

User-Specific Process Development Service for Shot Peening Applications

Process developments in shot peening applications are mostly an adaption from previous processes which have proven to fulfill requirements. What if companies are suffering from loss of experienced personnel, are facing new challenges in shot peening or are implementing shot peening for the first time? These challenges can be addressed by external experts with profound process know-how and vast experience.

Kumar Balan has described in his well-respected article series on tribal knowledge in shot peening that the loss of tribal knowledge is progressing. If substitutes do not grow in time, weakening of technical progress inside companies is the consequence. While universities and institutes perform a lot of peening research on very specific materials and thus create certain niche knowledge valid for only a small group of operators, we can find loss of practical knowledge in the industry. First and second generation shot peeners have left the process for reasons of internal redeployments, fluctuation or simply age. These effects have been reinforced by economic pressure and the pandemic.

CHALLENGING PROCESS DEVELOPMENTS

On the other hand, there is a strong need to control existing processes, improve surface enhancement effects, optimize utilization of the invested energy and to implement new peening processes to industrial parts which had not needed shot peening earlier. So what's the way out?

sentenso and its engineering partner, strahlportal, find an increasing market request for shot peening process development in the industry. While in the past most of these development requests came from the aerospace and

automotive sector, new branches come into place now. As Wolfgang Hennig, process and training manager from sentenso reports, "Cutting and sawing tools or components with high pressure in small bores are typical examples for recent shot peening challenges. Moreover the sentenso team is facing extended peening targets on well-known parts like coil springs in sports cars or leaf springs in utility vehicles where new high-strength steels require more area specific and controlled shot peening."

WIDE AND DEEP PROCESS UNDERSTANDING REQUIRED

For such peening developments, wide and deep process understanding is essential. Most new peening processes require an experimental approach, iterative development steps and sometimes even modifications at the shot peening machine. For that kind of work vast process experience, specific engineering knowledge and strong affinity to practical work are the keys to success. In process development the achievements of digitalization and simulation will support but not at all replace the work of a collaborative team of experienced engineers and technicians.

sentenso founder and manager Volker Schneidau points out, "It should be fully recognized how machine settings like air pressure or wheel speed and media flow rate will lead to process parameters like media impact velocity and finally end up in quality parameters like intensity, coverage and, more importantly, residual stress distribution on the part. All these and several more parameters like media properties or nozzle and part movement interact with each others and require an appropriate combination of settings in order to keep the development time and costs affordable."



Internal peening of a coil spring | Internal peening of blade slots in a rotor



Flight direction and speed analysis at a blast lance for internal peening

And Wolfgang Hennig adds, "At this point it should be mentioned that the special quality characteristics, such as peening media properties, intensity and coverage, which are not common in other metal sectors, must be fully penetrated and understood. Due to the reason that knowledge in shot peening or in surface enhancement in general is mainly based on personal experiences and hardly integrated in practical mechanic training or academic engineering education, it

is important to consider the time factor. Mostly it takes process engineers several years to gather enough background information, practical experience and, call it a feeling, for suitable process and quality parameters. This fact is very often underestimated in production and development departments, mainly on management levels.”

But let's not just lament—it is better to see what we can do about it.

SOLUTIONS TO FUTURE DEVELOPMENT TASKS

1. Awareness

Our shot peening community should permanently insist on the importance and the benefits of surface enhancement in all related industry, research and development areas. We already see some promising trends in reputable engineering guidelines, in industrial research projects, and recent seminar programs of research associations and networks.

However, we cannot force companies to put more emphasis and implement serious control over shot peening based on know-how and machine technology. So we need to go further.

2. Training

Shot peening training is needed more than ever as tribal knowledge gets lost and requirements grow at the same time.

- The EI shot peening education program with standardized qualification levels is a very solid base for shot peening knowledge.
- We encourage more students with practical experience to take the Level 3 course and support the education with more high-level course material on the process and the quality parameters such as residual stresses.
- We should not forget that practical, hands-on shot peening training is crucial to the learning success. If this cannot be properly performed inside companies it should be integrated into the training curriculum.
- One other really helpful way to guide peening personnel is training on site where the trainer can easily address questions and tasks from every day work with the process and the machine.

Training will always form only part of the solution to challenging process development tasks. Even with reasonable qualification, process development inside companies is often limited by lack of suitable machines, machine controls, machine availability and time-to-market requirements.

3. External Process Development

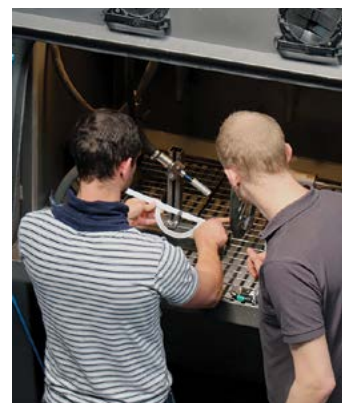
Peening process development services can complement or even replace internal developments as a whole. There are several options to outsourcing this task. Advantages and disadvantages should be considered.

- In many cases it is the easiest way to start a cooperation with a machine manufacturer who provides an appropriate testing center. This can be a good solution if there is already a reliable relationship between the operating company and the machine manufacturer or if the manufacturer has very specific machinery available. The disadvantage could be a certain obligation towards the manufacturer and a limitation of technical solutions.
- It is also possible to bring processes to a shot peening service provider. There are several such providers in the market who have extended experience based on hundreds or thousands of earlier peening applications with similar requirements. In this case it is often not possible to gain control of all technical solutions of process parameters if the provider considers relevant parts of this information as confidential.
- A third way to external process development is the cooperation with a specialized engineering company for shot peening which provides consulting and testing capacities. Consequently companies need to pay for this service but will be fully supported with the engineers' expertise and the provisions of the testing facilities. The development work should be independent and transparent.

CUSTOMIZED PEENING PROCESSES

sentenso Smart Peening Solutions and its engineering partner strahlportal in Datteln, Germany are well-positioned for this type of work. Volker Schneidau says: “Even if sentenso is offering shot peening process and quality control equipment and the company also provides solutions to special requirements in machine engineering, our team is focused to follow the main principle in process development, always to find the best suitable solution to a customer peening task.”

In order to achieve this goal sentenso has equipped its technology center with different air and wheel type shot peening machines, robotized nozzle and controlled part movement and tooling such as a big variety of peening nozzles. Part-holding fixtures and part verification tools (PVT) have to be customized. sentenso also provides all of its laboratory equipment including 3D microscope and fast and robotized stress measurement with single spot analysis of less than one minute on well accessible surface areas. These fast measurements allow for peening process optimization in extreme efficiency and a minimum of time. All information for the customer to implement



Discussions on an adequate process setup

his own process is concentrated in a process report that documents the machine and part setup, the relevant process and consequential quality parameters.



Part verification tool with Almen strip holder

Due to the reason that residual stress distribution in the surface of a part can only be measured destructively, the in-process control tasks are essential for the peening machinery. The interpretation and repeatability of peening results needs detailed data acquisition and logging. Finally the way to success and especially the final process should be documented in order to create the basis for the main target—the process transfer into serial production.



Robotized residual stress measurement

CONCLUSIONS

Shot peening process developments can be challenging and time consuming. Limitations of human or technical resources, knowledge and experience may lead to the decision to use external service providers such as machine manufacturers, shot peening service providers or specialized engineering companies.

Process development is a journey which requires solutions to complex tasks as, for example, media type variation, intensity determination in difficult-to-reach areas, visual coverage development, edge inspections, topography analysis and often time consuming and costly, residual stress determination. For these tasks specialized skills are required which will mostly need a team of engineers, technicians and material experts who fully understand the development tasks. Moreover, it is very helpful if the team gathers knowledge and experience out of different branches such as aerospace, automotive or medical.

sentenso and strahlportal in Germany are well prepared to provide development services to international customers. In close cooperation with the process engineers, the peening task is realized with the required equipment. After its development, the process needs to be transferred from the test machine to the customer production machine. Such a process transfer is often less time consuming than a full process development on the production machine itself. ●

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