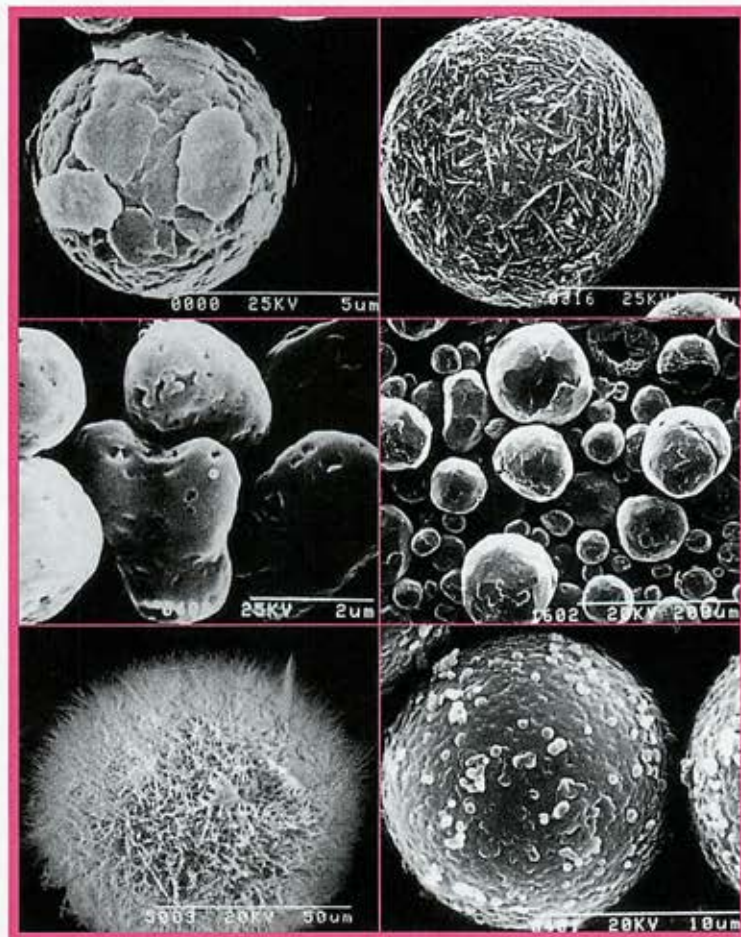


HYBRIDIZATION[®] SYSTEM

POWDER SURFACE MODIFICATION TECHNOLOGY



PATENTED

NARA

NARA HYBRIDIZATION SYSTEM (NHS)

This new high technology is designed to physically produce new functional composite powder material by dry-method embedding/filming fine powder onto the surface of core powder with excellent dispersibility. It is Hybridization System to materialize ideas of particle design.

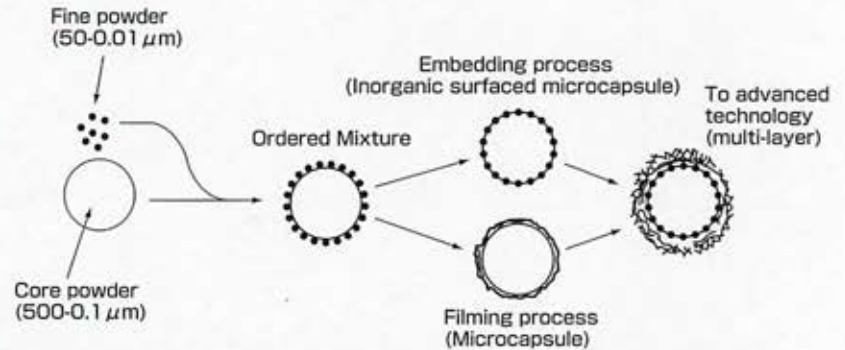
Construction/Principle

This new NARA HYBRIDIZATION SYSTEM produces an entirely new product by embedding/filming one powder onto another. It consists of the O.M.dizer, Weighing feeder, Hybridizer, Collector and Control panel. The fine powder and the core powder are fed into the O.M.dizer, where the two powders are mixed and dispersed to form an "Ordered (interactive) Mixture". The ordered mixture is weighed to be fed into the Hybridizer, the main unit of the system.

The Hybridizer comprises of a high speed rotor, stator and cycle tube.

The processed material (the ordered mixture) fed to the Hybridizer is dispersed and is repeatedly subject to mechanical effects as mainly impact force, compression, friction and shearing force as well as the particles mutual effect, to uniformly embed, film or sphere in a short time (1-10 mins.) The products are then recovered in the collector.

The process is a batch operation, but a batch type continuous operation interlocked with the weighing feeder is also applicable. Moreover, as the stator, cycle tube and rotor of the Hybridizer can be cooled, material with a low heat resistance can be processed, too.

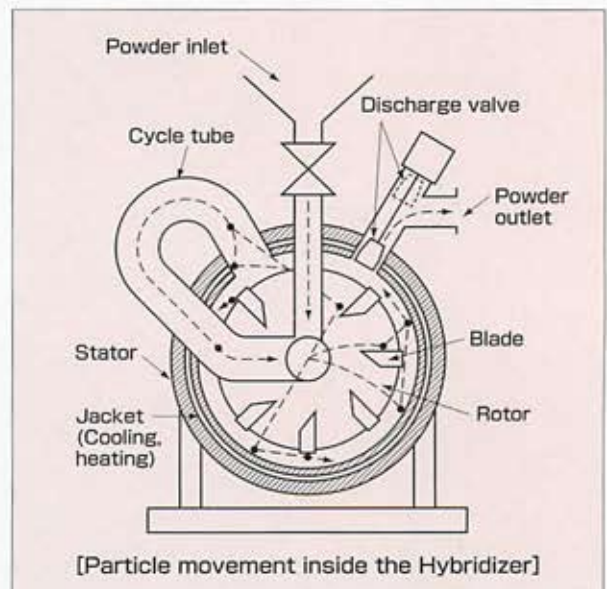
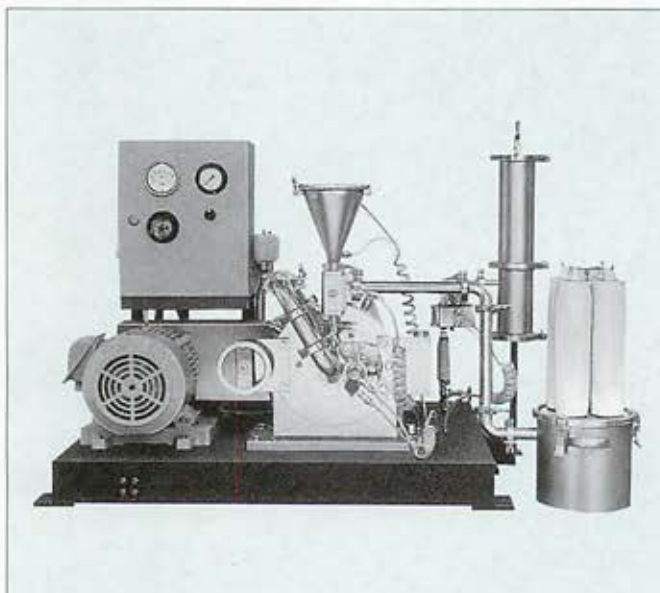
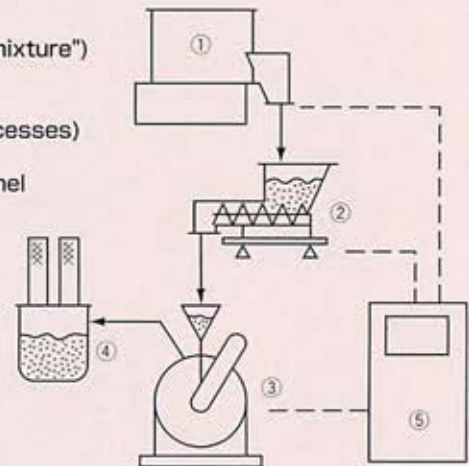


[Surface Modification Technology in powder/powder system]

HYBRIDIZATION SYSTEM

System flow-chart

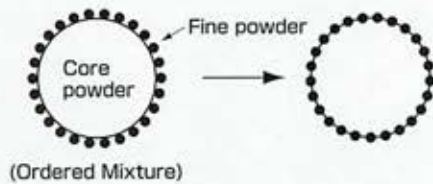
- ① O.M.dizer (formation of "ordered mixture")
- ② Weighing feeder
- ③ Hybridizer (embedding/filming processes)
- ④ Collector
- ⑤ Control & Operation Panel



HYBRIDIZATION SYSTEM

● Fundamental Processes by Hybridization

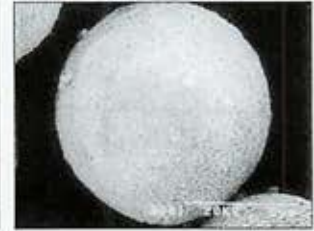
Embedding process



- Embedding process : The fine powder functioning as pigment, flowability modifier, flame retardant, magnetic powder is embedded onto the surface of the core powder by the impact force. The technique is not only limited to surface modification but also composite material creation.



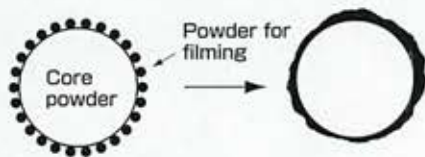
Core powder : Nylon
(Left : Ordered Mixture,



Fine powder : TiO_2

Right : Embedding processed product)

Filming process



- Filming process : Various kinds of resin or wax fine powder are given the impact force to soften, melt, and wrap the core powder to form a membrane. This is a dry type microcapsule process and aims at various kinds of masking and sustained release. A micro-sponge is also used as a core powder.



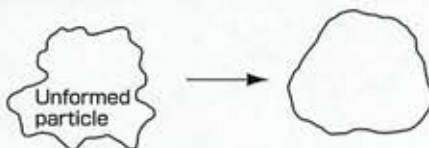
Core powder : Styrene resin



Fine powder : PMMA

(Left : Ordered Mixture,
Right : Filming processed product)

Sphering process



- Sphering process : The unformed particle shape, not the particle composition, is spherized by the impact force of Hybridizer by utilizing plastic deformation of metal or resin. Its aims are improvement of flow characteristics, adjustment of bulk density and surface area.



Sphering process of unformed stainless powder

■ Purposes

1. To produce a new functional composite material
(Particle design/development of new material)
2. To save high-priced/rare materials
(Cost/energy saving)
3. To improve material property
(Flowability, dispersibility, wettability, colouring, particle size distribution, sustained release, electric/magnetic characteristics, flavour/taste, etc.)

■ Features

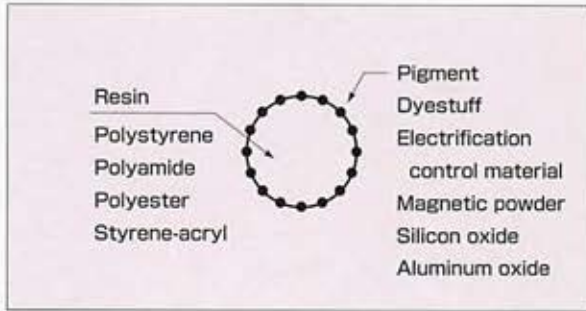
- Powder surface modification by powder.
- Mechanical process in the dry method.
- Short time duration process (1-10mins.)
- Wide combinations of binary powders
(Inorganic/Organic matter, Metals)
- Applicable to controlled atmosphere
(Inert gas) operation.
- Temperature control can be obtained by a cooling construction.

APPLICATION EXAMPLES OF P

● Application Ex. 1) Toner (Developer for electro-print)

(a) Embedding/filming process

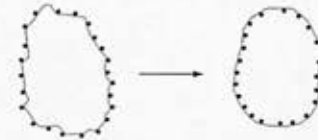
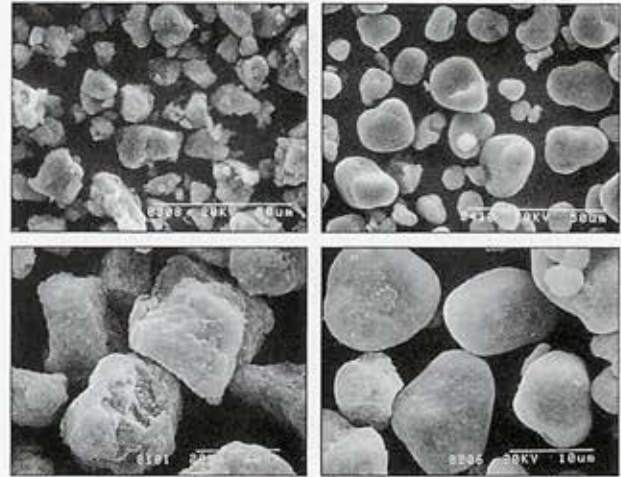
→ Adjustment of colouring, magnetic/ electric/thermal characteristics



The above model figure can be considered not only for toners but as a general composite model in the case of resin as the core powder, the conception can be spread to such colouring-related materials as cosmetics, paints, pigment, various kinds of resin material and electric/electronic/magnetic material.

(b) Sphering process

→ Improvement of powder property, adjustment of electric characteristic

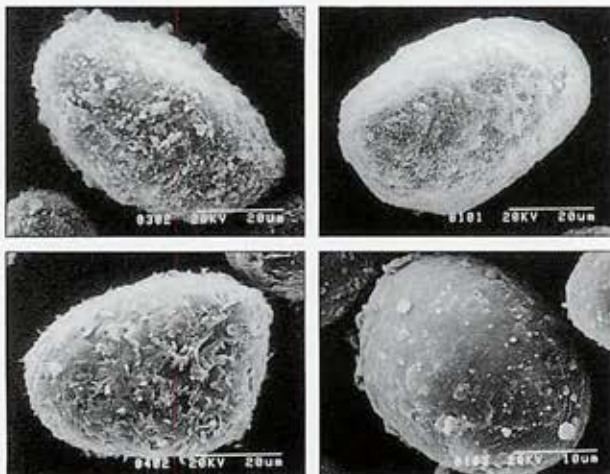


Sphering process of monocomponent toner. The toner is sphered with magnetic powder on the powder surface buried.

● Application Ex. 2) Medicine

(a) Embedding process

→ Dispersion of materia medica, Promotion of dissolution



Embedding process of materia medica with starch as the core powder

(b) Filming process

→ Emission speed control of materia medica, Masking of bitter taste and smell, Insulation from contamination

※ Filming material (surfaced material)

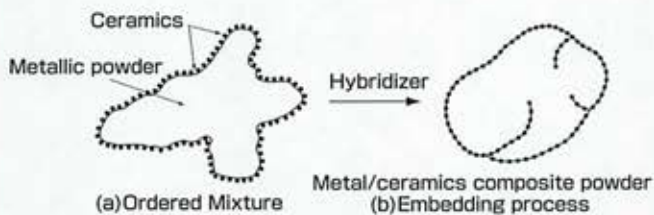
- Wax, resin
- Stomach/intestines solubility coating material

← Photos Upper left : Prednisolone
Lower left : Theophyllin
Upper right : Indometacin
Lower right : Oxyphenbutazone

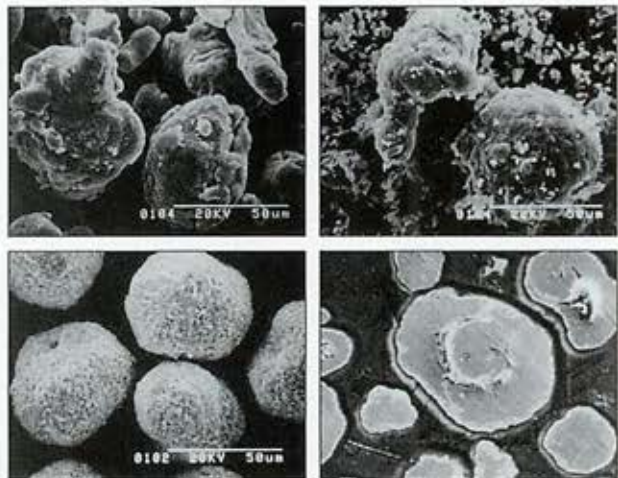
HYBRIDIZATION SYSTEM (NHS)

● Application Ex. 3) Composition in Metal/Ceramics Powder

→ Improvement of mechanical strength, Adjustment of thermal characteristics (Ex. dilatation, strength), Preparation of dispersion-strengthened alloy, etc.



Embedding process with unformed metallic powder used as the core powder and sphering process of metal powders are simultaneously performed, then a composite powder is obtained with shape of the fine powder held on the metallic powder.



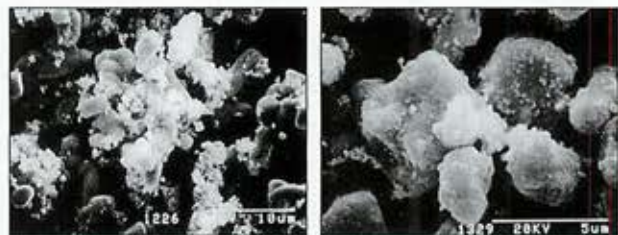
Core powder : Stainless
Upper left : Core powder
Lower left : Composite processed product

Fine powder : Yttria
Upper right : Fine powder
Lower right : Composite powder section

● Application Ex. 4) Composition in Ceramics/Metal Powder

→ Adjustment and addition of electric characteristics, Improvement of sintering and formability

Right photo : Development of boride system cermet-coating
Improvement of boride reactivity and wettability by nickel-coating. Hard coating can be obtained.



Core powder : Boride
Fine powder : Nickel
(Left : Ordered Mixture, Right : Embedding processed product)

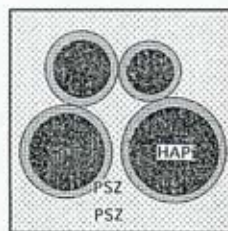
● Application Ex. 5) Composition in Inorganic/Inorganic Matter

※ Principle of process : Selecting a core powder not easily broken and a fine powder with as fine particle as possible.



HAP/PSZ composite powder

→ Process example :
Hydroxyapatite (HAP)/Zirconia (PSZ) composite.
Particle design model of the material aiming at a sintered compact biomaterial possessing biocompatibility and mechanical strength.



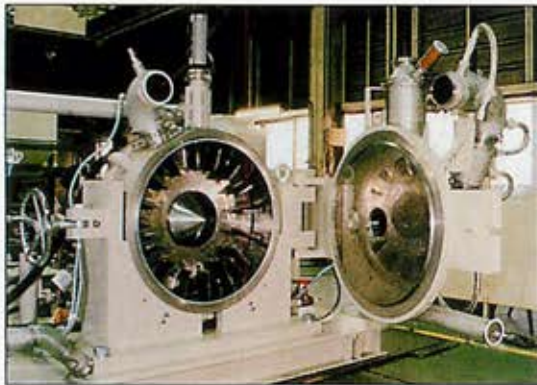
Composite powder model



Section of sinter compact

NARA HYBRIDIZATION SYSTEM (NHS)

→ Why don't you try your ideas on the creation of functional composite powder material based on particle design !

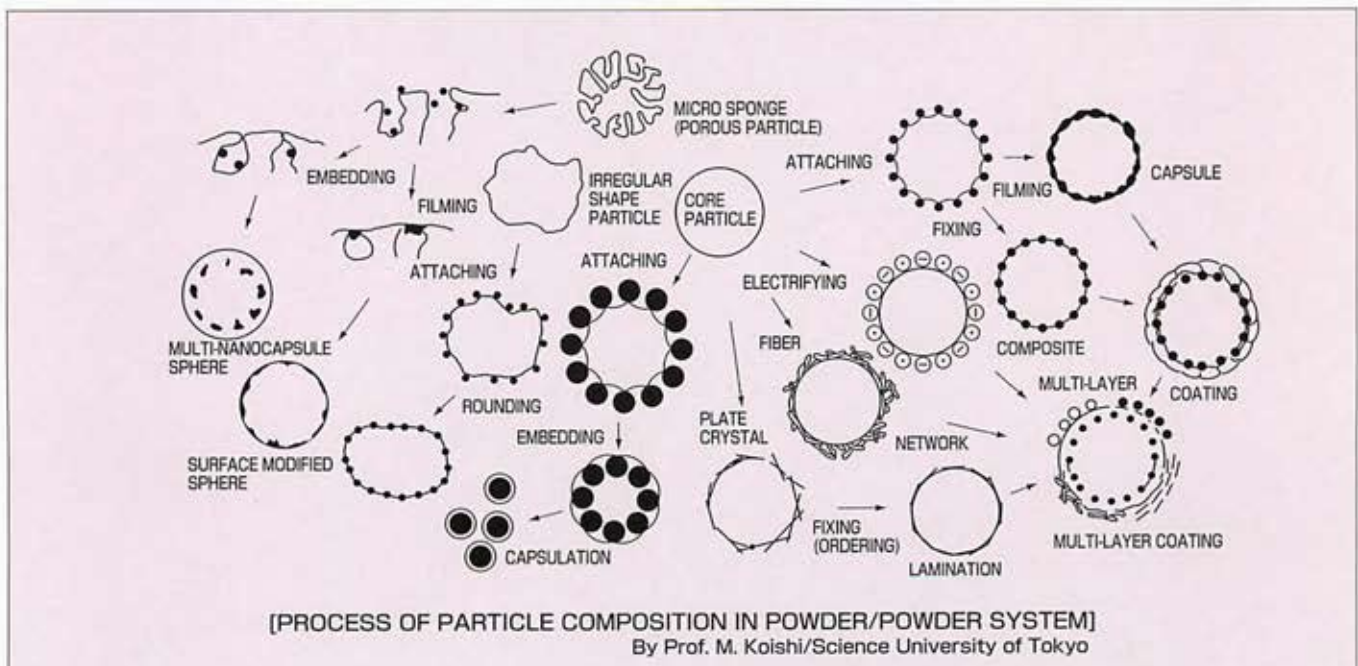
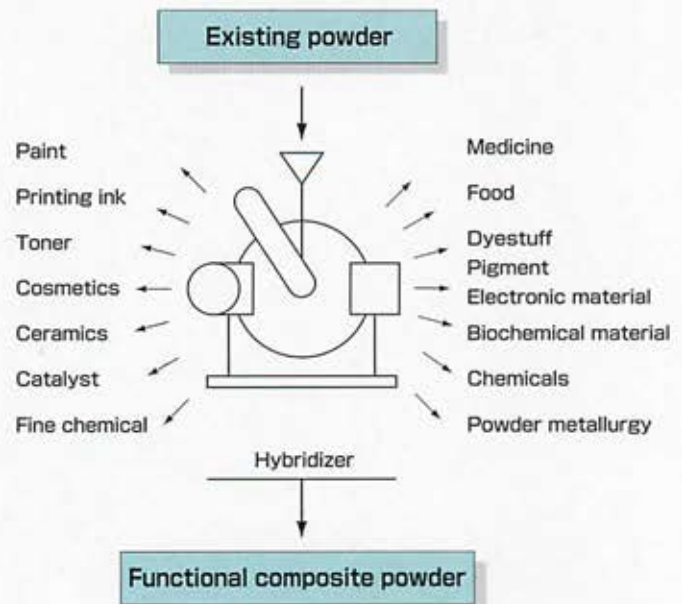


- Numerous possible combinations of material.
- Easy processing as well as process in the dry method.
- Extremely short time duration process.
- Rich in general purpose and widely applicable to various industrial fields.

"Your ideas" and "Combination of binary powders" are most important.

Modification purposes

1. Improvement of dispersibility.
2. Improvement of flowability.
3. Improvement of wettability.
4. Isolation of reaction.
5. Sustained release control.
6. Improvement of electric/magnetic characteristics.
7. Improvement of catalyst effects.
8. Improvement of coloring.
9. Shape control.
10. Improvement of weather resistance.
11. Improvement of light stability.
12. Inversion of crystal form.
13. Promotion of dissolubility.
14. Improvement of sinter characteristics.
15. Addition of irregularity.
16. Preparation of solid solution.



HYBRIDIZATION SYSTEM

HYBRIDIZATION SYSTEM NHS-O TYPE

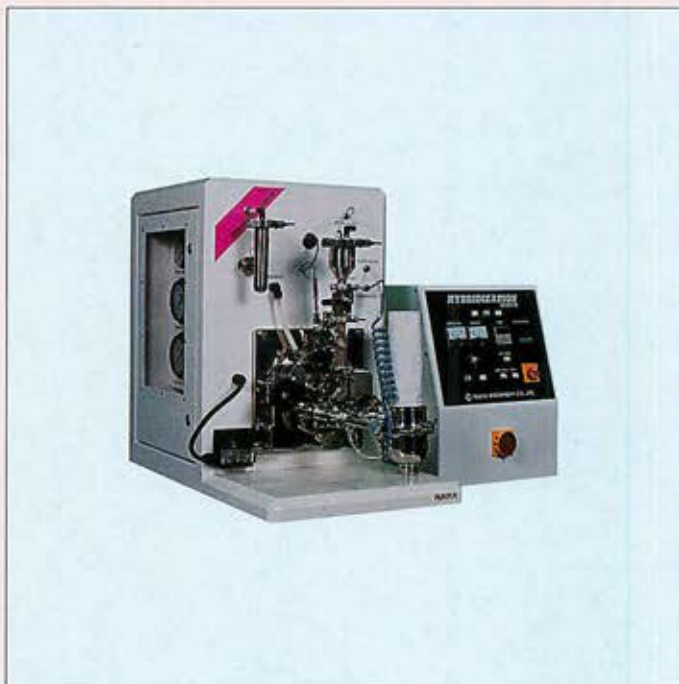
This NHS-O type is designed as laboratory equipment for research & development purposes or for the production of a small quantity of sample materials.

■ Features

- Compact type (desk machine)
- Most suitable for basic research of high-priced/rare material as only a small quantity of material is usually required for experiments.
- Easy disassembly, cleaning and assembly
- As an option, controlled atmosphere operation is possible.

[Specifications of NHS-O]

- Hybridizer : embedding/filming processes
power : 2.2kW
capacity : 50g/batch (max.)
- ※ Dimensions : 500(L)×900(W)×800(H) (mm)
- ※ Specifications and equipment are subject to change without responsibility on the part of manufacturer.

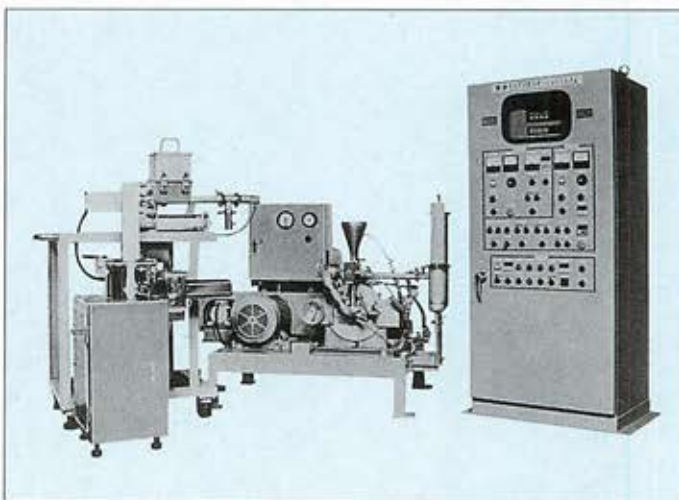


■ Principle of NHS modification process

1. Clarification of processing purpose
2. Combination and selection of binary powders
→ particle size ratio between the core powder and the fine powder, particle shape, friability and softening points are to be considered.
3. Decision of mechanical process condition
 - Speed of rotation : related to application and extent of process
 - Processing time : related to process uniformity
 - Feeding quantity and processing temperature are to be considered.

■ NHS Series

Model	Power (kW)	Feeding quantity (g/batch)	Rotor Dia. (mm)
NHS-0	2.2	50	118
NHS-1	5.5	200	230
NHS-2	11	400	330
NHS-3	22	800	470
NHS-4	45	1600	670
NHS-5	90	3200	948



■ Charged Experiments & Processing

Various experiments and processing are carried out subject to charges.

Three types of test machines, NHS-0/NHS-1/NHS-3 are provided. Please consult with us freely. We are ready to share abundant data and know-how.

Reference to : the back

NARA'S PRODUCTS

PULVERIZERS/CRUSHERS

Jiyu Mills
Super Jiyu Mills
Rotary Cutter Mills
Hammer Mills
Sample Mills
Super Clean Mills
Excellent Mills

SUPER FINE PULVERIZERS

New Cosmomizer
Micros

CRYOGENIC MILL

Goblin

SEPARATOR

Whizzer Air Separators

DUST COLLECTORS

Cyclo Clean Filters
Jet Clean Filters
Wet Scrubbers

DRYERS

Fluidized Bed Dryers (Batch & Continuous)
Built-in Thermal Tubes Type Fluidized Bed Dryers
Pneumatic Dryers
Cage Mills
Tornesh Dryers
Media Slurry Dryers
Tower Dryers
Paddle Dryers
Multifin Processors

FEEDERS

Double Screw Feeders
Plug Screw Feeders
Rotary Valves

MIXERS/GRANULATORS

NMG-P(Pharma Type)
NMG-H(Heavy Duty Type)
NMG-L(Laboratory Type)

MILLING TYPE PARTICLE STANDARDIZER

Nebulizer

SURFACE MODIFICATION • COMPOSITION • SOLID PHASE REACTOR

Hybridization System
Miralo
LaboKiln
Laser Ablation System

DESIGNING & FABRICATION FOR POWDER PROCESSING EQUIPMENT

LICENSEES

KOMLINE-SANDERSON ENGINEERING CORP. (U.S.A.)

Tel : +1-908-234-1000 Fax : +1-908-234-9487
Paddle Dryers Single Paddle Dryers
Multifin Processors

CARRIER VIBRATING EQUIPMENT, INC. (U.S.A.)

Tel : +1-502-969-3171 Fax : +1-502-969-3172
Fluidized Bed Dryers (Batch & Continuous Type).
Media Slurry Dryers (Sales Agency)

KILBURN ENGINEERING LTD. (INDIA)

Tel : +91-222-566-3101 Fax : +91-222-566-8436
Paddle Dryers
Fluidized Bed Dryers (Batch & Continuous Type)
Pneumatic Dryers

SALES AGENTS

ACTRA LIMITED (KOREA)

Tel : +82-31-732-3939 Fax : +82-31-733-7878
All NARA'S PRODUCTS

CHINA ABC INTERNATIONAL CORPORATION (TAIWAN)

Tel : +886-2-2706-1544 Fax : +886-2-2703-6142
All NARA'S PRODUCTS

GOOD MORNING ENTERPRISE CO., LTD. (TAIWAN)

Tel : +886-2-6616-0668 Fax : +886-2-6616-0669
All NARA'S PRODUCTS



NARA MACHINERY CO., LTD.

5-7, 2-chome, Jonan-Jima, Ohta-ku, Tokyo-143-0002, JAPAN,
Tel : +81-3-3799-5011 Fax : +81-3-3790-8027

<http://www.nara-m.co.jp/english/index.html>



■ SUBSIDIARIES

N.M.KOREA CO., LTD. (KOREA)

Add : #1915 Hyosung Olympic County Il 175-12
Jamsil-Dong Songpa-Gu Seoul, Korea
Tel : +82-2-3431-7967~9 Fax : +82-2-2203-1358

NARA MACHINERY EUROPE (GERMANY)

Add : Europaallee 46, 50226 Frechen
Tel : +49-2234-2776-0 Fax : +49-2234-23067