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Shaping the Industry of the Future

HOW DO YOU perceive the industry of the future? Are traditional processes going to be questioned and reformulated? These are some of our thoughts as we follow our daily routine activities and plan for the future. In our own process-oriented world of blast cleaning and shot peening, products will be made faster, cheaper, smarter, and safer. We must be capable of producing repeatable and reliable results with minimal environmental impact. Translated into more tangible terms, the time line between concept and commercialization will shrink for us all!

At Wheelabrator, we recognized this movement over the past decade and focused on innovation to help our customers adapt to this reality. Our research and development department got infused with a concentrated dose of adrenaline and became the cornerstone of equipment design, application validation and process development. The result was a rejuvenated "Application Validation" department.

How Does "Application Validation" Help?

Most OEMs work with custom applications on a regular basis. At the time of sale, it's the winning ***concept*** that gains approval, since a machine typically doesn't exist in a form suitable for validation. Variables that could have an impact on machine design are cycle time, media type, shape, size and velocity. Now, just imagine if we can, with reasonable accuracy, determine these variables in advance for your application? That's exactly what Application Validation does.

The North American Application Validation Center of Wheelabrator, one of five across the globe, is housed in a 25,000 square-foot facility in LaGrange, Georgia. The center is home to fifteen different machine types that are specially designed to cover almost every conceivable application in wheel and airblast systems. A potential customer walks in with a component to be peened or cleaned and leaves with specific information pertaining to media type, size, impact velocity, possible cycle time, intensity value, coverage and saturation time (in peening applications), part handling, fixtures, and, of course, the machine type. More importantly, validation also unearths possible issues, allowing us be proactive. This removes most elements of surprise and reduces the time between concept and commercialization even more.

Wheelabrator's Application Validation Center

A Case Study: The Challenge

One such opportunity arose when a prospect contacted Wheelabrator seeking suggestions on strengthening the welded seam along the circumference of a fabricated automotive wheel rim. (The company name is being withheld for reasons of non-disclosure commitments.) Let's follow the process from the point the customer came to Wheelabrator until the time a process specification was developed.

The prospect, a well-known name in the automotive wheel industry, had tangible expectations on weld and ultimately the wheel life. They had not carried out tests to determine the suitability of peening or its ability to enhance the life of the welds stitched along the circumference of their fabricated truck wheel. Here was every peening equipment designer's dream—to develop a peening specification and process for a brand new application!

As in all automotive applications, production volumes were quite large and required reduced cycle times or multiple machines. In addition, this was a new process and there was limited space at their facility to house it.

The manufacturer wanted to produce one wheel every 4.5 seconds and within the aforementioned space constraint. Since they were pioneering this process, they did not want to disclose details about the quantifiable life values expected after shot peening. Their final expectation was a peened product that enhanced weld life and a certified peening process that could be standardized and incorporated into their manufacturing process.

Finding the Solution

Our first task was to blast test sample wheels at our Application Validation center. The center's staff devised a test fixture that was able to spin the wheel in the vertical orientation and expose it to a vertically mounted blast wheel. The blast wheel was driven by a 15 HP motor with an inverter to vary the wheel speed. The rotational speed of the test fixture and the fabricated wheel could also be varied.

The team pooled their collective experience to determine intensity ranges for similar parts that were tested in the past. We gave the customer a test plan that described all test parameters except the intensity. The intention was for the customer to test the peened samples through x-ray diffraction or other means and choose the set of parameters that gave them the most desirable results. Accordingly, Wheelabrator test peened the wheels to three different intensity ranges: 0.009 to 0.011 A, 0.011 A to 0.015 A and 0.015 A to 0.017 A. These intensity ranges were achieved using two different shot sizes. The customer could also see the difference in coverage achieved from the two shot sizes.

After extensive testing at their end, our customer found the middle range of intensity best suited for their requirement. Given that the welds were not very wide, greater coverage achieved with smaller size shot (S 170 in this case) and the associated compressive stress outweighed a higher intensity value obtained with larger size shot at reduced coverage. Coverage could been increased with longer exposure time. However, we were also working within the constraints of a defined cycle time. The only parameter we could vary was the media flow rate using a higher horsepower motor. We have learned from many shot peening exercises that more media is not necessarily beneficial in peening.

Translating Test Data Into Machine Design

Our peening tests provided a saturation time of 24 seconds per wheel in our test rig. After careful consideration of the space constraints at the work site and customer preferences for loading and unloading, the Wheelabrator concept team determined a multi-table design as the best solution for our customer. Our customer was well-versed with robotic loading and unloading systems and decided to employ the same for this process.

Based on production volumes, Wheelabrator proposed a solution of two identical machines. Each machine was fitted with eight satellite tables mounted on a main indexing rotary table. Information on cycle time from our tests allowed us a specific idle time that we used for indexing. This also helped us determine the quantity of satellite tables on the main table.

Blasting in each machine was carried out by two horizontally mounted blast wheels spinning at 3600 RPM (programmed to run at a lower speed), and powered by a 15 HP motor each. The operating sequence is as follows:

- Two identical robots are positioned in front of each machine.
- One of the robots picks up two wheels from a conveyor with specially designed grippers and loads them on two exposed satellite tables.
- The main table indexes to carry the new parts into the machine and exposes two peened parts to the load/unload area.
- The second robot picks up the two peened parts and transfers them to an outfeed conveyor for downstream operations.

Our customer wanted a shot-peening process to strengthen the welded seam on truck rims.

Repeatability and consistency of peening results were paramount to our customer, as it should be in any peening operation. The blast wheels were fitted with variable frequency drives for speed variation and feedback loop to check if the wheel speed was within tolerance. Our customer continues to carry out saturation tests and to plot saturation curves at regular intervals to ensure a repeatable process. The satellite table drive was also controlled by an inverter so that the spinner speed could be varied. Though this flexibility is available, once set, the process doesn't require this parameter to be changed. Media flow was monitored and controlled by two VLP MagnaValves. Media size was monitored and undersized abrasive (smaller than S170) was removed by a 48″ vibratory classifier. Due to flow capacity constraints of the classifier, it continuously classified a percentage of the total flow from the two blast wheels.

The entire mechanical system was sequenced by an Allen-Bradley PLC with a PanelviewPlus TouchScreen HMI. With this interface, the customer continues to obtain process information in real-time. They also monitor machine health and troubleshoot issues using the I/O maps provided in the interface.

Lessons Learned

Wheelabrator's new process met the customer's end goal of improved weld and wheel life. The intensity range was tested with the developed parameters at Wheelabrator and found satisfactory, however, the intensity results at the job site were at the lower end of the range. After multiple discussions within Wheelabrator and with the customer, we decided to keep the shot size but use the next range of higher hardness. This brought up the intensity values by approximately 0.002″, leaving sufficient margins at both ends of the range.

The Wheelabrator design team also developed an electro-pneumatically powered masking arrangement to protect the inside of the wheel from getting blasted by overspray. The mechanism for this arrangement was mounted on the roof of the cabinet to protect it from damage from the blast media.

We started our discussions with thoughts on the future industry. Wheelabrator believes that the guiding principles for a successful career or market position in the shot peening or blast cleaning industries are going to be helping customers (or your employer) accomplish more in less time, without sacrificing effectiveness. Developing and testing the process shortened the cycle time for both us and our customer. Involving our customer in product and process development increased their confidence in the final product. Elimination of equipment performance risks, assurance of reliable and repeatable results, and innovative problem-solving skills are how Wheelabrator continues to shape the industry of the future.