ABSTRACT

Sheet metal forming is a significant net shape manufacturing process in manufacturing industries. Sheet metal forming technology has been widely used to produce consumer products (like beer cans, washers, cabinets, electronic and computer boxes), automotive components (like bumpers, body panels and fuel tanks) and aircraft parts. Forming Limit Diagram (FLD) is an effective tool to evaluate the formability of sheet metals. The information upon the formability of sheet metals is important for both sheet metal manufactures and users. Though the conventional die and punch forming of sheet metals is used in most of sheet metal forming industries, the incremental sheet metal forming finds its way to evolve to replace the first one in some of the applications with complex geometry due to its flexibility and die-less forming nature. Due to the properties of Aluminium alloy sheets, they are extensively used in automotive, aerospace and domestic applications. Moreover, the aluminium alloy sheets are formed by incremental forming process when large sized components are to be formed to a higher total forming strain. The development of forming limit diagram and study of formability in aluminum alloys for incremental forming helps the manufacturers of sheet metals during the design of the process and also the customers during its end use.

This research work on AA5052, AA6061 and AA8011 alloy sheets, establishes the optimum process parameters of single point incremental forming process for maximum sumof strain and minimum surface roughness, identifies the significance of each process parameter on the sum of strain and surface roughness, constructs the forming limit diagram for single point incremental forming, studies the effect of each process parameter on sum of strain and analyzes the formability through the chemical composition, microstructure, tensile properties, FLDs, fractography and original surface texture. It is found that all sheets show better formability when they are formed by SPIF compared to that of conventional die and punch forming. Among all the sheets considered for the study, the AA5052 alloy sheet possesses very much high formability. For all the sheets considered, the surface roughness is lower while using ball end type tool. The average strain hardening exponent (n) value influences the sum of strain. The fractography of the sheets show the evidence for ductile fracture. The chemical composition, microstructure, tensile properties, FLDs, fractography and original surface texture are in good correlation with the sum of strain.