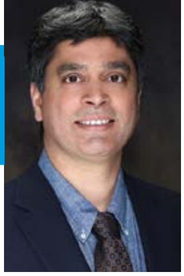
AN INSIDER'S PERSPECTIVE



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Tribal Knowledge in the Blast Industry

Part Four

KNOWLEDGE IS UBIQUITOUS

Our discussions here are my attempts at provoking thoughts of operating effectiveness among the most important audience—you, the user of cleaning and peening equipment. Therefore, I start Part Four by acknowledging that in addition to the role played by industry colleagues, end-users too have greatly contributed to the development of tribal knowledge. I share this personal experience to validate my statement. As some of you are aware, the foundry sector uses wheelblast machines quite extensively in their finishing operations. Globally, foundries strive to reach the ultimate (some might even call utopian) goal of minimizing wear rate on blast wheel parts, decreasing their cycle time and maximizing productivity while reining in their operating costs. Unfortunately, the presence of highly abrasive sand in the castings being cleaned makes that task difficult to achieve. Proper design of the airwash separator is one of the critical elements towards reaching this goal. Later in this article, we will discuss the capacity of airwash separators and sand loading.

During a visit to a railway foundry in Southeast Asia that produces passenger and freight railcar wheels, I noticed a custom contraption upstream to their three wheel blast cleaning machine. Upon enquiry, I learnt that the one of the operators, who I am certain was not exposed to formal terms such as "separator lip length" and "abrasive loading," took it upon himself to reduce the machine wear rate. He recognized that substantially high sand content in their wheel castings was rendering their airwash separator ineffective in separating it from the abrasive. So, the solution was to reduce the sand loading before presenting the part to the blast machine. The foundry did not have additional investment earmarked for this task prior to blasting. That did not stop the operator from designing a device which included a spring-loaded paint brush where the soft bristles were replaced with rigid wire brushes. The staging area in this machine was built with a spinning arrangement for the wheel (part), and the operator used this as a pre-cleaning station for the sand by simply having the wire brush scrape against the spinning wheel face, thereby eliminating a large percentage of the sand.

An ingenious idea requiring minimal investment, and likely archived in the future as an equipment manufacturer's patented design!

THE LUNG OF YOUR BLAST MACHINE

About 75% of automated blast operations use blast wheels. With greater media flow rates compared to nozzles, the reclaim system needs to not only be designed appropriately, but also requires regular maintenance to work efficiently. Part Four will focus on engineering concepts shared by my respected industry colleague, Mark Lambrix. Mark retired recently after over 45 highly productive years at Wheelabrator in different engineering and product management capacities. With specialized experience in foundry projects, Mark explained the concept of designing an efficient airwash separator. "The airwash separator is essentially the lungs of a blast machine. Without proper sizing and setting, it has the potential to create all sorts of complications leading to process inefficiency and increased operating costs. In terms of sizing, we categorize duty conditions into five types, with each having its recommended rating guideline."

Type 1	Non-abusive (clean)	Light scale with minimal to no sand	@ 70 lb. per inch of lip
Type 2	Moderate (average)	Moderate scale, minimal sand	@ 55 lb. per inch of lip + 0.4 lb. of sand per inch of lip (or less abrasive: more sand)
Type 3	Normal (above avg.)	Normal foundry applications	@ 40 lb. per inch of lip + 0.75 lb. of sand per inch of lip (or less abrasive: more sand)
Type 4	Core Knock-out	Heavy contamination-foundry with max amt of sand	@ 25 lb. per inch of lip + 0.8 lb. of sand per inch of lip *might need a double-lip separator based on cycle time
Type 5	Shot Peening	Light to moderate scale	@ 50 lb. per inch of lip

Shot peening applications fit into Type 5 and are generally considered gentle duty, allowing for up to 50 lb. of media per inch of lip. As we know, contaminant removal is never a goal in peening applications. Mark adds, "Due to the multiple variables in blast machine operation, it is wise to always provide more than adequate separation and eliminate any separation anxiety."

Double-lip Airwash Separator from Wheelabrator

How does separator efficiency impact shot peening results? Fines and dust that are inadequately separated by the airwash will contaminate the peening media. Not all wheelblast machines are equipped with vibratory classifiers to separate such fine contaminants, and even when provided, though continuously, will only classify a sampling of the total flow. The resulting wear of wheel parts (or blast nozzles) will cause displaced blast patterns, with the media stream no longer impacting the target, leading to insufficient coverage. Wear of wheel parts will also alter media velocity, adversely affecting intensity and necessitate process re-validation.

Mark used to work on difficult foundry installations, and dealt with rectifying initial design flaws by appropriately sizing the separator. Stressing the criticality of separation, Mark adds, "It is imperative that a full length of curtain be maintained at all times. The air stream will use a gap in the curtain when one exists, and short circuit through the gap without carrying out the intended task of cleaning the abrasive."

The airwash separator has a "Swinging Baffle" complete with counterweights on a threaded rod. The swinging baffle is a device/mechanism that helps regulate the flow of dirty abrasive in a thin curtain across the width of the separator at the point of separation. The counterweights on the swinging baffle help obtain a full-length abrasive curtain.

In terms of maintaining a full-length curtain, Mark explains, "These weights should be heavy enough to shut-off the flow when it is low, but light enough to let it open when the flow is sufficient to fill the unit from end to end (full length)." Newer designs of "smart separators" have a sensor-assisted gate to allow the baffle to swing open only when the requisite level of media is built up behind the baffle. A final note of caution from Mark, "Regardless of whether your shot peening machine has a well-designed separator and possibly a vibratory classifier, a wheelblast peening machine should have a Rotary Screen installed as the first check point to eliminate large-sized contaminants and avoid downstream damage from such foreign objects."

VENTILATION IN BLAST MACHINES

Airblast peening machines dominate applications in the Aerospace industry, with a few wheelblast exceptions in structural peening (chords, stringers, etc.) and when processing the entire OD of new landing gear.

In contrast, due to the high-part volume, wheelblast machines dominate applications in the automotive industry. It is quite common to see machines with multiple blast wheels peen components such as leaf and coil springs, connecting rods and transmission components. In an airblast machine, specifically those with up to four (4) blast nozzles, the ventilation system also provides the pneumatic power to reclaim peening media. The ventilation velocity and volume in such cases are designed to mobilize and convey the expected flow rate of media and also ventilate the cabinet of any dust generated during the peening cycle. In a wheelblast machine, due to the high quantity/rate of media being discharged by the blast wheel(s), a mechanical reclaim system is exclusively employed for the same task.

Mark and I discussed the ventilation requirement in wheelblast machines. "The first step in determining the exhaust/ ventilation requirements of a blast machine is to segment the different areas that are going to be your ventilation points. Commonly, they are: (a) blast cabinet exhaust, (b) elevator exhaust, (c) separator exhaust, (d) blow-off exhaust and (e) touch-up exhaust. Not all machines will be provided with (d) and (e). Much like the duty classification with airwash separators, we classify the volume from each of these generation points into three classes: Class 1 (Heavy Duty), Class 2 (Medium Duty) and Class 3 (Light Duty). Heavy duty will include all foundry applications whereas light duty is where shot peening will be categorized. Medium duty typically includes descaling applications."

As a Design Engineer with Wheelabrator back in the 1990s, I recall calculations where the first wheel in the machine was designated a specific CFM based on the above duty classes. The baseline power for this wheel was 30 HP, and a multiplier was applied based on whether a lower or higher power motor operated the blast wheel. For example, a 15 HP blast wheel motor was given a multiplier of 0.85 whereas with a 50 HP motor, the multiplier increased to CFM x 1.2. The second, third and every additional wheel accounted for gradually reducing ventilation requirements. The type of cabinet, whether batch type or pass through, also contributed to additional air volumes to be ventilated from the blast cabinet. Different ventilation volumes were assigned to various sizes (capacities) of bucket elevators, airwash separators (lip length). Blow-off exhaust is generally a multiplier applied to the CFM of the blower used. For example, a 3000 CFM blower will require exhaust ventilation of 3000 x 15%. Additional CFM is applied to air cannons that ultimately discharge the blow-off air.

When ventilating touch-up rooms (and manual blast rooms), the type of abrasive, and mode of ventilation (downdraft or cross draft) determine the ventilation volume. Abrasives that contain compounds of high toxicity such as free-silica, coatings containing lead, and chromates, are ventilated at a relatively high velocity (90 feet per minute in a down draft booth). Low-toxicity materials such as steel abrasives and aluminum oxide are ventilated at 40 feet per minute in down draft. In down-draft type of ventilation, the cross-section assumed for calculation of area comprises of the length x width of the cabinet. In cross-draft ventilation, the cabinet width x height is used to calculate the cross-sectional area. Ventilation velocity differs based on the type of draft system being used.

Cross-draft systems are more common in blast applications. A relatively lower ventilation velocity of 50 feet per minute is used for cross draft when shot peening or blasting clean metal with metallic media. Smaller blast cabinets, such as the ones where the operator accesses the parts through handholes, rely on multiple air changes per minute (volume of cabinet x air changes per minute) to provide the ventilation volume. Most manufacturers follow guidelines provided by ACGIH (American Conference of Government Industrial Hygienists) and adapt them to their specific equipment designs.

"Duct Velocity or Carrying Velocity," explains Mark Lambrix, "is the velocity necessary to keep dust airborne in the ventilation duct and avoid settlement. Average duct velocity is in the range of 3000 to 4000 feet per minute." This is altered by adjusting the blast gates in the ductwork. In aerospace applications, it is common to process parts manufactured from titanium or aluminum and their alloys that have a propensity to generate potentially explosive dust. In such cases, the duct velocity needs to be considerably higher (4500 feet per minute) to prevent settlement along the ductwork.

Certain applications that clean or peen with small-sized media such as S-70 and S-110 incorporate an Abrasive Trap or Drop-out Box as part of the ventilation ductwork. Small particles of abrasive could get airborne and travel through to the dust collector. Such particles could be hot and cause damage to the cartridges. At critical temperatures, this could even result in a filter fire. The purpose of the abrasive trap is to reduce the velocity of such particles inside this "box" (due to larger area than the ductwork) and separate it from the ventilation stream.

WHEELBLAST MACHINES AND SHOT PEENING

Earlier in our discussion, I mentioned that 75% of automated blast operations are served by wheelblast machines. However, upon questioning our students at the peening workshops, I often find that very few of them work with wheelblast equipment, and in some cases are blissfully unaware of their existence. I take the opportunity to remind everyone that the origin of shot peening (after the blacksmith and his ball-peen hammer hitting the leaf spring!) was in a wheelblast machine when peening valve springs. High-volume automotive parts can only be peened in a wheelblast machine to keep up with the production requirements. Therefore, it is important to know this type of media propulsion even if your daily work involves peening with blast nozzles. Some useful facts concerning wheelblast peening:

1. Increasing the media flow rate when peening parts with open geometry, where flooding is not a concern, is the fastest way to decrease cycle time and increase productivity. The only limiting factor is the motor power where excessive amps due to high shot load could trip the motor. Therefore, stay within the current (amp) limits.
2. In an airblast peening machine, increasing media flow has a direct effect on peening intensity. Other parameters (air pressure) will need to be adjusted to maintain the original intensity value.
3. Monitoring media quality (size and shape) are equally important in wheel peening as it is with airblast. However, unlike airblast machines where 100% of the media is classified, only a sampling (about 20%) is taken for continuous classification in a wheelblast machine.
4. Wheelblast machines are operated with a single media size at a given time. Use of two media sizes will result in cross-contamination.

SUMMARY

What started off as a casual chat with some retired colleagues is now a series on information packets that most likely cannot be located in a formal textbook! However, this may not be all. Though a sequel to this part is not imminent, I am hopeful that this will trigger an interest in friends that wish to contribute and help me continue writing on Tribal Knowledge.