Investigation of the Temperature Influence of the Static Joining Partner on the Lower Welding Limit during Magnetic Pulse Welding

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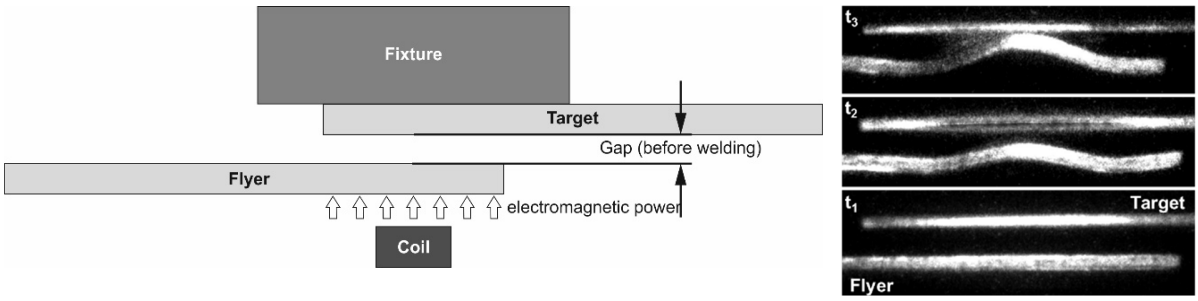
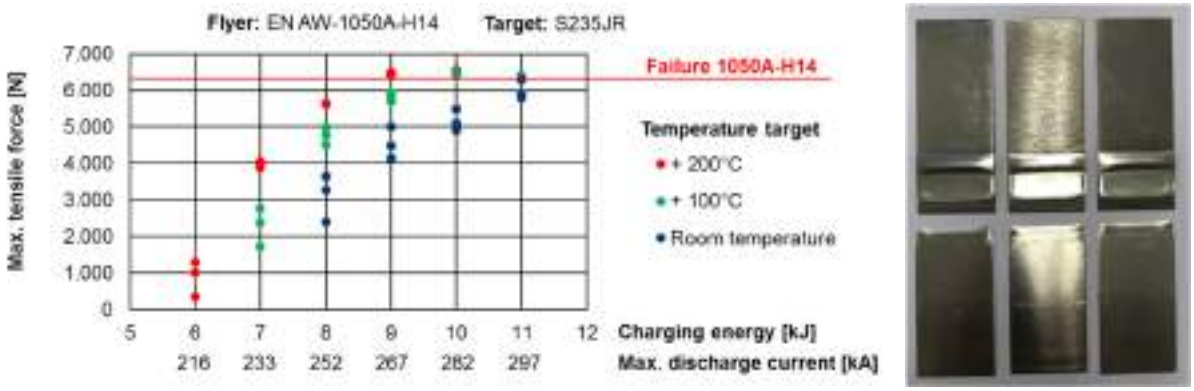
Abstract. Magnetic pulse welding is a collision welding process and enables, as a representative of cold welding processes, the realization of metallurgical joints below the melting temperatures of the joining partners. As a result, no temperature-induced microstructural changes occur and the mechanical properties of the joining partners remain unchanged. This advantage makes magnetic pulse welding in particular suitable for the production of high-strength aluminium-steel joints. During the welding process the metallurgical bound results from a high-speed collision of the two joining partners. In case of an asymmetrical impact, the kinetic energy of the accelerated joining partner (flyer) or the contact pressure on the static joining partner (target) caused by the rolling movement of the flyer represents the complete energy input of the process. For a successful joint, this energy input must be large enough to transfer the colliding surfaces of the partners into the viscous state (jetting) and to bring the cleaned/oxide-free metals to a distance at which the electron exchange and thus the metallurgical bound takes place. However, besides the increasing basic research of the joining mechanism in the last two decades, a current trend in the research community is to identify further process parameters with which the process and the joint strength can be influenced. A new approach is to consider not only the kinetic energy of the flyer but also the thermal energy of the joining partners in order to achieve the minimum energy input required for a successful welding. Thus, the aim of this study is to investigate the influence of an increased temperature of the target during the collision process on the lower welding limit, the weld seam characteristics and the weld seam strength. The results show that an increased target temperature shifts the lower welding limit to lower discharge current levels.



(a) (b)

FIGURE 1. Schematic representation (a) and high-speed images of the magnetic pulse welding process (b).



(a) (b)

FIGURE 2. Influence of the target temperature on the welding process window/tensile force of the material combination EN AW-1050A-H14 / S235JR (a) and welded specimens after the tensile shear test with failure in the weaker base material EN AW-1050A-H14 (b).