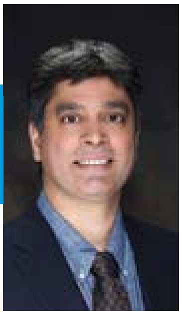

**AN INSIDER'S PERSPECTIVE**

*Kumar Balan | Blast Cleaning and Shot Peening Specialist*

# More On Choice of Media Propulsion

## INTRODUCTION

To err is human, to forgive was the kindness of my General Manager (thank you, Mr. Spratley)! For those of us that have spent our careers evaluating applications and suggesting viable solutions, the choice of media propulsion is almost always obvious. Afterall, it is frivolous picturing a batch of aircraft blades or engine components tumbling under blast wheels with the pretext of being shot peened. Similarly, cleaning a 10' wide plate in a roller conveyor type machine cannot be practically accomplished with a bank of suction blast guns. However, not all parts are as simply proportioned and the logic clear as the above examples.

Let us consider some aerospace applications—landing gear components could be peened in airblast as well as wheelblast machines and the same with aircraft structures. Peening auto transmission gears follows the same logic. Though my industry colleagues that work exclusively with wheel or air machines will make a convincing argument about the efficacy of one over the other, they will also agree that there are several other considerations before a determination can be made. This brings me to explain my first act of acknowledging my boss' kindness.

At an earlier stage in my career, I was presented with an opportunity to design a machine to clean tubes to remove mold residue from its outside diameter. At the suggestion of a salesperson that sold aluminum oxide, the customer had decided on a nozzle/airblast machine to clean these tubes. Traditional solution for this application would have been a centrifugal wheel machine cleaning with steel shot. The customer being always right, I went along with the airblast solution, and the result was less than optimal!

Salient aspects of this application that I overlooked were (a) rapid breakdown of AlOx and subsequent generation of dust, (b) insufficient impact energy given the lower specific weight of AlOx as compared to steel shot or grit, (c) increased compressed air consumption due to the need for high pressure, multiple nozzles, and finally, (d) embedment of AlOx particles on the tube surface making it difficult to distinguish between mold residue and broken abrasive.

An expensive correction ensued, and a new wheelblast machine was supplied to blast the tubes with steel shot. Aside from the classic consideration that blast wheels are better suited for higher productivity and those listed above, end-users also consider commonality of machines in their facility, spares, compressed air availability, space and a variety of less critical features when evaluating their choice.

## BLAST PATTERN EVALUATION

For those of you that are new to our industry and wish to learn more, I suggest you refer to a short series of articles relevant to the topic[1]. Our current discussion will continue from where we left off in 2017 in the previous articles. I have learnt that besides productivity concerns, the prime driver for our choice of nozzles over wheels is the blast pattern.

Blast pattern with nozzles are portable when automated (and to a less accurate extent in manual systems). The target in airblast is focused, causing minimal to no damage to the surrounding areas. Airblast machines have also experienced a rapid rate of development in this aspect as compared to wheelblast which has progressed from fixed to oscillating wheels yet confined to its location on the walls of the blast cabinet.

Degradation or deflection of this blast pattern is the second point of consideration. As nozzles wear, it leads to increased compressed air consumption and a corresponding drop in intensity in shot peening applications. Useful life of a nozzle is predictable, and timely replacement puts the process back on rails. With wheels, the wear is more elaborate. Blast pattern degradation could be from wear of control cage, impeller, and blades.

It starts from the control cage, whose opening when worn, could shift the pattern by several inches inside the machine. The illusion of blasting or peening the parts in the required areas could easily be shattered when inadequate coverage is observed on the part, and uncommon wear noticed in the inside of the cabinet.

In our discussions in 2018[2], I reported on an innovative tool that Wheelabrator had designed to detect wear in a blast wheel control cage. This device automatically adjusts/corrects the control cage setting based on wear so that the part can continue to receive expected coverage in required areas.

1"The Role of Wheelblast in Shot Peening", Parts 1 and 2, Spring and Summer editions of *The Shot Peener.*

2"Emerging Technologies and Blast Machines", *The Shot Peener*, Summer 2018.

Though I cannot attest to the popularity of this innovation, it is possible that there is some end-user pensiveness in relying on electronics in an abrasive environment. A similar innovation involved automatically targeting the control cage to shift the blast pattern. The adoption of this device may also have been marred due to moving parts and wear concerns.

## COMPARABLE PARAMETERS

Whether your work involves peening or cleaning, the underlying principle is about the transfer of impact energy. Energy can neither be created nor destroyed, only transferred from one medium to another. In our blast machines, this transfer takes place from the media/abrasive to the component being processed with the aid of compressed air or electricity (wheel motor). This energy then either pulverizes and cleans the scale or imparts residual compressive stress on to the component being processed. To demonstrate my non-partisan attitude to both types of media propulsion systems, I list here comparable parameters that we aim to control during the transfer of this energy, typically in shot peening and sometimes in cleaning.

| Parameter | Wheelblast | Airblast |
|---|---|---|
| **Velocity** | Variable frequency drives or inverters | Air pressure with closed feedback (PID) loops |
| **Media flow rate** | Flow control valves | Flow control valves and orifice (suction blast) |
| **Media size** | Classifiers with two screens, limited to a single size by way of sampling (a fraction of total flow) | Classifiers with two or more screens, operable to classify multiple sizes (100% flow) |
| **Media shape** | Spiralator | Spiralator |
| **Exposure** | Reliant on the work handling arrangement<br>Adjustment of media flow rate will impact coverage | Variability in work handling as well as through nozzle movement<br>Adjustment of media flow rate will affect the intensity and coverage. Consider this adjustment carefully. |

## PROMINENCE OF WHEELBLAST

Outside of Aerospace, it is common to see wheelblast machines for shot peening applications. Their absence in aerospace is in part due to the complexity involved in peening aircraft parts, the need to target specific areas and unacceptance of overspray, the requirement to use multiple media sizes in the same machine and the extent of sophistication expected in a peening machine. Though I do not wish to mislead readers in thinking that wheelblast machines are not sophisticated, a large concentration of them are found outside of aerospace.

Some popular, high-throughout automotive applications include shot peening leaf and coil springs and connecting rods. These components are traditionally processed in wheelblast machines. For example, a six-wheel machine peens both sides of a connecting rod every three seconds. A three-wheel machine shot peens one coil spring every 4.5 seconds. When designed well, these machines are built with process control components such as closed-loop flow control valves, frequency drives for blast wheels (to vary shot velocity), classifiers to accept a sampling of peening media, spiral separators for shape control and arrangements to control and monitor part movement (since wheels are typically in fixed locations).

The Mining and Oil & Gas industries also use wheelblast machines for peening applications. Sucker rods that travel deep into the earth are peened in skew roll machines that spin and move the rods through the blast zone. As we know, peening process is agnostic to the machine being used as long as proper process control is maintained.

Those that are familiar with Roll Etching using blast wheels are familiar with the reclaim system in such machines. Roll etching involves preparing mill rolls that are used in various stages of reducing thickness of cold rolled coils of steel sheets.

This requires varied sizes of high hardness grit. These machines were one of the first with sophisticated process control. Given the capacity of standard classifiers and their inability to process 100% of the media flow, such machines were equipped with multiple levels of classifiers and dedicated storage hoppers so that the blast wheel always received the same size of grit to achieve a consistent and repeatable etch profile on the mill roll being blasted.

So, what does one do when applications can be addressed with either media propulsion system? In addition to some of the considerations discussed above, examine the part being peened. Will the inundating flow of media from a blast wheel flood tight areas in your part (example: planetary gears) and result in media-media instead of media-part surface impact?

Is your process likely to be scaled upwards in the near future? Would a future part design require only certain areas of the component to be peened? At some point in the future, will be you required to use a different media size in your machine (airblast is your answer)?

## THE FUTURE OF WHEELBLAST IN PEENING

*The Shot Peener* magazine presents a wealth of information in these columns on automated, robotic, computer-controlled airblast machines for shot peening. I would like to explore the possibilities in a wheelblast machine that could transform them into a more acceptable choice for peening when suited for the application. Some of those possibilities include:

**Cleaning of peening media**

Shot peening does not generate a lot of dust (peening is best accomplished with clean parts). However, the dust that is generated during peening should be separated out from the peening media that is circulated through the machine. Wheelblast machines are commonly fitted with an airwash separator that functions as the "lung" of the blast machine. When adjusted optimally, this unit separates dust and fines from the working mix.

I spoke to an old friend and industry colleague—Bob Schoen who is the Field Training Manager for Blast Cleaning Technologies (BCT) in West Allis, Wisconsin. "At BCT, we place great emphasis on clean abrasive/peening media in our cleaning and peening machines. Our R & D efforts have led to a highly effective design of airwash which allows us to monitor and automatically adjust (a) the thickness of the abrasive curtain, and (b) generation of a full length of this curtain along the lip length." To explain the importance of this concept, the ideal thickness of the airwash separator curtain is between ¼" and 3/8" to allow effective passage of clean air. A full length of curtain allows fresh air to pass through the curtain and carry the fines/dust along with it to the dust collector. Both techniques result in less wastage of peening media and wear of wheel components.

**Analysis of work mix**

Efficient blast cleaning relies on a healthy work mix of small and large abrasive particles. This is not the case for peening applications which rely on uniformity of shot size. A mix of particle sizes helps pulverize heavy scale (large particles) and scour tight geometries (small particles) in the part being cleaned. An effective means of automatically checking the health of the abrasive work mix, realtime in wheelblast machines will enhance their cleaning efficacy.

**Automated drop test arrangement**

Mike Langtry of Langtry Blast Technologies explains their company's innovation in this field. "Drop tests are easy when you are flowing peening media in tens (airblast) and not hundreds of pounds as in a wheelblast machine. For this purpose, we designed an automated arrangement that diverts the discharge of the infeed hose to the blast wheel into a calibrated hopper mounted over a weigh scale. A simple selection on the system HMI allows collection of shot for a pre-determined time period to accurately weigh the pounds-per-minute to that blast wheel. This allows calibration of the flow control valve (typically a MagnaValve) connected to that blast wheel. Collected media is then discharged into the blast cabinet after the drop test."

## SUMMARY

Several other opportunities exist in the wheelblast world to bring it closer to accuracy and repeatability that peening specifications dictate. Also, data collected through such initiatives is digital, which could help build that predictability engine that AI models hungrily await—gradually carrying us into the next generation of blast machines. I am confident of being able to report more on that in the future.

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