FATIGUE IMPROVEMENT OF WELDED ELEMENTS BY ULTRASONIC IMPACT TREATMENT (UIT)

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

ABSTRACT
The ultrasonic impact treatment (UIT) is one of the new and promising processes for fatigue life improvement of welded elements and structures. This process is also known also as ultrasonic peening (UP). The fatigue testing of welded specimens showed that the UIT is the most efficient improvement treatment as compared with traditional techniques such as grinding, TIG-dressing, heat treatment, hammer peening and laser peening. The description of UIT technology and the results of fatigue testing of welded elements of steels and aluminum alloys in as-welded condition and after application of UIT are discussed in this paper.

Keywords: fatigue improvement, welded elements, ultrasonic impact treatment, UIT.

INTRODUCTION
The basic system for UP treatment (total weight - 11 kg) includes an ultrasonic transducer, a generator and a laptop (optional item) with software for optimum application of UP - maximum possible increase in fatigue life of parts and welded elements with minimum cost, labour and power consumption. In general, the basic UP system could be used for treatment of weld toe or welds and larger surface areas if necessary (Kudryavtsev, 2013).

Figure 1 illustrates the concept of the fatigue life improvement of welded elements by UP. In case of welded elements, it is enough to treat only the weld toe zone - the zone of transition from base metal to the weld, for a significant increase of fatigue life. The so-called groove, shown in Figure 1, characterized by certain geometrical parameters is produced by UIT (Kudryavtsev, 1989).

![Profile (a) of weld toe improved by UIT and the view (b) of fillet weld in as-welded condition (left side sample) and after application of UIT (right side sample)](image)
RESULTS AND CONCLUSIONS

A large number of different welded specimens made from steels and aluminum alloys were fatigue tested in as-welded conditions and after application of UIT. Figure 2 presents the results of fatigue testing of lap joint made from 3 mm-thick aluminum alloys 5083 and 6061-T6. Parameters of fatigue testing: axial loading, R=0.

The fatigue testing of welded specimens made from aluminum alloys 5083 and 6061-T6 showed that the UIT provided significant increase in fatigue performance of considered type of welded joint. The limit stress range of welded elements in this case was increased by UIT by ~100% and fatigue life - by 6-10 times depending on the level of applied stresses (Kudryavtsev, 2011).

The fatigue testing of welded specimens showed that the UIT is the most efficient improvement treatment as compared with TIG-dressing, application of LTT electrodes and other post weld treatments. The developed computerized complex for UP was successfully used in different applications for increasing of the fatigue life of welded elements, elimination of distortions caused by welding and other technological processes, relieving of residual stress, increasing of the hardness of material surfaces and surface nanocrystallization. The areas/industries where the UP was applied successfully include: Railway and Highway Bridges, Mining, Construction Equipment, Shipbuilding, Automotive and Aerospace.

REFERENCES

