AN INSIDER'S PERSPECTIVE

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I Wish My Machine Did This

WHAT IS WRONG WITH THIS PROCESS?

If it seems like I am starting this discussion on a negative note, I urge you to re-construct this question as, "what would I like this process to be?" By process, I am referring to blast cleaning, shot peening, grit blasting and all such associated applications that you are involved with. In here, we have all accepted the inevitability of dust and media leakage, noise, and unanticipated maintenance to be part of this process. However, these undesirable characteristics need not prevent us from dreaming of what it could be. Our discussion here is to give life to some of these "wishes," learn why they are important to the end user and test their viability in production conditions.

At the recent CastExpo in Columbus, Ohio, I met with seasoned foundry professionals who had spent over 40 years in the industry amongst blast machines. Their musings are my inspiration for this article. Before I start, I would like to share a discussion from over 25 years ago with a senior executive of a blast machine company. He was reporting on a technological breakthrough that his company was working on where the operator could "dose" the abrasive storage hopper with a concentrated liquid, which when mixed with the abrasive, would enable the abrasive to not only clean the part, but also coat it with the subject liquid. My impressionable mind then did not want to question the wisdom of this technology for fear of reprimand, but if this had been fruitful, SSPC[1] (AMPP now) would certainly wonder how they were going validate the cleanliness of steel if it emerged all painted from a blast machine! I promise not to humor you with such "wishes" but instead will present some gems my industry colleagues have brought up that are worth debating.

THE WISH TO RECOVER LEAKED SHOT

Let us start from some basics by following the shot particle through the machine. Bob Schoen is the Field Training at Blast Cleaning Technologies in West Allis, Wisconsin and a well-respected industry professional. "Media leakage is endemic with this process. No matter how robust your maintenance program, spillage from part carryout, worn seals or badly designed spill hoppers under access doors result in media spillage around the machine perimeter. I find that 80% of the media leakage is within 5'-8' of the blast cabinet, with the exit handling system such as vibratory shakers and such contributing to the remainder," explains Bob. "For a solution, consider strategically placed inlet (suction) points around the machine at floor level. Such points, when operated individually, in a defined sequence open up a high capture area to return either swept or shoveled abrasive back into the system. This abrasive could be diverted to the abrasive adder, or to an alternate storage arrangement. A dedicated suction source similar to an industrial vacuum can work independent of the machine ventilation system and can continue to be functional even when the machine is shut down. This will help recover some of this spillover and make the area less prone to personnel slippage."

There is certainly merit in exploring this further. Though the risk of introducing foreign particles such as fasteners and other impurities greater than the size of steel shot is certainly high, this can be addressed by installing screens at multiple points within the reclaim system to separate and prevent them from approaching the blast wheel spinning at 3000 plus RPM, or the blast nozzle.

CAN WE TALK NEAR THE MACHINE?

I admit to have nodded knowingly when someone talks to me near an operating machine, without actually being able to hear the person. Thankfully, after all these years, most equipment issues have a past reference in my brain that I draw on! As an industry, we have begrudgingly accepted that "Hearing Protection Required" is a norm for blast machines. My colleagues in the shot peening world, especially those low-intensity aerospace applications in the N and low A strip values, are exempt from this part of our discussion since they can still carry on a conversation with the machine peening

[1] SSPC (Society for Protective Coatings) is now united with NACE and is called AMPP (Association for Materials Protection and Performance). AMPP publishes standards for metal surface preparation.

at low air pressures! But for the rest of us, a Time Weighted Average of 85 plus dBA is "business as usual"! Most times, especially in foundries and forge shops, the ambient noise clouds the noise generated by our not-so-innocent blast machine, and we get a free pass! The industry has innovated with sound mitigation measures such as thicker cabinet walls, inflatable door seals, rubber sound insulation (in addition to hanging rubber liners), hanging sound curtains around classifiers, silencers for dust collector fan outlets and so on. But there is something more fundamental about sound—it has a definite frequency, or it appears within a frequency band.

How about if a sound engineer invests some time to determine the frequency bands where our machines create noise and produce a counter-noise to nullify the effect of the source noise? If white noise can help people sleep, surely something can be done to reduce the blast machine noise so that we can have a conversation with the machine running.

I HAVE NO SPACE FOR A NEW MACHINE

It is common for the blast process to be an after-thought in a production line, especially in cleaning applications. Even in peening, I have worked on several projects where the benefits of peening were accepted only after experiencing a component failure. Though we welcome all users, new and existing, late adoption does present a unique problem about space constraints to new users, in all three dimensions! To quantify this, I reviewed a few common machine sizes, both airblast and wheelblast. With a classifier in the system, whether vacuum reclaim or mechanical, the system requires at least about 18' (5.5 M) above floor level for its location. This is predicated by the standard reclaim tower with a cyclone on top, a classifier and then a blast tank underneath, with some media storage squeezed in between. A mechanical reclaim system works in a similar set-up, with the media reclaim duct and cyclone replacing the bucket elevator and airwash separator.

Though the part size (work envelope) plays a major role in determining the cabinet height, the reclaim system requirement described above is quite generic. Is it time to re-think our basic premise of a reclaim system and re-design parts of it by de-escalating them from their penthouses? I know what you are thinking—if they do not go higher, they will consume more floorspace (as in a dual elevator system to decrease overall height). I am not giving into that; I am hinting towards something a lot more drastic—I am suggesting a completely different way of handling media that we have not thought of yet. I am going to leave this thought for you to build upon.

On the other hand, perhaps it is time to consider alternate peening technique. We have discussed a list of them in these columns back in 2018[2]. David Lahrman, VP Business Development at LSP Technologies in Dublin, Ohio, has the following to add, "The conventional wisdom that laser shock peening is an expensive alternative to shot peening is being challenged with every application we work on at LSP Technologies. Undeniably, there are specific applications that can be addressed only with lasers, but we are also innovating to the possibility of bringing this technology to mainstream applications such as transmission gears and aircraft parts. All that without the need for shot reclaim, ventilation and all those maintenance-prone aspects of conventional shot peening." More of this technique was discussed back in Fall 2021[3].

MEASUREMENT OF COVERAGE

My next stop along this journey was at Toyo Seiko for discussions with Shota Watanabe and Larry Catanzarite. They are good friends and colleagues on different SAE and Surface Enhancement committees. They introduced me to the latest UV version of their coverage checker. Shota explained, "Our new ultraviolet LED with a wavelength of 375 nm with a light source, measures the degree to which fluorescent paint applied to the surface prior to peening is peeled off during peening. Unlike the previous version with white light, there is no need to prepare a measurement condition. This new technique allows us to measure dual-peened surfaces such as seen in case-hardened material like heavy-duty transmission components." More about this can be found here.[4]

SAE J2277 lists several direct methods involving optical analyzers and indirect ones such as fluorescent tracers, dry marker inks, replicas, coupons, etc., all of which are validated by 10X-30X magnification. However, the validation continues to be subjective. I have had several customers approach me enquiring about economically viable, inline techniques to assess coverage on each and every part. Though I have discussed process controls in your peening operations that will ensure every part is impacted by the same quantity of media, at the same velocity, the answer to automate inspection of each and every part for coverage remains evasive. Operators and engineers realize the criticality of complete coverage, and misgivings of excess coverage. More efforts need to be placed to explore better coverage techniques in a critical process like peening.

WORKING MIX IN A FOUNDRY

The inspiration for this article came from foundry colleagues that work with a completely different set of goals (cleaning) as

[2] *"Non-conventional Peening Techniques", The Shot Peener, Winter 2018*
[3] *"Laser Shock Peening", The Shot Peener, Fall 2021*
[4] *https://toyoseiko.co.jp/en/product/coverage-checker-uv*

compared to Aerospace and Automotive users of shot peening equipment. Interestingly, as a side note, foundries often employ the MagnaValve to monitor and meter media flow since it affords the luxury of no moving parts in the valve—foundries have enough maintenance issues with moving parts in other equipment to contend with!

Balanced working mix or operating mix is a critical factor when discussing shot (or grit) in a foundry cleaning application. These terms refer to the perfect blend of large and small size abrasive particles where the former is responsible for denting and pulverizing the scale and rust while the latter sneaks into the crevices and tight areas in the castings. As you can imagine, this concept of an operating mix is not permissible in shot peening where we rely on the classifier and our regular inspections to constantly eliminate contaminants larger than the shot or smaller fines that do not fit within a narrow threshold and endeavor to maintain consistent shot size in the process.

Foundries are familiar with shot screening with their experience of carrying that out that exercise regularly with sand. However, it is a chore. Robert (Bob) Adelman, Manager of Value Added Services at Grede Reedsburg Foundry in Wisconsin, explains, "Shot screen analysis on the fly will greatly help with managing our process. This, when combined with a reliable, automatic shot adder eliminates reliance on the operator to carry out this task. If left for too long, and if there is an issue with our operating mix, it leads to improper cleaning and possible re-work. Not adding shot in regular intervals results in a working mix that is too fine, adversely affecting cleaning time. Adding a large quantity of new shot all in one go upsets the balance once again, with the work mix running too coarse. An "on the fly" shot screen analysis will mitigate a lot of these issues." In extremely busy foundries such as Grede, re-work adds significantly to cleaning and handling costs and they keep strict tabs to minimize such occurrences.

Handling is a large part of any blast operation, and simply put, re-handling is wasted money. Bob added, "Blast equipment manufacturers should start thinking of a bypass at the exit end that would return product requiring re-blast to the infeed side. In most continuous machines, re-blasting tends to be dedicated cycle—the re-blast parts are sorted and stored separately to be re-introduced as a separate cycle often in a dedicated shift."

Jim VanCoulter, the Mill Room Supervisor at the same foundry, points out to another interesting benchmark for operating economics—abrasive durability. This is something we do not assign much importance to in the shot peening world. In foundries that operate multiple blast cleaning machines that are fitted with high HP wheels, every particle of shot better do all the work it is intended to do. More details on the measure of durability can be found in our discussions in Fall 2017[5]. Foundries often use pounds of shot consumed per ton of castings cleaned as their indicator of durability and cost of operation. Very often, anomalies in this pre-registered target value indicate issues with the machine or even abrasive quality, both of which could have a cascading effect on cleaning room efficiency. Such numbers are usually manually tabulated based on production data (tons of castings cleaned and drums of shot consumed). The summary of my discussions with my foundry colleagues led me to thoughts of automating these mundane yet critical processes that have significant bearing on whether an operation is profitable or not.

PRESCRIPTIVE MAINTENANCE

Everything we have discussed here are "wishes" expressed by industry professionals. Some exist to a certain degree, while others are still "pies in the sky," but none are out of line in expectation. I would like to conclude our discussion with an interesting thought from a book I read recently by Thomas Friedman[6]. He differentiates between Conditional Maintenance (if it looks dirty, wash it), Preventive Maintenance (change the oil every six thousand miles), and Prescriptive Maintenance. This last maintenance technique relies on sensing mild patterns (aka machine operating data) and uses the immense processing power available today to predict failures well in advance. To quote from this book, "with a much finer grain of fidelity, we can make finding the needle in the haystack the norm—not the exception."

Our industry relies on conditional and preventive maintenance techniques. Imagine if data collection advanced to the extent described in this book where a simple change in sound that is undistinguishable to the operator's ear could actually predict a future unclean part, or the possibility of less than 100% coverage on a mission-critical aerospace component, or the possibility of a door leak leading to operator slippage?

All of these speak to the future of our industry. I am excited, as should you be! I look forward to reporting with more on this.

[5] "*The Critical Role of Shot in Achieving Consistent Shot Peening Results*", *The Shot Peener, Fall 2017*

[6] "*Thank You for Being Late, An Optimist's Guide to Thriving in an Age of Accelerations*" by Thomas Friedman