

Self Restraint 시험법을 이용한 용접성 평가
(Weldability Analysis by the Self Restraint Test)

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Abstract.

The solidification crack susceptibility of aluminum alloy weld metal have been evaluated by means of the self restraint and external restraint cracking test. It has been observed experimentally as follows : (1) The manganese is beneficial to decrease the solidification cracking susceptibility. (2) Weld metal containing zirconium is less sensitive to the solidification cracking than the weld metal containing chromium does. (3) The self restraint test method shows the same tendency in results as the external restraint test does.

1. Introduction

Many test methods have been developed and utilized to investigate the solidification cracking of aluminum alloys. These test methods can be divided to two types, self restraint and external restraint type. The external restraint type has the advantages in separately controlling the mechanical variables and metallurgical variables, and permits the fundamental studies on the mechanisms of solidification cracking. The self restraint test method can duplicate conditions more closely related to actual welding situations where the restraint is imposed on the structure.

This experiment has attempted a comparative evaluation of both methods, GTAW crater cracking test and self restraint cracking test.

2. Experimental procedure

Self restraint method (GTAW cracking test) was conducted with the 100 X 100 X 3.2 mm specimen and external restraint method (Varestraint cracking test) with the 127 x 25.4 x 3.2 mm specimen. During the test, an actual weld bead was deposited to produce the same thermal conditions of a representative heat input of the actual GTAW. The materials used in this experiment are high strength aluminum alloys homogenized by heating for 24hr at 460°C and extruded at 395°C. These bars were solutionized at 460°C and water quenching, then naturally aged at room temperature for 96 hr and aged by two-step aging at 100°C for 10 min and 160°C for 180 min.

3. Experimental Results and Discussions

The solidification cracking susceptibility of the high strength aluminum alloy was analyzed through the self restraint and external restraint test method, and the results of both methods show the same tendency. The effect of Mn on the solidification cracking behaviour indicates that the susceptibility of solidification cracking decreases with increasing Mn content and reveals that the solidification cracking susceptibility reaches low value at the Mn content of 0.6~0.7 %. It can be noted that the results imply the important role of Mn, Cr and Zr during the solidification cracking formation stage and that the weld metal solidification cracking behaviour is strongly connected with the solute redistribution and microsegregation during the weld metal solidification stage as well as the solidified microstructure. Weld metal solidification cracking is caused by the combination of mechanically and/or thermally induced strain and the crack susceptible microstructure. Since thermally induced strains are inherent in the process of melting and solidification, the only practice

method of preventing solidification cracking lies in the elimination or control of the crack susceptible microstructure. Welding parameters, solidification rates, alloy composition and microsegregation are all the factors which play an important roles in the control of solidification cracking associated GTAW of the high strength aluminum alloys.

4. CONCLUSION

The solidification cracking tendency of Al-Zn-Mg alloys increases with the proposition of Cu, Cr alloying elements and decreases with the proposition of Mn, Zr alloying element. Mn is very effective to reduce the total crack length and to improve the resistivity of solidification cracking tendency in Al-Zn-Mg alloy weldment. The GTAW cracking ratio of the high strength aluminum alloy shows the same relationship as the total crack length which is the summation of the crack lengths from every cracked area in the vareststraint test. Therefore, the most solidification cracking susceptible aluminum alloy in GTAW cracking test is also the most solidification cracking susceptible aluminum alloy in the vareststraint test.