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Versatile Technique for Surface Prep

Pneumatic blasting can finish, clean and treat such surfaces as metal, plastic, glass, stone and rubber

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Pneumatic blasting has evolved from sandblasting into a versatile industrial tool for finishing, cleaning/removal and surface-treatment/preparation. With the development of progressively sophisticated delivery systems and blast media, the process can be used on a range of materials, such as metals, stone, glass, plastics and rubber.

It can alter surface characteristics in various ways. As a finishing technique it can blend tool marks, hone and burnish, frost or add a matte or satin finish. It can remove glare, chemical impurities, coatings, carbon deposits, scale, excess brazing, casting materials, flashing, burrs and rust.

In the areas of surface treatment and preparation it can: 1) strengthen 2) add fatigue resistance 3) reduce design weights, porosity, friction or susceptibility to corrosion 4) improve lubrication and 5) create a surface profile for optimum coating adhesion.

In addition, it can perform multiple tasks simultaneously, such as cleaning, deburring and surface profiling. It can also create a precise RMS finish.

How it works

Pneumatic blasting uses a compressor-created difference in air pressure to propel a stream of particles entrained in moving air onto a work surface. Two techniques are used to accelerate the particles: 1) suction and 2) pressure.

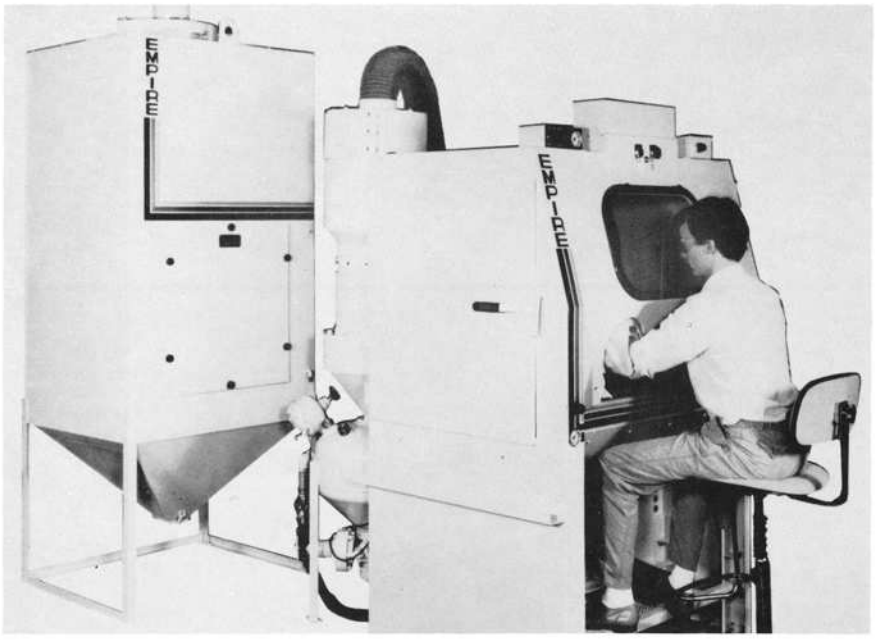
Suction-blast systems use the venturi principle to induct media from a storage hopper to a blast gun, where the discharge is focused onto the workpiece. The suction method is simple and inexpensive. Production rates are adequate for many applications.

Suction systems require no expensive modifications to operate continuously without shutdowns for media refills, a feature that becomes particularly important in automated systems. Suction systems also simplify the use of multiple guns: automatic systems with 12 suction-blast guns are common; some have 48 guns or more.

Pressure-blast systems force particles from the storage vessel to the nozzle, imparting the acceleration of the moving air to the media over an extended distance. Particles that exit a pressure-blast nozzle typically have velocities of 250 fps. By applying basic physics (Impact Energy = $^1/_2$ Mass x Velocity^2), it becomes apparent that pressure systems are highly efficient. When the media's mass is doubled, the kinetic energy is doubled. When the media's velocity is doubled, the kinetic energy is quadrupled.

The result is a common fourfold increase in production, and the use of limited compressed air per unit of work. Pressure systems provide good control at high and low operating pressures, making them excellent for tough and delicate procedures.

Pressure-blast systems are recommended for plastic, wheat starch and other lightweight media. This is because they will deliver a lightweight particle to the work surface with high momentum. A pressure system is ideal for hard-to-reach areas.



This production blast system includes reclaimer/dust-collection to recycle media and remove dust, debris and fines. Raised work station and padded armrests reduce operator fatigue. (Illustrations courtesy of Empire Abrasive Equipment Co.)

Blasting cabinets

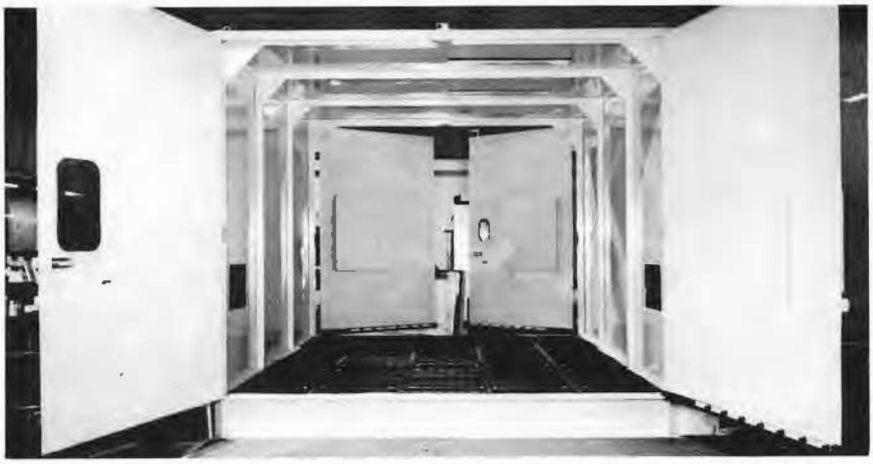
Industrial blasting equipment is available in a number of configurations ranging from manual cabinets to automated systems. Blast cabinets, in their most rudimentary form, consist of an enclosure in which an operator, using protective gloves that intrude into the cabinet but are isolated from the outside enviornment, manipulates a workpiece in the path of the blast stream.

Cabinets employing either pressure or suction systems can be upgraded with various automated accessories. These can include oscillating blast nozzles, powered turntables and adjustable media-recovery systems. Such systems eliminate fines and dust, ensuring that only "on spec" media hits the workpiece. High-quality cabinets with adjustable reclaimers recycle many different types of media and perform tasks ranging from cleaning tools to precise surface profiling.

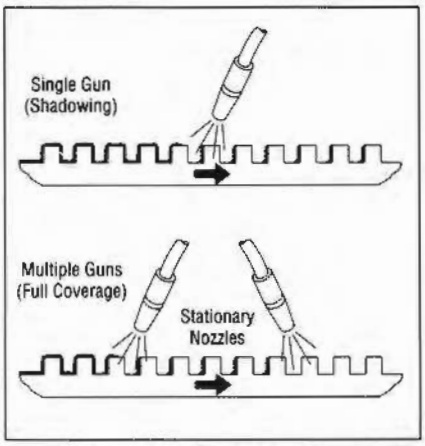
Blasting rooms

Another common type of blasting equipment is the blast room, which is used for large workpieces. In its simplest form it consists of a pressure blaster similar to the "pots" applied for outdoor sandblasting and an enclosure. Sufficient volume is needed to contain the workpiece and one or more operators.

The rooms can be constructed by the user or the blasting-equipment manufacturer. Sophisticated models include features such as media-reclaimer/dust-collection systems and powered floors that reduce labor costs by automatically collecting media. Rooms are



Blast room for processing large parts isolates the blasting from the outside environment. Automatic media-collection/recycling equipment can be included.



The single gun in the top drawing fails to clean "shadowing" surfaces. Multiple guns (bottom) remedy the problem.

suitable for various surface preparation, finishing, cleaning and treatment tasks.

Blasting nozzles

A single blast nozzle will typically produce a pattern of about 1 in. in diameter. This will not normally provide adequate coverage on a wide work surface at acceptable rates. This limitation is overcome with the application of oscillating or multiple nozzles. For surfaces with more than one facet, multiple nozzles provide complete coverage when aimed into each crevice of the workpiece.

Multiple nozzles can be combined with oscillation for improved coverage. For example, a rotary head spinning six to nine suction nozzles delivers high production rates and even coverage on surfaces up to 3 ft wide when combined with a conveyor for part transport. Rotary heads also perform exceptionally well on irregularly shaped workpieces.

Part handling in automated blast systems usually relies on in-line conveyors or powered turntables. When equipped with indexing satellite stations, turntable machines perform multiple, segregated tasks during a single cycle.

With the addition of robotic arms and/or programmable computer controls, automated blast systems ensure precise, repeatable operations on various parts with a minimum of operator involvement. Automation of blasting offers the potential for high production rates, reduced labor costs and improved repeatability.

Media selection

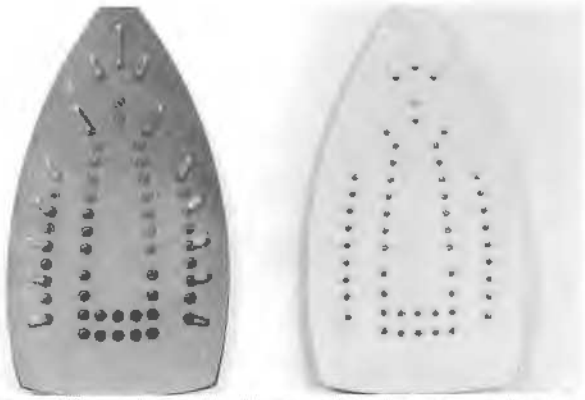
Choosing the right blast medium is critical to achieving desired results and controlling costs. Factors to consider include how a medium acts on a particular surface and how much it actually costs, not just its initial cost. For example, an abrasive that costs twice as much as another but can be recycled 20 times instead of once, makes more economic sense than its "less expensive" rival.

Pneumatic blasting materials range from soft sodium bicarbonate to hard ceramic shot, aggresively angular aluminum oxide to smooth, round glass beads. As rules of thumb, round media tend to disperse their impact over a wide area; angular media cut into a work surface. Heavy media make a deep impact; low-density particles tread lightly. Hard materials focus their work; soft materials spread it out. Table 1 gives information about commonly used media and how they are normally applied.

Pneumatic blasting is not the answer

Table 1. Media Guide

	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	NO	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-HI	HIGH	VERY-HI	HIGH	HIGH	MED-HI	LOW-HIGH
Recyclability	HIGH-LOW	HIGH	HIGH	VERY-HI	VERY-HI	MED-HI	MED-LOW	MED	MED-LOW	MED	LOW
Probability of Metal Removal	VERY LOW	VERY LOW	MED-HI	VERY LOW	MED	MED-HI	MED-HI	MED	LOW-MED	VERY LOW	VERY LOW
Hardness, MOH Scale	5.5	7	6-7.5	6-7.5	8-9	8-9	9	8	5.5	3-4	1-4.5
(Rockwell Rc)		(57-63)	(35-55)	(20-66)	(40-66)						
Bulk Density (lb/cu ft)	100	150	280	280	230	125	95	130	100	45-60	40-80
Mesh Sizes	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
Shape: ▲ Angular; ● Spherical	●	●	▲	●	▲	▲	▲	▲	▲	▲ or ●	▲



Surface profiling of iron with silicon carbide improves adhesion of Teflon coating.

Valve stems for tires are blast-treated with aluminum oxide before application of rubber coatings.

every time a surface has to be prepared. For example, if oil is present on a part, it can contaminate recycled media. Mechanical-wheel blasting and air brush, just to name two, are generally efficient for covering large areas. Pneumatic blasting is not suitable for heavy-duty surface alterations, such as removing parting lines. The process can warp thin parts or chip delicate workpieces when not carefully applied.

On the plus side, blasting is relatively benign to the environment. It costs from $700 for an entry-level cabinet to $25,000 for a top-of-the-line manual machine. It is easy to maintain and simple to operate.

Pneumatic blasting's major benefit is versatility. It is possible to achieve precise results in a wide range of surface-preparation applications. This is because the user can adjust such variables as media, air pressure, nozzle orientation and blast duration. The variables must be properly controlled.

Critical procedures, such as peening and surface-profiling, require sample testing from the equipment supplier. This is the best assurance that the job can be performed on spec at an attractive price.

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