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Development and Characterization of Al–Zn–Mg–Cu Alloy for Aeronautical Applications in India – An Experimental Approach

M. K. Sridhar[1], B. K. Muralidhara[2] and P. Ragothama Rao[3]

Summary

Among the high strength 7XXX series aluminium alloys, 7010 aluminium alloy, comprising of Zn, Mg and Cu as alloying elements has great potential for aeronautical applications due to its attractive properties. Extruded material, imported to India, from other countries costs around €8.6 (Rs 500) per kg and is relatively expensive. Therefore, in the present investigation, it has been proposed to develop high strength Al–Zn–Mg–Cu alloy, with superior stress corrosion properties, using materials and facilities available in India and compare with International standards of aluminium alloy used for aeronautical/space application.

In the present investigation, vertical chill cast ingots of alloy have been prepared using reverbratory furnace. The homogenised ingots were extruded in a horizontal extrusion press so that minimum extrusion ratio of 8 is obtained. Suitable lengths of extruded slabs were solutionialised and quenched. Later, these slabs were controlled stretched. Characterization of the material developed and the type approval testing was carried out as per ASTM standards in various testing agencies.

The results of the research indicate that chemical composition of developed Al alloy meets the specification values of Al alloy as per AMS 4205 standard. Electrical conductivity values were found to be comparable with acceptable values as per IACS. The exfoliation corrosion rating of developed alloy was found to be better than EA grade, as per test standard. The ultimate tensile strength, yield strength and percent elongation of developed alloy evaluated at ambient temperature, at low temperature of -40°C and at high temperature of 90°C were found to be higher than minimum acceptable values as per the specification.

In the fracture toughness test, the values of the developed Al alloy compared well with that of the imported alloy. The residual stress values of the developed Al alloy were found to be compressive in nature and were less than 10% of its yield strength. Further, the fatigue life of the developed alloy was found to be better than that of standard alloy and imported alloy. The fatigue data and the crack growth data indicate superior crack propagation life and damage tolerance behavior of indigenously developed Al alloy.

[1]Group Director, Aeronautical Development Agency (ADA), Bangalore, India.

[2]Professor, Department of Mechanical Engineering,University Visvesvaraya College of Engineering, Bangalore University, Bangalore,India.

[3]Group Director, Centre for Military Air worthiness Certification (CEMILAC), Bangalore, India.

To sum up, the results indicate that the developed Al alloy in India satisfies all the requirements and has been found to be suitable for aeronautical applications, with envisaged cost reduction of around 40%.