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MEDIA TYPES

Guidelines and considerations when selecting a media for mass finishing.

"With mass finishing, there are no absolutes," said Dan Lord, president of C&M Topline, a manufacturer of vibratory finishing equipment.

That certainly holds true for the media—one of the main components of mass finishing along with the equipment and compound solution. But qualified guidelines exist for determining which type of media, as well as its size, shape and formulation, to select based on the type of part being finished.

Media can be divided into five types. Four categories of abrasive media exist: ceramic, plastic, synthetic (although some group plastic and synthetic together) and organic, which includes wood, walnut shells, treated corncobs and egg shells.

The selection of an organic media "is only limited by creativity," said Jim White, vice president of marketing for Burr King Manufacturing Co. Inc., Warsaw, Mo.

The fifth category is often referred to as burnishing media, which includes stainless steel, porcelain and carbon steel. "The burnishing mode mechanically pounds down the 'mountaintops' on the parts" to impart the required surface finish, White explained.

Eric Hurley, sales manager and process development manager for Vibra Finish Co., Hamilton, Ohio, is one who categorizes synthetic media as a distinct type. Synthetic media is a blend of urea formaldehyde resin and abrasive material, such as aluminum oxide or silicon carbide. Because synthetics aren't petroleum-based, they cost less than plastic media, Hurley said. "Synthetics are anywhere from 15 to 20 cents per pound cheaper."

In addition, synthetics provide environmental benefits because of their clean, nonfoaming residue. "Another advantage is that they run cleaner, as far as residue and wastewater go," Hurley said.

On the downside, synthetics have a lower specific gravity than plastics, meaning they do not remove

Machine matters

Selecting the largest, coarsest media that will not distort parts but will reach the surfaces that need to be finished without getting lodged in the parts helps minimize deburring and polishing time. But the finishing machinery plays the main role when it comes to reducing cycle times.

Three machine technologies are primarily found in mass-finishing systems: tumbling barrel, vibratory bowl and centrifugal force, which includes disk and barrel versions. According to Anthony F. Kenton of Nova Finishing Systems Inc., the "old fashioned" barrel works on 1 gravity of pressure, the vibratory-type works on 8 gravities, the centrifugal disk produces up to about 25 gravities and the centrifugal barrel generates up to 32 gravities.

"Let's say for every 100 minutes a barrel turns to produce a finished part, the vibratory bowl will take 10 minutes to produce the same results and the centrifugal-force machines will take about 1 minute," he explained. "It's a factor of 10, roughly."

Drag finishing is another mass-finishing process. It involves attaching parts to special fixtures and "dragging" them in a planetary motion through a bed of abrasive or polishing media. The design

Earth-Chain

The sPINner magnetic deburring and polishing machine uses special stainless steel pins in a soap and water solution to finish parts.

ensures that parts cannot impinge on each other.

Another technology is also designed to prevent parts, particularly small, delicate ones, from banging into each other during finishing. Called the sPINner magnetic deburring and polishing system, from Indianapolis-based Earth-Chain USA Inc., a division of Techniks Inc., it uses stainless steel pins as the media.

According to Earth-Chain, a magnetic disk rotates below a container holding the media and parts. The 30 HRC pins, which measure from 0.008" to 0.060" in diameter and from 0.040" to 0.200" in length, have a magnetic property that responds to the magnetic field. The rotation of the magnetic field causes the media to flip and turn rapidly, enabling the pins to remove light burrs.

"The parts move with the flow of the media, which is like a cyclone motion," said Greg Webb, the company's vice president. "The parts move similar to cars on a highway going the same rate of speed."

He added that the equipment allows deburring of IDs because the media, when excited by magnetic force, retains that energy inside parts and still responds to the external magnetic field. "If relying on vibration, the pins would jam in the parts."

For 90 percent of the applications, Webb said cycle times are from 10 to 20 minutes. The sPINner is able to finish large parts as long as they don't exceed a machine's weight limit, but small parts are its forté. "We do a lot with implantable medical devices coming off Swiss and screw machines," he said.

Depending on size, the cost of the equipment ranges from under $2,000 to around $20,000, and the media lasts about 3 to 5 years, depending on the material being finished.

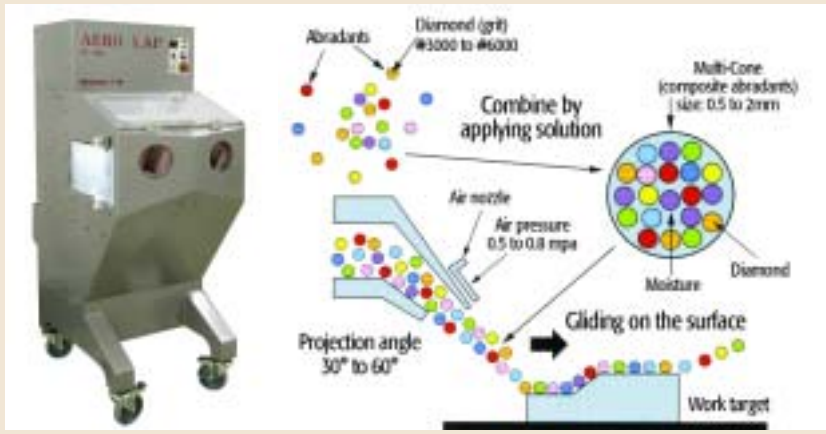
Another noteworthy finishing technology is the Aero Lap polishing machine from Okamoto Corp., Buffalo Grove, Ill. Introduced to the U.S. market at IMTS 2004, it imparts mirror finishes on even difficult-to-polish parts, such as cutting tools, pin punches, and small molds and dies. The company says that materials such as stainless steel and tungsten carbide, and physical vapor deposition and chemical vapor deposition coatings can be lapped without any measurable change in part geometry.

The machine uses a damp abrasive diamond media with varying grit sizes that is soft to the touch. The Multi-Cone diamond powder is accelerated by a special centrifuge and transferred to a lapping nozzle. From there, Okamoto reports, the media glides across the surface of the part, which the operator holds and positions in the machine.

Unlike most finishing equipment, the Aero Lap is strictly for polishing. "It's not really for deburring," said Victor Truelsen, the company's technical sales engineer. "Burrs can clog the nozzle."

He added that the diamond powder, which reportedly has a long life cycle, is recyclable.

—A. Richter



Okamoto

Left: The Model YT-300 Aero Lap polishing machine performs lapping with a damp diamond powder. Right: The Multi-Cone media glides over the part to impart a mirror finish without altering the part's geometry.

material as aggressively. Then again, Hurley noted, that makes a synthetic an appropriate choice when finishing delicate parts.

"The other negative is the simple fact that synthetics generally have a higher wear rate than plastics," Hurley said.

He emphasized that regardless of a specific media's pros and cons, the type of part determines which one to use. "There is no type of metal that automatically goes to synthetic over plastic," Hurley said. "It depends on the level of finish you're looking for and the overall part itself."

When it comes to surface finish, Anthony F. Kenton, president and CEO of Nova Finishing Systems Inc., Huntingdon Valley, Pa., noted that organics, which are run with a dry compound, impart the finest surface finish of any media used with vibratory equipment, but also require the greatest amount of processing time because of their low specific gravity. "If your parts go into a dry organic media from a machining operation," he said, "you're talking about days of processing."

Therefore, some parts are most effectively finished with multistep processing, starting, for example, with a coarse ceramic followed by a plastic and completed with a synthetic, organic or burnishing media. "I don't like to do more than three steps," Kenton said. "But I've done five, and that's a rare situation."

Additional steps, obviously, add time and add media and equipment requirements. "I'd say there is a higher percentage of single-step processes," Hurley said.

What happens to the parts after mass finishing, such as anodizing or plating, also has an impact on media selection. "If I know there's going to be a plating process after the parts come out of mass finishing, that won't dictate a single media, but it will definitely indicate a plastic or synthetic media process," Hurley said. "It's not to say a ceramic won't work, because there are a few people who are plating after ceramic media processes, but the percentage of those is fairly low compared to plastics or synthetics for plating or anodizing."

Considering Size

Because mass finishing is a cost-effective alternative to manually finishing parts, it only makes sense to select a media with a size and shape that prevents it from lodging into part features and having someone remove it by hand.

"Don't select a media that gets stuck in any holes," instructed Lord of Goleta, Calif.-based C&M Topline. "Select a media that's bigger than the holes. Start with something bigger than what you think is needed. As it wears, it continues to work and will last longer."

Like a grinding wheel, as abrasive mass-finishing media wears, breaks down and, consequently, becomes smaller, it releases abrasives and exposes

Mass-finishing glossary

Here are some definitions to a selection of common mass-finishing terms.

Burnishing media: The media is free of abrasive particles and is used for lapping, light deburring and cleaning of parts. Common ones are made of stainless steel, porcelain or carbon steel.

Centrifugal barrel: A machine with a number of drums mounted on a turret's periphery. The turret rotates in one direction, while the drums rotate at a slower speed in the opposite direction.

Centrifugal disk: Like a centrifugal barrel, significantly faster than vibratory finishing. Machines consist of an open-top bowl and a rotary disk for a base.

Ceramic media: Produced by mixing clay or other vitreous materials with abrasives. Primarily used to finish ferrous metals.

Compound: Generally, a fluid consisting of water and a biodegradable soap, which is used with the media to improve the surface finish, extend media life and minimize media dust. Powder and paste compounds are also available.

Cones: A versatile shape that enables the media to enter holes with various diameters without becoming stuck.

Cylinders: With end angles from about 22° to 60°, cylinders are able to access recesses easier than other shapes.

Diamonds: Have sharp points that can finish slots and corners.

Media-to-parts ratio: The amount of parts in a mass-finishing operation compared to the quantity of media. High ratios reduce the opportunity for parts to impinge on one another.

Organic media: Agricultural and wood products, including corncobs, walnut and other nut shells, hardwood sawdust and wood cubes. Usually run dry, organic media imparts a lustrous polish finish.

Plastic media: An abrasive, petroleum-based media, which is normally used on nonferrous materials.

Shape: An important consideration when selecting the appropriate media for a given type of part. Factors to consider include whether a shape can reach all the surfaces requiring finishing, the likelihood of the media lodging in holes, grooves or other recesses, and ease of separating the parts from the media. A mix of shapes or random shapes are sometimes appropriate.

Spheres: Provide effective flow action and surface contact, and evenly blend and smoothe workpiece surfaces.

Triangles: An effective shape for reaching corners and slotted areas and providing a uniform finishing action.

Tumbling barrel: The slowest mass-finishing process, it is a low-pressure abrading process that deburrs and finishes parts via a controlled rolling and sliding action of the workpieces, media and compound.

Synthetic media: A blend of urea formaldehyde resin and abrasive. Considered by some to be part of the plastic media category.

Vibratory bowl: A piece of mass-finishing equipment that has an open-top, chamber. The vibrating chamber causes the media and compound to scrub and peen the workpieces.

new ones, even down to its nub. "Media never loses its abrasive characteristics as it wears," said Burr King's White.

The rate of wear is based on the media's metal-removal rate. "The faster the media cuts, the faster it wears out," said Lord.

Kenton uses a media's "half life" to determine when it is no longer appropriate for an application. "If somebody has one of our vibratory machines, if he runs it 40 hours per week, he's probably going to get 4 to 6 months before the media reaches its half life, or half its size," he said. "At that point, it usually becomes too inefficient to use with that particular part you started with it. And if the part has a lot of holes, the media might get stuck."

Of course, there are exceptions. Kenton noted that one of his customers used 2", cone-shaped media that had to be discarded when they reached 1⅞" in size. "That's the way some parts are."

In general, the larger the size, the faster the media works. That doesn't mean, though, that the largest size media should always be used. Part geometry dictates how large a size is acceptable to perform the work without getting stuck. Conversely, a smaller size is more versatile. "But at the same time, because it is smaller, it's going to take longer," Kenton said. "There are a lot of trade-offs."

A mix of sizes often offers the best of both worlds. Ralph Labelson, vice president of machinery and media supplier Richwood Industries Inc., Huntington Beach, Calif., used the analogy of a hand moving through a bucket of balls. With small balls, say 1/32" in diameter, a hand is able to travel quickly and easily to the bottom. One-inch balls would greatly impede the hand's movement. However, large media keeps parts separate, whereas small media lets parts impinge on each other, "so sometimes you'll mix a large with a small," he said. "Large to keep parts separate and small to do a lot of work in cracks and crannies."

Kenton added that a mixed media moves faster over parts than uniformly sized media where the individual pieces prevent rapid movement. "If I threw in a bunch of different size balls, they all would kind of walk up each other," he said. "They would move and rotate a lot faster and be a lot more aggressive."

Shaping Up

In addition to an array of sizes, mass-finishing media is available in a host of shapes, including triangle, cylinder, cone, wedge, tetrahedron, sphere, pin and diamond. Understanding how a shape contacts the part geometry to most effectively deburr and polish helps determine which shape or shapes to select.

"Obviously, the more media contact you can get with the shape, the better off you'll be," Vibra Finish's Hurley said.

Even with the variety available, Kenton separates mass-finishing media into two basic shapes: rollers and pushers. With their rounded surfaces, rollers tend to remove burrs by crushing them. On the other hand, pushers have a straight, angular geometry to scrape off the burr. Generally, scraping burrs is preferred, "but if you have a lot of holes or round shapes, the cylindrical shape would probably be better," he said.

Kenton added that the more "mobile" a shape the faster the media works, and one unique and versatile shape is more mobile than the rest. It's called a cylindrical wedge. "It's the only shape that has its center of gravity on the outside edge of the media," he explained. "If you touch it, it will keep rolling back and forth by itself for a great deal of time. The other shapes lose their kinetic energy very quickly."

Finishing dry

Similar to machining itself, most precision metal parts manufacturers perform wet mass finishing. Generally, it is done using media run in a compound comprised of water and a biodegradable soap. Although organic media is run in a dry compound, such as sawdust, cycle times can be extremely long.

However, one dry media is being promoted as surpassing the cutting performance of ceramic and plastic wet media. It's called resin-bonded dry-finishing media.

"The biggest excitement I've seen in dry processing is this new media coming out of Japan," said Nova Finishing Systems Inc.'s Anthony F. Kenton. "It's being sold in the U.S. by Finishing Associates Inc., which is the company I reside within. It's a nylon-resin material with a type of sawdust and pumice mixture."

The company states that the media has an abrasive content of up to 95 percent and its 1.5 to 2.0 specific gravity allows the media to be used in vibratory finishing equipment and centrifugal disk and barrel machines. In addition to eliminating the need for compound and any related wastewater treatment issues, Finishing Associates reports that the media reduces surface hardening of parts and allows processing of thin, flat parts without them sticking together.

—A. Richter

The following companies contributed to this report:

Burr King Manufacturing Co. Inc.
(800) 621-2748
www.burrking.com

C&M Topline
(800) 827-1333
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Earth-Chain USA Inc.
(877) 354-3837
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Nova Finishing Systems Inc.
(215) 942-4474
www.novafinishing.com

Okamoto Corp.
(847) 520-7700
www.okamoto.com

Richwood Industries Inc.
(714) 892-8100
www.richwoodindustries.com

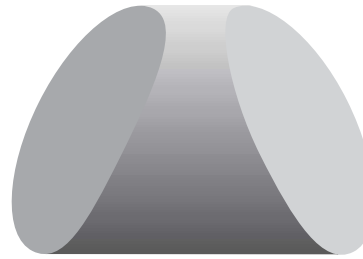
Vibra Finish Co.
(800) 253-1941
www.vibrafinish.com

Recipe for Success

Whether mass-finishing media simply polish parts, aggressively deburr them or perform somewhere in between is based on their formulation. The number of grades varies according to the manufacturer, but the main ones for cut-down, or metal-removal, media are coarse for a fast cut, medium and fine for a slower cut.

The cutting rate depends on the amount of abrasive, which might vary from 20 to 40 percent, depending on the composition and grit size. Richwood Industries' Labelson said a "strong media that holds up longer" might be made with a 280 grit, while a media with a "150 grit cuts faster, but breaks down quicker because you have more abrasive in the media."

Kenton compared the composition of abrasive ceramic and plastic media to cement. "Similar to cement, you've got aggregate, which in most cases is aluminum oxide, and the matrix that holds it together," he said. "The only way to get fast cutting is to continuously have new grits being exposed. This occurs when the degradation rate is controlled, which is a function of the matrix."



A cylindrical wedge is a highly mobile shape.

Once the appropriate media, equipment and compound have been selected, the key to successful mass finishing is controlling the variables. Variables include the media-to-parts ratio, pump calibration and the amount of water in the compound. "You can have the best process in the world—the most efficient, cost-effective process—but if you don't control that process, you're going to produce rejects no matter what you do," Hurley said.