Numerical Modeling of the Development of Intermetallic Layers between Aluminium and Steel during Co-Extrusion

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Abstract. Undergoing the Tailored Forming process chain, coaxial aluminium-steel profiles joined by co-extrusion are formed into hybrid bearing bushings by die forging. During the joining of aluminium and steel, intermetallic phases may develop. As these phases are very hard and brittle, it is important to be able to predict the width of the resulting intermetallic layer, because it is likely to reduce the strength of the compound for the subsequent forging step. In the scope of this paper, a possibility for numerical calculation of the resulting phase thickness during the co-extrusion of aluminium and steel, by means of Lateral Angular Co-Extrusion (LACE), is presented. In the first step, an analogy test on a forming dilatometer was developed for the experimental investigation of the intermetallic phase formation. The width of the intermetallic phase seam was determined by means of scanning electron microscopy using an image processing tool. Based on the experimental findings, a calculation instruction was defined to describe the intermetallic phase thickness as a function of temperature, contact pressure and contact time. The function was implemented in a commercial finite element (FE) software by means of a user-defined subroutine and validated on the basis of experimental data.