ABSTRACT

The aim of this research study was to verify, experimentally and numerically, the feasibility of hydroforming process for producing defect-free sheet metal parts from Inconel alloy 625. The pressurized fluid used in hydroforming is shown to have the effect of increasing the forming limits of materials; that is deeper drawing depths are achieved without rupture. Also, using a specific pressure profile, wrinkle-free parts with deeper draws could be produced.

Tube hydroforming is a well accepted production technology in automotive industry while sheet hydroforming is used in selected cases for prototyping and low volume production. Research in advance methods is expanding the capabilities of hydroforming technologies to produce parts from Al, Mg and Ti alloys, super alloys as well as ultra high strength steels. These materials have great potential to be used in aircrafts, aerospace, automobile, defense, electronics and medical industry. In this work, the forming conditions of Inconel nickel-chromium alloy 625 (ASTM B446 - UNS N06625) using hydroforming process were investigated.

Sheet and tube hydroforming experiments were conducted using the double acting hydraulic press. Numerical analysis of the sheet and tube hydroforming process was conducted using the commercial finite element codes DEFORM 3D and Altair HyperForm respectively. Based on the

experiments and numerical work, a working curve, which guarantees a sound formed part of Inconel alloy 625 was found. The effects of process parameters were also investigated.

Experiments demonstrated deeper draws before the material failed and the numerical analysis with commercial codes predicted the failure and wrinkling characteristics very well. The results obtained from this work will be useful for forming super alloys using hydroforming process.