Accepted Manuscript

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PII: S0924-0136(17)30297-2
DOI: http://dx.doi.org/doi:10.1016/j.jmatprotec.2017.07.025
Reference: PROTEC 15322

To appear in: *Journal of Materials Processing Technology*

Received date: 7-3-2017
Revised date: 5-7-2017
Accepted date: 15-7-2017

Please cite this article as: Wang, Ailing, Liu, Jun, Gao, Haoxiang, Wang, Li-Liang, Masen, Marc, Hot stamping of AA6082 tailor welded blanks: experiments and knowledge-based cloud – finite element (KBC-FE) simulation.Journal of Materials Processing Technology http://dx.doi.org/10.1016/j.jmatprotec.2017.07.025

Hot stamping of AA6082 tailor welded blanks: experiments and knowledge-based cloud – finite element (KBC-FE) simulation

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Abstract

A novel hot stamping technique known as 'Solution Heat treatment, Forming and in-die Quenching (HFQ®)' was employed to manufacture lightweight structural components from AA6082 tailor-welded blanks (TWBs) of different thickness combinations: 1.5-1.5 and 2.0-1.0 mm. A finite element (FE) model was built to study the deformation characteristics during the hot stamping process. The FE model was successfully validated by comparing simulation results with experimental ones. Subsequently, the verified simulation results were analysed through a novel multi-objective FE platform known as 'Knowledge-Based Cloud – Finite Element (KBC-FE)'. KBC-FE operates in a cloud environment and offers various advanced unique functions via functional modules. The 'formability' module was implemented in the current study to predict the limiting dome height and failure mode during the hot stamping process. Good agreements were achieved between the predicted and experimental results, from which studies were extended to predict the forming features of 2.0-1.5 mm TWBs. The 'formability' module has successfully captured the complex nature of a hot stamping process, featuring a non-isothermal and non-linear loading path. The formability of TWBs was found to be dependent on forming speed and blank thickness, out of which the latter has a dominant effect.

Keywords: Tailor welded blanks; High strength aluminium alloys; Formability; Hot stamping; KBC-FE; Knowledge-Based Cloud-FE simulation.