STATUS OF SHOT PEENING AND BLAST CLEANING TECHNOLOGY IN INDIA

S.K. Rautaray  
Research Scholar  
M.A College of Technology  
Bhopal

M.C. Sharma  
Prof. Mech. Engineering  
M.A College of Technology  
Bhopal

ABSTRACT

This paper describes the application differences between the process of shot peening and blast cleaning operations. The extent of developments of these processes in India has been presented through review of few available papers. The application of these technologies specially the technology of shot peening in Indian manufacturing Industries has been felt to be under-valued may be due to lack of appreciation of its exceptional merits. It was therefore suggested that extensive promotional measures may be taken up for application of these technologies as manufacturing tool in Indian Industries.

1. INTRODUCTION

Impact treatment consists of processes used for cleaning or modification of surfaces. It includes shot blasting, grit blasting, sand blasting and blast cleaning. These processes commonly known as Impact Blasting have gone vast changes from its original conception as sand blasting. The basic purpose was to remove surface impurities such as removal of foundary sand, forge scale from castings and forgings including heat treatment scales. Surface preparations such as surface cleaning and surface finish prior to painting, metal spraying etc. are also carried out by impact blasting.

In this process when the abrasive media used are of spherical shape like that of steel shots or glass beads the process generally is called to be shot blasting which not only cleans and gives finish to the surface but also induces residual compressive stresses in it whereby fatigue life of the component is increased. The shot blasting however when done under controlled conditions is specifically termed as to be the process of shot peening. By shot peening the shots exclusively induce surface compressive residual stresses, work-harden the surface and improve the surface integrity and thereby improve the fatigue strength and fatigue life of components subjected to cyclic loading.

Further in impact blasting when the abrasive media are not in the spherical form but are of irregular shape like sand and grits the process is known as sand blasting and grit blasting respectively, employed mainly for metal surface cleaning and finishing while induction of residual stress if any is considered to be secondary. The term blast cleaning seemed to be derived from sand / grit
blasting.

For successful shot peening and blast cleaning operations and to widen the scope of applications of these processes, research and development work are being carried out at several places to develop suitable equipment, shots and instrumentation for effective control and monitoring of these processes. However, a better understanding of the extent to which these processes have been developed and applied in the field of manufacturing in India may be best obtained from the review of various R&D efforts made so far in this direction.

2. REVIEW

Summary of few findings (Sharma and Rautaray, 1991; Sharma and Mubeen, 1992) have been presented below;

Maheswari, Y. while working on airless shot peening machine reported that conventional flat blade wheels were more popular in India. However, curved vane wheels gave similar velocity (73 m/s) at low noise level as compared to flat blade wheels. Need for high quality shots was emphasised for more fatigue life, economy and for more uniform peening intensity with less wear and tear of the peening machine. Nadkarni, V.S., Sharma, M.C. and Sharma, S.G. developed and evaluated a pressure fed shot peening machine and based on saturation curves reported that the performance of the unit may be comparable to that of standard machines. Mannan, S.L. worked on stress relaxation of shot peened components and reported that residual stress relaxation was dependent on residual stress state, material and material condition, loading mode and other service conditions like temperature and environment. Sharma, M.C. and Mubeen, A. developed syphonic type shot peening machine and it was found to be useful for comparatively low intensity peening (0.25 mm `A`).

In other experiment Sharma, M.C. and Mubeen, A. reported that fatigue strength of decarburised parts was improved considerably after shot peening. Rao, R.N.V.D.M., while studying the effect of shot peening on fatigue and corrosion fatigue behaviour of spring steel and low silicon aluminium alloy reported the beneficial effect of shot peening in improving fatigue strength and corrosion fatigue resistance. The results of shot peening were compared to those of grit peening and it was concluded that for low intensity peening the surface roughness produced by grit peening was not found to be harmful.

Ojha, L.N. and Sharma, M.C. conducted studies on shot peening effect on boiling heat transfer on flat surface of brass and reported that shot peening has resulted improvement in heat transfer. Roughness caused by shot peening was responsible for creating active nucleation sites which were favourable for boiling mode.

Agnihotri, G and Shrivastav, K.D. reported that shot peening of heat transfer surfaces has provided an opportunity to improve heat transfer rate. Gupta, A.K. and Saxena, B.K. reported on the effect of shot peening on stress concentration.

Kumar, A.N. reported microstructural studies of the effect of shot peening on fretting fatigue behaviour in aluminium alloys and reported that sub-surface damage leading to extensive delamination was the cause of initiation of fretting fatigue cracks and to this shot peening proved to be the most beneficial treatment. Tiwari, V.K. conducted study on stress corrosion cracking and reported that micro-structure played an important role with hydrogen assisting the fracture.

Bhonsle, S.N., highlighted problems faced in shot peening machines while peening helical springs and suggested few basic design changes to enable the spring manufacturers to take full advantage of shot peening technology. Tiwari, R.P. reported about pneumatic shot peening machines and its role in production process in Indian Industries. Nahar, N. reported recent advances in designing of pneumatic shot peening machines. It was pointed out that considering the basic operating principles the shot peening machines can be turned as a controlled version of the abrasive blasting machine as peening has become distinct only because it involves adequate controls and simultaneously instead of grits or other abrasives, special shots are used.

3. DISCUSSION

The above findings have revealed that shot peening processes involve complexity. Results obtained in each of these studies are related to specific peening condition and control. However, in almost all the above studies the beneficial effect of shot peening has been measured in terms of fatigue strength, fatigue life, decarburised fatigue strength, corrosion fatigue resistance, stress corrosion cracking resistance, heat transfer rate, boiling heat transfer etc. The application of these technologies specially shot peening in Indian manufacturing industries has been felt to be under-valued possibly due to lack of appreciation of its exceptional merits. What is therefore exactly needed at this stage is to promote this technology as a manufacturing tool in Indian industries.

The shot peening and blast cleaning technology can be extensively well applied to automobile industry, tractor industry, aerospace industry, agricultural machine manufacturing industry etc. Automation of these processes can provide substantially increased production savings. Automation should be considered when the process requires definite control and uniformity. Repeatability of required process parameters can most easily be accomplished by automation. This has been felt to be necessary in the absence of non-destructive test method to ensure the integrity of a process which cannot be trusted to operators' judgement. However, the determining factor must be need for automation versus cost and therefore it may be viewed in the perspective of appropriate shot peening and blast cleaning technology.
A Brief Outline for Shot Peening Equipment Control Selection used for improving fatigue resistance of machine parts.

<table>
<thead>
<tr>
<th>Manual Control</th>
<th>Automatic Control</th>
<th>Computer Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual sieving and separation of foreign particles</td>
<td>Automatic shot classifier and separator</td>
<td>Automatic mass flow control and monitor</td>
</tr>
<tr>
<td>Manual periodical Mass flow measurement and Intensity check</td>
<td>More consistency in peening intensity</td>
<td>Computer will control the entire shot peening process. All the operations will be programmable</td>
</tr>
<tr>
<td>Cheapest but less consistency in peening intensity</td>
<td></td>
<td>Least manual interference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Most costly and sophisticated used for Aircraft components for high precision.</td>
</tr>
</tbody>
</table>

4. CONCLUSIONS

Shot peening technology is used for incorporation of surface residual compressive stresses, induction of work-hardened surface and for improvement of surface integrity, whereas blast cleaning refers to descaling, surface cleaning, finishing, deburring etc. Shot peening may be termed as a controlled version of abrasive blasting since both these processes are pneumatic systems and are operated with same principle, an abrasive blasting machine can be converted to a shot peening machine with adequate control on all process parameters. The extent of development and applications of shot peening technology in Indian industries has been felt to be under-valued and therefore extensive promotional measures may be taken up for their acceptability as manufacturing tool. Automation of shot peening and blast cleaning processes may be viewed in reference to the type of job and cost involved and accordingly appropriate shot peening and blast cleaning equipment and technology may be developed.

5. REFERENCES
