



Spray Dryer

Suitable for water soluble samples

Solvent Recovery Unit

Required for organic solvent samples

Economical System

ADL311SA
With GF300 Glassware set



Versatile System

GB210
Without glassware



GF300
For Spray Drying



GB210A
For Spray Drying



Selectable Glassware:



GF200
For Granulating



GB210B
For Granulating

Large Capacity System

DL410



GAS410
Organic Solvent Recovery Unit



Safe N₂ gas sealed circulation system

Spray Dryer

Compact & Economical

ADL311SA

Water evaporation rate Max. 1,300mL/h

Temp. control range 40~220°C

Sample flow Max. 26mL/min.

Spray nozzle (selectable) Nozzle for liquid Nozzle for gas

Customer benefit Low cost & economical

Easily micronize liquid samples with a spray dryer.



ADL311SA: For aqueous soluble samples
(When organic solvent is used, a GAS410 organic solvent recovery unit is required.)

- Easy setup, easy operation
- Suitable for heat sensitive samples. High heat is not directly applied to dry, fine powder.
- Obtain contaminant free fine powder which is not oxidized and contains minimal moisture.
- Direct drying of solution or solution liquid into fine powder. No pre- or post processes such as filtration, separation, or pulverization required.
- Safe and explosion free working is guaranteed in combination with GAS410 due to oxygen & pressure control.
- Organic solvents are recovered in a closed loop to protect the environment to enable minimized pollution.
- Easy operation with one-touch detachable mechanism for drying chamber and cyclone.
- An arm jack is equipped as standard for easy installation and removal of glassware attachments.
- A service outlet (max.2A) and a sample stand are equipped as standard for connecting a magnetic mixer for stirring suspended liquid samples.
- Unique peristaltic pump, nozzle cooling mechanism, pulse jet mechanism and a nozzle knocker for stable spray drying.
- ADL311SA is highly mobile on wheels, or usable with shorter height as a bench top unit by removing the movable caster.

Specifications

| Model | ADL311SA |
|---------------------------------------|---|
| Supported samples | Water soluble samples |
| Evaporated water amount | Max. 1300mL/h |
| Spraying system | Two-way nozzle, Nozzle No. 1A as standard (0.4μm) |
| Temp. adjusting unit setting range | 40 to 220°C (inlet temperature), 0 to 60°C (outlet temperature) |
| Temperature adjusting accuracy | Inlet temperature±1°C |
| Drying air amount adjusting range | 0 to 0.7m ³ /min |
| Spray air pressure adjusting range | 0 to 0.3MPa |
| Liquid sending pump flow rate range | 0 to 26 mL/min |
| Spray air line washing function | Spraying at the nozzle tip, manual pulse jet system |
| External output | Inlet temperature, outlet temperature, temperature outlet (4-20 mA) |
| Temperature adjusting device | PID digital temperature adjusting device |
| Touch panel | Blower, heater, liquid sending pump, pulse jet switch, error display |
| Control select switch | Inlet temperature, outlet temperature control switch (Outlet temp. control is conditional.) |
| Temperature sensor | K-thermocouple |
| Heater | 2.0kW(at200V) to 2.88kW(at240V) |
| Liquid sending pump | Fixed amount peristaltic pump |
| Spraying air pump | For water soluble samples air compressor is used (sold separately). For organic solvent samples the integrated compressor in GAS410 is used (no separate air compressor required). |
| Service outlet | For stirrer: AC115V, MAX2A |
| Suction blower | Bypass blower |
| Filter | Suction filter, exhaust filter |
| Recovery of solvent | Solvent recovery unit GAS410 (sold separately) is used. |
| Spray nozzle cooling mechanism | Connector: nipple x 2, O.D.:φ10.5 mm |
| Spray air connection diameter | Nipple diameter:φ7 mm |
| Spray air pressure | Bourdon tube: 0.3 MPa |
| Exhaust connecting diameter | φ50mm |
| Safety function | Inlet/outlet temperature overheat, sample feed reverse rotation mechanism, over current electric leakage breaker, nozzle connection error |
| External size | W580 x D420 x H1,125 mm |
| Weight | 80kg |
| Power supply (50/60 Hz) rated current | AC220V 17A, AC240V 18A Switching of terminals necessary |
| Accessories | Silicon tubes (with a stopper) x 3, exhaust duct (with one hose band) x 1, outlet temperature sensor, spray air tube, sample box, static electricity removal earth, "Tetron" braided tube hose 5m (with two hose bands) |

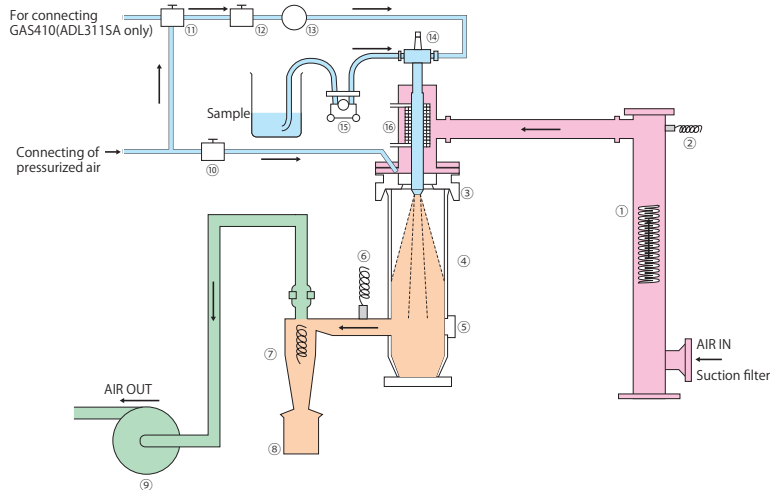


Example of installation: ADL311SA + GAS410

Control Panel

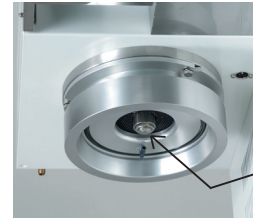


Diagram



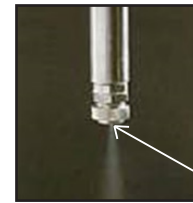
| No. | Part name | No. | Part name |
|-----|------------------------------|------|--|
| (1) | Heater | (9) | Blower |
| (2) | Inlet temperature sensor | (10) | Solenoid valve |
| (3) | Distributor | (11) | 3-way solenoid valve (ADL311SA only) |
| (4) | Drying chamber | (12) | Needle valve |
| (5) | Cap | (13) | Pressure meter |
| (6) | Outlet temperature sensor | (14) | Spray nozzle |
| (7) | Cyclone | (15) | Liquid sending pump |
| (8) | Product collecting container | (16) | Nozzle cooling mechanism connecting port |

Spraying Nozzle



The tip of the nozzle comprises of a nozzle for liquid and a nozzle for gas.

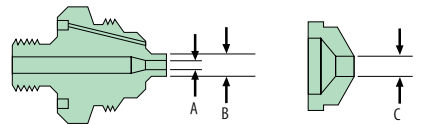
Two-way nozzle system



Easy to take apart for cleaning to prevent contamination

Nozzle for liquid(F)

Nozzle for gas(A)



| Model | Nozzle No. | Size (μm) | Particle size |
|------------------|------------|-----------------|---------------|
| 1A (Standard) | (F)1650 | A 406 B 1270 | 1~40μm |
| | (A)64 | C 1626 | |
| | (F)2050 | A 508 B 1270 | |
| 1 | (A)64 | C 1626 | 5~40μm |
| | (F)2050 | A 508 B 1270 | |
| 2A | (A)70 | C 1778 | 5~50μm |
| | (F)2050 | A 508 B 1270 | |
| 2 | (A)70 | C 1778 | 10~40μm |
| | (F)2850 | A 711 B 1270 | |
| 3 | (A)64 | C 1626 | 10~50μm |
| | (F)2850 | A 711 B 1270 | |

Particle sizes may vary on samples used and parameter settings.

Piping



ADL311SA+GAS410

Optional items

| Product Name | Product Code |
|--|--------------|
| Fine powder recovery cyclone | 212780 |
| Safety cover | 212784 |
| Static removal brush set | 212788 |
| Viton packing for cyclone inlet/outlet (1 set of 2 types) | 212781 |
| Teflon packing for cyclone inlet/outlet (1 set of 2 types) | 212782 |
| Airfilter + Mist separator + Regulator set | Contact us |
| Supply air filter box (for 0.3 micro meter collection) | 212790 |
| Air compressor | Contact us |

Applications

- Food and medicinal products
Powdered milk, egg yolks, soy sauce, coffee, starches, proteins, hormones, serums, antibiotics, enzymes, fragrances, essences, etc.
- Organic chemistry
Waxes, dyes, cleaning agents, surface acting agents, agricultural chemicals, antiseptic agents, synthesized resins, pigments, etc.
- Inorganic chemistry
Ferrites, ceramics, photocopy toners, magnetic tapes materials, photosensitive materials, various industrial chemicals, waste fluid samples, etc.

Example of implementation (spray dryer ADL311SA)

| Sample name | Composition (%) | Inlet temp. (°C) | Outlet temp. (°C) | Dry air amount (m ³ /min) | Spray air pressure (MPa) | Sent amount of sample liquid (g/min) | Sample recovery rate (%) |
|--------------------------------------|-----------------|------------------|-------------------|--------------------------------------|--------------------------|--------------------------------------|--------------------------|
| Dextrin (solution) | 10 | 150 | 80 | 0.4 | 0.1 | 6.1 | 66 |
| Dextrin (emulsion) | 40 | 150 | 80 | 0.4 | 0.1 | 5.1 | 63 |
| Oxidized titanium (suspended liquid) | 10 | 150 | 85 | 0.42 | 0.1 | 5.3 | 50 |
| Soy sauce | 50 | 130 | 75 | 0.36 | 0.1 | 5.1 | 60 |
| Salt | 10 | 145 | 85 | 0.38 | 0.1 | 5.3 | 52 |

Repeatability of spray drying test (spray dryer ADL311SA)

| Test No. | Sample Name | Sample Density (%) | Drying conditions | | | | | Test sample amount (g/min) | Sent amount of sample liquid (g/min) | Test Time (min) | Yield (g) | Recovery Rate (%) |
|----------|-----------------|--------------------|-------------------|-------------------|--------------------------------------|--------------------------|----------------------------|----------------------------|--------------------------------------|-----------------|-----------|-------------------|
| | | | Inlet temp. (°C) | Outlet temp. (°C) | Dry air amount (m ³ /min) | Spray air pressure (MPa) | Test sample amount (g/min) | | | | | |
| 1 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 0.15 | 93.1 | 3.1 | 30 | 4.3 | 92.4 | |
| 2 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 0.15 | 93 | 3.1 | 30 | 4 | 86 | |
| 3 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 0.15 | 91.4 | 2 | 30 | 4 | 87.5 | |
| 4 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 0.15 | 84.9 | 2.8 | 30 | 3.7 | 87.2 | |
| 5 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 0.15 | 83.8 | 2.8 | 30 | 3.7 | 88.3 | |

Solvent Recovery Unit

Highly safe N₂ gas sealed circulation system

GAS410

Circulation flow 0.12 to 0.65m³/min

Recovery capacity 1,300ml/h or more

Cost savings With integrated freezer
With integrated compressor

Organic Solvent Recovery System used in conjunction with Spray Dryers



The Organic Solvent Recovery unit is used to prevent external discharge when combined with a spray dryer (ADL311SA or GB-210A) when using an organic solvent.

- Dehumidifier (Freezer) integrated in GAS410. No extra Freezer/dehumidifier equipment needed.
- Compressor included, no need for a separate compressor to operate the spray dryer ADL311SA when using organic solvent samples.
- Flammable or toxic solvents can be processed by combining a N₂ gas sealed circulation system and a solvent recovery system (with freezer and capacitor).
- Explosion safety with closed loop N₂ inert gas system.
- Recovery of solvent to protect the environment and enable minimized pollution.
- Drying of easily oxidized materials is possible.
- Supports low temperature drying of materials that easily deform with heat.
- No freezing risk due to organic solvent with aqueous solution mixtures which could cause damage to the closed loop GAS410 system.
- Spray drying and recovery of products and solvents are performed with meticulously devised safety measures.

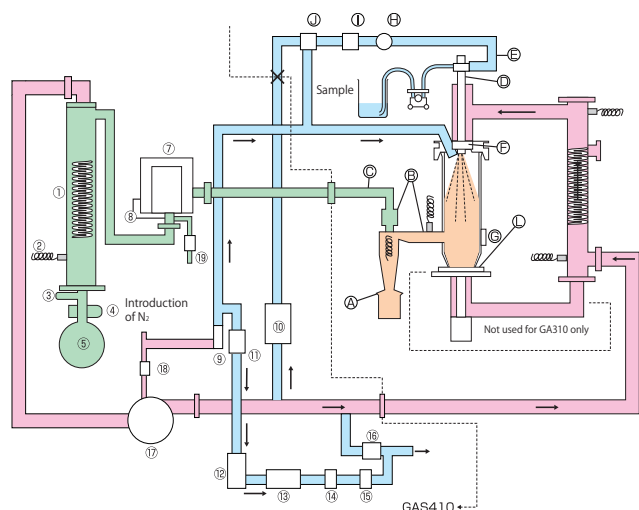


Example of installation: ADL311SA + GAS410

Specifications

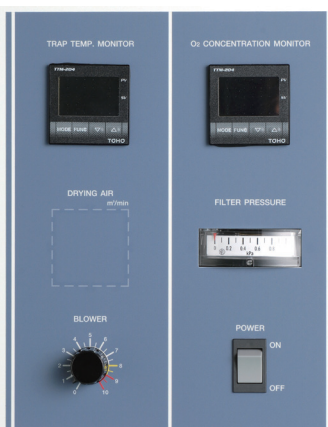
| Model | GAS410 |
|---------------------------------------|--|
| Solvent recovery system | Capacitor + freezer |
| Circulating gas | N ₂ gas (sealed circulation when connected to ADL311SA or GB-210A) |
| Circulating volume flow | 0.12 to 0.65m ³ /min |
| Compressor (for spraying) | Linear compressor integrated |
| Circulation blower | Roots blower |
| Solvent recovery container | 2L flask |
| Freezer | Air-cooled condensation full-sealed type: 400W R404A |
| Solvent recovery mechanism | Capacitor cooling mechanism |
| Filter | Cartridge filter |
| Instruments | Cooling trap temperature display monitor Filter differential pressure meter (monitor for clogging of filter) O ₂ density display monitor Blower wind amount adjusting volume |
| O ₂ Sensor | Solid electrolyte (Zirconium) limit current type |
| Pump | For circulation to measure Oxygen |
| Safety function | O ₂ density meter, flammable gas alarm, electric leakage breaker, N ₂ gas forced introduction (when removing nozzles) |
| External size | W700 x D950 x H1,500 mm |
| Weight | Approx. 130 kg |
| Power supply (50/60 Hz) rated current | AC200 to 240V 5A(15A) |
| Required N ₂ amount | 15 L/h at 0.1 MPa |
| Accessories | Set of connection parts, anti-seismic clamps, interface cable, sample gas for gas alarm inspection, 2L flask |

Diagram



| No. | Part name | No. | Part name |
|------|--|-----|--------------------|
| (1) | Capacitor | A | O ring |
| (2) | Sensor | B | Packing |
| (3) | Ball valve | C | Hose |
| (4) | Clamp | D | Spray nozzle |
| (5) | Recovery flask | E | Tube |
| (6) | Filter element | F | Aluminum honeycomb |
| (7) | Filter case | G | Cap |
| (8) | Differential pressure meter | H | Pressure meter |
| (9) | Flow meter (for introduction of N ₂) | I | Needle valve |
| (10) | Compressor | J | 3-way valve |
| (11) | Solenoid valve (for N ₂ control) | K | Solenoid valve |
| (12) | Flow meter (for measuring O ₂ density) | L | Packing |
| (13) | Filter | | |
| (14) | Pump | | |
| (15) | O ₂ Sensor | | |
| (16) | Solenoid valve (for exhaust) | | |
| (17) | Blower | | |
| (18) | Solenoid valve (for introduction of N ₂) | | |
| (19) | Solenoid valve (for air supply) | | |

Control Panel



Major control functions and detection function

- Closed system (N₂ gas sealed circulation type)
- O₂ density control function
- Flammable gas detection function
- Inlet temperature overheat detection function
- Outlet temperature overheat detection function
- In case of an abnormality, the alarm sounds and liquid flow stops.
- Other self diagnostics functions
 - Detection of temp. sensor disconnection
 - Overheat prevention
 - Detection of absence of spray nozzle

Fields



- Non-oxide ceramics
- Polymer material
- Super conductivity materials
- Medicinal products
- Food products
- Material research

Connection



Rear of GAS410



ADL311SA + GAS410 + stand with caster wheels

Optional items

| Product name | Product code |
|--|--------------|
| Filter element 0.1μ | 212785 |
| Viton packing for cyclone inlet/outlet (1 set of 2 types) | 212781 |
| Teflon packing for cyclone inlet/outlet (1 set of 2 types) | 212782 |
| Dry air flow meter (differential pressure type)* | 212786 |

* The item marked "*" shall be ordered together with the main unit.

Spray Dryer Pulvis Mini Spray

Supports spray drying of fine powder of 1 μ m

GB-210A

Evaporated water Max. 1,300ml/h

Temp. control range 40 to 220°C

Sample flow Variable up to 26ml/min

Spray nozzle (selectable) Nozzle for liquid Nozzle for gas

Capable of drying ultra small samples as low as 0.5g of solid content.

Can spray dry into fine powder 1 μ m in size when optional mini cyclone is used.



Compact spray dryer that can produce powder easily on a laboratory scale. It is capable of variety of applications from preliminary experiments in a pilot plant to drying work in general laboratories.

- Samples unstable at high temperatures can be reliably processed into fine powder. The heat is applied instantly and indirectly to the powder itself.
- Prepared fine powder will not be oxidized, contains minimal moisture and is contaminant-free.
- Direct drying from solution/suspension liquid to fine powder with a reduced risk of contamination. No pre or post processes such as filtration, separation, or pulverization are required.
- Processing of samples containing organic solvents is made possible by connecting the Solvent Recovery Unit GAS410.
- This unit can also be used as a fluid bed drying granulator by installing a separate mini bed attachment GF200 instead of GF300 spray drying attachment.
- An automatic lift is equipped as standard to enable easy installation or removal of glass drying chamber attachment.
- A service outlet (max. 2A) and a sample stand are equipped as standard for connecting a magnetic mixer for stirring suspended liquid sample.
- Stable spray drying using a unique peristaltic pump, nozzle cooling mechanism, pulse jet mechanism and a nozzle knocker enable stable spray drying.

Specifications

| Model | GB-210A |
|--------------------------------------|---|
| Temp. adjusting unit setting range | 40 to 220deg.C (inlet temperature), 0 to 60deg.C (outlet temperature) |
| Temperature adjusting accuracy | Inlet temperature \pm 1deg.C |
| Spraying system | Two-way nozzle, Nozzle No. 1A as standard |
| Drying air amount adjusting range | 0 to 0.7m ³ /min |
| Spray air pressure adjusting range | 0 to 0.3MPa |
| Liquid sending pump flow rate range | 0 to 26 ml/min |
| Spray air line washing function | Spraying at the nozzle tip, manual pulse jet system |
| External output | Inlet temperature, outlet temperature, temperature outlet (4-20 mA) |
| Automatic lift | Moving up/down of glass chamber automatic lift |
| Temperature adjusting device | PID digital temperature adjusting device |
| Touch panel | Blower, heater, liquid sending pump, pulse jet switch, error display |
| Control select switch | Inlet temperature, output temperature control switch (outlet temp. control is conditional) |
| Temperature sensor | K-thermocouple |
| Heater | 2.0 kW (at 200V) to 2.88 kW (at 240V) |
| Liquid sending pump | Fixed amount peristaltic pump |
| Spraying air pump | Spraying air compressor (sold separately) is used. |
| Service outlet | For stirrer: AC100V, Max. 2A |
| Suction blower | Bypass blower, brushless DC motor |
| Filter | Suction filter, exhaust filter |
| Recovery of solvent | Solvent recovery unit GAS410 (sold separately) is used. |
| Spray nozzle cooling mechanism | Connector: nipple x 2, O.D.: ϕ 10.5 mm |
| Spray air connection diameter | Nipple diameter: ϕ 7 mm |
| Exhaust connecting diameter | ϕ 50mm |
| Safety function | Inlet/outlet temperature overheat, sample feed reverse rotation mechanism, over current electric leakage breaker, nozzle connection error |
| External size | W760 x D420 x H1,350 mm |
| Weight | 110kg |
| Power supply (50/60Hz) rated current | AC220V 17A, AC240V 18A, Switching of terminals necessary |
| Accessories | Silicon tube (with a stopper) x 3, tiron tube (with a stopper) x 2 exhaust duct (with one hose band) x 1, outlet temperature sensor, spray air tube, sample box, static electricity removal earth, Teflon braided hose 5m (with two hose bands), a container table |

Control Panel

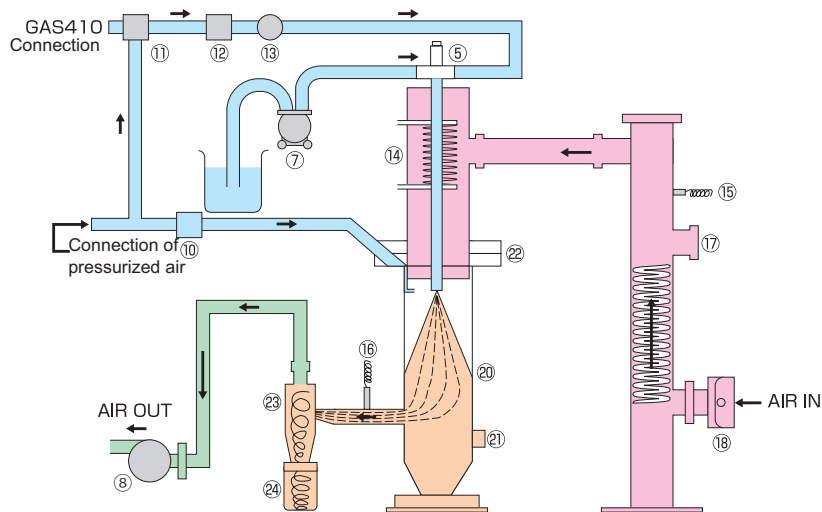


Inlet temperature, outlet temperature, and drying air amount are digitally displayed. Setting is made on the touch panel that allows operation settings, operation status display

as well as error display, and settings of various operation conditions.

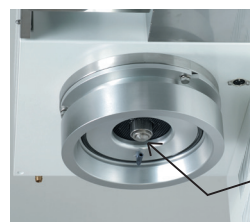
| | |
|-------------------------|--|
| Mini spray attachment | GF300 |
| Evaporated water amount | MAX1300mL/h |
| Sample for drying | Suspended solution, emulsion |
| Ultra hard glass | Cyclone, drying chamber, product container |

Diagram



| No. | Part name | No. | Part name |
|------|--------------------------|------|--------------------------------|
| (1) | Heater | (16) | Outlet temperature sensor |
| (5) | Spray nozzle | (17) | Blind |
| (7) | Liquid sending pump | (18) | Suction port, suction filter |
| (8) | Blower, exhaust filter | (19) | Nozzle cooling connection port |
| (10) | Solenoid valve | (20) | Drying chamber |
| (11) | 3-way solenoid valve | (21) | Cap |
| (12) | Needle valve | (22) | Distributor |
| (13) | Pressure meter | (23) | Cyclone |
| (14) | Nozzle cooling port | (24) | Product collecting container |
| (15) | Inlet temperature sensor | | |

Spraying Nozzle



The tip of the nozzle comprises of a nozzle for liquid and a nozzle for gas.

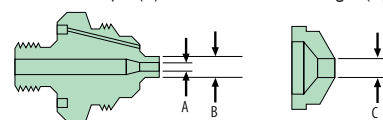
Two-way nozzle system



Easy to take apart for cleaning to prevent contamination

Nozzle for liquid(F)

Nozzle for gas(A)



| Model | Nozzle No. | Size (μm) | Particle size |
|------------------|------------|-----------------|---------------|
| 1A (Standard) | (F)1650 | A 406 B 1270 | 1~40μm |
| | (A)64 | C 1626 | |
| | | | |
| 1 | (F)2050 | A 508 B 1270 | 5~40μm |
| | (A)64 | C 1626 | |
| | | | |
| 2A | (F)2050 | A 508 B 1270 | 5~50μm |
| | (A)70 | C 1778 | |
| | | | |
| 2 | (F)2850 | A 711 B 1270 | 10~40μm |
| | (A)70 | C 1778 | |
| | | | |
| 3 | (F)2850 | A 711 B 1270 | 10~50μm |
| | (A)64 | C 1626 | |
| | | | |

Particle sizes may vary on samples used and parameter settings.

Applications



- Food and medicinal products: Powdered milk, egg yolks, soy sauce, coffee, starches, proteins, hormones, serums, antibiotics, enzymes, fragrant materials, essences, etc.
- Organic chemistry: Waxes, dyes, cleaning agents, surface acting agents, agricultural chemicals, antiseptic agents, synthesized resins, pigments, etc.
- Inorganic chemistry: Ferrites, ceramics, photocopy toners, magnetic tape materials, photosensitive materials, various industrial chemicals, waste fluid of samples, etc.

Optional items

| Product name | Product code |
|---|--------------|
| Fine grain sample collecting cyclone | 212780 |
| Safety cover | 212784 |
| Static removal brush set | 212788 |
| Air filter + Mist separator + Regulator set | Contact us |
| Supply air filter box (for 0.3 μm collection) | 212791 |

Handling



The one touch removal system has made the removal and cleaning of the drying chamber, the cyclone, and the product container much easier.



Solvent Recovery Unit GAS410

Repeatability of spray drying test

| Test No. | Sample name | Sample density (%) | Drying conditions | | | | Test sample amount (g) | Sent amount of sample liquid (g/min) | Test time (min) | Yield (g) | Recovery rate (%) |
|----------|-----------------|--------------------|-------------------|-------------------|--------------------------------------|---|------------------------|--------------------------------------|-----------------|-----------|-------------------|
| | | | Inlet temp. (°C) | Outlet temp. (°C) | Dry air amount (m ³ /min) | Spray air pressure kPa(kg/cm ²) | | | | | |
| 1 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 198 | 6.6 | 30 | 8.1 | 81.8 |
| 2 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 198.7 | 6.6 | 30 | 8.1 | 81.5 |
| 3 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 200.6 | 6.7 | 30 | 8 | 79.8 |
| 4 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 198.1 | 6.6 | 30 | 8.2 | 82.8 |
| 5 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 199.3 | 6.6 | 30 | 8.4 | 84.3 |

Spray Dryer Pulvis Mini Bed

Spray Dryer (For Granulating, Drying, Mixing)

GB-210B

Processing capacity 50g to 300g

Temp. control range 40 to 220°C

Sample flow Variable up to 26ml/min

Spray nozzle (selectable) Nozzle for liquid Nozzle for gas

Spray dryer capable of granulating and drying wet powder.



Designed to granulate powder and dry wet powder using a fluid bed. This is a fluid bed drying granulator used in combination with the basic unit GB210 and Mini-bed attachment GF200.

- Conditions such as hot air temperature, air amount, binder liquid flow amount can be set easily with the setting dial on the front of the unit.
- The chamber is made of ultra hard glass and the user can observe status of the fluid bed or spraying status. Also, the flowage meter, the spraying pressure meter, the chamber inlet/outlet temperature indicator are useful for evaluation of data.
- The unit can also be used as a spraying dryer by installing the mini spray attachment GF300 (optional).
- The unit has an automatic lift as a standard to enable convenient installation or removal of the glass chamber attachment.

Control Panel



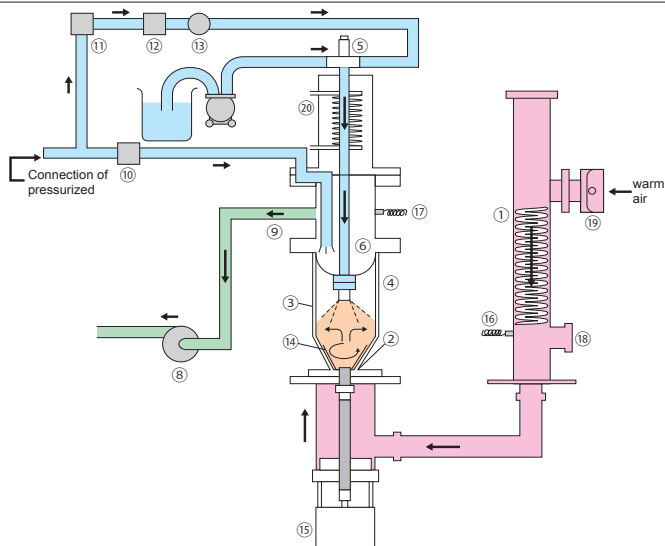
Inlet temperature, outlet temperature, and drying air amount are digitally displayed. Setting is made on the touch panel that allows operation status display as well as error display, and settings of various operation conditions.

Specifications

| Model | GB-210B |
|--------------------------------------|---|
| Temp. adjusting unit setting range | 40 to 220deg.C (inlet temperature), 0 to 60deg.C (outlet temperature) |
| Temperature adjusting accuracy | Inlet temperature±1°C |
| Spraying system | Two-way nozzle, Nozzle No. 1A as standard |
| Drying air amount adjusting range | 0 to 0.7m ³ /min |
| Spray air pressure adjusting range | 0 to 0.3MPa |
| Liquid sending pump flow rate range | 0 to 26mL/min |
| External output | Inlet temperature, outlet temperature, temperature outlet (4-20 mA) |
| Automatic lift | Moving up/down of glass chamber automatic lift |
| Temperature adjusting device | PID digital temperature adjusting device |
| Touch panel | Blower, heater, liquid sending pump, pulse jet switch, error display |
| Control select switch | Inlet temperature, output temperature control switch (outlet temp. control is conditional) |
| Temperature sensor | K-thermocouple |
| Heater | 2.0 kW (at 200V) to 2.88 kW (at 240V) |
| Liquid sending pump | Fixed amount peristaltic pump |
| Spraying air pump | Spraying air compressor (sold separately) is used. |
| Service outlet | For stirrer: AC100V, Max. 2A |
| Suction blower | Bypass blower, brushless DC motor |
| Filter | Suction filter, exhaust filter |
| Spray nozzle cooling mechanism | Connector: nipple x 2, O.D.:φ10.5 mm |
| Spray air connection diameter | Nipple diameter:φ7 mm |
| Exhaust connecting diameter | φ50 mm |
| Safety function | Inlet/outlet temperature overheat, sample feed reverse rotation mechanism, over current electric leakage breaker, nozzle connection error |
| External size | W760 x D420 x H1,350 mm |
| Weight | Approx. 110 kg |
| Power supply (50/60Hz) rated current | AC220V 17A, AC240V 18A, Switching of terminals necessary |
| Accessories | Silicon tube (with a stopper) x 3, tiron tube (with a stopper) x 2, exhaust duct (with one hose band) x 1, outlet temperature sensor, spray air tube, sample box, static electricity removal earth, Teflon braided hose 5m (with two hose bands), a container table |

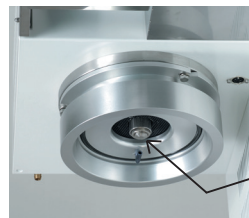
| Mini bed attachment | GF200 |
|-----------------------------|---|
| Processing capacity | 50 to 300g (It differs depending on whether the unit is of the batch type or specific samples used.) |
| Flow layer chamber capacity | 3L |
| Spray nozzle | Dual fluid nozzle: 1A standard |
| Stirring blades | Integrated inside the flow layer chamber |
| Filter | Polyester (Carbon fiber mixed PTFE membrane laminate) |
| Filter cleaning mechanism | Pulse jet system |
| Glass parts | Ultra hard glass |
| Weight | Approx. 13 kg |

Diagram



| No. | Part name | No. | Part name |
|------|---------------------|------|--------------------------------|
| (1) | Heater | (11) | 3-way solenoid valve |
| (2) | Micro porous plate | (12) | Needle valve |
| (3) | Flow layer chamber | (13) | Pressure meter |
| (4) | Filter chamber | (14) | Stirring blades |
| (5) | Nozzle | (15) | Stirring motor |
| (6) | Filter | (16) | Inlet temperature sensor |
| (7) | Liquid sending pump | (17) | Outlet temperature sensor |
| (8) | Blower | (18) | Blind |
| (9) | Interim pipe | (19) | Suction port, suction filter |
| (10) | Solenoid valve | (20) | Nozzle cooling connection port |

Spraying Nozzle



The tip of the nozzle comprises of a nozzle for liquid and a nozzle for gas.

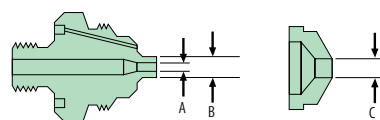
Two-way nozzle system



Easy to take apart for cleaning to prevent contamination

Nozzle for liquid(F)

Nozzle for gas(A)



| Model | Nozzle No. | Size (μm) | Particle size |
|------------------|------------|-----------------|---------------|
| 1A (Standard) | (F)1650 | A 406 B 1270 | 1~40μm |
| | (A)64 | C 1626 | |
| 1 | (F)2050 | A 508 B 1270 | 5~40μm |
| | (A)64 | C 1626 | |
| 2A | (F)2050 | A 508 B 1270 | 5~50μm |
| | (A)70 | C 1778 | |
| 2 | (F)2850 | A 711 B 1270 | 10~40μm |
| | (A)70 | C 1778 | |
| 3 | (F)2850 | A 711 B 1270 | 10~50μm |
| | (A)64 | C 1626 | |

Particle sizes may vary on samples used and parameter settings.

Applications



- Granulation, drying, mixing of powder
- Applications:
Medicines, food, catalyst, die, detergent, ceramics, etc.

The unit accepts sample weight as less as 50 to 300g and is suitable for experiments of expensive samples or those of a laboratory level.

Handling



Use of the one touch removal system has made removal or cleaning of the drying chamber, cyclone or the product container much easier.

Optional items

| Product name | Product code |
|--|--------------|
| Safety cover | 212784 |
| Viton packing for cyclone inlet/outlet (1 set of 2 types) | 212781 |
| Teflon packing for cyclone inlet/outlet (1 set of 2 types) | 212782 |
| Air filter + Mist separator + Regulator set | Contact us |
| Supply air filter box (for 0.3 μm collection) | 212791 |

Example of implementation

| Sample | | Binder | | Testing conditions | | | | | | Result | |
|--------------------------|------------|----------|-------------|--------------------|------------------|-----------------------------|--|-----------------|--------------------|-------------------|----------------------------------|
| Name | Weight (g) | Name | Density (%) | Spray amount (g) | Inlet temp. (°C) | Liquid sending speed(g/min) | Spraying pressure kPa(kg/cm ²) | No. of spraying | Nozzle height (cm) | Average dia. (μm) | 12 to 115 mesh recovery rate (%) |
| Silicon | 200 | PVA | 5.0 | 77 | 125 | 15 | 59(0.6) | 4 | 27 | 339 | 58 |
| Oxidized iron | 160 | PVA | 2.5 | 50 | 120 | 15 | 98(1.0) | 4 | 21 | 205 | 62 |
| Ceramics | 200 | PVA | 3.0 | 106 | 120 | 15 | 78(0.8) | 3 | 22 | 404 | 82 |
| Alumina | 160 | PVA | 3.0 | 60 | 110 | 15 | 59(0.6) | 4 | 22 | 311 | 88 |
| Silica | 150 | CMC | 1.0 | 100 | 120 | 15 | 78(0.8) | 4 | 22 | 306 | 60 |
| Lactose | 200 | Sorbitol | 70.0 | 10 | 100 | 14 | 98(1.0) | 4 | 25 | 390 | 80 |
| Tea essence | 250 | Guar gum | 0.5 | 24 | 85 | 6 | 59(0.6) | 10 | 28 | 333 | 77 |
| Grease containing powder | 200 | Glucose | 30.0 | 11 | 85 | 4 | 59(0.6) | 7 | 22 | 236 | 82 |

*The average granule diameter is a geometric average.

Spray Dryer

Fine powder: 40 to 100µm with larger capacity

DL410

| | | | | | | | | | |
|------------------|----------------|---------------------|-------------|-------------|--------------------------|---------------------------|----------------|-----------|----------------|
| Evaporated water | Max. 3,000mL/h | Temp. control range | 40 to 300°C | Sample flow | Variable up to 70ml/min. | Spray nozzle (selectable) | Two-way nozzle | Operation | Easy operation |
|------------------|----------------|---------------------|-------------|-------------|--------------------------|---------------------------|----------------|-----------|----------------|

Spray drying of fine powder as small as 100µm with a high recovery rate.



This spray dryer can produce fine particles from 40 to 100µm which are considered to be extremely difficult to produce in laboratories. It is useful for preliminary tests for pilot plant or expensive samples, micro capture spray drying research, substitute for general laboratory drying method etc.

The DL410 is a larger capacity spray dryer that also does not require the liquid sample or solution to undergo any pre or post-processes such as filtration, separation, or pulverization. The use of organic solvents is fully supported with the attachment of our GAS410 organic solvent recovery unit. Small, expensive and/or heat sensitive samples can be dried quickly and efficiently with this easy to operate system.

- Processes samples as small as 0.5 g of solid matter
- Safe for heat-sensitive samples, such as food or medical products
- No risk of contamination
- Digital display of inlet/outlet temperature and drying air volume
- Detachable drying chamber, cyclone and product vessel
- Fast and easy clean up
- Universal power supply and multilingual touch screen controller

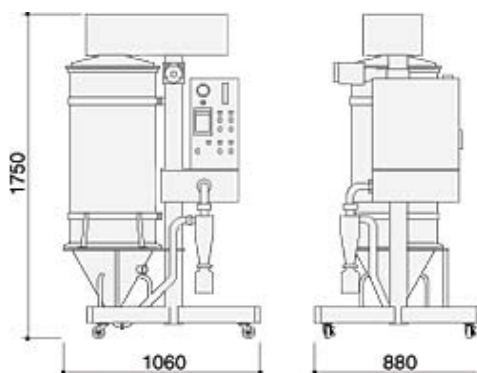
Easy operation and maintenance

- The hot air inlet and drying chamber cover automatically move up and down, and since the cyclone and product vessel can easily be removed, cleaning and maintenance after your experiment is easy.
- Control functions are conveniently arranged on the control panel for various conditions.
- The temperature recorder, air flow meter, pressure gauge and other measurements allow easy control of experiment conditions.

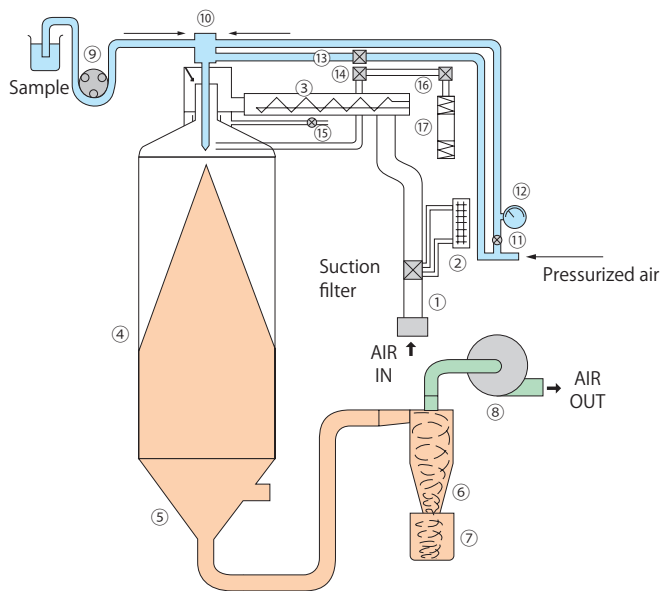
Specifications

| Model | DL410 |
|--|---|
| Water Evaporation Rate | Max. approx. 3,000 ml/h |
| Temperature Control Range | 40°C - 300°C at inlet |
| Temperature Control Accuracy | ± 1°C at inlet |
| Dry Air Flow Rate | Max. 1.2 m ³ /min |
| Air Spray Pressure Control Range | 0 - 600 k Pa (0-6 kg/cm ²) |
| Spraying system | Two-way nozzle (Dia. of orifice: 0.7mm) Nozzle No.3 standard supply |
| Spray/hot air contact system | Downward spray parallel flow system |
| Temperature Controller | PID digital temperature controller |
| Temperature Sensor | K thermocouple |
| Stainless Pipe Heater | 2kW x 2 at 240V |
| Sample Liquid Feeding Pump | Quantitative peristaltic pump, flow rate variable up to 70ml/min. |
| Solvent Recovering Capability (option) | Organic solvent recovery unit GAS410 must be used |
| Spray Line Cleaning | Needle inside the nozzle to clean the mesh automatically |
| Safety Devices | Self-diagnostic functions (e.g. temperature aberration); Sample feed reversal |
| Air Spray Pressure Gauge | Bourdon tube: 600k Pa (6 kg/cm ²) |
| External Dimensions (W x D x H) | 1750 x 1060 x 880 mm or 69 x 42 x 35 in |
| Weight | 180 kg or 397 lbs |
| Power Supply | AC 200V - 240V, single-phase 24 A |
| Included Accessories | |
| Sample liquid tube | Silicone tube - 2 pcs |
| Safety Cover | Yes |
| Static removal brush | 1pc |
| Air hose | 1 pc |
| Exhaust Duct | 1 pc |
| Optional Accessories | |
| Organic Solvent Recovery Unit | GAS410 |
| Inlet/outlet Temperature Recorder | 212792 - factory installed |
| Viton/Tiron Feeding Tube | Please inquire |
| Nozzle | 4, 5 (options), 3 standard |
| Compressed Air | 28 L/min air volume and 8 kgf/cm ² compressed air is required |
| Type of Gas | N ₂ gas (99.99% purity, medical grade) is required when using GAS410 |

Dimensions (Unit:mm)

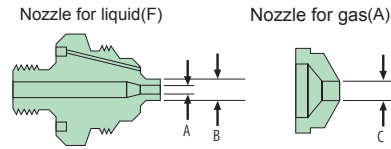


Diagram



- | | |
|-------------------------------|---------------------------------------|
| (1) Orifice tube | (10) Atomizing nozzle |
| (2) Drying air flow meter | (11) Atomizing pressure control valve |
| (3) Heater | (12) Atomizing pressure gauge |
| (4) Drying chamber | (13) Needle knock Solenoid valve |
| (5) Drying chamber lower half | (14) Nozzle blower Solenoid valve |
| (6) Cyclone | (15) Cool air control valve |
| (7) Product vessel | (16) Head elevation control valve |
| (8) Aspirator | (17) Air cylinder for head elevation |
| (9) Sample feed pump | |

Spraying Nozzle



Spraying Nozzle size (μm)

| Model | Nozzle No. | Size (μm) | Particle size |
|-----------------|------------|----------------------------|---------------|
| 3 (Standard) | (F)2850 | A 711 B 1270 | up to 50μm |
| | (A)64.5 | C 1638 | |
| | (F)60100 | A 1530 B 2550 C 3060 | |
| 4 | (F)60100 | A 1530 B 2550 C 3060 | 40~100μm |
| | (A)120 | C 3060 | |
| | (F)100150 | A 2550 B 3825 | |
| (A)130 | C 4530 | | |

Particle sizes may vary on samples used and parameter settings.

Control Panel



Multilingual touch screen controller

Application

(1) Spray granulation

With the process of granulation and spheronization, powder liquidity is significantly improved and the pressure is uniform. Applications: aluminum, zirconia, ceramics, heavy metals, cemented carbide fields etc.

(2) Micro capture

In spray drying, the combination of core and coating material is a source solution to obtain encapsulated powder.

Applications:

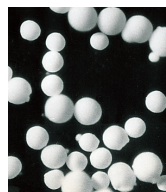
- Ink for pressure-sensitive paper
- Adjustment of pharmaceutical products flavouring and lysis.
- Encapsulation of fragrances used in food and hygiene related products
- Encapsulation of dyes, fertilizers, oils, adhesives etc.

(3) spray cooling granulation

Difficult to get dry powder, such as wax, oils and fats, fatty acids, etc.

(4) Special applications

Spray concentrated, spray reaction, powder sizing, etc.



Powder generated by DL410
0 50 100μm

Equipment

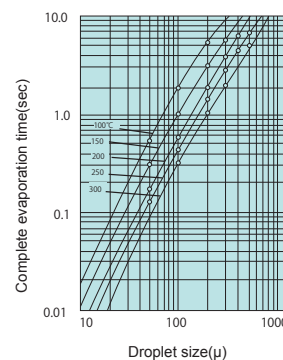


Static removal brush

Burn prevention safety cover

Burn prevention safety cover and the static removal brush are standard equipment.

Time



Drying time until the liquid droplets are completely evaporated with hot air.

Reference Spray Dryer, Model Supporting Organic Solvent

Repeatability of granulation test

| Mesh | #1 | #2 | #3 | #4 |
|------------------------|-------|-------|-------|-------|
| 12and up | 5.6 | 0.8 | 1.2 | 1.3 |
| 12~16 | 0.5 | 0.9 | 1 | 1.2 |
| 16~24 | 0.6 | 0.8 | 1.2 | 1.4 |
| 24~32 | 0.7 | 0.8 | 0.9 | 1.1 |
| 32~42 | 1.6 | 1.7 | 1.9 | 1.8 |
| 42~60 | 5.9 | 4.3 | 4.8 | 3.5 |
| 60~80 | 9.6 | 8.5 | 8.5 | 6.6 |
| 80~115 | 13.2 | 15.6 | 13.4 | 12.8 |
| 115and under | 66.8 | 66.6 | 67 | 70.3 |
| Average Particle size* | 135.6 | 135.7 | 138.3 | 136.9 |

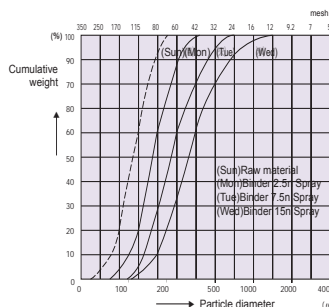
*Average particle diameter of the geometric mean

The granulation process has many operation factors, the reproducibility depends on the skill level of the operation. The flow state of the granules has a significant impact on the test results. By adjusting the amount of hot air consistent flow conditions are achievable.

(Conditions)

| | |
|-------------------------|--|
| Raw material | Sintered alumina (average particle size 40) 400g |
| Binder | 5% PVA solution(#500)25g |
| Inlet temperature | 100°C |
| Binder liquid feed rate | 12.4g/min |
| Binder spray times | 6 times |
| Binder spray pressure | 78kPa(0.8kg/cm ²) |
| Nozzle height | 25cm from microporous plate |

Change of particle diameter

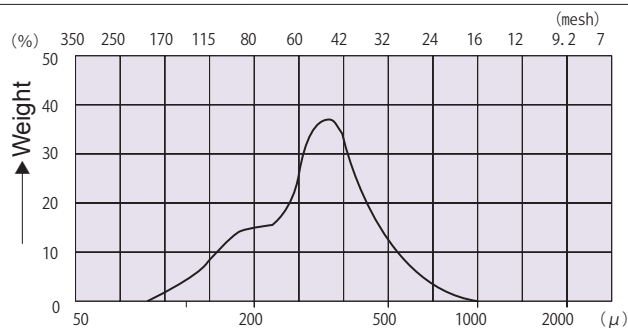


The factors that influence the particle diameter are the binder liquid feed rate and the spray pressure, the former being the most influential. A higher binder amount will result in larger diameter particles.

(Conditions)

| | |
|-------------------------|-------------------------------|
| Raw material | Lactose(100 mesh under) 200g |
| Binder | 70% Sorbitol solution |
| Inlet temperature | 90°C |
| Binder liquid feed rate | 12g/min |
| Binder spray pressure | 98kPa(1.0kg/cm ²) |
| Nozzle height | 25cm from microporous plate |

Repeatability of granulation test



Particles generated by the pulvis mini bed are usually in the range of 0.1~1.5a. The particle size uniformity is lower than extrusion granulation and compression granulation methods.

The granularity consistency may be regulated by test conditions.

(Conditions)

| | |
|-------------------------|-------------------------------|
| Raw material | Lactose(100 mesh under) 200g |
| Binder | 70% Sorbitol solution 7.3g |
| Inlet temperature | 90°C |
| Binder liquid feed rate | 12g/min |
| Binder spray times | 7 times |
| Binder spray pressure | 98kPa(1.0kg/cm ²) |
| Nozzle height | 22.5cm from microporous plate |

Example of implementation (Spray dryer ADL311SA)

| Sample name | Composition (%) | Inlet temp. (°C) | Outlet temp. (°C) | Dry air amount (m ³ /min) | Spray air pressure MPa | Sent amount of sample liquid (g/min) | Sample recovery rate (%) |
|--------------------------------------|-----------------|------------------|-------------------|--------------------------------------|------------------------|--------------------------------------|--------------------------|
| Dextrin (solution) | 10 | 150 | 80 | 0.4 | 0.1 | 6.1 | 66 |
| Dextrin (emulsion) | 40 | 150 | 80 | 0.4 | 0.1 | 5.1 | 63 |
| Oxidized titanium (suspended liquid) | 10 | 150 | 85 | 0.42 | 0.1 | 5.3 | 50 |
| Soy sauce | 50 | 130 | 75 | 0.36 | 0.1 | 5.1 | 60 |
| Salt | 10 | 145 | 85 | 0.38 | 0.1 | 5.3 | 52 |

Repeatability of spray drying test (spray dryer ADL311SA)

| Test No. | Sample name | Sample density (%) | Drying conditions | | | | Test sample amount(g/min) | Sent amount of sample liquid(g/min) | Test time (min) | Yield (g/min) | Recovery rate (%) |
|----------|-----------------|--------------------|-------------------|-------------------|--------------------------------------|---|---------------------------|-------------------------------------|-----------------|---------------|-------------------|
| | | | Inlet temp. (°C) | Outlet temp. (°C) | Dry air amount (m ³ /min) | Spray air pressure kPa(kg/cm ²) | | | | | |
| 1 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 147(1.5) | 93.1 | 3.1 | 30 | 4.3 | 92.4 |
| 2 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 147(1.5) | 93 | 3.1 | 30 | 4 | 86.0 |
| 3 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 147(1.5) | 91.4 | 2.0 | 30 | 4 | 87.5 |
| 4 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 147(1.5) | 84.9 | 2.8 | 30 | 3.7 | 87.2 |
| 5 | Coffee solution | 5.00 | 150 | 75 | 0.45 | 147(1.5) | 83.8 | 2.8 | 30 | 3.7 | 88.3 |

Example of implementation (Pulvis mini spray GB-210A)

| Sample name | Sample density | Inlet temp. (°C) | Outlet temp. (°C) | Dry air amount (m ³ /min) | Spray air pressure kPa(kg/cm ²) | sent amount of sample liquid(g/min) | Recovery rate (%) |
|-------------------|----------------|------------------|-------------------|--------------------------------------|---|-------------------------------------|-------------------|
| Dextrin | 20%solution | 140 | 85 | 0.48 | 147(1.5) | 8.8 | 60 |
| Drug suspension | 10%suspension | 145 | 80 | 0.42 | 196(2.0) | 8.2 | 82 |
| Black tea extract | 20%solution | 155 | 100 | 0.4 | 147(1.5) | 7.8 | 72 |
| Silica gel | 20%solution | 150 | 75 | 0.48 | 147(1.5) | 12.6 | 70 |
| Iron oxide | 3%suspension | 175 | 90 | 0.4 | 127(1.3) | 9.5 | 75 |

Example of implementation(Pulvis mini bed GB-210B)

| Sample | | Binder | | | Test conditions | | | | | Results | |
|--------------------------|--------------|----------|-------------|--------------------|------------------|----------------------------|---|---------------------|--------------------|-------------------|------------------------------|
| Name | Weight (min) | Name | Density (%) | Spray amount (min) | Inlet temp. (°C) | Liquid sending rate(g/min) | Spray pressure kPa(kg/cm ²) | Spray times (times) | Nozzle height (cm) | Average dia. (µm) | 12-115 mesh recovery rate(%) |
| Silicon | 200 | PVA | 5.0 | 77 | 125 | 15 | 59(0.6) | 4 | 27 | 339 | 58 |
| Oxidized iron | 160 | PVA | 2.5 | 50 | 120 | 15 | 98(1.0) | 4 | 21 | 205 | 62 |
| Ceramics | 200 | PVA | 3.0 | 106 | 120 | 15 | 78(0.8) | 3 | 22 | 404 | 82 |
| Alumina | 160 | PVA | 3.0 | 60 | 110 | 15 | 59(0.6) | 4 | 22 | 311 | 88 |
| Silica | 150 | CMC | 1.0 | 100 | 120 | 15 | 78(0.8) | 4 | 22 | 306 | 60 |
| Lactose | 200 | Sorbitol | 70.0 | 10 | 100 | 14 | 98(1.0) | 4 | 25 | 390 | 80 |
| Black tea essence | 250 | Guar gum | 0.5 | 24 | 85 | 6 | 59(0.6) | 10 | 28 | 333 | 77 |
| Grease containing powder | 200 | Glucose | 30.0 | 11 | 85 | 4 | 59(0.6) | 7 | 22 | 236 | 82 |

Binder category and features

| Category | Features |
|-------------------------------|---|
| Gelatin | Gelatin Low density and weak bonding strength. No need to heat. |
| Dextrin | While it has excellent disintegrating and formability, the binding strength is weak. |
| Potato starch | Good granulation properties and inexpensive. Used in the pharmaceutical and food sector. |
| Arsinic acid soda | Suitable as a binder for the high viscosity samples. Used primarily in the food sector. |
| Gum arabic | Warm and spray. Need large amount of binder. |
| CMC(Carboxymethyl cellulose) | High viscosity at low temperatures. High amount of powder remains. |
| HPC (hydroxypropyl cellulose) | Good cohesion and is suitable for hydrophilic material. |
| MC(methyl cellulose) | Strong binding strength, is suitable for rough particles. |
| PVA(Polyvinyl alcohol) | Excellent in granulation properties but somewhat difficult to disintegrate granulated products. |
| PVP(Polyvinylpyrrolidone) | High molecular weight and strong binding strength, is suitable for hydrophobic material. |

Repeatability of spray drying test (Pulvis mini spray GB-210A)

| Test No. | Sample name | Sample density (%) | Drying conditions | | | | | | Yield (g) | Recovery rate (%) | |
|----------|-----------------|--------------------|-------------------|-------------------|--------------------------------------|---|------------------------|-------------------------------------|-----------|-------------------|-----------------|
| | | | Inlet temp. (°C) | Outlet temp. (°C) | Dry air amount (m ³ /min) | Spray air pressure kPa(kg/cm ²) | Test sample amount (g) | Sent amount of sample liquid(g/min) | | | Test time (min) |
| 1 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 198.0 | 6.6 | 30 | 8.1 | 81.8 |
| 2 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 198.7 | 6.6 | 30 | 8.1 | 81.5 |
| 3 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 200.6 | 6.7 | 30 | 8.0 | 79.8 |
| 4 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 198.1 | 6.6 | 30 | 8.2 | 82.8 |
| 5 | Coffee solution | 5 | 150 | 80 | 0.45 | 147(1.5) | 199.3 | 6.6 | 30 | 8.4 | 84.3 |

Example of implementation Pulvis mini spray GB-210A, organic solvent recovery unit GAS410

| Sample | Sample Density (%) | Inlet temp. (°C) | Outlet temp. (°C) | Drying nitrogen (m ³ /min) | Spray pressure (kg/cm ²) | Sent rate of sample liquid (g/min) | Dispersion medium or solution | Results | | | Others |
|-------------------------------|--------------------|------------------|-------------------|---------------------------------------|--------------------------------------|------------------------------------|-------------------------------|----------|------------------|---------------------------|-------------------------------|
| | | | | | | | | Powdered | Recovery rate(%) | Solution recovery rate(%) | |
| Hydroxypropyl methylcellulose | 10 | 90 | 55 | 0.5 | 1.0 | 9.9 | * | G | 65.3 | 92.5 | Chloroform1:Ethanol1 |
| Cellulose polymer | 5.0 | 70 | 47 | 0.5 | 1.0 | 8.3 | Methylene chloride | G | 72.3 | | |
| Polymer | 2.0 | 100 | 64 | 0.5 | 1.0 | 8.4 | * | G | 77.8 | 80.7 | Ethanol95:Water5 |
| Resin | 23.5 | 80 | 55 | 0.5 | 1.0 | 4.2 | * | G | 81.9 | 96.7 | (Methanol4:Water1)Distributed |
| Carbon + resin | 5.8 | 100 | 70 | 0.5 | 1.0 | 5.3 | IPA | G | 85.1 | 94.1 | |
| Polymer + inorganic salt | 10.2 | 140 | 98 | 0.5 | 1.0 | 3.8 | * | G | 97.6 | 97.4 | Dimethylacetamide |
| Polyvinylpyrrolidone (K30) | 10.0 | 80 | 55 | 0.5 | 1.0 | 7.7 | Ethanol | G | 79.4 | 95.0 | |
| Polyvinyl pyrrolidone + drug | 10.0 | 80 | 55 | 0.5 | 1.0 | 7.7 | Ethanol | G | 75.9 | 95.4 | |
| Botanical extract | 3.0 | 130 | 71 | 0.5 | 1.0 | 9.1 | * | G | 96.5 | 91.9 | Ethanol6:Water4 |
| Silicon carbide | 38.5 | 150 | 84 | 0.5 | 1.0 | 12.1 | Ethanol | G | 89.9 | 99.9 | Use nozzle 3S |
| Aluminum nitride | 13.2 | 150 | 99 | 0.5 | 1.0 | 12.9 | Butyl acetate | G | 92.2 | 86.7 | Use nozzle 3S |
| Nitride ceramic | 60.5 | 120 | 83 | 0.5 | 1.0 | 11.3 | MEK | G | 74.7 | 88.7 | |
| Superconducting material | 33.3 | 80 | 60 | 0.5 | 1.0 | 15.7 | Acetone | G | 66.6 | 99.6 | |
| Drug | 3.61 | 100 | 68 | 0.6 | 1.0 | 10.0 | * | Yes | 73.6 | 87.2 | Ethanol+Methylene chloride |
| Drug | 13.2 | 60 | 45 | 0.32 | 1.25 | 6.0 | * | Yes | 87.6 | 94.7 | Methylene chloride+Ethanol |
| W-Cu | 50.0 | 100 | 62 | 0.5 | 0.5 | 20.7 | Ethanol | Yes | 60.3 | 91.9 | |
| Metamorphic polystyrene | 48.7 | 140 | 60 | 0.45 | 1.0 | 22.3 | Water | Yes | 67.6 | 91.7 | |
| Polymer | 0.5 | 150 | 88 | 0.5 | 1.0 | 8.5 | * | Yes | 83.1 | 97.6 | Methanol3+Water1 |
| Organic matter | 50.0 | 150 | 88 | 0.4 | 1.0 | 8.3 | Methanol | Yes | | | |
| Silica dispersion | 10.0 | 100 | 88 | 0.5 | 1.0 | 4.8 | * | Yes | 96.2 | 99.5 | Ethanol+Water(little) |

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