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Review of Shot Peening Process as a Tool to Improve Surface Properties

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Abstract:- **Shot peening is a cold working process used to generate a compressive residual stress layer. Most practical and cost effective method to induce surface residual stress is controlled shot peening, it help to extend life of critical component. The variation in shot peening parameters like angle of incidence, distance between nozzle and workpiece, time of peening, velocity of peening, can affect optimized solution to improve fatigue properties of material by using Taguchi method, ANN etc.**

Keywords:- *Shot Peening, Controlled Shot Peening Parameters of Shot Peenong.*

I. INTRODUCTION

Industrial component and structures are regularly subjected to alternating loads, which make them prone to fatigue failure. All fatigue cracks form at surface due to surface stress concentration features. Shot peening process is bombardments on treated surface with shot stream, shots are minute hard spherical media. As a result, compressive residual stress field is generated in near surface layer which amend performance and elongate the life of critical components like gears.

Metallic components which are subjected to cyclic loading,wear needs improvement in fatigue resistance and for this shot peening is beneficial process.

II. OVERVIEW ON SHOT PEENING

Most effective method of inducing surface residual compressive stress is controlled shot peening by which life of critical component can be extend.

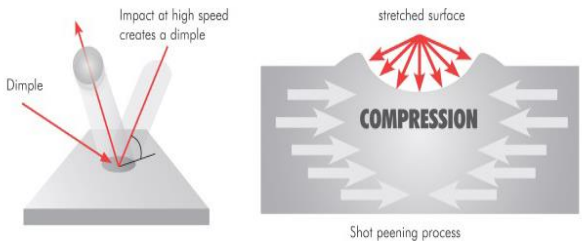

Fig 1:- Shot peening process

Residual tensile stress induced during manufacturing is responsible for component failure . During the shot peening process, each piece of shot that strikes the material acts as a tiny peening hammer, imparting to the surface a small indentation or dimple “as shown in figure 1.1”. To create the dimple, the surface of material must yield in tension.

In shot peening different parameters are used and they are controlled depending upon experimentation made by different experimentation techniques.

❖ *Parameters Used in Shot Peening*

There are number of shoot peening parameters used such as angle of peening, angle of contact, velocity of peening, shot size, pressure of air.

To ensure repeatability, accuracy, reliability parameters of shot peening process needs to be carefully controlled. .

➢ *Coverage*

It is define as ratio of area covered by hits and total surface treated by shot peening. It is generally express in terms of percent. The notion of coverage is based on research work of American firm wheelaborator.

➢ *Shot Size*

Different type of shots are used in shot peening i.e. shape of shots, size of shots and material of shots. If shot size is too big it cant remove tool marks and performance is poor.

III. RESIDUAL STRESS MEASURMENT

Various methods for measurement of residual stress are as follows.

❖ *Diffraction Techniques*
- X ray diffraction technique
- Neutron diffraction method

❖ *Mechanical Method*
- Hole drilling method
- Sectioning technique

These are some important methods of residual stress measurement.

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IV. EXPERIMENTATION COMPARISON

❖ *Various researchers have experimented on different parameters & materials:*

G.Donzella studied process of shot peening to study residual stress induced by shot peening on some sintered steels. Shot peening was carried out with input parameters shot type, shot diameter, coverage, Alemen intensity and output parameters were residual stress, micro hardness. Micro structure analysis clearly shows presence of densified surface layer after shot peening. Where porosity was almost completely eliminated.[1]

Lechun Xieetal studied shot peening to investigate micro structure of(TiB+TiC) & its residual stress after shot peening. The diameter of sample is 15 mm and thickness 3 mm. The shot peening was performed on air blast machine with input parameters were shot hardness(700HV), shot diameter(0.3mm), shot peening time(0.5min), Shot peening intensity(0.2mmA),Coverage(100%), distance between nozzle and work piece(100mm), nozzle diameter (15mm), Velocity (0.5Mpa) and output parameters micro hardness, compressive residual stress. The experimentr concluded that compressive residual stress were introduced and improved at surface deformation layers and significant increment of micro hardness in surface layer had been observed.[2]

M.A.S Torres & Voorwald studied the shot peening process to study residual stress and stress relaxation on fatigue life of AISI 4340 steel. The shot peening was carried out on air blast machine with input parameters shot peening intensity, distance between nozzle and work piece , rotation of table, shot size and output parameters were fatigue life of material, compressive residual stress field (CRSF). The shot peening process was done with high quality control. Fatigue test were carried out on rotating bending machine. The graph plotted depth vs. residual stress shows the compressive residual field which concluded that increase in intensity resulted in an increase in the maximum compressive residual stress and width of CRSF[3]

Molinariet studied shot peening process for the surface modifications induced by shot peening and their effect on the plane bending fatigue strength of Cr-mo steel produced by powder metallurgy. The specifications of the shot peening parameters (input) shot types ASH 170, ASH230, ASH330, shot diameters and coverage(100%), Almen intensity, Nozzle diameter, Distance between nozzle and workpiece , Angle of incidence. The residual stress profile was measured by X – ray diffraction. For different shot peening conditions the graphs were plotted as porosity vs. depth, depth vs. hardness. From experimentation it was concluded that strain hardened layer tends to decrease as the shot diameter increase[4].

Dr. lakhwinder singh analysed shot peening process for determining optimization of shot peening process for AISI 304 naustenitic steel using taguchi method and grey relational analysis with principal component analysis. The input parameters selected were nozzle angle, air pressure, time of peening, shot size and the response parameters selected were compressive residual stress, hardness. The residual stresses and harness were calculated and optimized and from compared optimized values it was concluded that GRA with 27 PCA and taguchi analysis gave optimal process parameters which gave the heighest fatigue life of the specimen [5].

Franck renaud suggested the optimized shot peening parameters for the steel specimen. For experimentation steel (17CrNiMo6)specimen was selected and material mainly for precise gear manufacturing. Input parameters selected were exposure time, nozzle diameter, air pressure, distance between nozzle and work piece, impact angle, mass flow rate and response parameter is compressive residual stress. From the experimentation it was concluded that the data related to the final material selection was collected which will be helpful for design purpose of component.[6]

V. CONCLUSION

Above review reveals following conclusion:

- Fatigue properties of component can be improve by shot peening.
- Due to shot peening main changes induced in surface layer of material are compressive residual stress, work hardening and surface roughness.
- Life improvement due to compressive stress is caused by prolonging the cracks growth rate.

VI. APPLICATION OF SHOT PEENING

Shot peening is used on cams, coil springs, clutch springs. Shot peenignis crucial process in spring making. Some of different types of spring includes extension springs, leaf springs and compression springs. Engine valve spring is most widely used application due to its cyclic fatigue.

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