
- ***The lower the concentration of the spray solution, the smaller the particle size and the fewer the pores of the dried particles.***

6. About after-sales service

Thank you for choosing IN-SD 5N pilot spray dryer. When you choose this equipment, you have become our sincere service object, we will try our best to do everything for you.

Service hotline: Tel: 734-855-4890

Webeitr:www.usalab.com

Note: The attached ※ is optional