Pengaruh solution treatment terhadap ketahanan korosi dan kekuatan mekanik paduan Mg-9Al-1Zn = Effect of solution treatment on corrosion behaviour and mechanical strength of Mg-9Al-1Zn alloys

Ravi Naldi, author

Abstrak

Paduan Mg-9Al-1Zn (AZ91) merupakan paduan logam ringan yang digunakan dalam industri otomotif. Masalah utama dari paduan ini adalah memiliki ketahanan mulur yang rendah. Solution treatment merupakan salah satu metode yang efektif untuk meningkatkan ketahanan mulur logam. Pengaruh solution treatment terhadap sifat mekanik dan sifat korosi paduan as-cast AZ91 diteliti dengan menggunakan uji creep, hardness, elektrokimia, dan hilang berat. Solution treatment dilakukan pada suhu 420°C selama 2 jam kemudian dilakukan pendinginan cepat dalam air. Perubahan struktur mikro dan komposisi paduan diamati dengan mikroskop optik, scanning electron microscopy (SEM), energy dispersive X-ray (EDX) dan X-ray diffraction (XRD). Paduan as-cast AZ91 terdiri dari fasa Î±-Mg sebagai matrik dan fasa Î² (Mg17Al12) yang tersebar di sepanjang batas butir. Ukuran butir yang berbentuk sama sumbu (equiaxed) berada pada rentang 40-100 µm. Pengurangan fraksi volume fasa Î² yang signifikan terjadi setelah solution treatment dimana ukuran fasa Î² mengecil dan terdistribusi secara acak pada batas butir dan matrik. Solution treatment menyebabkan perbesaran pada butir logam menjadi berukuran 100-500 µm.
Hasil uji hilang berat menunjukkan bahwa laju korosi pada paduan as-cast didapatkan sebesar 179 mmpy kemudian meningkat setelah diberi perlakuan solution treatment menjadi 270 mmpy. Pontensial korosi bebas (open circuit potential) paduan turun setelah solution treatment.
Hasil uji polarisasi potensiodinamik tidak menunjukkan perubahan yang berarti setelah solution treatment. Namun hasil uji impedansi (electrochemical impedance spectroscopy) menunjukkan turunnya nilai impedansi paduan setelah solution treatment. Turunnya ketahanan korosi setelah solution treatment disebabkan oleh berkurangnya fasa Î²(Mg17Al12) yang berperan dalam menahan laju korosi. Nilai kekerasan paduan as-cast AZ91 yaitu sebesar 61,68 HV turun menjadi 60,66 HV setelah solution treatment. Hasil uji creep menunjukkan bahwa waktu mulur putus paduan as-cast AZ91 terjadi 10 kali lebih cepat dari paduan yang telah mengalami solution treatment. Hal ini disebabkan oleh berkurangnya fasa Î² yang memiliki titik leleh yang lebih rendah disbanding Mg. Perlakuan solution treatment menurunkan ketahanan korosi paduan AZ91 namun dapat meningkatkan ketahanan mulur paduan.
<hr><i>Alloy Mg-9Al-1Zn (AZ91) is a lightweight metal alloy used in the automotive industry. The main problem with this alloy is that it has low creep resistance. Solution treatment is an effective method for increasing metal creep resistance. The effect of solution treatment on the mechanical properties and corrosion properties of AZ91 as-cast alloys was studied using creep, hardness, electrochemical, and weight loss tests. Solution treatment was done at 420 ° C for 2 hours followed by water colling. Changes in microstructure and alloy composition were observed with optical microscopy, scanning electron microscopy (SEM), energy dispersive X-ray (EDX) and X-ray diffraction (XRD). The as-cast AZ91 alloy consists of the Î±-Mg phase as the matrix and Î² phase (Mg17Al12) which are spread along the grain boundary. The size of the axle-shaped grain (equiaxed) is in the range of 40-100 µm. Significant reduction of Î² phase volume fraction occurs after the solution treatment where the phase size of Î² decreases and is distributed randomly

at the grain boundary and matrix. Solution treatment causes enlargement of metal grains to be 100-500 µm in size.

The results of the weight loss test showed that the corrosion rate in as-cast alloys was obtained at 179 mmpy then increased after being treated with a solution treatment to 270 mmpy. Open circuit potential of the alloy drops after the solution treatment.

Potentiodynamic polarization test results show no significant change after the solution treatment. However, the results of electrochemical impedance spectroscopy show a decrease in the value of the alloy impedance after the solution treatment. The decrease in corrosion resistance after the solution treatment is caused by the reduction of the Î² phase (Mg17Al12) which plays a role in holding down the corrosion rate. The hardness value of AZ91 as-cast alloy which is equal to 61.68 HV drops to 60.66 HV after the treatment solution.

The creep test results show that the creep fracture time of AZ91 as-cast alloy occurs 10 times faster than the alloy that has undergone a solution treatment. This is caused by a reduction in the Î² phase which has a lower melting point compared to Mg. The solution treatment treatment reduces the corrosion resistance of AZ91 alloys but can increase alloy creep resistance.</i>