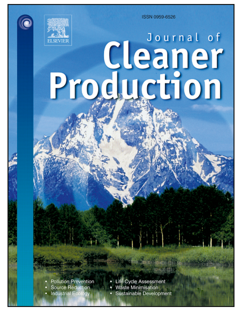

Magnetic Pulse Welding: An efficient and environmentally friendly multi-material joining technique

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Magnetic Pulse Welding: An efficient and environmentally friendly multi-material joining technique

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Abstract

Magnetic pulse welding, a high speed joining process using electromagnetic forces, because of clean and multi-material operation has a wide range of possibilities for further development and application. Unlike conventional joining processes, the weld interface does not melt keeping the material properties intact without generation of hazardous emissions in form of heat, fume, and spatters. This paper presents a comprehensive review that considers almost all the major aspects of the subject. The paper first gives a general understanding of the process starting from its origin to its modern day status and states the widespread industrial applicability of the process. A detailed discussion of the current state of art in magnetic pulse welding is then presented. The operating principle is then described along with detailed insight into the various mechanisms responsible for a sound welded joint. The parameters controlling the process along with their effect on the weld are discussed followed by the various advantages and limitations of the process. Future trends in joining using magnetic pulse welding based upon current research developments are finally highlighted.

Keywords: Magnetic Pulse welding, Process parameters, Wave formation mechanisms, State of art, Future directions

1 INTRODUCTION

The use of newer and environmentally friendly manufacturing techniques has become more widespread in the past decade due to strict environmental rules and regulations imposed by various government agencies and due to globally increasing energy prices (Velchev et al., 2014). Sustainability and sustainable production studies aimed at reducing the global environmental burdens and efficient use of materials and energy have also become a wide research area nowadays. Studies aimed at identification of process parameters leading to reduced energy consumption have been reported in the literature. Keeping in mind the impact on the environment, researchers have tried to modify the existing processes, replace them with alternate processes and develop newer nonconventional manufacturing processes (Munoz and Sheng, 1995). Reduction in use of cutting fluids during machining (Banerjee and Sharma, 2014), optimization of cutting conditions (Hanafi et al., 2012), modelling of direct energy requirements (Balogun and Mativenga, 2013), joining of sheets using compression beading (Alves et al., 2011), single point incremental forming processes (Ingarao et al., 2014), solution heat treatment, forming and in-die quenching (HFQ) (Raugei et al., 2014), laser direct deposition for repairing and remanufacturing precision engineering components (Wilson et al., 2014), hot-wire laser welding (Wei et al., 2015), abrasive flow machining with a movable

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