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# UNDERWATER ULTRASONIC PEENING OF WELDED ELEMENTS AND STRUCTURES

**Yuri Kudryavtsev(*), Jacob Kleiman, Alexander Lugovskoy**
Structural Integrity Technologies Inc., Markham, Ontario, Canada
(*)*Email:* ykudryavtsev@sintec.ca

## ABSTRACT

The objective of the study described in this paper is to identify the efficiency of new technology and equipment UltraPeen® for underwater ultrasonic peening (UUP) of welded elements. 34 large-scale welded samples were produced and fatigue tested. Half of these samples were welded in open air (a) and another half - underwater (b). Then 50% of the samples a) and b) were subjected to UUP. The results of the fatigue testing showed that the UUP provides significant fatigue improvement of welded elements similar to what is observed for UP in air.

***Keywords:*** underwater ultrasonic, welded elements, UIT, ultrasonic peening.

## INTRODUCTION

The ultrasonic impact treatment (UIT) is one of the new and promising processes for fatigue life improvement of welded elements and structures (Kudryavtsev, 1989, 2010). In most industrial applications this process is also known as ultrasonic peening (UP) (Kudryavtsev, 2009). 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 fatigue testing of welded specimens showed that the UP is the most efficient improvement treatment when compared with such traditional techniques as grinding, TIG-dressing, heat treatment, hammer peening, shot peening and application of LTT electrodes. The new ultrasonic system presented on Figure 1 was designed to perform underwater UP at the depth of up to the 30 meters.

Fig. 1 - The new ultrasonic system UltraPeen® with easy replaceable working heads for underwater ultrasonic peening

## RESULTS AND CONCLUSIONS

Figure 2 shows the process of UUP of welded samples for their subsequent fatigue testing. The UUP of welded samples was performed in accordance with the parameters recommended by (Kudryavtsev, 2010).

Fig. 2 - The process of underwater ultrasonic peening by using UltraPeen® system

All testing has been conducted under constant amplitude axial tension in servo-hydraulic fatigue testing machines. The applied stress ratio has been R=0.1. Failure is defined to have taken place upon complete separation of the specimen. The results of the fatigue testing showed that the UUP provides significant fatigue improvement of welded elements similar to what is observed for UP in air. The fatigue life of welded samples increased under the action of UUP by 3-5 times depending on the level of applied stresses.

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