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Featured Article

An innovative Japanese manufacturer is using water jet atomization to produce metal powders with well-shaped, uniform particles in the range 1.5–500 microns. Following water atomization, the resulting metal powders are dried, screened and blended. A key aspect of the blending operation is a rotary batch mixer imported from the U.S. Find out how the mixer helped the company achieve batch uniformity rapidly and more gently than with agitated blenders. **Read more on page 6.**

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Japanese metal powder manufacturer relies on U.S. rotary batch mixer

Good blending, short mixing times and complete discharge without segregation, even with the large capacities involved

By Steve Knauth

Nippon Atomized Metal Powders Corp. uses a patented water-jet atomization process to make high-quality super-fine metal powders that are of consistent composition and particle size from copper, bronze, brass, silver, gold and stainless steel.

Applications for the metal powders include electronic components and assemblies, bearings, cutting and polishing tools, jewelry and metal injection molding.

To get there, Nippon Atomized refined the process of water jet atomization to produce metal powders with well-shaped, uniform particles in the range 1.5–500 microns.

Following the water atomization stage, the resulting metal powders are dried, screened and blended. A key aspect of the blending operation — and one involving one of the few non-Japanese equipment items in the factory — is a 700-THCX-90-SS rotary batch mixer supplied by Munson Machinery Co., Utica, N.Y.

Koji Yamamoto is general manager of the R&D division of Nippon Atomized and heads one of the firm's two production divisions. He says the mixer blends large batches with short cycle times. Discharge is complete, and most importantly, Yamamoto says, the mixer is effective at avoiding particle size segregation on discharge.

A tradition in metal powders

Nippon Atomized Metal Powders was established in 1964 in the city of Noda, which is around 20 miles north of Tokyo and perhaps best known as the home of Kikkoman soy sauce. In 2012, Nippon Atomized built a new site in a neighboring prefecture to make super-fine metal powders by the water jet atomization process. Today the company employs around 100 people and has an annual output of about 2,400 tons, of which one-third is exported. Powdered metal products include:

Nippon Atomized Metal Powders was established in 1964 in the Japanese city of Noda, in Chiba Prefecture. In 2012 the company built this new plant in neighboring Ibaraki Prefecture.

- Copper, silver and gold powders for conductive pastes used in electronics
- Bronze powders for bonding industrial diamonds in cutting tools
- Bronze and brass powders for bearings in electric motors and car parts
- Silver and gold powders for metal clay, a craft material developed in Japan
- Soft magnetic alloy powders for inductors used in electronic power supplies
- Small amounts of stainless steel powders for metal injection molding

Atomization in the making of metal powders can involve gas or water jets, centrifugal sprays, mechanical milling and electrolysis. Water-jet atomization technology was invented by a Japanese research institution

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and licensed and then improved upon by Nippon Atomized Metal Powders.

In water atomization, Yamamoto explains, water pumped at high pressure through a ring-shaped nozzle creates a convergent conical jet. Molten metal fed into the center of the cone is blasted into fine droplets, which solidify into powder as they fall into a tank of water beneath the nozzle.

Compared to other methods, water jet atomization is economical and flexible, Yamamoto says. It allows tight control over density, shape and diameter — from microns to millimeters — and works with many different metals and alloys.

A drawback of the original water atomization process is that the particles could have poor shape and fineness compared to those made by gas atomization. Nippon Atomized's higher-pressure process produces super-fine powder with spherical particles down to 1.5 microns.

In use of a water jet, critical variables include the aspect angle, water pressure and flow rate. Temperatures of the molten metal, water and surrounding atmosphere are also important. Finally, downstream operations such as drying and blending of the powders must be done correctly to maintain powder quality.

Scrap into valuable products

Raw materials enter the site in various forms, many of them having been recycled. The copper, for instance, is a mixture of electrolytically refined virgin metal and scrap from electric cables and the electronics manufacturing industry. Stainless steel arrives as scrap. Other raw materials include high-purity tin, gold and silver.

Metals are melted in an induction furnace. As the melt forms, the furnace operator uses a spectrograph to adjust and control the resulting alloy compositions.

Downstream of the furnace is the water atomization machine, followed by equipment to dewater and dry the metal powder. Powders pass through a gyratory box screener to control particle size. For the finest powders, ultrasonic sieving and an air classifier carry out the same task. Finally, the powders are homogenized and blended, sieved again and packed into drums for shipping.

Material rejected at various points in the process is returned to the appropriate stage: re-sieving, re-mixing, atomization or re-melting. A small fraction ends up as waste that is sold to mining companies or scrap merchants.

Batches of metal powder typically weighing 8,800–11,000 lb (4,000–5,000 kg) are loaded into the Munson rotary batch mixer from an overhead container that is moved into position by a crane.

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Pure copper powder, the coarsest powder processed in the rotary batch mixer, ranges from 85-100 microns.

Nippon Atomized Metal Powders' main product for oil-less bearings is partially premixed copper-tin bronze powder.

Combines capacity with performance

The Munson rotary batch mixer plays a key role in producing metal powders having particle sizes from 10 micron up to 500 micron (30 mesh) and specific gravities in the range 1.8–3.5. The mixer's volume is 90 cu ft, and typical batch sizes are 8,800–11,000 lbs.

"We use the mixer mainly as a homogenizer to avoid material segregation," Yamamoto says. "We need to be sure that particle size distribution is the same across the batch, and from one batch to the next. With the Munson, we get good blending and complete discharge without segregation, and short mixing time, even with the large capacity."

Nippon Atomized purchased the mixer to increase capacity. "Our previous double-cone blender was limited to 1,500 kg per charge," Yamamoto says, "and a batch took 20 minutes to blend. This was too small and too slow for our production needs. The rotary batch mixer blends up to 5,000 kg in just 5–7 minutes."

The unit's four-way mixing action — tumble, turn, cut and fold — achieves batch uniformity rapidly, and more gently than with agitated blenders. Continuous rotation keeps material in motion at all times, preventing particle-size segregation during discharge.

Why the company imported

Yamamoto says Nippon Atomized imported a mixer because, "We wanted complete discharge without segregation, plus large capacity. There are no Japanese mixers that combine these important features. I believe one domestic machinery producer makes a similar rotary batch mixer. However, that mixer has a complex construction and I believe it would to be hard to use. It was also comparatively expensive."

The Japanese powder metallurgy industry mostly uses V-blenders and double-cone blenders, Yamamoto explains. These mixer types provide complete discharge, but there tends to be segregation of particle sizes: "In general, the particle size distribution moves from fine to coarse as the mixer is discharged. The Munson mixer avoids this problem."

Headroom is tight at the Nippon Atomized facility, Yamamoto says, and it was a challenge to fit the Munson mixer into the available space, as it is loaded from an overhead container moved into position by a crane. Customer acceptance was

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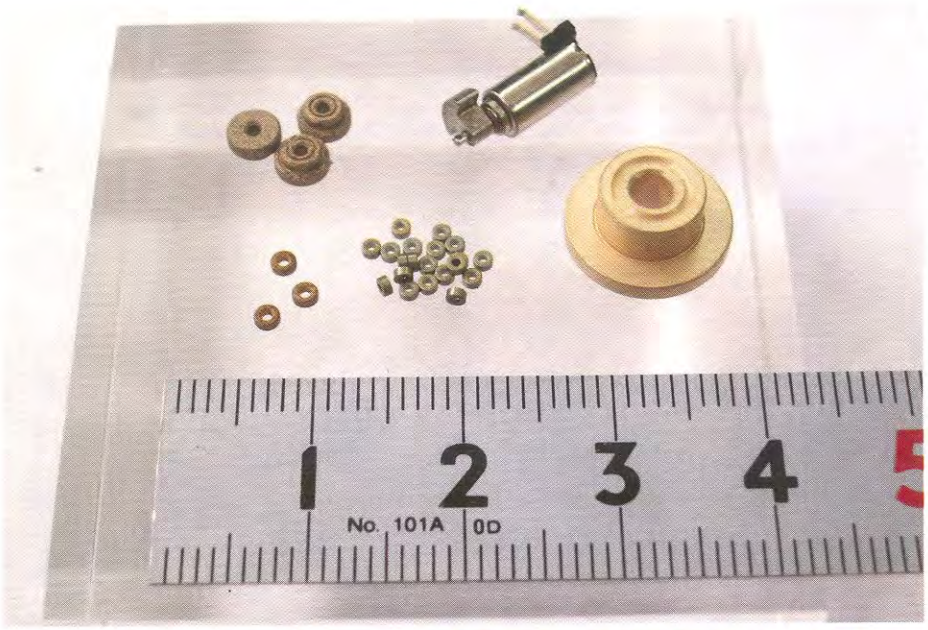

Customers make accurately shaped products with Nippon Atomized Metal Powders' fine, uniform oil-less metals.

also an issue, and even now some are reluctant to change to the offshore mixer for their products.

But any initial headaches were well worthwhile, Yamamoto says, with the mixer proving both effective and reliable after nearly three years in operation. When a change of grade is required, cleaning is straightforward; a small quantity of the new product is used to clean the mixer and is then recycled.

"We don't have to worry about maintenance," Yamamoto says. "With our previous mixer, the axle and drive chain caused a lot of trouble. Here, as long as the drum alignment is okay, the rotary batch mixer is trouble-free, and the quality of blending means lower costs for quality control."

The next step, Yamamoto concludes, is "to replace our other old mixers with Munson machines."

Steve Knauth is marketing manager with Munson Machinery Co.

Founded in 1823, Utica, N.Y.-based Munson Machinery Co. is a maker of high-quality mixers, blenders and size reduction equipment for bulk solid materials.

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