Common Sense about Centrifugal Wheel Blast Machines

If you manage or conduct surface preparation operations in a shop and can answer the 10 questions on the opposite page correctly, move to the next article. This one was not meant for you. If you fail, however, there is common sense information here you can use to improve your shop cleaning operations.

Some of the most frequent questions and problems that are encountered in centrifugal blasting operations are listed at right. When the questions come from operators, people who should know the answers, the real problem is the lack of basic knowledge about equipment where it is most needed, in the management of shop cleaning operations.

The intent of this article is to provide basic information to help wheel blast operators monitor their blast operations and make the suitable corrections when required. By knowing what to look for, an operator could save thousands of dollars per month in operating cost.

It takes only one quick trip around a wheel blast machine to spot problems. Look for the following among others:
- tarp hung up to contain shot leaks;
- one or more defective or incorrect ammeter readings;
- a V-belt that squeals;
- shot or grit lying everywhere;
- a maintenance store room with no end liners and 8 sets of side liners;
- useable shot (or nothing at all) being discharged from the fines refuse tube;
- more than 3 patches on any nine-square-foot (0.8-square-meter) area of the cabinet exterior;
- a defective or non-existent manometer on a dust collector; or
- paper, wood, and shot being discharged from the separator trash shoot.

If any of these conditions exist, then it is necessary to take corrective action.
Can You Answer These Questions About Wheel Blasting?

1. The average cost of S280 shot, less freight and scrap surcharges, is
   (a) $305.00 per ton ($336 per metric tonne).
   (b) $375.00 per ton ($412 per metric tonne).
   (c) $405.00 per ton ($445 per metric tonne).
   (d) $455.00 per ton ($500 per metric tonne).

2. The most important thing to consider when choosing a shot supplier is
   (a) price.
   (b) size.
   (c) durability.
   (d) hardness.
   (e) all the above.

3. Which size and type of abrasive is best for cleaning the exterior of new railcars, structural steel, and
   other steel products in a centrifugal blast machine?
   (a) G40 grit, average hardness at 45 Rockwell “C”
   (b) G50/G40, average hardness at 64 Rockwell “C”
   (c) S280/G25 mix
   (d) S280 or S330
   (e) none of the above

4. True or false?
   A good operator needs to inspect the machines once a week.

5. The correct way to set blast patterns is by blasting on
   (a) a painted surface.
   (b) a flat steel plate.
   (c) a piece of plywood.
   (d) the product to be cleaned.
   (e) any of the above.

6. True or false?
   A blast machine will self-destruct and should be rebuilt every 2 or 3 years.

7. A manometer can best be described as
   (a) an air velocity meter.
   (b) a pressure differential meter.
   (c) a vacuum meter.
   (d) an air volume meter.

8. True or false?
   The ammeter and hour meter on control panels are intended for maintenance personnel only.

9. Which is most detrimental to maintaining a good operating mix?
   (a) large new abrasive additions
   (b) wide fluctuations in dust collector performance
   (c) less than a full curtain of abrasive across the separator lip
   (d) all of the above
   (e) none of the above

10. Pound for pound, which 30 HP wheel rotating at 2250 RPMs will throw more shot?
    (a) a 2½ in. (62 mm) wide, 19½ in. (488 mm) diameter curved blade/vane wheel.
    (b) a 2½ in. (62 mm) wide, 19½ in. (488 mm) diameter straight blade/vane wheel
    (c) Both will be equal.

See page 58 for answers.
Fig. 1
A top end liner has a hole in it.
It is any time you can see an opening in the control cage from the working end of the wheel, its pattern is way off.

Fig. 2
A wheel blade has been glued to housing in an attempt to stop leaks. This is poor maintenance of wheel liners.

Fig. 3
A wheel view of what it can do to a poorly lined cabinet. Failure was due to liner seams in direct path of blast.

Fig. 4
The exterior view of same machine. Note damage to elevator housing in left foreground.

End View
Above machine as is

End View
With 18" x 18" hook liners
Where to Find Helpful Information

A.W. Mallory’s “Guidelines to Centrifugal Blast Cleaning,” a monograph published by the Steel Structures Painting Council (SSPC Publication 84-03) and by JPCL in excerpt form (June 1984), should be required reading for anyone directly involved in the day-to-day operation or maintenance of blast wheel equipment.

Most blast equipment manufacturers will provide service personnel to assist in evaluating problems. In addition, most companies that supply abrasives and parts can also provide technical help with written materials or service calls by personnel.

Keep in mind that you do not need merely a list of parts to be purchased and replaced. You need answers! “What is wrong with the machine? What caused it to fail, and how can the failure be prevented in the future?”

If, when your machine was new, it would clean twice as fast as it does now, you may need only a good tune-up to double your production. A new machine or new style wheels are not necessarily the solution to your problems. Buying upgraded wheels and/or more horsepower should be necessary only if your production has outgrown your machine’s original design capabilities. Parts for older model wheels are generally much less expensive alternatives. The most cost-effective upgrades are improved wheel liner components, cabinet liner materials, and noise control devices.

Abrasives

Shot costs, on average, $405.00 per ton ($445 per metric tonne). While grit cleans more aggressively than shot, it costs about $30.00 more per ton ($33 per metric tonne) and breaks down about 17 percent faster than shot. In addition, it wears out machine parts more quickly than shot does. The simple fact is, unless you need an etch or better than 3 mils (75 microns) of surface profile, you can use shot alone in your centrifugal blast machine to save money and wear.

The most important criterion in choosing an abrasive is durability. Hardness, chemistry, and microstructure can be varied to gain manufacturing cost advantages but can result in loss of durability. If you are purchasing abrasive in truck load quantities, send random samples to be tested for hardness and chemistry.

Never be duped into buying what is called soft shot. This is a product that will last longer but does so because it does not transfer energy to the work surface as does shot manufactured to Society of Automotive Engineers (SAE) specifications.

The Wheel

The blast wheel is the heart of the machine and therefore requires careful control and maintenance. Its sole function is to throw huge amounts of shot onto the work surface. The shot should be thrown directly, not ricocheting needlessly off walls or wheel liners or out the back of the wheel housing or cabinet.

The blast wheel is the heart of the machine.

It's 10:00 a.m.; do you know where your blast pattern is? Most likely not; in fact, many operators would not know where to look (Fig. 1).

If this were going to be a technical manual, “How to Set a Blast Pattern” would be the title of this section. But you should have directions in your equipment manuals to conduct this task. If not, ask your service representative to show you how.

The first step should be to find a suitable target plate, a flat piece of 10 gage (3 mm) to ¼ in. (6 mm) steel plate anchored directly in front of the wheel at the same distance that work will be presented. By blasting on this plate for 1 to 3 minutes, you will be able to tell precisely what adjustments are necessary.

Now that you know where the blast pattern is, mark the control cage so that other operators will know, too.
Loose belts, worn or misaligned parts, and vibrations will also affect the blast pattern. Correct these before setting the blast pattern.

## The Ammeter

If the wheel is the heart of the machine, the ammeter is the stethoscope. It reveals instantly and exactly the efficiency at which each wheel motor is producing cleaning energy. Anything other than a full load amp reading means you have a problem that needs immediate attention.

A good maintenance practice is to regularly calibrate the panel ammeter to be sure it is monitoring correctly.

## The Separator

The separator is probably the most misunderstood system on a blast machine. While its name defines its function, it remains a mystery in most shop cleaning operations, possibly because it is normally located on top of the machine, where it is out of sight and out of mind.

To regain control of a failing blast operation, you should check this area first for mechanical problems, because if you cannot get good, clean abrasive to the wheel, there is no real point in doing much else. Incorrect separator setting increases parts and cabinet wear significantly.

If a machine has a dust or abrasive consumption problem, the separator is the place to start looking for solutions. While it is not the only source of such problems, it is the most common source.

## The Cabinet

The cabinet is generally seen as a containment structure, but in many cases, because it is poorly maintained, it leaks abrasive in several areas. The only excusable areas for abrasive leaks, however, are at the work exit and entrance of the machine.

In some shops, you will find a machine with 3 or 4 patches in one spot, one on top of the other, or the type of repair in Fig. 2. If the true costs of this kind of inefficient maintenance were ever compiled, it might look like the cost breakdown shown in Table 1.

<table>
<thead>
<tr>
<th>Cost Breakdown of Patching the Cabinet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four steel plates, 2 in. x 4 in. x 3/8 in.</td>
</tr>
<tr>
<td>Welding rod</td>
</tr>
<tr>
<td>Labor for patches</td>
</tr>
<tr>
<td>Two eye injuries</td>
</tr>
<tr>
<td>One 12 foot x 12 foot (3.6-meter x 3.6-meter) tarp</td>
</tr>
<tr>
<td>Replacement of 2 overhead light fixtures</td>
</tr>
<tr>
<td>Repairs to nearby machine</td>
</tr>
<tr>
<td>Lost abrasive</td>
</tr>
<tr>
<td><strong>Total, less lost production time</strong></td>
</tr>
</tbody>
</table>

If the cabinet had been properly repaired, the cost would have been about $250.00, plus a half an hour of labor.

The cabinet is a containment device, but what you see on the outside is meant to be only structure or outer shell. The heart of the containment is the liners and seals on the interior.

Patches and leaks are indications that the inner shell is breaking down and needs repair (Figs. 3 and 4). These repairs can range from $6.00 to $100.00 per sq ft ($65 to $1087 per sq m), depending upon whether you need rubber curtains or cast, bolt-on liners. You may need to replace only a section of worn liner directly in line with the blast.

If cast liners were used, replace them with the same. Never replace them with materials having less wear characteristics, such as rubber curtains. Never, never weld a cast liner in place. If you are using manganese plates, they should be at least ¾-in. (9.6 mm) thick and no greater than 18-inch to 24-inch (0.45-meter to 0.6-meter) squares.
### The Dust Collector

The dust collector can be thought of as a large vacuum cleaner because the same principles apply. Water and oil are positively to be kept out, and it must be emptied often.

The manometer is the key to what is going on inside the dust collector. It is a pressure differential meter that indicates the condition across the filter media. As dust builds up on the media, the pressure differential between the clean air side and dirty air side increases. If too much dust is allowed to be collected, the volume of air begins to decrease. At this point, if the problem is not corrected, a whole series of costly events develops at the blast machine. All previous separate adjustments become useless. Dust starts bellowing out of the cabinet, and vent pipes begin to fill with dust.

After water and oil intrusion and the lack of monitoring devices, the third most common prob-

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<table>
<thead>
<tr>
<th>Component</th>
<th>Primary Function</th>
<th>Controlling Factor</th>
<th>To Be Monitored By</th>
<th>How Monitored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separator</td>
<td>Remove Contaminants</td>
<td>Air Wash &amp; Screens</td>
<td>Operator</td>
<td>Visual and Analysis</td>
</tr>
<tr>
<td></td>
<td>Maintain Consistent Mix</td>
<td>Additions and Adjustments</td>
<td>Operator and Maintenance</td>
<td>Visual and Analysis</td>
</tr>
<tr>
<td></td>
<td>Control Consumption</td>
<td>Removal Size</td>
<td>Operator and Maintenance</td>
<td>Visual and Analysis</td>
</tr>
<tr>
<td>Wheel</td>
<td>Direction of Blast</td>
<td>Control Can Setting and Wear</td>
<td>Operator and Maintenance</td>
<td>Pattern Test</td>
</tr>
<tr>
<td></td>
<td>Velocity of Blast</td>
<td>RPM and Wear</td>
<td>Operator and Maintenance</td>
<td>Visual Checks</td>
</tr>
<tr>
<td></td>
<td>Quantity of Blast</td>
<td>Feed Valve</td>
<td>Operator and Maintenance</td>
<td>Ammeter</td>
</tr>
<tr>
<td>Cabinet</td>
<td>Contains Blast</td>
<td>Liners and Seals</td>
<td>Operator and Maintenance</td>
<td>Visual Checks</td>
</tr>
<tr>
<td></td>
<td>Contains Dust</td>
<td>Seals and Dust Collector</td>
<td>Operator and Maintenance</td>
<td>Visual Checks</td>
</tr>
<tr>
<td>Work Conveyor</td>
<td>Moves Work to Blast</td>
<td>Speed of Conveyor</td>
<td>Operator</td>
<td>Feet Per Minute Gage</td>
</tr>
<tr>
<td>Reclalm System</td>
<td>Return Shot to Separator</td>
<td>Reliability</td>
<td>Operator and Maintenance</td>
<td>Visual Checks</td>
</tr>
<tr>
<td>Dust Collector</td>
<td>Collect and Contain Dust</td>
<td>Consistent CFM</td>
<td>Operator and Maintenance</td>
<td>Manometer</td>
</tr>
<tr>
<td>Shot</td>
<td>Transfer of Energy</td>
<td>Hardness</td>
<td>Test Lab</td>
<td>Rockwell C Scale</td>
</tr>
<tr>
<td></td>
<td>Durability</td>
<td>Microstructure</td>
<td>Test Lab</td>
<td>Microscope</td>
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Preventive Maintenance

To see the need for constant preventive maintenance on a wheel blast machine, consider this scenario. At 9:30 a.m., a four-wheel, 30 HP monorail machine is in use. The operator's daily equipment inspections were stopped 4 weeks earlier because of production demands. Maintenance inspections are carried out once a week now, instead. Everything is going fine, so the operator goes for a drink of water.

A small part falls off the monorail hook and through a new hole in the bar grating, inside of the blast chamber. The lower screw conveyor sustains only minor damage as it grinds and twists this part into the elevator. The elevator hooks the part with its first passing bucket. The part rides until it goes over the top, where it hangs up on the discharge shoot. At this point, the bucket bolts are ripped out of the belt, and 3 other buckets are ripped out before the whole belt comes apart. Two buckets and the part make it into the upper screw. The rest of the mess falls to the bottom of the elevator housing in a twisted heap. One bucket gets pushed through the upper screw trough. The other bucket punches only 3 holes in the rotary screen before it stops. The part makes it into the trash shoot and lands with a thud just as the operator walks up. The operator looks in the barrel and wonders where that piece of junk came from. Everything looks normal, so more parts are loaded onto the conveyor. Two minutes later, the machine shuts down, to the operator's amazement, and smoke begins trickling out of the pit.

This or similar events have happened at many plants because of poor judgment. The savings achieved by cancelling the daily preventive maintenance were themselves cancelled by what I call relativity of the blast machine.

In a centrifugal blast machine, “everything is relative so everything matters.” If you fail to maintain one section, it, in turn, affects another and another, as shown by the scenario above. Next to knowledge, preventive maintenance is of utmost importance to wheel blast operations and should never be lacking. Figure 5 lists the primary components of the blast system, personnel with monitoring responsibilities, and monitoring methods.

The opposite view is the notion that blast machines are self-destructing devices. If so, then every blade, bushing, tip, saw blade, hoist cable, and anything else that is subject to wear are also self-destructing. Yet, you never hear anyone describing a shear as being self-destructing. But then you never see a shear used and abused as blast machines are. When a shear blade needs repairs, it is repaired. When a blast machine needs repair the need is often ignored. When it comes to wheel blast machines, managers and operators often have this kind of negative attitude.

Summary

Somewhere, a writer pointed out that blast machines are simple. This writer meant that the individual parts are simple, but the system is complex. The basics of computer programming are also very simple manipulations of ones and zeros. But the fact does not help a person to write a new program.

Know your equipment and its design capabilities: train your personnel; and maintain your equipment so that it will not self-destruct. Keep records of abrasive usage and ammeter and hour meter readings, and make adjustments when the readings suggest they are necessary.