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Wpływ parametrów technologicznych na trwałość połączeń płaskowników warstwowych wytwarzanych metodą walcowania na gorąco

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Abstract

„Influence of technological parameters on the durability of joints of clad plates produced by hot rolling”

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The main subject of the study are clad flat bars; the base layer is commercial structural steel S355J2, while the applied material is the experimental NANOS-BA® steel. The subject of the study is the phenomena occurring during the connection of well - weldable S355J2 structural steel with ferritic - pearlitic microstructure with nano-structured, non - weldable NANOS-BA® steel with nanobainitic microstructure in the process of hot rolling and heat treatment. The main objectives of the study were: to assess the impact of technological parameters of the hot rolling process on the durability and quality of joints produced using this method and to determine the optimal process conditions enabling the creation of permanent diffusion joints between the joined steels. The theoretical part presents a review of the literature on the technology of manufacturing of clad plates and flat bars. Current trends and directions of the development of the technology for the production of clad plates are discussed. The idea and purpose of joining the S355J2 steel with the NANOS-BA® steel are presented, together with an assessment of the possibility of using this type of products in the industry. Selected mechanisms and phenomena occurring during joining clad plates in the process of hot rolling and heat treatment are discussed. In the experimental part, computer simulations of the hot rolling process of the S355J2 / NANOS-BA® charge for clad plates were carried out using the QForm software. The results of the computer simulations were verified using semi-industrial hot rolling physical tests of the S355J2 / NANOS-BA® charge and the S355J2 / S355J2 and NANOS-BA® / NANOS-BA® reference material for clad plates. Based on metallurgical tests of samples taken from the S355J2 / NANOS-BA® flat bars and the reference material, the mechanisms of shaping the microstructure and mechanical properties of the plating materials were described, taking into account different material states: before joining the layers, after hot rolling with integrated intermediate annealing, after additional isothermal annealing and cooled freely in the air.

The main aim of the study was to develop the basic technological parameters enabling the production of a new generation of high-strength S355J2 / NANOS-BA® clad plates with high strength $R_{p0.2}$ > 460 MPa, with good plasticity expressed in total elongation at room temperature A > 10% and high-strength joint with shear strength of over 300 MPa.

Keywords: clad plates, nanobainite steel, hot rolling – bonding method, high strength steels, NANOS-BA® steel, nanostructured steels, bainitic-austenitic steels.