

Chapter 7

Optimizing Shot Peening Machines for Compact Components

V. Gopal

KCG College of Technology, India

R. Bharanidaran

Vellore Institute of Technology, India

T. Mothilal

KCG College of Technology, India

M. Vignesh Kumar

KCG College of Technology, India

ABSTRACT

Optimizing shot peening is a cold-working process employed to generate a compressive residual stress layer and modify the mechanical properties of metals. It involves impacting a surface with a shot with sufficient force to induce plastic deformation. Peening a surface spread it plastically, leading to alterations in its mechanical properties. Its primary application is to prevent the propagation of microcracks from the surface. Such cracks do not propagate in a material that is under compressive stress. Optimizing shot peening can induce such stress on the surface. In this process, shots are accelerated using centrifugal force generated by a rotating impeller, which directs the shots to impact the surface to be peened. Media choices include spherical cast steel shots, ceramic beads, or conditioned cut wire. Peening necessitates well-graded shots with consistent hardness, diameter, and shape, and a mechanism for removing optimized shot fragments throughout

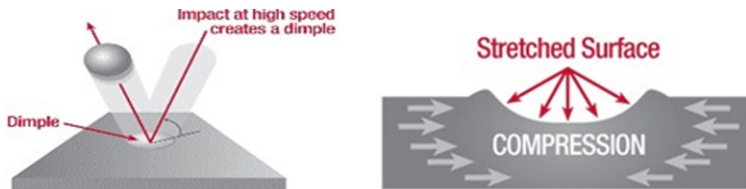
DOI: 10.4018/979-8-3693-3314-3.ch007

the process is desirable.

INTRODUCTION

The shot peening process significantly influences the microstructure and mechanical properties of metals. Shot peening refines the surface grains into nanocrystals, leading to increased surface hardness, tensile strength, and enhanced corrosion resistance (Pan.H.,2023). It is a process of cold working a part to enhance its resistance to metal fatigue and certain forms of stress corrosion. It entails bombarding the surface of the desired part with metallic (usually steel), glass, or ceramic beads with sufficient force to create dents on the surface (P.S.G College, 2011). As depicted in Figure 1 (Kirk, David., 2009 and Haverty, Donncha and Brendan Kennedy, 2009), optimizing shot peening induces plastic deformations on the surface of the peened part. This process alleviates surface tensile stresses that may have been introduced during part machining. More importantly, it introduces beneficial compressive residual stress, thereby fortifying the surface of the part. Additionally, shot peening is occasionally employed to manipulate or modify the shape of thin parts.

Figure 1. Principle of shot peening



Compressive residual stress refers to any stress remaining in a material after the source of the stress has been removed. It occurs when the shot creates dimples in the surface by displacing the material sideways. This compression is generated by the transfer of kinetic energy from a moving mass (shot particle) into the material's surface, capable of undergoing plastic deformation. Atoms just below the surface resist this displacement, leading to compressive lateral stress aimed at restoring the surface to its original state. This stress contributes to surface hardening and prevents crack formation and propagation.

The depth and magnitude of the compressive residual stress layer depend on various factors, including shot type, intensity, coverage, and part hardness. The depth of the compressive layer can vary, from 0.05 mm for light peening applica-

14 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/optimizing-shot-peening-machines-for-compact-components/351743

Related Content

Development of Stress Management System for Prevention of a Mental Disease using Smart Finger Plethysmogram Measurement

Hidehiko Hayashi and Akinori Minazuki (2014). *International Journal of Computational Models and Algorithms in Medicine* (pp. 66-74).

www.irma-international.org/article/development-of-stress-management-system-for-prevention-of-a-mental-disease-using-smart-finger-plethysmogram-measurement/148349

An OR Practitioner's Solution Approach for the Set Covering Problem

Yun Lu and Francis J. Vasko (2015). *International Journal of Applied Metaheuristic Computing* (pp. 1-13).

www.irma-international.org/article/an-or-practitioners-solution-approach-for-the-set-covering-problem/132521

Extraction of Target User Group from Web Usage Data Using Evolutionary Biclustering Approach

R. Rathipriya, K. Thangavel and J. Bagyamani (2013). *Trends in Developing Metaheuristics, Algorithms, and Optimization Approaches* (pp. 253-263).

www.irma-international.org/chapter/extraction-target-user-group-web/69728

Levy Flight and Chaos Theory-Based Gravitational Search Algorithm for Global Optimization: LCGSA for Global Optimization

Sajad Ahmad Rather and P. Shanthi Bala (2022). *International Journal of Applied Metaheuristic Computing* (pp. 1-58).

www.irma-international.org/article/levy-flight-chaos-theory-based/292496

Hybrid Heuristics for the Territory Alignment Problem

Jorge Freire de Sousa, José A. Barros-Basto and Paulo Lima Júnior (2012). *Hybrid Algorithms for Service, Computing and Manufacturing Systems: Routing and Scheduling Solutions* (pp. 258-293).

www.irma-international.org/chapter/hybrid-heuristics-territory-alignment-problem/58525