Mechano Fusion System AMS
Designed for particle-to-particle combination in order to enhance particle performance

The Mechano Fusion System explores possibilities for new materials.

Mechano Fusion refers to the process by which mechanical energy is applied to several different types of particles to induce a mechano-chemical reaction, thereby creating new materials. Since there is an infinite variety of possible particle combinations, various forms of particle designs and processing technology have now become a reality in a broad range of fields. Coupled with the above, Mechano Fusion technology has been employed to yield new materials with enhanced particle performance.

Main Features
The Mechano Fusion System can:
1. produce composite particles, control particle forms (making them spherical or flat) and mix particles in rigorous precision.
2. eliminate the need for pre-mixing particles during particle performance improvement processes (any addition of a pre-mixing process achieves a further cut in processing time.)
3. fuse higher volumes of particles while providing the same level of Mechano Fusion effect as the previous model.
4. allow for ease of loading and unloading powder materials (it is even possible to unload the entire amount of material.)
5. control product temperature by the use of a water-cooled jacket that is provided on the casing.
6. can substantially save space due to its reduced size compared with the previous version.

Principles & Structure
The basic operating principle of the Mechano Fusion System is shown in the left-hand diagram. The powder materials in the rotary container are subject to a centrifugal force and are securely pressed against the wall. The materials undergo strong compression and shearing forces when they are trapped between the wall and the inner piece with a different curvature.

In the new Mechano Fusion System (AMS Model), as indicated in the drawing below, the powder materials are delivered outside through slits on the rotary rotor walls. They are then carried up above the rotors by the rotor-mounted circulating blades. Subsequently, the materials return again to the rotors where they receive strong forces from the inner

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pieces. This cycle of both three-dimensional circulation and effective compression/shearing of the powder materials are repeated at high speeds, thereby forming them into a composite material.

Applications

The Mechano Fusion System is capable of both preparing particles with enhanced performance and mechanically processing large quantities of new material particles. The processes employed include:

* combining particles of organic and inorganic substances, metals, ceramics and other similar materials;
* modifying the surface properties of these particles;
* controlling particle forms; and
* distributing and blending particles in a fine, precise manner.

Typical applications of the Mechano Fusion System include:

- Catalysts
- Ceramic parts
- Electrical parts
- Magnets
- Toner
- Electronic parts
- Cosmetics
- Medicine
- Pigments
- Toner
- Lithium secondary cells
- Ni-MH secondary cells
- Fuel batteries
- Biochemical applications
- Cement materials
- Powder metallurgy
- Thermet materials

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Application for cosmetics

Mechano Fusion can fuse nano-order particles onto the surfaces of particles as fine as several microns in both a quick and simple manner. For example, combining a titanium oxide particle (with a BET diameter of 15 nm) on the surface of a PMMA particle (with a mean diameter of 5 μm) produces a product that exhibits not only entirely different properties from those of the component particles, but also fluidity similar to liquid.

1. Combination of particles into a composite

1.1 Resin electrification control (resin to resin fusion)

PMMA particles, with poor electrification quality, can be successfully modified into particles that have strong negative-electrode charging properties. This is accomplished by fusing the ultra-fine particles of the fluorocarbon resin to the surfaces of the PMMA.
1.2 Lightweight heat-resistant materials (metal to metal fusion)

**Surface-coated particles**

![Image of surface-coated particles]

(1) This microscopic photograph shows a surface-coated structure resulting from mechano fusing nickel (bright) and aluminum (dark).

**Particles in which other types of ultra-fine particles are dispersed**

![Image of dispersed particles]

(2) Shown above is an aggregate structure that is produced by rotating micron-sized Ni-Al composite powder materials at high speeds for mechano fusing.

**Lamella structure particles**

![Image of lamella structure particles]

(3) This photograph depicts a lamella structure composed of Ni-Al composite powder materials that are mechano fused using a zirconia medium.

1.3 Application for electrical and electronic parts (metal to ceramics combination)

![Image of electrical and electronic parts]

Ultra-fine ceramic particles are fused around the surfaces of the metal particles. This process yields a new material that combines the electromagnetic properties of the metal material with the electrical insulation qualities of the ceramics.

1.4 Application for high-performance structural materials (metal to ceramic polyphase coated composite particles)

![Image of high-performance structural materials]

This is a double layered composite particle in which a layer of zirconia superfines and a layer of copper superfines are fused in two steps onto the surface of the stainless (SUS316L) spherical particles.

This is a polyphase coated layer composite particle in which a mixture of stainless flake particles and zirconia superfines are fused onto the surface of stainless spherical particles.

The Mechano Fusion System offers a broader array of potential for both various other particle combinations and morphological designs. (Typical applications: high-temperature, high-strength materials)
1.5 Control of the coating rate during the particle-to-particle combination process and that of the structure of a formed product

(a) Preparation of composite materials in which particles of another type are dispersed
(Ex. Ceramic particles fused on metal matrix particles)

(b) Production of network structure composite material
(Ex. Metal particles fused onto ceramics-matrix particles)

Fusing ceramic particles at various spots on the metal matrix particles, followed by incineration, produces a composite material in which the microscopic ceramic particles are dispersed in the matrix.

2. Particle form control

2.1 Formation of particles into spherical forms (cell material)

The Mechano Fusion technique generally serves to make particles more spherical in form, and is employed to improve particle fluidity and packing density, as well as particle electrification.

2.2 Flattening (cell material)

The proper setting of Mechano Fusion process conditions can permit the flattening of the metal particles being processed. Flat particles prove to be significantly effective in the enhancement of product quality when applied as electric cell materials, special paint for electronic parts and various types of fillers.
2.3 Sphere formation performed simultaneously with particle combination (toner)

It is possible to prepare toner products that excel in fluidity and possess adequate electrification properties by shaping the square toner particles into spherical forms while fusing the static charge controlling and fluidity improving agents.

3. From precision to mechanical blending

3.1 Hue comparison

A blend of yellow iron oxide and blue dye (5 wt.%)

The Mechano Fusion process generates strong compression and shear forces that disperse particle aggregates finely and blend the dispersed particles precisely. At the same time, this methodology can achieve the mechano-chemical modification of particle properties. Thus, the resultant product assumes different hues from those mixtures produced by a conventional high-speed mixer.

3.2 Comparison in terms of lightness

Using black magnetite powder (as guest particles) and white PMMA powder (as host particles), an evaluation was carried out as to the mixing effects of a high-speed mixer and a Mechano Fusion System. This test was based on the optical lightness of the test mixture. The mixture produced by the conventional mixer in five hours was processed by the Mechano Fusion System in only a few minutes, which resulted in a substantial decrease of power lightness. This provides an unmistakable proof that Mechano Fusion is much more effective in finely blending and fusing powder particles.
New Product News

Mikro Classifier CC

With this new classifier from Hosokawa MikroPul, powder coating production can be much more efficient. By using air classification with a high sharpness of cut, yield can considerably be increased, while losses decrease in similar scales.

An improved rotor design, secondary air flow and integrated central fittings create an optimum of material and air flow. As a result, agglomerates are significantly well dispersed.

The new MikroClassifier operates in a wide range of cut sizes between 5 µm and 100 µm. Off-line and Inline classification is possible.

Tests showed that this system is in an ideal way suitable for powder coating products (epoxy or acrylate based) with enormous positive appeal to production. Other products which can be processed are minerals, food (sugar) and other fine or finest materials.

MikroCut Air Classifier-MC

The MikroCut is a new developed air classifier for in- and off-line operation. Due to its special design a high sharpness of classification, even in the range of 1 µm, can be achieved. The MikroCut is available in various sizes that are adapted to the throughput of the ACM-grinding systems of Hosokawa MikroPul. Typical applications are classification of powder coatings, pharmaceutical products, fillers, fine mineral materials etc.

Features:
• cut sizes from a few ten micron down to the submicron range
• high sharpness of classification
• no coarse particles in the fine
• high yield of product
• low energy consumption due to optimised rotor design
• easily cleanable

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