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Investigation of the process capability of water cavitation peening and shot peening processing

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Abstract: Water cavitation peening (WCP) with aeration is a recent potential method in the surface enhancement techniques. In this method, a ventilation nozzle is adopted to improve the process capability of WCP by increasing the impact pressure, which is induced by the bubble collapse on the surface of components in the similar way as conventional shot peening(SP). In this paper, the process capability of water cavitation peening and shot peening is investigated, The residual stresses in the near-surface and surface morphologies of spring steel SAE 1070 was characterized by X-ray diffraction (XRD), optical microscopy (OM). After peening treatment, changes in surface morphologies, as well as residual stress with the different peening duration were recorded. The obtained results indicate that the WCP processing had a better surface finish than SP processing.

Introduction

Cavitation impact has historically attracted attention due to its costly damage to hydraulic mechanical parts, such as hydrofoil surfaces, turbopump impellers, pumps, and valves [1-2]; therefore, most previous studies on cavitation have focused on the damage mechanism. However, it can also induce the residual compressive stress in the superficial layer of the specimens, which can improve the fatigue life of mechanical components by a similar way as conventional shot peening [3-4], and such method is named water cavitation peening (WCP). Compared with conventional shot peening, WCP has the following advantages: (1)complicated and narrow surface can be treated easily [5-6] (2)smoother surface can be obtained [7] (3)there is no thermal effect on the material surface (4)it is clean, inexpensive and nontoxic (5) the impact pressure and the process capability of WCP are isotropic [8]. In this paper, in order to further verify the process capability of WCP with aeration and SP, a standard N-type almen strip of spring steel SAE 1070 is treated by WCP with various process conditions. The bend distortion, surface morphologies and the depth distributions of residual stress were investigated.