Optimization of Material Properties and Process Parameters for Tube Hydroforming of Aluminum Extrusions

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Analysis of process optimization for hydroforming of central-bulge and T-branch from AA6063 tubes is conducted for W-temper and T4 heat-treated conditions. Systematic characterization of AA6063 mechanical properties as a function of aging time was also conducted. It was found that hydroforming in the W temper facilitates forming of a bigger T branch (due to available greater ductility), but limits the strength (hardness) of the final component compared to that formed in the T4 condition. By optimizing the material heat-treatment conditions and the process parameters during hydroforming, strains well in excess of the traditional forming limits can be achieved in the finished components. The relevant microstructural kinetics during hydroforming of the above two geometries in the two heat treated conditions and the associated strengthening mechanisms in aluminum alloys are discussed.