

The Role of Heat-Treatments performed before and after a Cold Roll Bonding Process of Galvanized Steel Sheets

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Abstract. A cold roll bonding (CRB) process for the symmetrical bonding of two sheets of the steel DX-51 (1.0226) with a galvanized zinc coating is presented. The coating was applied to form an intermediate layer between the two steel substrates during the bonding. The study is divided into two sections describing both the role of the heat treatment prior to the CRB process (heat pre-treatment) as well as after the CRB process (heat post-treatment). The film theory supposes that for establishing a firm bond, the superficial layers should feature an increased hardness in comparison to the substrate to overcome the oxide film on the surface. Since zinc is more ductile than iron, a bonding of galvanized steel sheets according to this mechanism is rather unlikely. By applying a heat pre-treatment prior to the roll bonding, the formation of brittle intermetallic Fe and Zn phases can be facilitated. These brittle phases fracture in the rolling gap, and thus, allow for a contact of the juvenile formed steel layers. Within this study, steel sheets were heat pre-treated in an oxygen-free atmosphere in the temperature range from 450 °C to 550 °C. Additionally, the influence of coating's thickness was investigated. A heat post-treatment was performed to strengthen the bond by increased diffusion activity. The influence of both the iron and the zinc diffusivity was analyzed by heat treatment of the bonded samples in the relevant temperature range for both elements at 700 °C and 180 °C, respectively. The properties of the bonds were estimated by both scanning electron microscopy and tensile shear tests.