Formability of AA-7075 sheets subjected to repetitive bending under tension

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The fundamental objective of this work is to study the cold formability of AA-7075_O by a testing methodology known as repetitive bending under tension. The repetitive bending under tension is a testing methodology to create a similar deformation condition to that which occurs during incremental sheet forming. In the case of repetitive bending under tension tests, the sheet metal sample is subjected to localised bending under tensile loading. This additional bending during testing is applied by sliding a set of rollers over the gauge length of the tested sample. In order to study the influence of various strain conditions at the plastic deformation zone, specimens with different geometries were investigated. In addition, samples from three different orientations of 0˚, 45˚ and 90˚ with respect to the rolling direction were tested to study the effect of mechanical anisotropy on deformation behaviour.

The results confirmed a significant increase in elongation to failure in samples subjected to repetitive bending under tension as compared to those subjected to standard tensile tests under similar conditions. It is shown that this could be due to a delay in localised necking during repetitive bending under tension. Finite element analysis (FEA) has also been used to simulate the process. In agreement with the experimental finding, FEA results show that the maximum force required to deform the material is less than that required during a standard tensile test. Analysis of 3D scanning of samples that went up to fracture during repetitive bending under tension and a standard tensile test revealed that the samples undergoing the former underwent a more uniform reduction in thickness and width along the gauge length, compared to the latter. TEM observations of the microstructure confirms grain refinement in the samples subjected to repetitive bending under tension. This could be due to a strain induced dynamic recrystallisation process occurring during the test. Analysing the crystallographic texture using neutron diffraction revealed that a strong {111}//ND fibre texture had been developed during the repetitive bending under tension test. This could be due plastic shear strain introduced by repetitively bending and unbending through the sheet thickness.

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