

Nano Spray Dryer – A Technique to Handle Specific Products Range

Ruchi Patel and J. B. Upadhyay

Department of Dairy Engineering, SMC College of Dairy Science, AAU, Anand-388110.

Email: jbupadhyay@yahoo.co.in

The latest generation of instruments – the Nano Spray Dryer revolutionizes today's spray drying possibilities with the unique ability to generate particle sizes in the nano range for milligram sample quantities at high yields. The Nano Spray Dryer offers a fast drying process for temperature sensitive materials, excellent product yields and low energy consumption (Li *et al.*, 2010).

Nano Spray Dryer is used for laboratory production of micro-particle powder by universities, research centre and food, biotechnology, beverage, chemical and pharmaceutical lab. This method is suitable for drying of all solutions including emulsion, suspension, heat-sensitive materials, biological products, bio-pesticide and enzyme etc. Because only mist size of particle sprayed by machine can get high temperature and the particle is transient heated to keep the active ingredient undamaged after drying process.

Process

The droplet generation is based on a piezoelectric driven actuator, vibrating a thin, perforated, stainless steel membrane in a small spray cap. The membrane (spray mesh) features an array of precise micron-sized holes. The actuator is driven at an ultrasonic frequency, causing the membrane to vibrate, ejecting millions of precisely sized droplets every second with very narrow droplet size distribution.

Principle

The drying gas enters in laminar flow from the top into the drying chamber and is heated (convective heat transfer between droplets and gas) up to the set inlet temperature (120°C). Fast heating is controlled by plugable PT-1000 temperature sensor. Sample feeding is performed with plugable

peristaltic pump and Continuous recirculation of the sample feed, from sample vessel to spray head. The piezo driven spray head generates ultrasonic atomization at 60 kHz driving frequency, which are gently dried into solid particles. The dried solid particles are electrostatically charged and collected at the collecting electrode. The drying gas exits the spray dryer, the outlet temperature is measured and, in addition, the gas is filtered. Easy cleaning of spray head with detergents or in an ultrasonic bath is done.

Layout of Nano Spray Dryer

The innovative piezocrystal driven spray head generates a mist of fine droplets with very narrow size distribution. Different spray caps with 4.0, 5.5 and 7.0 μm hole sizes are available to tune the average droplet size between 8 to 21 μm precisely. Particle separation rate is independent of particle mass (as in cyclones) and Innovative electrostatic particle collector is used for collection of fine nano particles (separation efficiency > 99 %). Excellent product yields: up to 90 % for small sample quantities <100 mg. Simple particle collection with manual particle scraper Integrated outlet gas filter for the protection of users and the environment is present (Oliveria *et al.*, 2013).

Controls

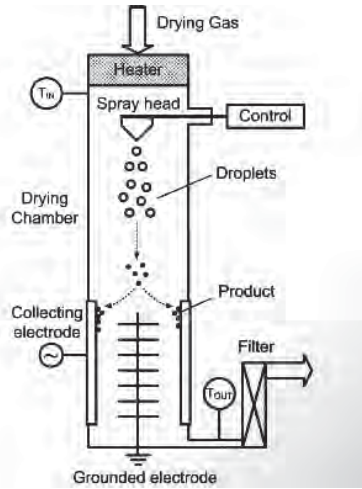
- > Visualized process parameters and simple display control.
- > Convenient setting of inlet/outlet temperature, drying gas flow, spray rate and pressure on the front panel.
- > Data storage of experimental runs in a Library.
- > Export of process parameters for further data analysis.



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Features



- Efficient spray process for minimal quantities (ml, mg)
- Innovative piezoelectric atomizing technology for fine
- Particles in the submicron range

Droplet atomizing technology

Hole Size	Water droplet Size (4, 3)	Span	Water flow rate
4.0µm	8µm	<1.4	20ml/h
5.5µm	15µm	<1.6	60ml/h
7.0µm	21µm	<1.6	150ml/h

- Narrow particle size distribution
- Novel electrostatic particle collector for the highest possible yields of fine particles
- Modular glass assembly and visible spray process
- Short set-up times and easy cleaning
- Easy to sterilize

Applications

- In Dairy and Food Industry
- Beverages, Flavours, Colourings, Milk and Egg products, Coffee, tea, cereals, spices
- In pharmaceutical Industry:
- Antibiotic, Medicatingredient, Additive
- Industry

- Plastic polymers and resins, cosmetic industry, ceramic and superconductors Biochemical Soaps and detergents, textile and oxides
- For plant vegetable extracts.
- Synthetic heat sensitive material

Technical Data

Power consumption	Max. 1500 W
Connection voltage	100-240 VAC 100-240 VAC ±10%
Frequency	50/60 Hz
Heating capacity	Max. 1400W
Heating control	± 1°C
Max. inlet temp.	120°C
Evaporating capacity	Max. 0,2l/h H ₂ O, higher for solvents
Drying gas flow	80-160 min
Spray caps	4µ m, 5.5µm, 7µm
Mean droplet size	8-21µm
Milk particle size	300nm-5µm
Mean residence time	1-4sec
interface	USB II
Protection rating	IP 42
Pollution degree	2
Environmental conditions	For indoor use only
Temperature	5-40°C
Altitude	Up to 2000m
Humidity	Max. relative RH 80% for temperature up to 31°C and then linearly decreasing to 50% at 40°C
Dimensions (W*H*D)	50*110*55cm (short set up) /58*150*55cm (tall-set up)
Weight	65kg (short set up)/70kg (tall-set up)

Maintenance Guideline

• Responsibility of the operator

The head of laboratory is responsible for training his personnel. The operator shall inform the manufacturer without delay of any safety-related incidents which might occur during operation of the instrument. Legal regulations, such as local,



state and federal laws applying to the instrument must be strictly followed.

- **Duty of maintenance and care**

The operator is responsible for ensuring that the instrument is operated in proper condition only, and that maintenance, service, and repair jobs are performed with care and on schedule, and by authorized personnel only.

- **Spare parts to be used**

Use only genuine consumables and genuine spare parts for maintenance to assure good system performance and reliability. Any modifications to the spare parts used are only allowed with the prior written permission of the manufacturer.

- **Modifications**

Modifications to the instrument are only permitted after prior consultation with and with the written approval of the manufacturer. Modifications and upgrades shall only be carried out by an authorized technical engineer. The manufacturer will decline any claim resulting from unauthorized modifications

Advantages

- Used in small scale EX: IN lab and IN R & D.
- Cost Saver.
- Work with minimal sample amount (>2ml or >200mg).
- Reduce R & D cost due to small sample volume.
- Decrease loss with minimal dead volume
- Control the particle size in the range from 300 nm to 5 μm
- Achieve extremely narrow size distributions
- Recover even the smallest particles (300 nm)
- Obtain high yields of up to 90%
- Fast drying process

Conclusion

Spray drying is an extremely well-established technology for the production of micro-particulate powders suited for a variety of Dairy Food, Pharmaceutical and other applications. In recent

years industry is force to replace the existing system with the nanoparticle production for good yield with narrow size distribution. However, the separation and collection of nanoparticles with conventional spray dryer set up is extremely challenging due to their typical low collection efficiency for fine particles < 2 μm . Currently, nanoparticles have to be agglomerated into larger microparticles, via a two-step approach, in order to collect them in a sizeable amount. However, this method has to contend with the issue of adequate redispersibility of the primary particles to reap the full benefits of nanosizing.

References

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