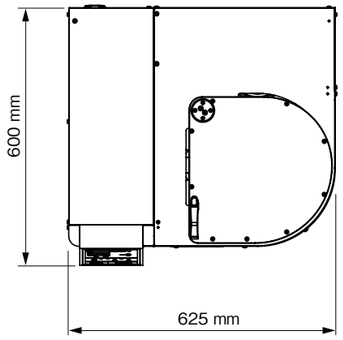
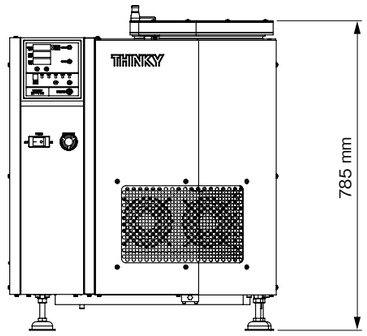
Product Specification

Product		Planetary Centrifugal Nano Pulverizer with Chiller
Model		NP-100 (Nano Pulverizer-100)
Method		Planetary, propeller-less pulverizing/mixing method
Operating time setting range		00 minute 00 second to 30 minutes 00 second (Maximum 30 minutes recipe based operation in total/Setting in the unit of 1 second)
Revolution Speed (MILL/MIX Mode)		Maximum 2000 rpm (Indicates speed by 0 rpm or within the range of 400 rpm through 2,000 rpm. Setting in the unit of 10 rpm.)
Revolution Speed (CLEAN MEDIA Mode)		Maximum 2000 rpm (Indicates speed by 0 rpm or within the range of 400 rpm through 2,000 rpm. Setting in the unit of 10 rpm.)
Temperature set range in chamber		–20 °C – +20 °C
Recommended container		Pulverization container set (Zirconia) Media separation set (SUS)
Media for pulverizing		Zirconia ball (Maximum quantity: 35 g, Maximum size: 5 mm)
Volume of material		100 mg – 10 g
Maximum liquid volume		80 ml
Maximum gross weight		350 g
Supply power	Voltage	Single phase, AC120 V±10%, 50/60 Hz
	Consumption power	At standby: 55/53 VA [50/60 Hz] During standby operation: 540/400 VA [50/60 Hz] During operation: Max. 1,400 VA
Working ambient environment		10 – 30 °C, 35 – 85 % RH (without condensation)
External dimensions		H785 × W625 × D600 (mm)
Main unit mass		Approx. 96 kg

Product appearance/specifcations may change without notice.





For requests concerning demonstrations and evaluation testing, please contact THINKY CORPORATION

Email : ***info@thinkymixer.net***

or the sales agent below

For the latest information about products and exhibitions, visit:

http://www.thinkymixer.net

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Sales agent

THINKY

Oh!

Pulverization to 100 nanometers in only 2 minutes!?

Planetary Centrifugal
Nano Pulverizer

NP-100

Planetary Centrifugal **Nano Pulverizer**

NP-100

Nano pulverization at low temperature.
Ultralow volume (100 mg) pulverization
is completed in 2 minutes at the shortest.

This sophisticated pulverizer is developed by applying the planetary centrifugal system.
Since particles of 3 or less microns are said to be difficult to obtain by dry pulverization, nano pulverization is achieved by wet pulverization.
The accumulation of our unique knowledge and skills enables us to accomplish short-time pulverization in 2 minutes. NP-100 is full of inventive ideas. Please experience the amazing performance.

NP-100 Nano Pulverizer

In Response to Many Needs

After repeated challenges...

We present NP-100 with confidence to fulfill your needs in the field of pulverization. THINKY MIXER plays an active role in various areas nowadays, enabling us to interact with people in a wide range of fields.
The development for NP-100 has started by a researcher who has been a user of THINKY MIXER, suggesting the possibility of pulverizing nano materials.
The development from a brand new viewpoint brought constant challenges and difficulties. With many researchers' assistance and cooperation, we could overcome numerous hardships and invented the unique and innovative pulverizer, NP-100.

Unique and innovative pulverizer

NP-100 planetary centrifugal nano pulverizer has an optimal rotation-revolution ratio to maximize the collision energy of the pulverizing medium. It generates strong centrifugal force during rotation and revolution, and the pulverizing medium accelerates to crush the materials in the container.
The significant improvement in pulverization efficiency allows ultralow volume (100 mg), fine crushing (100 nm), and short-time (2 minutes) pulverization which used to be regarded as impossible. Moreover, the mounted cooling mechanism can decrease the temperate inside the chamber to -20 °C, reducing the risk of contamination and keeping the crystal structure of compounds with low melting point during nano pulverization.
Excellent operability provides simple operation; a batch system without troublesome cleaning and a mesh filter to easily collect the medium after pulverization. Since NP-100 pulverizes both inorganic and organic materials and crushes a minimum amount of sample as needed, it is utilized as an essential tool for researches with high-cost/high-tech materials. NP-100's areas of activities are expanding not only in medical but in various fields.

Accessories

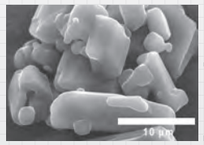
Pulverization container set
80ml zirconia containers & adapters

Special containers and adapters are made of zirconia with excellent abrasion resistance. Contamination from the medium and the containers generated during pulverization is suppressed as much as possible.

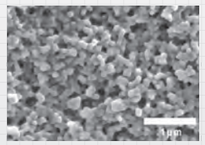
Mesh filter

Nylon 200 Mesh (0.08 mm aperture) is used to separate zirconia balls (0.1 mm).

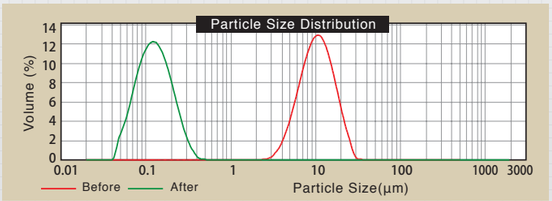
Pulverize Examples



Before

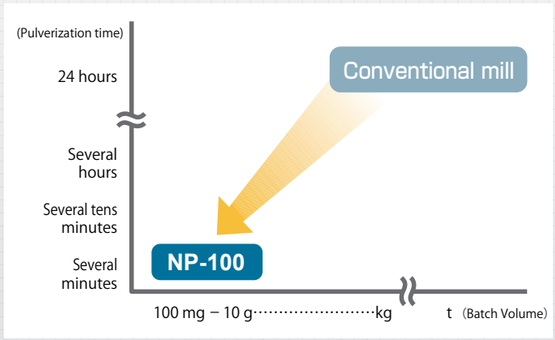


After (SEM image x30 K)



Features of NP-100

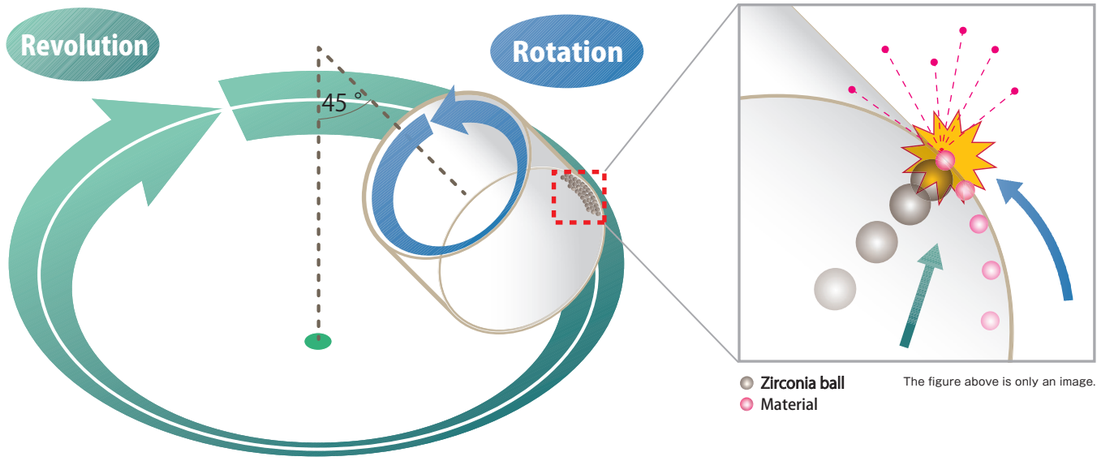
- Nano level pulverization
- Ultralow volume (mg) pulverization
- Significant reduction in pulverization time
- Easy to collect the pulverized material
- Chiller equipped
- Low running costs

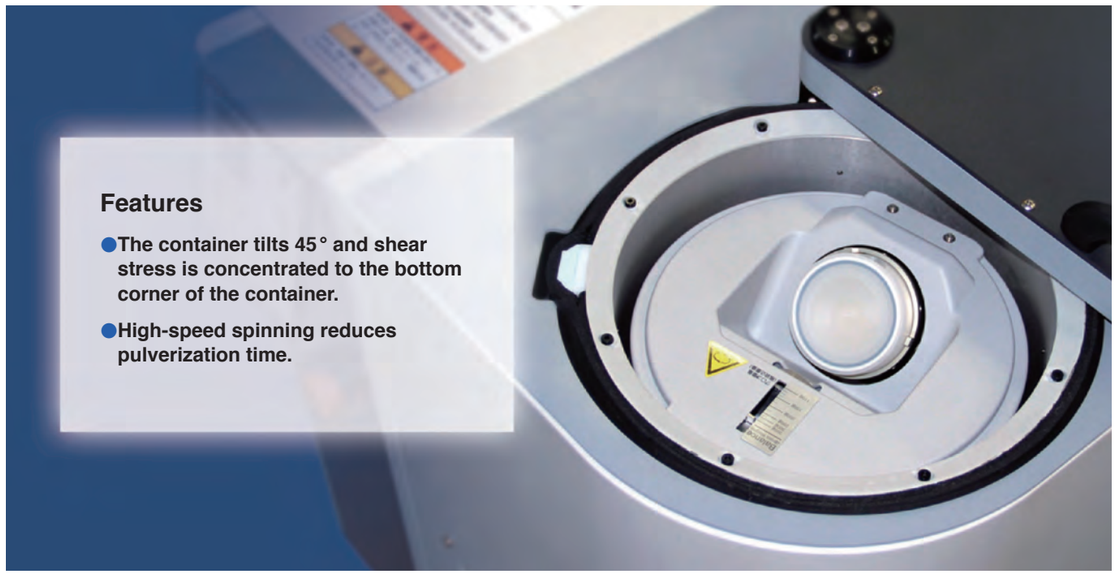


Principle of THINKY Planetary Centrifugal Pulverization

Unique planetary centrifugal system

NP-100 is the revolutionary pulverizer that applies the same planetary centrifugal system as THINKY MIXER.
The planetary centrifugal system consists of 2 axes where the container rotates counterclockwise while revolving clockwise at a certain radius around an axis. The pulverizing medium, zirconia balls that have excellent abrasion resistance are placed in the container, which then rotates and revolves at high speed to apply centrifugal force to the medium. The pulverizing medium with centrifugal force crushes against the material and the collision energy makes the material finer.





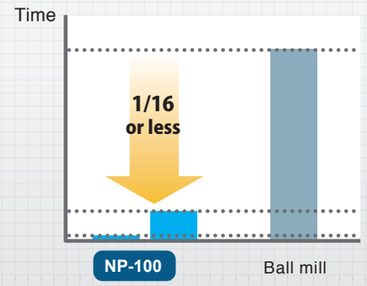
Advantages of NP-100<Exceptional superiority>

Short-time pulverization

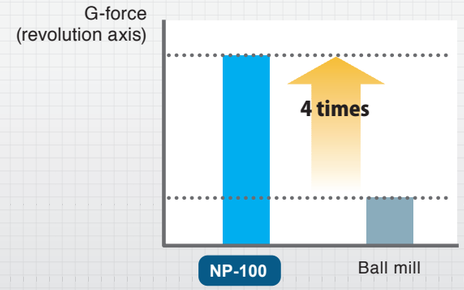
●**Superiority of NP-100**

	NP-100 Planetary centrifugal system	Planetary ball mill of a different manufacturer Upright, batch system
Number of revolutions	Max. 2000 rpm	Max. 1100 rpm
Pulverization time	2 minutes for organic compounds to 15 minutes for inorganic material	240 minutes

●**Pulverization time**



● **Pulverization energy**



Pulverization energy is similar to G-force.

Suppression of heat generation during pulverization using chiller

With chiller

The cooled chamber suppresses build up heat during pulverization.

- Material property has little or no effect
- Safety of the operator
- Suppressing abrasion of the container
- Continuous operation is possible
- Cooldown time not required for the machine

Temperatures inside the chamber by thermography

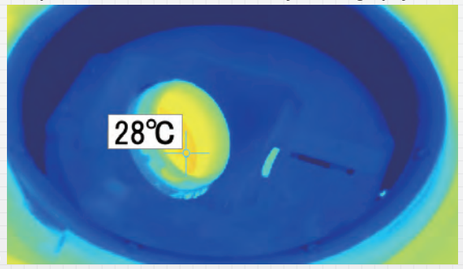


Image of FLIR E50

Without chiller

The cooled chamber builds up heat during pulverization.

- Material property is largely affected
- Increased contamination
- Heat generation in the machine impairs reproducibility
- Continuous operation is impossible
- Cooldown time required for the machine
- Process time takes longer

Temperatures inside the chamber by thermography

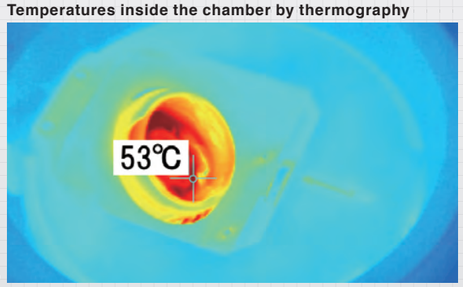


Image of FLIR E50

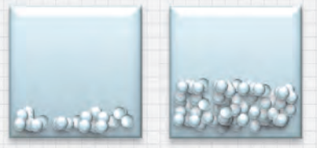
Advantages of NP-100<Exceptional superiority>

Suppression of contamination

		NP-100 Planetary centrifugal system	Planetary ball mill upright, batch system
Contaminated zirconia content (ppm)		≤ 0.1	≥ 100
Factors of contamination	Medium feed amount	≤ 10 %	Approx. 33 %
	Material temperature rise	Suppression mechanism equipped	Suppression mechanism not equipped
	Pulverization time	≤ 2 minutes *	≥ 240 minutes *

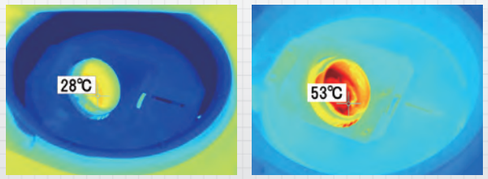
*These values are according to our experiments. They also vary depending on the materials.

Medium feed amount (Volume ratio)



NP-100 max. 10 %　　Ball mill about 33 %

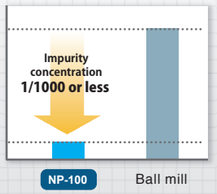
Suppressing material temperature rise using chiller



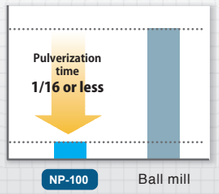
-20 °C environment (Chiller turned on)

Ordinary temperature environment (Chiller turned off)

Contamination generated



Reduction in pulverization time



Low-volume pulverization

R&D needs

- Evaluations of diverse materials' properties in a short time.
- Evaluation with ultralow volume could be processed for rare and expensive materials.

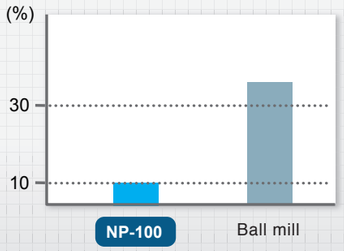
Images of minimum amount of material required for batch pulverization

NP-100　Minimum material feed amount: 100 mg

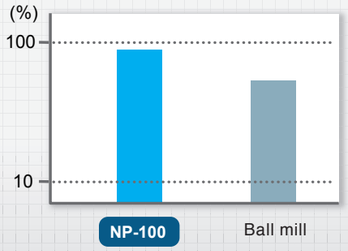
Ball mill　Minimum material feed amount: Several tens of grams

Low running cost

Amount of zirconia balls



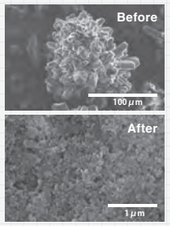
Collection rate of zirconia balls



Pulverized / Deagglomerated samples

Electrode Materials for Lithium Ion Battery

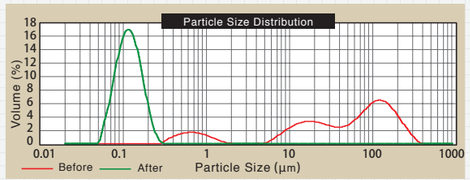
Positive-electrode Material Pulverization : Lithium Carbonate



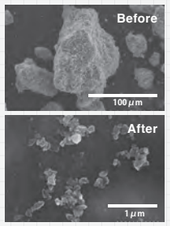
Parameter	1700 rpm 20 min
Compound	1 g
Grinding tool	Zirconia ball (ϕ0.1 mm) 20 g

■Particle size distribution (μm)

	D10	D50	D90
Before	1.031	59.842	186.178
After	0.075	0.117	0.181



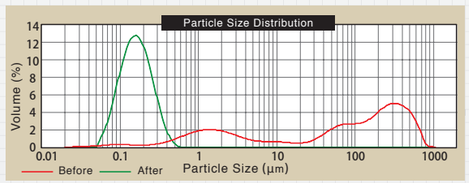
Positive-electrode Material Pulverization : Lithium Nickelate



Parameter	1700 rpm 20 min
Compound	1 g
Grinding tool	Zirconia ball (ϕ0.1 mm) 20 g

■Particle size distribution (μm)

	D10	D50	D90
Before	0.906	98.271	461.035
After	0.089	0.16	0.288

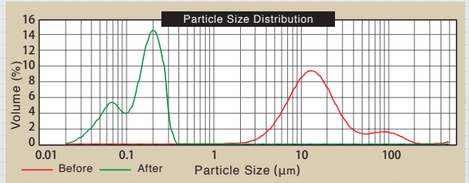


Negative-electrode Material Carbon-based material Deagglomeration : Carbon Black

Parameter	1700 rpm 10 min
Compound	1 g
Grinding tool	Zirconia ball (ϕ0.1 mm) 20 g

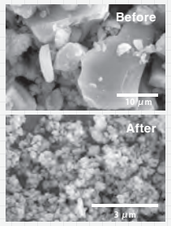
■Particle size distribution (μm)

	D10	D50	D90
Before	6.230	14.149	51.851
After	0.056	0.166	0.262



Inoganic Materials

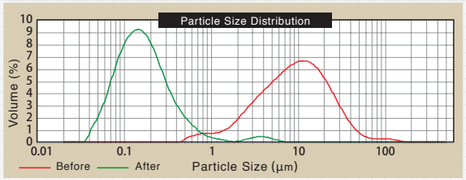
Pulverization : Glass



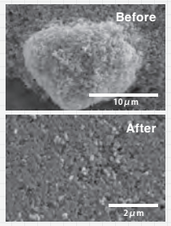
Parameter	ϕ0.5 mm Zirconia ball (Pulverizing) 2000 rpm 4 min (Cooling) 400 rpm 4 min ϕ0.1 mm Zirconia ball (Pulverizing) 2000 rpm 4 min (Cooling) 400 rpm 4 min
Compound	1 g
Grinding tool	Zirconia ball(ϕ0.5 mm)→(ϕ0.1 mm)15 g

■Particle size distribution (μm)

	D10	D50	D90
Before	2.468	9.260	26.784
After	0.072	0.156	0.414



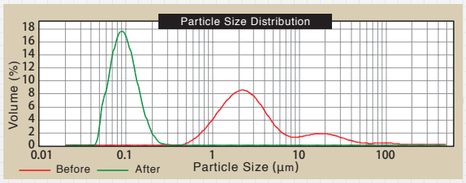
Deagglomeration : Titanium oxide



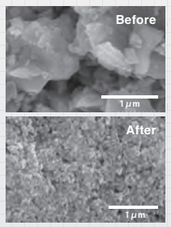
Parameter	(Pulverizing)1700 rpm 10 min (Cooling) 400 rpm 4 min
Compound	10 g
Grinding tool	Zirconia ball (ϕ0.1 mm) 35 g

■Particle size distribution (μm)

	D10	D50	D90
Before	1.089	2.560	17.112
After	0.062	0.094	0.149



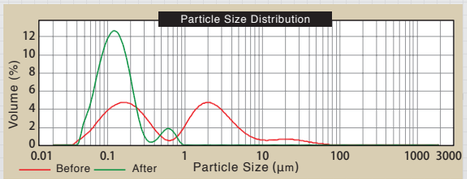
Deagglomeration : Inorganic pigments



Parameter	1700 rpm 10 min
Compound	1 g
Grinding tool	Zirconia ball (ϕ0.1 mm) 20 g

■Particle size distribution (μm)

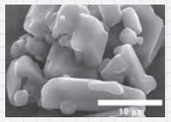
	D10	D50	D90
Before	0.095	0.821	4.919
After	0.069	0.125	0.239



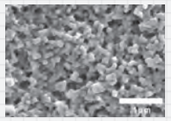
Pulverized / Deagglomerated samples

Medical and pharmaceutical materials

Phenytoin (Low solubility compounds)



Before

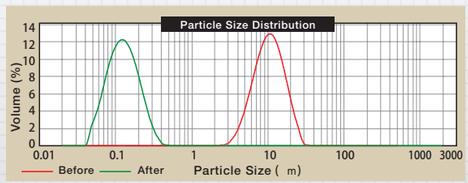


After (SEM image x30 K)

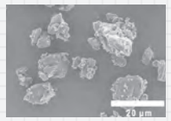
Parameter	2000 rpm 2 min
Compound	Phenytoin
Weight	100 mg
Concentration	10 mg/ml
Grinding tool	Zirconia ball (φ0.1 mm)

Particle size distribution (μm)

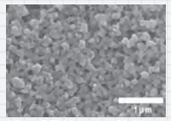
	D10	D50	D90
Before	5.774	10.58	18.639
After	0.069	0.125	0.231



Indomethacin (Low solubility compounds)



Before

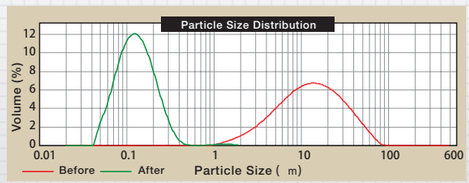


After (SEM image x30 K)

Parameter	2000 rpm 3 min
Compound	Indomethacin
Weight	100 mg
Concentration	10 mg/ml
Grinding tool	Zirconia ball (φ0.1 mm)

Particle size distribution (μm)

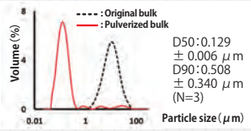
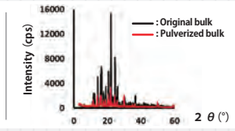
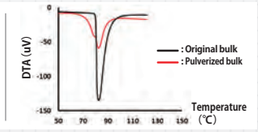
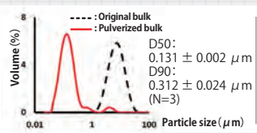
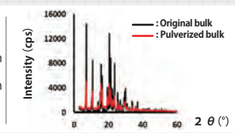
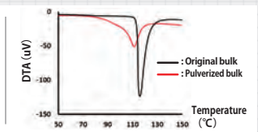
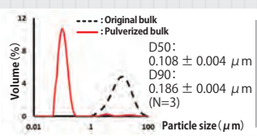
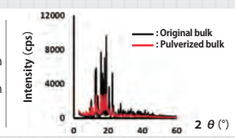
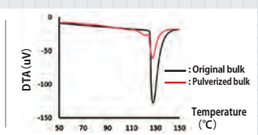
	D10	D50	D90
Before	3.89	12.894	37.092
After	0.069	0.126	0.237



Nano Particle Formation of Low Melting Point Compounds

For nano pulverization of low melting point compound, control of both excessive pulverization energy and heat generation is essential in order to reduce amorphous particles. NP-100 has been proven to conduct nano pulverization of low melting point compounds by decreasing the rotation speed, using the cooling mechanism to achieve a low temperature environment at -20 °C to cool the zirconia container effectively, and selecting the best solvent for the compound.

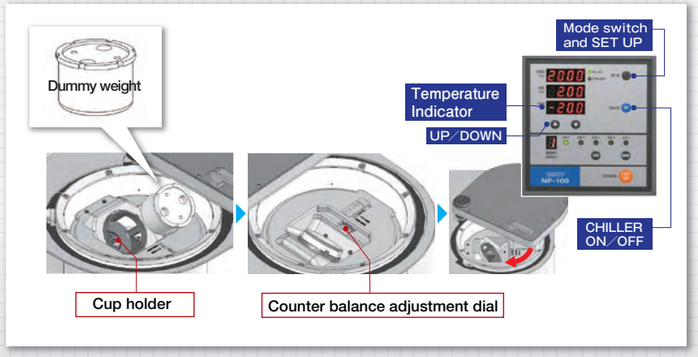
Crystallinity evaluation method after pulverization

	Particle size distribution: Laser diffraction Representative diameters: D50 and D90 (m)	Crystallinity: Powder X-ray diffraction (PXRD)	Crystallinity: Thermogravimetric and differential thermal analyzer (TG / DTA)
Verification sample (1) **Fenofibrate** Melting point **80 °C** 〈Compound〉100 mg 〈Medium〉 φ0.1 mm, 2.5 g 0.3 % MC solution: 0.5 ml → 9.5 ml 〈Temperature before and after pulverization〉 0 ℃ to 9.3 ℃	 D50:0.129 ± 0.006 μm D90:0.508 ± 0.340 μm (N=3)		
Verification sample (2) **Flurbiprofen** Melting point **115 °C** 〈Compound〉100 mg 〈Medium〉 φ0.1 mm, 2.5 g 0.3 % MC solution: 0.5 ml → 9.5 ml 〈Temperature before and after pulverization〉 0 ℃ to 15.5 ℃	 D50: 0.131 ± 0.002 μm D90: 0.312 ± 0.024 μm (N=3)		
Verification sample (3) **Probucol** Melting point **125 °C** 〈Compound〉100 mg 〈Medium〉 φ0.1 mm, 2.5 g 0.3 % MC solution: 0.5 ml (SDS added)→ 9.5 ml 〈Temperature before and after pulverization〉 6.3 ℃ to 20.3 ℃	 D50: 0.108 ± 0.004 μm D90: 0.186 ± 0.004 μm (N=3)		

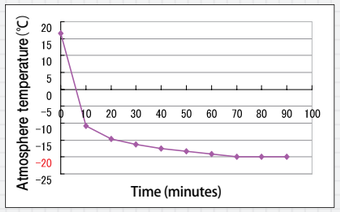
Reference paper : Nano-pulverization of poorly water soluble compounds with low melting points by a rotation/revolution pulverizer K.Yuminoki, M.Takeda, K.Kitamura, S.Numata, K.Kimura, T.Takatsuka, N.Hashimoto Journal of pharmaceutical sciences 103:3772-3781, 2014

Operation

Precool before pulverization



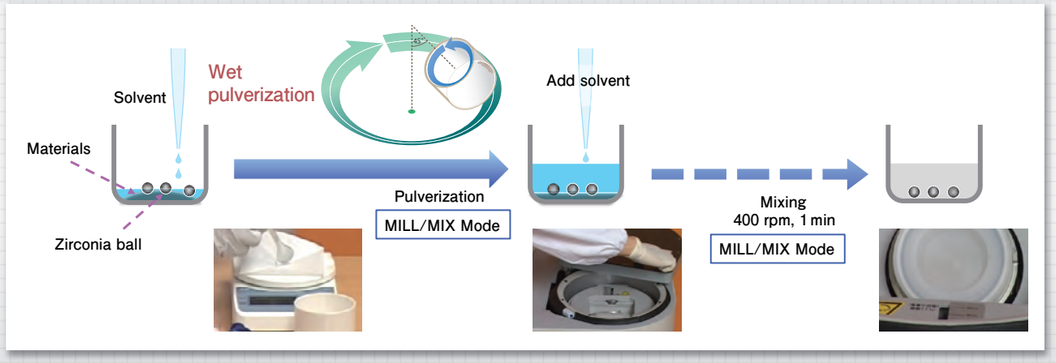
Cooling time in the chamber



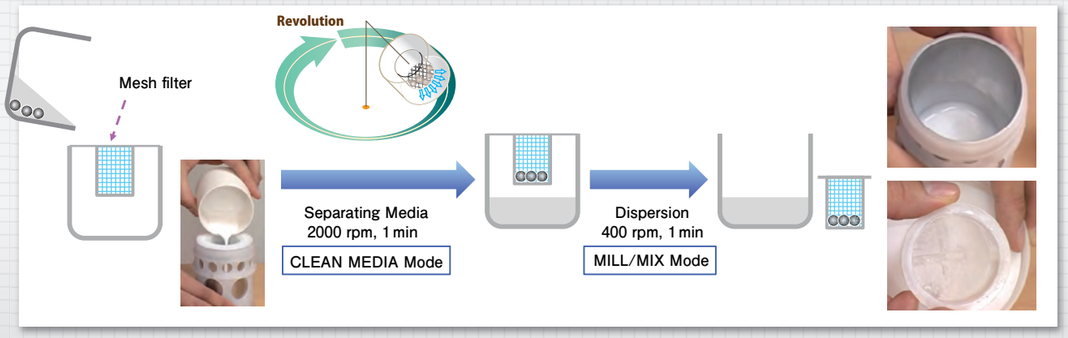
Approx. time to cool to -20 °C

- Temperature indication : ≈30 minutes (Temperature of the chamber interior atmosphere)
- Cup holder : ≈60 minutes

Basic operation (Pulverization)



Basic operation (Separation of media)



Users' Voice / Column

Users' voice

NP-100 nano pulverizer is essential for the study of next-generation batteries

Shohji Tsushima

Professor, Doctor (Engineering)
Department of Mechanical Engineering,
Graduate School of Engineering,
Osaka University

Research overview

The current major objects of study are flow batteries (redox flow batteries) and polymer electrolyte fuel cells. Flow batteries can easily be scaled up, and they are expected to become a large-scale power storage device. What is important along with scaling up is enhancement of battery performance. I study exponential improvement in flow battery performance by the efficient supply of electrolytes to porous carbon electrodes so that the phase interfaces formed by the electrodes and the electrolyte can be used to the limit.

Trigger to adopt NP-100 and the area of the use

I had used THINKY MIXER before for preparation of electrode material slurries of polymer electrolyte fuel cells. Before that, a mortar was used for manual mixing. Someone introduced THINKY MIXER as the de facto standard and I adopted it. The variation in the finish among operators was eliminated, and the efficiency of experiments was improved remarkably. Then, I initiated the study of flow cells as a member of Phase Interfaces for Highly Efficient Energy Utilization Project of JST Strategic Basic Research Programs Sakigake, and NP-100 was adopted for deagglomerating and pulverizing the electrode material carbon.

The conventional porous carbon electrodes mentioned before were thick but had a problem of long travel distance of ions, which limited performance improvement. However, thinner electrodes had smaller ion reaction areas. Then, a compact carbon layer is formed on the surfaces of the thin electrodes to increase the surface area and ensure sufficient reaction area, achieving both thinness and performance. NP-100 is used to deagglomerate the carbon particles. When the carbon is placed on the electrodes, the carbon and solvent are prepared like ink and applied by an inkjet printer with small nozzles. Therefore, the carbon particle sizes need to be kept fine, and NP-100 fully works with it. In addition, the capability of ultralow-volume processing, the cooling function, and excellent reproducibility also match the needs. I continue to make full use of this equipment to contribute to the research and development of future energy devices.

Column

NP-100 joint developer's untold story of the development

Naofumi Hashimoto

Professor, Doctor (Pharmacy)
Department of Pharmaceutical Sciences,
Faculty of Pharmaceutical Sciences,
Setsunan University

Development of NP-100

I started using THINKY MIXER more than ten years ago to prepare suspensions for safety studies at the Research Laboratories of Pfizer Inc., where I worked at the time. Safety studies are tests to examine adverse effects and toxicity by feeding the suspended drug to animals, and it is most important to create a uniform suspension because uneven suspensions do not administer constant doses of the drug, causing variations in the data. Compared with conventional stirrer mixing, THINKY MIXER is easy and can prepare a uniform suspension in a short time. I proposed that THINKY MIXER should be used for safety studies in the laboratories of Pfizer in each country, and it was accepted. On the other hand, my subordinate conducted an experiment to obtain finer particles by stirring the drug suspension, and I thought the beads put in THINKY MIXER could crush the drug finer and quicker. I tried it to achieve pulverization of the drug from several hundred microns to several microns. The operation duration, which used to be a whole day, was shortened to several minutes. After that, the Research Laboratories closed, and I moved to the university to continue research, as well as promote the development of nano pulverizers together with THINKY.

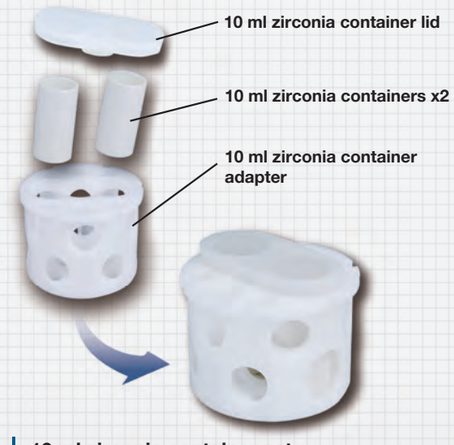
Major advantages to pulverize the drug into nano particles

Nano particles of the drug have exponentially increased the total surface area of the powder, leading to higher dissolution rates and better absorption from the gastrointestinal tract after oral administration. Forming nano particles was a very effective method for drugs with high pharmacological activity and difficult dissolution in water, which puzzled researchers at that time. In addition to the improvement in absorbability of oral administration, pulverization to 200 nanometers or less enabled application to various routes, including ocular instillation, transdermal, intravenous and intramuscular administration. While a larger dose may cause adverse effects, such as variations in absorbability and side effects, use of nano particles eliminates the need for an excess administration of drugs and achieves medicinal action with a smaller dose than conventional doses. Nano particle drug formulation leads to the development of safer medicines and may increase dramatically in the future. I am very glad to know that this equipment is now used in different fields.

Latest Optional Tools / Our Support System

Latest optional tools

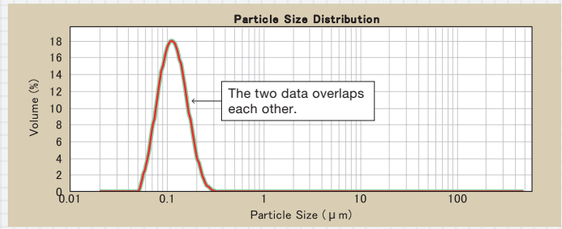
Zirconia containers to pulverize minimum of 10 ml material



10 ml zirconia container set

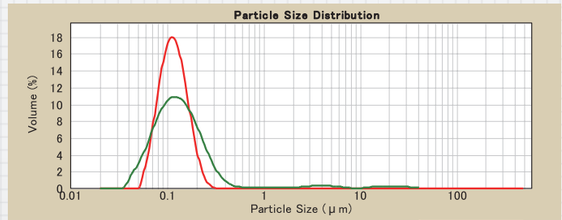
- Maximum liquid feed amount: 10 ml
- Recommended amount of pulverization: 10 to 100 mg
- Recommended recipe available (pulverizing phenytoin)

● **Simultaneous process of two samples in 10 ml zirconia containers**



* The particle sizes of the two samples are uniform.

● **Particle size difference when pulverizing 100 mg or less material in 10 ml zirconia container (red) and 80 ml standard container (green)**



* Compared with the standard container, the 10 ml zirconia container tends to have more uniform pulverized particle sizes. The reason is that the small diameter of the 10 ml container increases frequencies of collisions between the balls and the material to contribute to pulverization efficiency.

Comparison with the standard container (80 ml container)

- Increased frequency of collision between balls and material to improve pulverization efficiency
- Tendency of more uniform particle sizes after pulverizing 100 mg or less
- Reduced material loss due to adhesion of the container
- Simultaneous process of two samples to increase efficiency
- Less heat generation during pulverization

Our Support System

Two secure support systems

After-sales support

If you have any problems with a product, please contact us.

Application engineering

THINKY's professional application team supports parameter settings for customers. Before demonstration of pulverization, implementation of preliminary examination enables smooth presentation of the demonstration. Contact THINKY CORPORATION listed on the back cover.

Please contact THINKY CORPORATION

Email: **info@thinkymixer.net**

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