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Abstract

One of the well-known methods of severe plastic deformation (SPD), shot peening is widely used to improve the mechanical properties and fatigue behavior of metallic materials. The present study investigated experimentally the effects of different shot peening treatments of conventional and severe on the fatigue behavior of various carbon steels. A novel alternative approach has been proposed that utilizes the concept of artificial neural network to predict the fatigue life of carbon steels which are subjected to different shot peening treatments. The experimental results were employed to develop the network. After the results were modeled, it was indicated that the used neural network-based approach is greatly consistent with the experimental ones. Next, a comprehensive parametric analysis was performed while considering the influence of the effective parameters of shot peening on fatigue behavior.

Keywords: Shot peening; Fatigue life; Modeling; Artificial neural network

1. Introduction

Most failures such as fatigue fracture in engineering components are very sensitive to surface properties, so that in most cases the cracks initiate from the surface and propagate to the interior. It is well-established that the fatigue strength of mechanical components can be enhanced by grain refinement and improving the mechanical properties of the surface layer and producing compressive residual stress (CRS) [1, 2]. One of the widely used approaches in this regard is employing the shot peening (SP) process that makes the nucleation and propagation of fatigue cracks, especially in metallic materials, more difficult [3]. SP is a cold working process in which the surface of a component is bombarded with small shots under a controlled velocity that may deform the surface layer plastically and create considerable CRS [4].