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ULTRASONIC PEENING IN INDUSTRIAL APPLICATIONS

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ABSTRACT

The ultrasonic peening (UP) process, also known as ultrasonic impact treatment (UIT), is a relatively new technology that has proven to provide fatigue life improvement of welded elements and structures. The beneficial effect of UIT/UP is achieved mainly by relieving of harmful tensile residual stresses and introducing of compressive residual stresses into surface layers of a material, decreasing of stress concentration in weld toe zones and enhancement of mechanical properties of the surface layers of the material. Through the years of development of the UP systems and the technologies for their applications by Sintec engineers and by other UP users, Sintec accumulated a great deal of successful case histories of UP technology use in marine steels, bridges, heavy machinery, mining equipment, etc. The presented results show the convincing advantage of UP/UIT for increasing of fatigue strength of welded elements in materials and structures.

Keywords: welding, fatigue improvement, ultrasonic impact treatment, ultrasonic peening, industrial applications

INTRODUCTION

The ultrasonic peening (UP) is a new and promising process for fatigue life improvement of welded elements and structures (Trufyakov, 1995a, Trufyakov, 1995b, Kudryavtsev, 2005, 2007). The beneficial effect of UP is achieved mainly by relieving of harmful tensile residual stresses and introducing of compressive residual stresses into surface layers of materials, decreasing of stress concentration in weld toe zones and enhancement of mechanical properties of the surface layers of the material. The UP technique is based on the combined effect of high frequency impacts of special strikers and ultrasonic oscillations in treated material.

RESULTS AND CONCLUSIONS

The UP technology and equipment were successfully applied in many industrial projects for rehabilitation and weld repair of parts and welded elements (Kleiman, 2011), (Fig.1). The results of fatigue testing of large-scale welded samples imitating the transverse non-load-carrying attachments with UP applied to specimens in as-welded condition and also after 50% of expected fatigue life are presented in Figure 2. The UP caused a significant increase in fatigue strength of the considered welded element for both series of UP treated samples. The higher increase of fatigue life of UP treated welded elements for fatigue curve #3 could be explained by a more beneficial redistribution of residual stresses and/or “healing” of fatigue damaged material by UP in comparison with the fatigue curve #2.



Fig. 1 - Application of UP for rehabilitation of welded elements in a welded bridge (left) and of a large grinding mill (right).

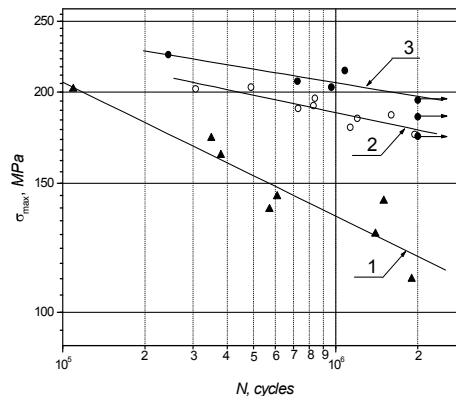


Fig. 2 - Fatigue curves of welded elements (transverse non-load-carrying attachment): 1 - in as welded condition, 2 - UP was applied before fatigue testing, 3 - UP was applied after fatigue loading with the number of cycles corresponding to 50% of expected fatigue life of samples in as-welded condition.

In summary, the fatigue testing of welded specimens had shown that UP is the most efficient improvement treatment as compared with traditional techniques such as grinding, TIG dressing, heat treatment, hammer peening, shot peening or application of LTT electrodes.

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