A Match Made in Testing: Equipment Solutions for Shot Peening Tasks

Ron Wright, Automated Airblast & Peening Manager at Wheelabrator, explains how to find the right process and equipment for any given shot peening task—and the methods that help in making the best choice.

AUTOMOTIVE AND AEROSPACE components are getting lighter and lighter. And wherever engineers decide next to take away a bit more material to reduce weight, there is likely to be a peening process required to strengthen the now slimmed-down part. That's why shot peening is becoming a key process across ever more part categories. Finding the right tool for this process is critical – to achieve the precise patterns of stresses needed, as well as repeatable results.

It is not uncommon for process owners to approach a shot peening project with a pre-conceived idea of the equipment they need. This choice, however, can really only be made through careful analysis and thorough testing. With a broad array of potential solutions and machine concepts available, this preliminary work is crucial when deciding the best way forward.

Conversely, if the process is being designed for a component that historically never required peening, this very application challenge may have been solved elsewhere in the world. The Wheelabrator Technology Center in Metelen, Germany, for example, has just developed a new design of flexible lances for internal peening, ideal for emerging applications such as intricate internal areas of engine blocks or the internal lengths of a hollow torsion bar.

High-accuracy robotic air peening system for landing gear.

Advanced Testing for Advanced Processes

Testing methods and the accuracy and depth to which shot peened parts are now commonly examined have advanced hugely, not least driven by the proliferation of peening in Automotive, with its pressures of time, cost and scale.

The role of testing in finding the right process cannot be overstated. Even though a component may look as if it has been completely treated by a shot peening operation, only advanced testing will fully reveal the pattern of residual compressive and tensile stresses worked into the surface.

The use of X-ray diffraction, for example, will show if the area just below the surface has not been treated sufficiently and if the compressive layer is compromised. In applications where a precisely peened surface virtually is a structural element of the part design, not getting it right means risking part failure or under-performance, with potentially catastrophic consequences.

Assessing Needs to Narrow Down Choices

While getting the process right to meet exacting specifications is at the heart of any equipment choice, workflow and quality needs also have to be taken into account when narrowing down machine concept options. Careful assessment of the specification requirements, part complexity, throughput and media choices are key identifiers in the preliminary evaluation. In most instances, based on experience, a wheelblast or airblast solution can be selected at this initial evaluation stage.

At Wheelabrator, we always aim to remain technology-agnostic, meaning that we don't rush into a decision between air and wheel technology until we have done some tests. This approach allows us to work across disciplines on finding the best blast process for a given application, be it a combined

Multi-axis air system for peening landing gear.

wheelblast/airblast machine or equipment that requires sector expertise from elsewhere in the Wheelabrator network. For example, I work closely with my colleague Alain Portebois in Charleville, France, and can draw on his application experience in advanced shot peening solutions for Aerospace and Automotive customers in Europe and around the world.

Refining the Concept – More Testing

For a shot peening project that, for example, looks to process large quantities of relatively simple parts, such as springs, connecting rods or (solid) torsion bars, our team at the Wheelabrator Peening Technology Center will use knowledge and experience of previous, similar processes. This would streamline efforts and allow us to move very quickly to the Application Validation phase using wheelblast technology from our Technology Centers in Burlington, Ontario, or Metelen, Germany. This next phase then involves the development of saturation curves to determine intensity, as well as coverage mapping. Empirical throughput calculations are also carried out, using data garnered from these testing efforts.

If, however, the application is to process relatively complex parts, such as transmission components, landing gear, aircraft structural components, or if the demand is to achieve higher intensities or use multiple media sizes, the team will use the same evaluation methods and techniques, and again move efficiently to the Application Validation phase. But in this case, a high-accuracy air peening system would be selected, with CNC or robotic control from the Wheelabrator Technology Center in Charleville, France, complete with specification-compliant supervision software to ensure absolute precision and process reliability.

Avoiding Costly Surprises

Two recent examples may suffice to show how this holistic, needs-based approach to equipment selection pays off. The task was to find the right shot peening solutions for connecting rods and clutch springs respectively. Both of these components could—on the face of it—be treated with either blast technology. But in both cases, testing and analysis showed a clear winner, backing up the choice of technology with empirical evidence.

For the connecting rods, testing was done with both air and wheelblast. The analysis showed very similar compressive stress distributions for both processes, but the production requirements demanded a faster solution for the task, so a wheelblast machine was chosen.

The circumstances were slightly different for the clutch springs. The current, generally accepted method of shot peening these components was with wheel blast technology. Yet the customer was observing a high failure rate of the peened parts and subsequently consulted Wheelabrator on the shot peening process.

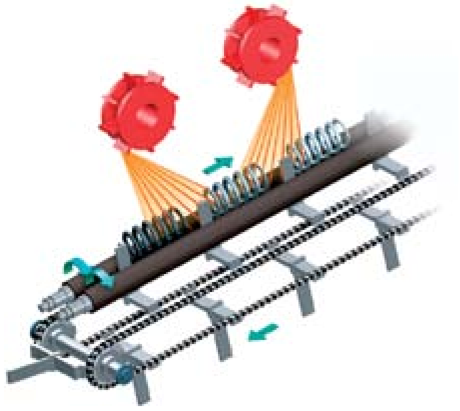
Our team identified the high stress areas, treated them strategically with robotic airblast technology and thus solved the failure problem. If this analysis had been performed at the beginning of the shot peening exercise, the failure problem would have been solved before it was allowed to occur in a live production setting.

Conclusion

Shot peening has gone mainstream. It takes place in a broad range of component categories and is often carried it out in extremely pressured production environments. This means it is crucial to get the process right first time and make use of the most suitable technology available.

Regardless of the equipment solution, the optimum delivery of spherical media to the appropriate high tensile areas of the part is the ultimate goal. If this is not applied properly, highly stressed parts will be subject to fatigue failure, crack propagation or stress corrosion.

Advanced testing and an open-minded, structured and application-driven approach to equipment selection are key to finding the perfect machine match for any given shot peening task.



Wheel peening equipment delivers even coverage on coil springs.