unopex

Unopex B 230

Pilot Scale Spray Dryer

Installation, Operation and Maintenance Manual

Document No: 520302

v1.5_en

Foreword

Dear Customer,

Thank you for choosing a Pilot Scale Spray Dryer from Unopex. You have made a good choice. Thank you for your trust.

Please read this manual carefully, note the safety precautions before installing and putting the Unopex B 230 Pilot Scale Spray Dryer into operation. You will find all necessary information for the safe operation of the pilot plant in this manual.

Original language version of this manual is in Turkish and serves as basis for all translations into other languages.

Table of Contents

1. Introduction

1.1 General Safety Rules

Installation, operation, maintenance and repair of the Pilot Scale Spray Dryer Plant should only be done by skilled technicians trained by the manufacturer.

Read this manual carefully and follow the instructions in this manual with regard to installation, start-up, operation, cleaning, maintenance, repair, storage and disposal.

Wear protective goggles.

Wear safety gloves.

Wear protective clothes.

Wear protective mask.

During work and service with the plant, be careful with injuries caused by hot vapours and hot surfaces.

1.2 Safety Notices

- The pilot plant is suitable for spray drying feeds containing only water as solvent. Do not work with liquids containing any solvents other than water.
- The pilot plant is suitable for working with only air as drying gas. Do not work with any gas other than air.
- The plant is not for use in areas which require ex-protection. Do not install or operate the plant in explosive environments.
- Do not install or operate the plant with explosive gas mixtures.
- Only maintain the plant in sufficiently ventilated environments
- Comply with the all requirements regarding ambient conditions and installation.
- External power supply must always meet the plant specifications.
- External pressure supply must always meet the plant specifications.
- Do not install damaged parts
- Do not drop any part of the plant.
- Place the plant on stable, horizontal and vibration-free surface.
- Keep limbs out of crushing zone.
- Do not move the plant while the parts assembled.
- Do not touch thin metal edges.
- Compressed air must be oil-free and dried (customer supply).
- The electrical connection cables are led through the bottom of the electrical panelboard, they must be properly connected according the identification and numbers specified by a specialist trained by the manufacturer.
- A safe earth connection to the pilot plant must be established.
- Certain gases in or in the vicinity of the plant are highly inflammable.
- Always be aware of the poisoning and explosion risk when working with harmful or hazardous substances or substances of unknown composition.
- Directly withdraw released gases and gaseous substances by sufficient ventilation.
- Only adequately qualified operators may work with the plant.
- Store the operation manual where it is easy to access in close proximity to the plant.
- Operators must be trained before handling the plant.
- Check that the operators have read and understood the operation manual.
- Do not allow third parties to make technical modifications to the plant or any part of it.
- Modifications to the plant or any part of it is only permitted with the written approval of the manufacturer. Modifications and upgrades shall only be carried out by an authorized Unopex specialist. The manufacturer will decline any claim resulting from unauthorized modifications.
- Before operation, check the plant for correct installation and assembling.
- Before operation, inspect parts, connections, sealings and tubes for good condition.
- Exchange defective or worn out parts immediately.
- Exchange clogged filters immediately.
- Only operate the plant in ventilated environments.
- Check for gas leakages by performing a dry-run without product solution.
- Check all connections for correct installation before operation,
- Do not inhale dried particles.
- Only recover particles in sufficiently ventilated areas.
- Do not open the drying circuit while drying air flow continues
- Do not disperse the dried particles.
- Do not use compressed air to clean dusty parts.
- Do not touch hot surfaces.
- Allow all hot parts to cool down after operation.
- Do not use clogged filters, exchange them immediately
- Check for sufficient grounding
- Clean all parts and components after each spray process.
- Depressurize air and gas circuit
- Switch off the plant, disconnect the power cord and prevent unintentional restart before removing housing or parts of it
- Do not spill any liquids over any electronic parts or components.
- Do not touch parts inside the plant with wet hands
- Do not squeeze cables, tubes or other items at assembling or reassembling.
- Exchange defective cabling or tubing before assembling or reassembling.
- Allow all hot parts to cool down before cleaning.

Choose and use adequate measures according to the applications, since some additional protective measures might be necessary.

1.3 Staff Qualification

Risks to users, property, and the environment can arise when the plant is used carelessly or improperly.

1.3.1 Responsible Body

- The head of department is the responsible body.
- This operation manual is to be stored where it is easy to access in close proximity to the plant and must be made available at all times to the operating personnel.
- Operators must be trained before handling and operating the plant. The head of department is the responsible for training his personnel. Only adequately qualified operators must be permitted to work with the plant.
- Check that the operators have read and understood the operation manual. Define precise responsibilities of the operators.
- System settings of the plant are protected via passwords on the touch screen operator panel and are shared only with the responsible body by the manufacturer. The responsible body must not share those passwords with anyone.
- The plant meets the recognized safety standards. Integration into a system may give rise to hazards that are characteristic of the other system's design and beyond the control of Unopex. It is the responsibility of the responsible body to ensure that the overall system, into which this plant is integrated, is safe.
- The responsible body must check whether local, national and federal regulations require any mandatory installation of further pollution control equipment for the plant/the entire system.
- Personal protective equipment must be provided to the operators.

1.3.2 Operators

- Work on the plant is reserved for appropriately qualified specialists, who have been assigned and trained by the responsible body to do so.
- Operators must be at least 18 years old. Under 18-year olds may operate the Pilot Scale Spray Dryer only under the supervision of a qualified specialist.
- The operator is responsible vis-a-vis third-parties in the work area.
- Carefully read the operation manual before operating the plant.
- Legal regulations, such as local, national and federal laws applying to the drying plant, installation and working area of the plant must be strictly followed.
- Ensure that the plant is operated in proper condition only.
- Observe all safety instructions and do not ignore, bypass, dismantle or disconnect any safety devices.
- When working with the plant, always wear appropriate personal protective equipments (e.g. protective clothing, protective gloves, protective eye goggles, protective mask). Protect yourself from inhalation of fine particles by wearing protective mask. The personal protective equipment must meet all requirements of all data sheets for the chemicals and materials used. Choose and use adequate measures according to the applications, since some additional protective measures might be necessary.

- Modifications to the plant and modifications to the spare parts used are only permitted with the prior written approval of the manufacturer. The manufacturer will decline any claim resulting from unauthorized modifications. Ensure that modifications and upgrades are carried out by authorized Unopex specialists only.
- Ensure that service, repairs or maintenance work are carried out with care and on schedule and by specialists trained by the manufacturer only.

1.3.3 Proper Use

The technical specifications of the pilot plant is given in Section-2.

Unopex B 230 Pilot Scale Spray Dryer has been designed and manufactured to spray-dry only aqueous solutions or suspensions with only air as drying gas.

All possibly hazardous substances and fumes have to be removed from the working area. Exhausts leaving the exhaust air duct of the plant have to be lead away instantly by a ventilation system which is equipped with safety devices and equipments to avoid contamination of the environment.

Handling and operation may require additional personal protective equipment. Be sure to operate the plant in accordance with safety rules.

Additional cleaning measures (primary cleaning and in place disinfection) are required if the plant is used with pharma, food or cosmetic products.

The plant must be installed and operated according to the instructions in this manual. Failure to comply with this manual is deemed improper use.

The following must be observed without fail:

- Only use the plant in a fault-free condition!
- Have start-up and repairs carried out only by specialists!
- Do not ignore, bypass, dismantle or disconnect any safety devices!

1.3.4 Improper Use

Unopex B 230 Pilot Scale Spray Dryer is permitted only for the purposes for which it was manufactured. Risks to users, property and the environment can arise when the plant is damaged, used carelessly or improperly.

Use of the plant for purposes other than the ones mentioned or beyond specified use limits shall relieve the manufacturer of all responsibility in case of damage to persons or things and invalidate the warranty.

The manufacturer accepts no liability for damage caused by technical modifications to the plant or any parts of it, improper handling or use of if this manual is not observed. Below uses are expressly forbidden:

- use of the plant by insufficiently trained personnel
- use of gases other than air
- use of the plant in areas which require ex-protected instruments
- use of the plant without genuine parts and genuine consumables
- spray drying of biohazardous materials or toxic substances
- spray drying of substances which might explode or ignite due to the processing
- spray drying of feeds containing any solvent other than water
- use of corrosive samples
- use of samples which might produce oxygen during the processing
- unattended operation

2. Technical Specifications

2.1 Technical Data

Model	Unopex B 230 Pilot Scale Spray Dryer
Application	Open mode spray drying of aqueous solutions
Drying gas	Air
Evaporating capacity	0.5 to 6 L/h water evaporation
Max. inlet temperature	250 °C
Ambient conditions	For indoor use only altitude up to 2000 meters above sea level temperature: 5–40 °C relative humidity up to 31 °C max. 80% and decreasing linearly to 50% up to 40 °C
Feed pump	peristaltic, variable speed
Configuration	co-current
Spray gas	Compressed air, 5-6 bar, min. 150 L/min
Atomization	2-fluid nozzle
Exhaust fan	variable speed
Material of construction	AISI316L for steel parts in contact with product AISI304L for steel parts not in contact with product
Connection voltage, frequency	380 V, 50 Hz
Heating	12 kW, PID controlled
Operating panel	touchscreen
Computer connection	data transfer with usb flash drive

2.2 Scope of Delivery

Unopex B 230 Pilot Scale Spray Dryer is delivered with complete standard parts.

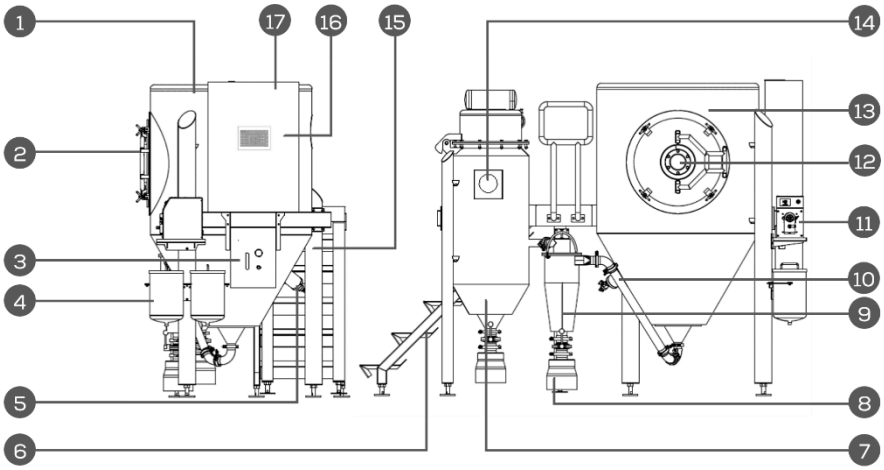
Delivered Unopex B 230 Pilot Scale Spray Dryer is suitable for spray drying feeds containing only WATER as solvent. DO NOT work with liquids containing any solvent other than water.

Delivered Unopex B 230 Pilot Scale Spray Dryer is suitable for working with only AIR as drying gas. DO NOT work with any gas other than air.

Use only genuine spare parts and genuine consumables ordered from Unopex to maintain warranty period, to assure continued system performance and reliability. Any modifications of the plant or any part need prior written permission of the manufacturer.

3. Description and Installation

3.1 Description of the Main Components



(1) 2-fluid nozzle
(2) manhole
(3) pneumatic board
(4) feeding vessel
(5) pneumatic hammer
(6) ladder for platform
(7) jet filter
(8) powder collecting vessel
(9) cyclone
(10) outlet temperature sensor
(11) peristaltic pump
(12) manhole sight glass
(13) spray drying chamber
(14) manometer for jet filter pressure
(15) inlet filter and drying air heater
(16) electrical panelboard
(17) inlet temperature sensor

3.2 In-plant Transportation

- Use a pallet jack or forklift for transport.
- Check the load bearing capacity of the transportation vehicle, route and the place of installation
- Store all the parts of the plant in a dry location. •
- Remove the packing material only at the place of installation.
- Protect the plant and any parts of it from transport damage.
- The original packaging has been designed for the transportation of the plant. Only the original packaging must be used for any possible further transport.

3.3 Un-packing

- Check for damage to the packaging. Damage can indicate property damage to the plant or any parts of it.
- Check for any transport damage when unpacking.
- If necessary, prepare a status report immediately and always contact your forwarding agent regarding the settlement of claims.
- Keep the original packaging for future transportation.

3.4 Ambient & Installation Conditions

Consider the ambient conditions under “Chapter 2.1”.

Take into consideration of the dimensions and weight of the plant. The space required for the spray drying plant will appear from the below drawing. Minimum 4 meters height is required.

Maintain wall and ceiling clearance for adequate air exchange (dissipation of waste heat, supply of fresh air for the plant and work area). Do not operate the plant in an inadequately dimensioned area.

Install the plant on a stable, horizontal surface where you can easily reach.

It would be of advantage to have a drain in the floor near the dryer, as water is used for cleaning.

INFORMATION	
	Use required sealing rings and gaskets for each connection and consider the correct mounting directions. Screw all threaded connections tightly. For disassembling proceed in reverse order.

3.5 Installation

- Carry and install the spray drying chamber with a rope tied from the supporting structure
- Attach supporting structure bolts (5 pcs) to the supporting legs.
- Connect the Heater with inlet filter to spray drying chamber.
- Attach the Ladder to the platform by means of bolts.
- Connect the Fan to the platform by means of bolts.
- Attach Cyclone to the platform by means of bolts.
- Connect ducts to the Chamber-Cyclone and Cyclone-fan, place the gaskets.
- Attach powder collecting vessel to the Cyclone.
- Attach the electrical panelboard to the supporting structure by means of bolts.
- Attach the pneumatic board to the supporting structure by means of bolts.

Installing the 2-fluid nozzle

- Insert the 2-fluid nozzle into the gap on top of the plant
- connect the feed tubing to FEED INLET (1) on the nozzle by means of screw coupling
- connect the atomizing air tubing to the ATOMIZING AIR (2) inlet on the nozzle by means of quick coupling
- connect the nozzle cleaner air tubing to NOZZLE CLEANER (3) inlet on the top of the nozzle by means of quick coupling
- for optional cooling/heating of the nozzle there are two additional connections (4, 5) which can be used with an external heating or cooling units (customer supply)

Connecting to the power supply

- ➢ External mains supply must meet the voltage and the current specified on the name plate
- ➢ Check for sufficient grounding.

INFORMATION

Additional electrical safety measures might be necessary to meet local laws and regulation!

External power or emergency stop switches must meet the requirements of the related standards, be accessible at any time and clearly labeled.

External connections and extension lines must be provided with a grounded conductor lead and power cords must meet the input power requirements.

Mains plug must be accessible at any time to cut the power in case of emergency by unplugging,

Connect the power cord (customer supply) to the mains supply meeting the proper voltage and current specified on the name plates. The mains circuit must handle the load of the connected plant and must be equipped with all electrical safety measures including proper grounding. After the installation, electrical safety tests are recommended to verify safe system condition such as sufficient grounding.

4. Operation

4.1 Installation Check Before Operation

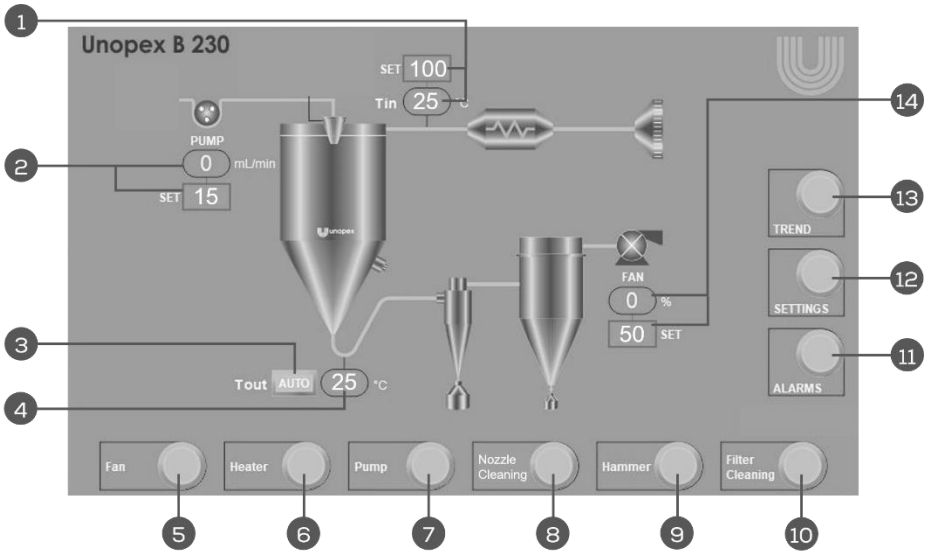
Carry out an installation check prior to spray drying process.

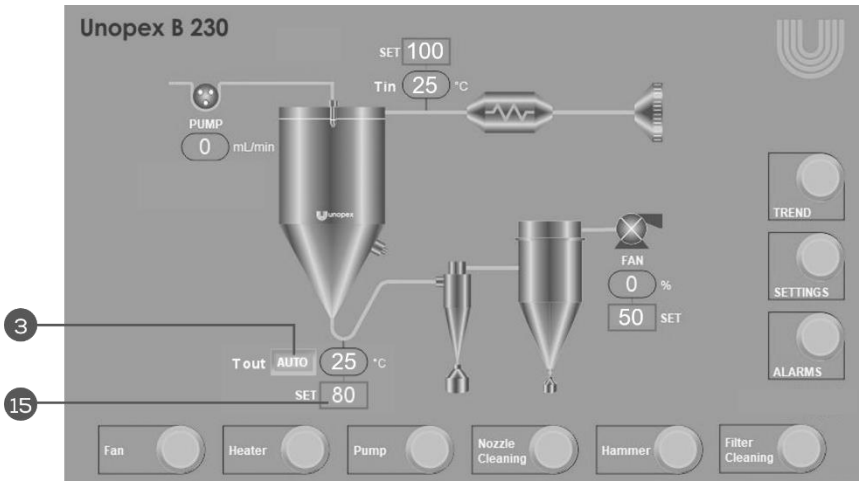
- Check the plant for correct assembling
- Check all bolts, sealings and tubes for good condition and tight connection
- Inspect all parts visually for possible damage
- Exchange worn out or defective parts or components immediately
- Check the electrical connections
- Make sure that product collection vessels are clean and dry, and have been connected to the cyclone and bag filter.
- Make sure that the inlet and outlet temperature probes have been inserted into the coupling.
- Make sure that the 2-fluid nozzle has been properly fitted and tubing connections are made. When working with the rotary atomizer instead of 2-fluid nozzle, make sure that the mechanical and electrical connections has been properly made.
- Make sure that all the duct connections have been made and all the bolts are screwed,
- Make sure that the spray dryer chamber manhole is closed and dampers on the cyclone and bag filter bottom outlets are opened.
- When the electric heater has been out of operation for a long period (minimum 3 weeks) the restarting may cause smaller leakage currents because of condensation in or on the insulation materials in the heating elements during the stand-still. The removal of this condensation should take place slowly, and this is done by successive increase of the temperature on the heating elements. Start of the electric heater should always take place in the following way:

  Heater is switched on the first time for not more than half a minute, it is switched off and after approximately 1 minute switched on again for half a minute. This is repeated a few times depending on the period the heater has been out of operation. Then the heater is switched on and off for longer and shorter periods respectively. After approximately 30 to 60 minutes, the heater becomes ready for continuous operation.

4.2 Operating Elements and Touchscreen Operating Panel

4.2.1 Introducing the Touchscreen Operating Panel

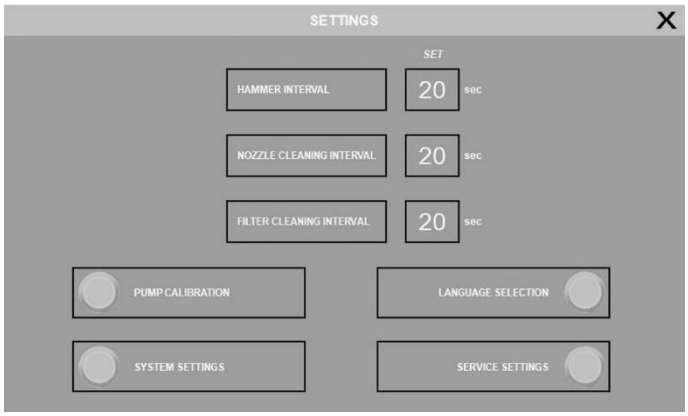




(1) set and display areas inlet temperature
(2) set and display areas peristaltic pump
(3) automatic control activation button for outlet temperature
(4) display area outlet temperature
(5) fan ON/OFF
(6) heater ON/OFF
(7) peristaltic pump ON/OFF
(8) nozzle cleaning ON/OFF
(9) pneumatic hammer ON/OFF
(10) filter cleaning ON/OFF
(11) button alarms page
(12) button settings page
(13) button trend page
(14) set and display areas fan output
(15) set area outlet temperature

INFORMATION When automatic control for outlet temperature (3) is activated, set area outlet temperature (14) appears on the touchscreen.

4.2.3 Settings



Calibrating the Pump Flow

Pump flow calibration process is very simple and takes short time.

Dip one end of the tubing into a beaker filled with distilled water and place the other end into an empty measuring cylinder. Place the tubing onto the pump bed and adjust the bed.

Press "SETTING" at home page on touchscreen operating panel and enter the "PUMP CALIBRATION" button. Use the following instructions on touchscreen operating panel for calibration of the pump.

Adjusting the Nozzle Cleaning Period

Automatic nozzle cleaning ensures trouble free spraying during operation. Typical set point for nozzle cleaning interval is 20 seconds. For more cleaning pushes, tab to SETTINGS page on the touchscreen operating panel and set lower numbers.

INFORMATION

If necessary, the password is defined as "111111", only authorized personnel should know the password.

4.2.4 Trend

Insert a usb flash drive onto the mobile control unit.

Tab to TREND page on the touchscreen operating panel, set recording period and start recording. Date, time, inlet temperature (°C), outlet temperature (°C), pump flow rate (mL/min) and air flow rate (%) will be displayed on the screen retrospectively. The data can be saved in csv file format into the flash drive by pressing "stop recording" and then "save to usb" on the touchscreen.

4.3 Starting a Spray Drying Process

1. Switch on the power.
2. On the touchscreen operating panel, turn on the fan. The fan default rate is 35%. Then set the fan to desired rate. (The rate of flow depends on the overall system pressure drop, exact volume flow could be measured with a suitable flow meter)
3. Set inlet and outlet temperatures.
4. Turn on heater. (Heater must be turned on while the fan is running)
5. Open compressed air supply valve.
   (oil-free dried compressed air, required piping and valves are supplied by customer)
6. Adjust pressure air regulator for nozzle atomizer:
   Typical set point is between 1.5 and 2.0 bar.
7. Adjust pressure air regulator for nozzle cleaning and hammer:
   Typical set point is 3 bar.
8. The process should start with distilled water to get steady process conditions.
9. Spray flow strongly influences the outlet temperature as water draws energy from the air by evaporation. When the present outlet temperature is near to the set temperature, set the pump flow to minimum value and turn on the pump in manual mode, distilled water feed will be sprayed into the spray chamber. Check that the spray flow is continuous and symmetrical, otherwise adjust the atomizing air pressure and pump flow rate. Manually adjust the pump flow until a constant outlet temperature is reached. Any variation in the amount of feed must be carried out in small steps.
10. Switch outlet temperature to auto mode. Outlet temperature will be kept constant at the set point automatically.
11. When the desired operating conditions are reached and have stabilized, switch from distilled water to the liquid feed. (Run at least 10 minutes on distilled water)
12. Set the nozzle cleaning period and turn on the nozzle cleaner.
13. Start hammer.

INFORMATION

The outlet temperature can be regarded as the upper thermal load of the product.
Do not allow the product to be damaged as a result of an excessively high outlet temperature.

INFORMATION

If it be necessary to stop the spray dryer suddenly, it is the most important that the pump is stopped immediately.

INFORMATION

The relevant parameters (Inlet temperature, outlet temperature, pump flow and fan rate) for the spray drying process depend on each other. For optimization; inlet temperature, outlet temperature, pump flow or fan rate need to be adjusted according to the requirements of the feed and the product.

4.4 Finishing a Spray Drying Process

1. Close the damper on the cyclone bottom outlet. Powder product is collected in powder collection vessel under the cyclone. It is important that this vessel is emptied before it is completely filled. Damper on the cyclone bottom outlet must be closed before emptying the powder collection vessel
2. At the end of the spray drying process, switch from the liquid feed to distilled water and continue to feeding for a short time to clean the tubing and the nozzle. (Run at least 10 minutes on distilled water)
3. Turn off the heater and nozzle cleaner.
4. Close compressed air supply valve and atomizing air supply valve.
5. Turn off the fan when the inlet temperature decreases below 90 °C. (If the exhaust fan is turned off on the touchscreen while the inlet temperature is above 90 °C, it will automatically continue to operate as soon as the inlet temperature decreases below 70 °C)
6. The product collection vessel now can be removed.

INFORMATION

Stop drying air flow before removing the product collection vessel. Otherwise, air stream might blow the product out of the product collection vessel.

Allow all hot parts to cool down before cleaning.

7. The power now can be switched off.

5. Cleaning - Maintenance and Repairs

In order to run the pilot spray dryer plant effectively, inspection and regular cleaning of all product contact parts should be done after each spray drying process. Never touch any component with sharp objects.

Check the housing for visible defects (switches, plugs, cracks, etc) and carefully clean it regularly with a damp cloth.

It is recommended to clean carefully the nozzle head and its components. The nozzle can be taken out and cleaned manually with water and mild soap solution or in an ultrasonic bath.

All sealings are recommended to be checked. When replacing the seals, take care not to damage any of them.

To prevent damaging the seals never touch them with sharp objects. To prolong the lifetime of the seals, rinse them routinely with water to avoid unwanted sample contamination to occur. Dry the cleaned seals with a soft, lint-free cloth.

The inlet filter element gets dirty over time depending on the ambient conditions and use. Do not use clogged filter element, wash it manually or replace it by a new one.

There is a differential pressure gauge mounted on the bag filter housing. If the pressure drop of the outlet filter increases by more than 500 Pa relative to the clean filter, take the filter bags out and wash them manually or replace them by new filters.

As cleaning media, mild soap solutions is recommended. After the application of this media, a careful washing with rinsing water must take place. Chlorine solutions must never be used.

After cleaning please make sure that the plant is assembled completely tight. Then dry all parts by leading hot air (60 – 80 °C) through the plant for 15 – 30 minutes before starting up.

Only specialists trained by the manufacturer may carry out service, repairs or maintenance work

5.1 Customer Service

Service and repair work on the plant must be performed with care by authorized personnel only. These authorized personnel have a comprehensive technical training and knowledge of possible dangers which might arise from the plant.

Contact Unopex customer service for spare parts delivery, repairs or technical advice. Contact information is given on the website www.unopex.com

6. Troubleshooting

Alarm Number	Alarm Description	Possible cause	Remedy
ARM101	Inlet temperature is too high, safety protection !	Inlet temperature above limit (> 260 °C) Inlet temperature below limit (< 260 °C)	Switch off the heater, alarm should disappear below 260 °C. Defective heating control or heating relay, contact the Unopex customer service
ARM102	Outlet temperature sensor failure !	Sensor not connected, defective sensor, sensor cable or internal wiring	Plug in the outlet temperature sensor correctly Switch off the device and try again Replace the outlet temperature sensor Contact the Unopex customer service
ARM103	Inlet temperature sensor failure !	Defective sensor, sensor cable or internal wiring	Switch off the device and try again Contact the Unopex customer service
ARM104	Frequency converter failure (pump) !	Defective frequency converter or wiring of pump	Contact the Unopex customer service
ARM105	Frequency converter failure (fan) !	Defective frequency converter or wiring of fan	Contact the Unopex customer service
ARM106	Emergency stop !	Emergency Stop Active	Release emergency stop
ARM107	Rotary atomizer failure !	Defective frequency converter or wiring of fan	Contact the Unopex customer service
ARM108	Wet scrubber pump failure !	Defective cable, internal wiring or wet scrubber pump	Switch off the device and try again Contact the Unopex customer service
ARM109	Wet scrubber water tank high limit alarm !	Liquid level in the tank is above operation limit	Decrease the liquid in the tank to proper level

Alarm Number	Alarm Description	Possible cause	Remedy
ARM110	Wet scrubber water tank low limit alarm !	Liquid level in the tank is below operation limit	Check fresh water supply valve Contact the Unopex customer service
ARM111	Inlet temperature is high !	Inlet temperature above limit (> 255 °C) Inlet temperature below limit (< 255 °C)	Switch off the heater, alarm should disappear below 255 °C. Defective heating control or heating relay, contact the Unopex customer service
ARM112	Fan connection failure !	Socket not connected, defective cable or internal wiring	Plug in the socket correctly Switch off the device and try again Contact the Unopex customer service
ARM113	Pump connection failure !	Socket not connected, defective cable or internal wiring	Plug in the socket correctly Switch off the device and try again Contact the Unopex customer service
ARM114	Pneumatic panel connection failure !	Socket not connected, defective cable or internal wiring	Plug in the socket correctly Switch off the device and try again Contact the Unopex customer service
ARM115	Heater connection failure !	Socket not connected, defective cable or internal wiring	Plug in the socket correctly Switch off the device and try again Contact the Unopex customer service
ARM116	Temperature sensor connection failure !	Socket not connected, defective cable or internal wiring	Plug in the socket correctly Switch off the device and try again Contact the Unopex customer service

INFORMATION Press ALARM RESET on the touch screen operating panel after each remedy.

7. Taking out of operation

Switch off the plant, remove the power cord, clean the plant thoroughly.

Store all parts of the plant in a dry location. For environmentally friendly disposal, do comply with all regional and local disposal regulations applicable for you.

Contact your local authorities for any questions concerning disposal

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