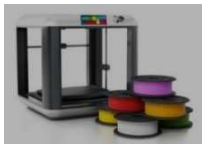
3D Ball Mill(3D Reactor) Medium /Small Size

Proposal of 3D Ball Mill (3D Reactor) that enables highly uniform mixing and milling effect

NAGAO SYSTEM

▼ Industries & Issues

Manufacturer of Electric/Metal/ Ceramics /Glass/Chemical

■ Aim to improve material quality.

(High uniform mixing and dispersion without blades is realized utilizing high speed 3D rotation.)

- ➢ Mixture of materials with specific gravity, viscosity difference (metal, ceramics and resin).
- ➢ High uniform mixing of battery material, ceramic material, magnetic material improves product performance.
- ➢ It realizes highly uniform mixing of paste and ink for the electronics.
- ➢ Realize highly uniform mixing and reduce loss during manufacturing process.

■ Aims to avoid defects in manufacturing processes due to uneven composition

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Paint manufacturer

■ Aim to improve paint quality to levels far beyond those of competitors

- ➢ High uniform mixing and dispersion of metal(Glass) and organic solvent realized
- ➢ 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

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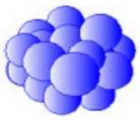
Pharmaceutical manufacturer

■ 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 process
  - ✓ 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

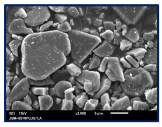


After 2D motion pulverization, mixture generated fine particles cohere at the bottom.

2

Highly focused impact force causes of thermogenesis.

3



The problem is that particle sizes are not uniform after mixture and pulverization.

4

Mixing with blades generates shear heat.

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

1 **Solidification in 2D motion dry pulverization, mixture, and dispersion.**

- ➢ **Solution:** Achieving no solidification by high-speed 3D motion dry pulverization, mixture, and dispersion. .

2 **Thermogenesis problem in 2D motion pulverization, mixture, and dispersion.**

- ➢ **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, mixture, and dispersion.**

- ➢ **Solution:** High-speed 3D motion is a batch type mixture that makes use of frictional force. Because it always moves around inside the container, there is no time to solidify.

4 **Uneven 2D motion mixing (because of only one axis)**

- ➢ **Solution:** Without propeller/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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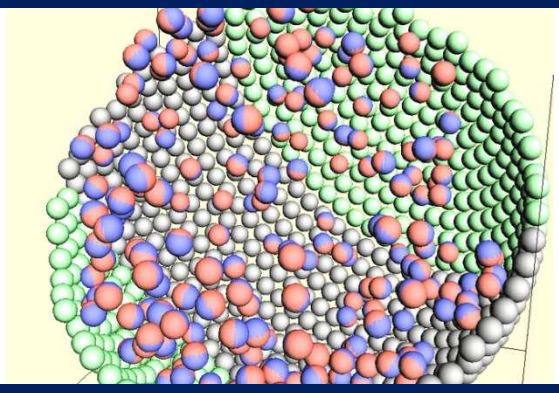
Small Size 3D Ball Mill (3D Reactor) 3D-80　Batch method【2g(ml)～100g(ml)】

Characteristics

- **Non criticality by high speed 3D motion**
- **High uniform mixing and dispersion without blades**
- **Unused blades are not affected by shear heat**
- **Reduced heat generation utilizing the entire container**
- **Mixing and dispersing without destroying the particle shape making use of frictional force**

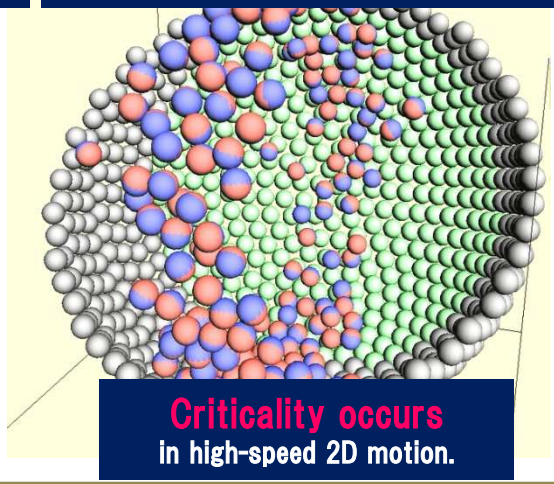
Case: Difference between high-speed 3D motion and high-speed 2D motion

High speed 3D motion (No Critical)



Strong friction force motion utilizing the whole container. There is no criticality.

High speed 2D motion(Critical)



Criticality occurs in high-speed 2D motion.

■ High-speed 3D motion is non-critical. Non-agglomerated and non-solidified particles realized.
■ 3D ball mill (3D Reactor) can mix substances of different specific gravities and viscosities uniformly without using blades.

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 370 mm × Depth 260 mm × Height 360 mm
Weight:	21 kg
Main axis (vertical) rotational speed:	0–600 rpm
3D axis (horizontal) rotational speed:	0–1,200 rpm
Actual 3D frame rotational speed	0–1,800 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

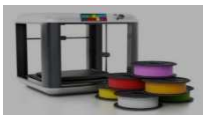
J-GoodTech
2015.2

▼ 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.

▼ 化学、繊維材料

Conductive pastes



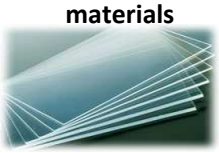
3D printer modeling materials

Inks, Paints

Electronics, battery materials

Ceramics materials

Chemicals, fiber materials



Glass materials

Film materials

Pharmaceutical products

Cosmetics

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 motion, 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 motion, 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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