77th IIW Annual Assembly and International Conference on Welding and Joining
7-12 July 2024
Rhodes, Greece

OP 431

Performance Study of 1100MPa High-strength Steel Joints under Laser-Arc Hybrid Welding Process

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The study investigates the impact of using different strength level filler materials on the welding process and joint performance of 1100MPa high-strength steel under a laser-arc hybrid process. Mechanical performance tests indicate that in the weld seam under the equivalent strength matching, the main microstructure is lath martensite with a small amount of bainite, resulting in poor toughness. The hardness of the weld seam and heat-affected zone is higher than the base metal, with softening near the fusion line leading to cracking during bending. By adding a small amount of CO2 in the shielding gas and adjusting the proportion of heat sources on the cover surface, the proportion of lath bainite in the weld seam is increased, improving the toughness of the weld seam and addressing the issue of bending cracking. The joint strength under the lower strength matching is slightly lower, but the low-temperature toughness is better than under equivalent strength matching, attributed to the higher proportion of acicular ferrite in the weld seam.