ALUMINIUM AND ITS INTERLINKING PROPERTIES

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Abstract

Aluminium and its alloys are preferred materials, because of its varied desirable properties, availability and inexpensiveness. Aluminium alloys exist in several different grades available in the market commercially, from pure (about 99% Al content) to specific varieties based on the impurities contained in it by chemical composition. The properties are differing in nature which can be scientifically seen and justified in different perspectives. The properties such as forming, fracture mode, tensile, etc. can be seen through the metallurgical aspect, chemical aspect, crystallographic texture, forming limits and mechanical properties. The truth of its properties can be viewed by interlinking/correlating nature of its different studies. The purpose of this chapter is to show the correlating nature of different properties of aluminium of same and different grades.

1. Introduction

Ease of possessing light weight, formability and good strength-to-weight ratio are the desirable properties opted by the designer in the selection of materials for most modern engineering applications. Aluminium alloys vary by their tensile properties, formability properties and surface characteristics from one another at different dimensions, annealing temperatures, duration of annealing and mode of cooling, composition and percentage of initial strain [30, 31, 32, 33, 34, 35]. In sheet metal forming, force is applied to a piece of sheet metal to modify its geometry rather then to remove any material. The applied force and stress on the sheet metal beyond its yield strength causes the material to plastically deform, without failing. As a result, the sheet can be bent or stretched into a variety of complex and required shapes. The forming operations of sheet metal include various types and conditions of strains, which can be significantly evaluated to predict the properties of the metal and its forming limit [2]. Preferably, the forming operation is done in most of the engineering applications, which require annealing procedures, microstructure examination, characterization of the sheets and their relations to attain higher formability [3].

The characterization involves the experimental determination of the microstructural aspects, tensile properties and formability parameters such as average plastic strain ratio and planar anisotropy [4]. For evaluating the forming limit diagrams (FLD), the results from the three strain conditions are combined. The formation of the crystallographic texture on the initial material also influences the formability of the sheet metal. Fracturing occurs in sheet metal forming when the strain exceeds a critical value and is considered as a factor determining the fracture limit diagram. The effect of sheet thickness on formability is a trend in study [5] (Rahavan et al., 2010). It is undertaken to interlink the formability of commercially pure aluminium grades of sheet metal through the study of mechanical (tensile) properties, formability property, forming limit diagrams, void coalescence properties and texture properties by experiments from the established results. Thus the study of the properties by one mode to the other is based on its correlation and interlinking properties.