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Metallurgy of Friction Welding of Porous Stainless Steel-Solid Iron Billets

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Abstract : The research work reported here was aimed at investigating the feasibility of joining high-porosity stainless steel discs and wrought iron bars by friction welding. The sound friction-welded joints were then subjected to a metallurgical investigation and an analysis of failure resulting from tensile loading. Discs having 50 mm diameter and 10 mm thickness were produced by loose sintering of stainless steel powder at a temperature of 1350 ^oC in an argon atmosphere for one hour. Minor machining was then carried out to control the dimensions of the discs, and the density of each disc could then be determined. The level of porosity was calculated and was found to be about 40% in all of those discs. Solid wrought iron bars were also machined to facilitate tensile testing of the joints produced by friction welding. Using our previously gained experience, the porous stainless steel disc and the wrought iron tube were successfully friction welded. SEM was employed to examine the fracture surface after a tensile test of the joint in order to determine the type of failure. It revealed that the failure did not occur in the joint, but rather in the in the porous metal in the area adjacent to the joint. The load carrying capacity was actually determined by the strength of the porous metal and not by that of the welded joint. Macroscopic and microscopic metallographic examinations were also performed and showed that the welded joint involved a dense heat-affected zone where the porous metal underwent densification at elevated temperature, explaining and supporting the findings of the SEM study.

Keywords : fracture of friction-welded joints, metallurgy of friction welding, solid-porous structures, strength of joints
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