Influence of Ratcheting Strain on Tensile Behaviour of A356 Al Alloy

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Abstract

The present study aims to describe the effect of previous asymmetrical stress-controlled cyclic loading, known as ratcheting, on tensile properties of the selected A356 alloy. In view of this, few tensile and ratcheting tests were carried out at room temperature on the as-received selected alloy. A356 aluminium alloy which is being potentially used in automobiles, aerospace components etc., where chances ratcheting deformation cannot be ruled out. In view of this, a few ratcheting tests were carried out at ambient temperature on the as-received selected alloy with varying mean stress (σ_m) and stress amplitude (σ_a) upto 2000 cycles. The magnitudes of σ_a and σ_m were choosen in such a manner that the maximum stress (σ_{max}) during cyclic loading must lie above the yield strength of the alloy and below the ultimate tensile strength. Post-ratcheting tensile tests were carried out on the ratcheted specimens at a nominal strain rate of 6.66×10^{-4}/s. Study of fracture surfaces generated after tensile tests were done using scanning electron microscopy (SEM). The results of ratcheting tests indicated that the material was cyclically hardenable in nature. Post-ratcheting tensile tests showed that generally the yield strength (YS) and ultimate tensile strength (UTS) increased with increasing amount of ratcheting strain. Interestingly, post-ratcheting tensile elongation also increase in the entire ratcheted specimen as compare to as-received one. The fracture surfaces under SEM shows several shrinkage pores causing favourable region for rise of stress concentration resulting initiation and growth of cracks. The entire fracture surface is mostly covered by quasi-cleavage facets as well as ductile dmples.

Keywords: A356 alloy; ratcheting behaviour; tensile properties