Fatigue of Welded Joints of Eutectoid Steel Strips

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PhD-dissertation

Thesises

Thesis I:

The low cycle fatigue behavior of the C75S bandsaw blade material was characterized by the notch sensitivity, and it was concluded that it is described by two major idiosyncrasies: on one hand, beside the main crack propagation, a number of small cracks formate at right angles to the main crack and are stopped by ferritic phases. On the other hand, if the notch radius $r \leq 5$ mm, the cycles of fatigue decrease exponentially, and it is almost independent of the mean stress.

Thesis II:

The life-span of the MAG welded joints of C75S steel strips made with unalloyed welding wire are mainly affected by the temperature of preheating and post weld heat treatment. In the aspect of the time of post weld heat treatment, the life-span is described by a curve, which has an optimum at 425°C and 5 minutes in the case of the measured values.

Thesis III

The fatigue of MAG welded joints made with Ni-alloyed welding wire has benn examined with short cycle fatigue tests. The life-spans of the welded joints, made with Ni-alloyed welding wire, are significantly higher - in the examined region by 25 % - than those welded with unalloyed wire, nevertheless the place of failure is not at the weld. The explanation of this is that in the boundary zones of the weld and the heat affected zone, where the fatigue crack is formed, the ductility and the fatigue resistance are increased by the diffusion of Ni. At the examined preheat temperature, in the aspect of post weld heat treatment time, the life-span is described by a curve, which has an optimum, in case of the measured values at 5 minutes.

Thesis IV

The affect of fusion welding technology on the fatigue properties of welded joints are inspected by the examination of laser welding technology. The fatigue resistance of laser welded joints is one order higher, than of those made with MAG welding. The optimal fatigue properties can be achieved with 425°C preheat and with 8 minutes post weld heat treatment at the same temperature. This exceptionally high increase in the fatigue properties is in a great part due to the fact that there is hardness decrease, insted of increase in the boundary zone of the weld and the heat affected zone.

Thesis V

One of the objectives is to specify a method, based on the physical modelling of the heat affected zone, which can examine the welded joints' mechanical properties and fatigue characteristics with proper safety and effectiveness. A system, able to examine the effects of arc welding in its own physical reality, has been devloped and was succesfully applicated to optimize pre heat temperature and post heat treat time.

Thesis VI

The failure cycle number of the C75S metal strips' fusion welded joint can be estimated in the range of low cycle fatigue with a sine curve, in the case of pulling stress set at right angle to the welding joint with an exponential curve, knowing the difference between the maximal measurable hardness in the joint and the hardness of the base material (ΔHV). The ΔHV-faliure cycle number curve resulting this way is able to specify the ΔHV indicating the borderline of the safe area designated by the faliure cycle criteria. This method allows quick testing of the fusion welded joints from the aspect of fatigue.