EFECT OF RETROGRESSION AND RE-AGING HEAT TREATMENT ON THE CORROSION FATIGUE CRACK GROWTH BEHAVIOR OF AA7050 ALUMINUM ALLOY

R. GÜRBÜZ, N. AKGÜN
Metallurgical & Materials Engineering Department, Middle East Technical University, Ankara, 06531 Turkey

ABSTRACT

The effect of retrogression and re-aging heat treatment on corrosion fatigue crack growth behavior on AA7050 T73651 aluminum alloy is investigated. C-T (Compact Tension) specimens are prepeared in L-S direction for fatigue crack growth tests . Samples are solution heat treated at 475 °C and aged at 120 °C for 24 h (T6 condition). After that, samples are retrogressed at 200 °C for times of 1, 5, 30, 55 and 80 minutes. Then, samples are re-aged at 120 °C for 24 h (T6 condition). Hardness measurements are taken at different retrogression times and at the end of the heat treatment. Fatigue crack growth tests are performed at as received condition and at different retrogression times with sinusoidal loading of R=0.1 and f=Hz in both laboratory air and corrosive environment of 3,5% NaCl solution. The highest fatigue crack growth resistance is observed for 30 min. retrogression and 5 min. retrogression for laboratory air and corrosive environment respectively. It is concluded that RRA can successfully be used to improve fatigue performance of this alloy.

1 INTRODUCTION

The demand of reduction in weight has always been a driving force to have improved material properties in transport industry. Optimization in material selection to minimize the weight of airplanes and cars considers various properties such as yield strength, toughness and corrosion resistance. For these reasons, high strength aluminum alloys has been a good candidate for manufacturers.

It has been well established that high strength aluminum alloys are highly sensitive to environmental degradation of mechanical properties. Especially, alloys heat treated to the maxium strength (T6 temper) resulted in unfortunate corrosion failures. The resistance to stress corrosion cracking and corrosion fatigue can be increased by over-aging heat treatment (T7 temper) but with a 10-15% loss in strength.

In the beginning of 1970's, retrogression and re-aging (RRA) heat treatment technique was introduced, which incresaes the corrosion resistance while keeping the mechanical strength similar to T6 temper condition. RRA consists of three step heat treatment process. The first step is peak aging at 120 ^{o}C for 24 hours (T6 condition); the second step is the retrogression at a higher temperature of 200 ^{o}C for a short time and the third step is reaging at 120 ^{o}C for 24 hours once again.

Coarse precipitation of the equilibrium phase η ($MgZn_2$) in the grain and subgrain boundaries while maintaining fine distribution of ή in the grain interiors is obtained by RRA heat treatment. The formation of coarse precipitates which act as hydrogen trapping sites results in a local reduction in the atomic hydrogen concentration in the matrix around the grain boundaries.

In the present study, the effect of retrogression time on air and corrosion fatigue crack growth behavior of AA705 aluminum alloy is investigated. The fatigue crack growth rates for both air and 3.5% NaCl solution are evaluated.