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A Comprehensive Experimental Study on the Effect of Process Parameters in Warm Roll Bonding of Aluminum Sheets

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Abstract

Roll bonding of aluminum sheets is a technology with actual and potential applications in several fields, such as the production of special materials or all-aluminum channeled products. The strength of the rolled bonds clearly depends on the main process parameters, including the rolling conditions (entry temperature, reduction, speed, etc.) and the pre-rolling treatment conditions (annealing temperature and time, surface preparation technique, etc.). The purpose of this paper is to further investigate, experimentally, the effect of additional parameters that have been generally neglected by the scientific literature, such as the initial wall thickness of the sheets and the post-rolling heat treatment. An extensive plan of experiments has been designed for evaluating the simultaneous effect of several process variables. The results have been analyzed with a statistical approach, using the strength of the bond as the main response variable, evaluated though peel tests. The analysis demonstrated that thicker sheets are easier to weld than thin sheets. The study also proved that a prolonged post-rolling heat treatment is useful to enhance the bond strength (by solid state diffusion), but only if a good mechanical bond has already been obtained by rolling. Furthermore, the surface quality of the rolled products has been measured and correlated to the strength of the bond.

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