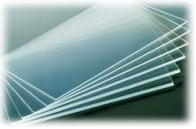
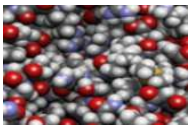
3D Ball Mill(3D Reactor) Medium /Small Size

Proposal of 3D Ball Mill(3D Reactor) that Enables Efficient and Sufficient Pulverization/Mixing

NAGAO SYSTEM

Industries & Issues






Manufacturer of glass/metal/electronics/chemicals

- Aim to improve materials quality and strengthen competitive power of products.

  (synthetic strength, conductivity, catalyst activity, heat conductivity, reactivity)
  - Use of nanoparticles to improve synthetic strength and quality/value
  - Use of platinum/gold/silver/copper and other such materials to improve catalytic activity
  - Use of nanoparticles, paste ink to improve reactivity of light emitting materials, conductive materials, etc.
- Aims to avoid defects in manufacturing processes due to uneven composition

Paint manufacturer

- Aim to improve paint quality to levels far beyond those of competitors
  - Improve heat resistance/light resistance/water resistance
  - Develop paints not likely to cause color unevenness or blurring
  - Solve larger-sized particle problems and avoid nozzle clogging
  - Improve coloring properties, storage properties, and quick-drying properties

Pharmaceutical manufacturer

- Aim to reduce product disposal costs in manufacturing processes
  - Product disposal costs due to heat generation in manufacturing process
  - Product disposal costs due to uneven mixing in manufacturing

✓ Fine particles can be delivered into cells with high efficiency. (Improved directing capacity of cell targeting)

✓ Fine particles enable dosage adjustment. (Beneficial for people having comparatively lower swallowing ability like children or the elderly)

Why they cannot solve the issues? & Solutions

1

After 2D motion pulverization, generated fine particles cohere at the bottom.

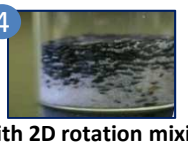
2

Highly focused impact force causes of thermogenesis.

3

The problem is that particle sizes are not uniform after pulverization

4



With 2D rotation mixing, unevenness is a problem.

■ Solidification, thermogenesis, and non-uniformity in pulverization, and unevenness in mixing often occur and affect sales profits.

1 **Solidification in 2D motion dry pulverization**
- **Solution:** Achieving no solidification by high-speed 3D rotation dry pulverization.

2 **Thermogenesis problem in 2D motion pulverization**
- **Solution:** Utilizing the entire inner area of the container promotes the dispersion of frictional heat and its generation. Effective with organic and inorganic substances.

3 **Uneven particle size in 2D motion pulverization**
- **Solution:** Batched pulverization utilizing friction force of high-speed 3D motion. Rounded particle form and uniform particle size.

4 **Uneven 2D motion mixing (because of only one axis)**
- **Solution:** Without blade. High-speed 3D motion makes it possible to use entire inner area of container efficiently. Low thermogenesis and uniform mixing can be achieved.

▼ Solution

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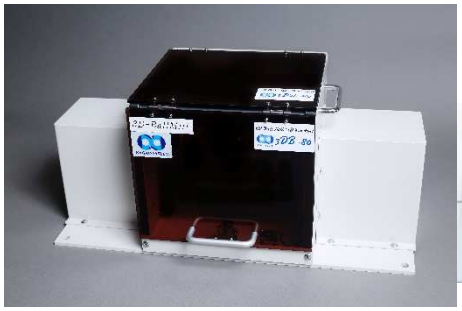
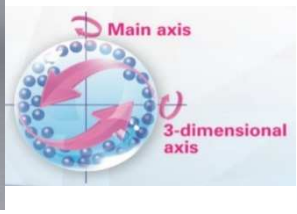
Small Size 3D Ball Mill (3D Reactor) 3DB-80　Batch method【2g(ml)～100g(ml)】





Characteristics

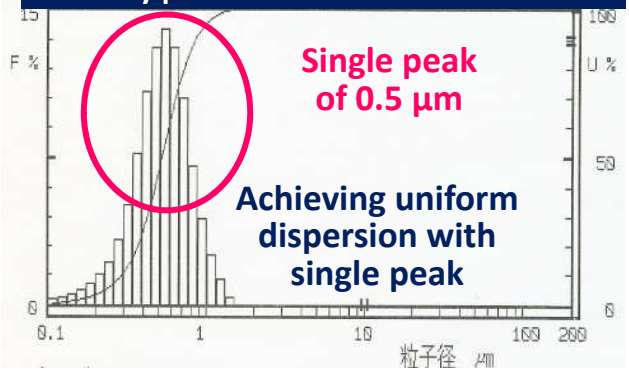
- **Dry process pulverization without solidification**
- **Low thermogenesis with spherical motion**
- **Uniform pulverization, mixing and dispersion**
- **Non-criticality based on high-speed motion**
- **Uniform mixing without blade**
- **Utilizing friction force and achieved pulverization with maintaining particle form**

Case: After 3D Ball Mill pulverization

After 3D Ball Mill wet pulverization for 90 minutes

Rounded and bulky shape of particles by means of strong friction force.

After 3D Ball Mill dry pulverization for 30 minutes



- Rounded and bulky shape of particles by means of strong friction force.
- 3D motion prevents particles from aggregating and solidifying.

Experimental results:

- Implementation of high-speed 3D motion that enabled a new type of pulverization, mixing, and dispersion which was considered to be impossible thus far.

1 Sesame pulverization experiment

2D motion:
- Pulverization failure with pasted form due to pulverization thermogenesis.

3D motion:
- Successful pulverization with little pulverization thermogenesis.

2 Sesame mixing experiment

2D motion:
- Sesame with low specific gravity moves outwardly Salt with high specific gravity moves inwardly.

3D motion:
- Uniform mixing of whole content.

3 Meringue experiment

2D motion:
- Unevenness in mixing. Less volume.

3D motion:
- No unevenness and uniform mixing. Having higher volume as a whole.

Product

Dimension:	Width 585 mm × Depth 310 mm × Height 270 mm (The door opens 460 mm)
Weight:	27 kg
Main axis (vertical) rotational speed:	0–600 rpm
3D axis (horizontal) rotational speed:	0–600 rpm
Actual 3D frame rotational speed	0–1,200 rpm
Power	AC 100 V or 220V (120 W DC brushless motor 2 units)
Maximum electricity consumption	240 W
Container	Zirconia, alumina, etc.
80 mm sphere container (Maximum processing capacity: approx. 100 mℓ or 100 g)	Metal (S45C, stainless steel, chrome steel, tungsten carbide, etc.)
Matching half-sphere container	Other specifications

Media coverage

TV TOKYO
WBS 2010.1

J-GoodTech
2015.2

Customers

- Public administration
  - ✓ The University of Tokyo, Kyoto University, Hokkaido University, Kyushu University, Tohoku University
  - ✓ Advanced Industrial Science and Technology (AIST), National Institute for Materials Science (NIMS), Japan Atomic Energy Agency
- Private sector business (confidentiality, non-disclosure)
  - ✓ Major automaker, major electronics manufacturer, major glass manufacturer, major chemicals manufacturer, major Pharmaceutical manufacturer, major paint manufacturer, many others.

Other Applications


Car materials

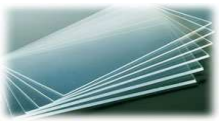

Ink, paint


Electronics, battery materials

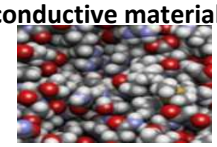

Metal, conductive materials


Cosmetics


Chemicals, fiber materials


Glass materials


Film materials


Catalyst materials


Pharmaceutical products

The best choice for research institutes, companies, and universities developing new materials using nano-sized and micron-sized fine particles.

Total Cost

In the first year, approx. 54% total cost reduction has been achieved.

- In 2D rotation, the problem is that fine particles cohere at the bottom during pulverization causing aggregation.
  As a result, restoring efforts are needed after aggregation. (Labor cost of researchers is high.)
- In 3D rotation, fine particles continually move inside the container during pulverization. There is no room for aggregation and it does not require any unnecessary processes.

Contact

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