

Taking It All Off!

"Discovering" the Right Media Puts a Dent in Stripping Costs

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Abrasive blast-finishing is a highly versatile process for altering surface characteristics. Cleaning, peening, deburring, surface profiling, stripping or creating a final finish—it's all possible with modern abrasive-blasting technology. But finding the right mix of blast media, equipment and operating parameters can be far from simple.

Although abrasive blasting is a mature technology, fine tuning continues to deliver major gains in production efficiency. Three examples follow. A producer of automotive components is now saving over \$100,000 per year in media costs alone on a single production line by having switched from glass beads to a soft ferrous media. "Bake and Blast"—cooking parts prior to blast stripping—has panned out as an attractive solution for removing multiple layers of coatings. Changing from an aluminum-oxide abrasive to plastic media has tripled the rates at which paint coatings are stripped from steel substrates while reducing energy costs for compressed air. Finishers discovered all three of these improvements within the last two years.

The question becomes: "What makes such big gains possible with a mature technology?" The answer: "Complexity and Competitiveness."

A partial list of the variables affecting abrasive-air-blasting efficiency include: the coating to be removed (if any), the substrate, the type and grain size of blast media, the surface profile desired, operating pressures, angle of attack, etc. Plug in other factors—such as media cost and durability, labor associated with the operation of different equipment approaches, energy costs, hazardous waste considerations, plus many others—and finding the optimal combination of machinery and media for your operation can be tricky.

In addition, proprietary considerations constrain the flow of information. In a competitive economy, "magic" formulas often remain secret. For instance, when our company is asked to test blast workpieces, the prospective customer frequently leaves us in the dark regarding the coating and substrate on which we

are working. Typically, we receive two sets of samples (unfinished and finished workpieces) and are asked to develop a proposal for achieving the desired results. As a consequence, building an historical matrix on the most effective combinations of media, coatings and substrates is complicated. At the same time, we are not in a position to analyze coatings and substrates for both reasons of cost and confidentiality.

As witnessed by the three cost-saving examples given previously, major opportunities to improve abrasive-blasting efficiency are available, though not necessarily easy to find.

Sorting Out the Variables

Once sample blasting has established that an abrasive-blasting process can, in fact, perform the stripping task required, it's time to look at cost factors. In the vast majority of industrial applications, a machine or system capable of recycling media offers the potential for big savings. Automated systems and premium blast cabinets usually include this capability as standard. In cases where large workpieces require stripping, some finishers still opt to use silica or slag which is good for only one pass and may indeed be the most economical approach for occasional stripping, but not for high-volume operations.

As a point of reference, TABLE A compares costs for stripping with 5,000 pounds per day of slag (100% breakdown rate) versus 5,000 pounds of steel grit (5% breakdown rate). Capital investment for the additional equipment required to recycle media has not been included. Media recovery systems can range in cost from modest, for blast and recovery devices with sweep-in troughs or shovel-in chutes, to expensive for complete rooms equipped with full recovery floors and custom material-handling equipment. Nevertheless, as TABLE A suggests, moving up to a system capable of recycling media offers very attractive return-on-investment opportunities. A blast room also minimizes potential health hazards and associated costs.

Equipment

Media and equipment are often inextricably related. For high-volume stripping of substrates where precise "targeting" of abrasives is not critical, mechanical blasting offers significant advantages. Because these mechanical systems use a bladed wheel rotating at high velocity to impart momentum to the abrasive, energy transfer is very efficient, making the mechanical approach ideal for use with high-density, non-brittle abrasives made with heavier metals. The problem with brittle abrasives such as glass beads is that the wheel shatters them before they're launched at the target. With lighter abrasives the problem is positioning. Because the wheel must be stationed farther away from a workpiece than an air-blast nozzle, for instance, frictional losses in transit between the wheel and workpieces are often unacceptable.

Though air-blasting consumes more energy, it permits the use of almost any media as well as precise targeting of abrasives. The traditional air-blast pot has evolved into cabinets, rooms and automated systems capable of reducing the labor factor in cost equations.

Through the use of programmable controllers, many automated blasting machines now have the versatility to strip a variety of workpieces with a simple program change. To set up a part for processing initially, specifics involving



Portable Blast & Recovery systems are available with shovel-in chutes or sweep-in troughs for economical media recycling.

TABLE A
Sample Cost Comparison
 (Based on 5,000 lb media use per day)

	CONVENTIONAL With Coal Slag (100% Breakdown)	ROOM With Steel Grit (5% Breakdown)	SAVINGS
Media (cost/lb X breakdown rate X lb)	\$.20/lb X 100%	\$.50/lb X 5%	\$875.00
Clean up (Man hours at \$25 per)	\$25 X 4 hrs	\$25 X 0.2 hrs	95.00
Disposal (Based on \$1 per thousand lb)	\$7.00/cycle	\$1.75/cycle	4.25
Extra electrical (For automated recycling—440V, 11.9A)	0	\$5.40/cycle	-5.40
TOTAL PER-DAY SAVINGS			\$968.85

nozzle movements, blast duration, blast pressures, conveyor speed and part orientation are entered on a control panel. Once operating parameters for a part have been stored, they can be put into action by simply entering a code related to the part type. When machines have been designed for multiple-part compatibility, calling up the appropriate code for a "stored" part puts the right program in action.

In air-blast machines, there are two basic operating principles: pressure and suction. The pressure system drives abrasives out of a pressurized container whereas the suction system relies on lower than atmospheric pressure to draw media out of the container. Each has its advantages. A pressure system can perform up to four times more work than a suction system when using an equal amount of compressed air, thus reducing energy costs. It is also more precise in delivering media at both high and low pressures. For really demanding tasks, such as removing highly adhesive coatings or getting to hard-to-reach areas, a pressure system is normally the only practical choice. And at the lower operating pressures often used with plastic-media, pressure is a must.

Suction systems cost less and simplify media delivery through multiple blast nozzles in automated blast machines. They

have fewer moving parts and are easier to maintain.

Of course, the selection of a pressure or suction system depends on desired surface finish, production rates and choice of media.

Media Selection

Media guidelines tend to be quite general as can be seen in TABLE B.

The reason, previewed earlier, stems from complexity. Juggling numerous variables makes loading a guide with specifics impossible for reasons of space alone, not to mention a lack of test data on specialized applications.

Applying some simple arithmetic helps elucidate why finding the "perfect" media can be so elusive. Assume first that different types of media capable of performing the stripping job have been identified. At a minimum, these candidates would have to be compatible with the blast equipment being considered, not damage the workpiece, and produce the desired surface profile defined in terms of a numerical RMS (Root Mean Squared). RMS represents surface profile in terms of the average horizontal distance between peaks and valleys as well as the average distance between their depths and heights. (Too deep a profile can increase the

amount of material required for recoating or, alternatively, leave peaks inadequately protected; too shallow a profile can lead to an inadequate bond between the freshly stripped substrate and new coating.)

From this point, the problem of selecting the most efficient media from the candidates appears straightforward. Just multiply the cost of media "X" (say \$.25 per pound) times its breakdown rate per cycle (say 10%) and media "X" looks like its cost is \$.025 per pound/cycle. In other words, each time a pound of media "X" travels through a blast cycle, a cost of \$.025 is incurred for lost media. Candidate "Y" in comparison costs \$.50 per pound and breaks down at a rate of 20% per cycle, resulting in a comparative figure of \$.10 per pound/cycle. Surprisingly, media "Y" may, in fact, be more economical than media "X" despite appearing four-times more costly in this oversimplified matchup.

Media "Y" could be faster acting, meaning it strips more coating per pound than media "X"—possibly five times as much—which alone would make it a better value in the comparison above. Factor in greater stripping speed in terms of reduced compressed air consumption, labor costs and wear on equipment, and media "Y" pulls even farther ahead. Media "Y" may even be able to do the job at lower operating pressures, netting additional energy savings. Costs for disposing of spent media also play a role.

In an effort to take some of the mystery out of air-blast stripping, we have been working with Perstorp Compounds, Inc., a producer of plastic media, to begin building a more detailed data base on how plastic blast media perform on various combinations of powder coatings and substrates.

Background on Plastic Media

Plastic blast media have been at work for almost ten years. Their use was initiated by the US military as an alternative to stripping fragile aerospace parts with

TABLE B—Media Guidelines

	Glass Bead	Ceramic Shot	Stainless Cut Wire	Steel Shot	Steel Grit	Aluminum Oxide	Silicon Carbide	Garnet	Crushed Glass	Plastic Media	Agri Shell
Finishing	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
Cleaning/Removal	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Peening	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO
Surface Profiling (Etch)	NO	NO	YES	NO	YES	YES	YES	YES	YES	YES	YES
Working Speed	MED	MED	MED	MED	MED-HIGH	HIGH	VERY-HIGH	HIGH	HIGH	MED-HIGH	LOW-HIGH
Recyclability	HIGH-LOW	HIGH	HIGH	VERY-HIGH	VERY-HIGH	MED-HIGH	MED-LOW	MED	MED-LOW	MED	LOW
Probability of Metal Removal	VERY LOW	VERY LOW	VERY LOW	VERY LOW	MED	MED-HIGH	MED-HIGH	MED	LOW-MED	VERY LOW	VERY LOW
Hardness, MOH Scale (Rockwell RC)	5.5	7 (57-63)	6-7.5 (35-55)	6-7.5 (20-66)	8-9 (40-66)	8-9	9	8	5.5	3-4	1-4.5
Bulk Density (lb/cu. ft.)	100	150	280	280	230	125	95	130	100	45-60	40-80
Mesh Size	30-440	8-46	20-62	8-200	10-325	12-325	36-220	16-325	30-400	12-80	MANY
Typical Blast Pressures (psi)	20-55	20-90	20-90	20-90	20-90	20-90	20-90	30-80	20-50	20-60	10-40
Shapes: ▲ Angular; ● Spherical	●	●	●	●	▲	▲	▲	▲	▲	▲ or ●	▲



Applied originally to strip coatings from delicate parts, plastic media have proved to be fast acting on a variety of coating/substrate combinations.

toxic chemicals, containing phenols or methylene chloride—both of which are banned from landfills by the US EPA and can cost over \$15 per gallon to incinerate.

Today, plastic media are used widely to strip both paint and powder coatings, and play an especially important role in removing coatings from soft substrates such as aluminum and certain composite materials, particularly when the performance and/or appearance of the substrate must be kept in tact.

Five basic types of plastic media are currently available, ranging in aggressiveness from polyester (the softest) up through poly allyl diglycol, acrylic, urea formaldehyde to melamine formaldehyde (the hardest). Polyester is very soft, very slow and not used normally unless a manufacturer is trying to salvage extremely delicate and expensive composite parts. Poly allyl diglycol carbonate works faster on composites but requires more care. Acrylic is typically applied to thin aluminum parts. Urea formaldehyde works well on powder coatings applied to robust composites, steel and some soft metals. Melamine formaldehyde shines when highly adhesive powder coatings need to be removed from hard metals.

Prior to the introduction of plastic media, powder coatings—which continue to grow in popularity because of their durability—were removed with high heat or harsh blast media. Parts not able to withstand these approaches had to be scrapped. Plastic media provides a gentle method for stripping tough coatings.

Plastic media are applied at lower pressures and rates than heavy abrasives. As a point of comparison, a machine using steel grit may cycle thousands of pounds per hour at pressures approaching 100 psi. One using plastic media normally operates between 20 and 40 psi while cycling about 300 pounds per hour and requires some special features for smooth operation. Air-blast machines handling plastic media should normally be equipped with devices to prevent ferrous debris from

being recycled into the blast stream, where it could cause substrate damage, as well as mechanisms to eliminate media bridging.

Sample Results

In its most recent series of tests, Perstorp Compounds, Inc., studied three types of plastic media: melamine formaldehyde (MF), urea formaldehyde (UF) and acrylic in both 16/20 and 20/40 US standard mesh ranges. The company used a pressure-blast cabinet equipped with a 1/4-inch nozzle, oriented 80° relative to the work surface, operating at 35 psi.

Samples tested included five substrates and ten powder coatings—between 3 and 5 mil thickness—as follows:

- An aluminum cast wheel coated with 1) acrylic clear, 2) acrylic clear with liquid base coat, and 3) TCIC polyester • Zinc die-cast coated with 1) acrylic black, and 2) acrylic high-gloss black with electro-coat base primer • Steel coated with 1) polyester, 2) polyester urethane, and 3) epoxy • Aluminum coated with acrylic clear • High-temperature plastic coated with TCIC polyester.

Stripping rates in the tests varied, but of most interest were some of the subtle interactions between media, coating and substrate. For instance, the aluminum cast wheels with their many surface angles, experienced damage (i.e., altered surface profiles) with all three media types, albeit to a very minor degree with mesh in the smaller 20-40 range. In addition, the smaller mesh plastics worked faster but degraded more rapidly as well.

On the flat zinc-die-cast and steel surfaces, damage was not a problem with any of the media/coating combinations. Epoxy proved the easiest coating to remove with MF (16-20) being 18% faster than acrylic (16-20) on steel.

In the case of TCIC polyester on high-temperature plastic, both MF and UF were too aggressive. Use of acrylic (20-40) at a lower pressure (20 psi) and less aggressive blast angle (40°) peeled the coating away with no damage to the substrate.

Test Blasting

As part of his most recent report to us, Donald Morrison, Quality Research & Development Manager at Perstorp Compounds, concludes: “Because of the many variables affecting stripping operations, including priorities related to costs and results, we recommend that test blasting be performed on each application.”

Our company agrees, particularly if abrasive blasting plays a significant role in your operations. Our newly expanded test lab and demonstration facility is able to simulate many production conditions in order to determine the best mix of media and machinery. “Discovering” the right media requires trial to avoid error and cut costs.



Empire test lab and demonstration center in Langhorne, PA, where parts are test blasted to find the most cost-effective combination of air-blast machinery and media.