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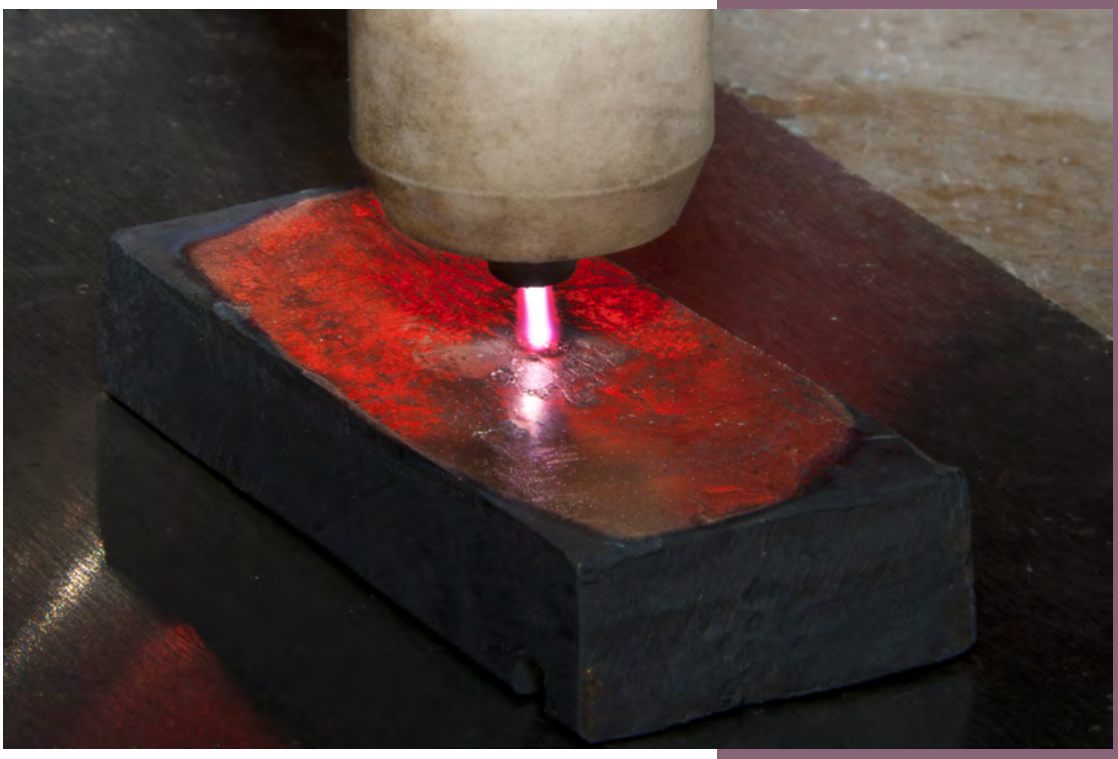

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ŁUKASIEWICZ – INSTITUTE OF WELDING

The International Institute of Welding and The European Federation for Welding, Joining and Cutting member

Krzysztof Krasnowski, Julia Khokhlova, Maksym Khokhlov, Valery Kostin – Relation between geometry of FSW tools and formation of nano- dispersed zones in macrostructure EN AW 6082-T6 alloy welded joints

DOI: *10.17729/ebis.2021.5/1*

The article presents the result of macrostructure formation with distribution of mechanical properties in cross-sections of 8 mm-thick one-sided butt-welded FSW joints of EN AW 6082-T6 alloy which were obtained using three types of specially designed tools: C-type – conventional tool consisting of a housing, cylindrical threaded probe and a shoulder with a grooved spiral, T-type – Triflute-type tool consisting of a housing, cylindrical threaded probe with three grooves and a shoulder with a grooved spiral, S-type – simple tool consisting of a housing, smooth cylindrical probe without a thread and a flat shoulder. Friction stir welding was performed using equipment of the Institute of Welding in Gliwice of Poland, and mechanical tests in the E.O. Paton Electric Welding Institute of the NAS of Ukraine. Mechanical test by indentation was performed using Micron-gamma device, which allows experimental identification of structural state of metal and determination of the strain hardening presence by limiting values of ratio of hardness to Young's modulus of elasticity. It was found that for all three specimens the HAZ hardness decreases, and in the zone of thermomechanical effect the hardness increases. Maximum hardness values are inherent to the central part of welded joint nugget, as well as to light-coloured oval concentrated fragments of structure in the nugget upper and lower part. Judging by the presence of nanosized hardened structure and uniformity of its distribution in the nugget, as well as good dispersion of oxide films and absence of discontinuities, the friction stir welding with C-type tool can be regarded as the optimum variant. An assumption was made that formation of a uniform structure in welds can be achieved at three–four revolutions of the tool in friction stir welding in one place. The model of thermal fields distribution in Al-plate during FSW using a C-type tool visualized the metal's thermal condition when formated hardened nano-dispersed weld zones.

Szymon Kowieski, Jolanta Matusiak – Tests of Technological Conditions of the Resistance Welding and Adhesive Bonding of Coated Steel Sheets

DOI: *10.17729/ebis.2021.5/2*

The article presents the effect of welding technological parameters and adhesive bonding conditions (surface processing, overlap dimensions and the thickness of the adhesive layer) on the formation of hybrid (welded-adhesive bonded) joints of steel sheets provided with protective coatings. The tests involved the joining of sheets made of steel HC340LA. The sheets made of steel HC340LA (provided with a ZE50/50 Granocoat ZE two-layer organic coating) were in the as-received state and after cleaning with isopropyl alcohol. The tests also involved sheets made of steel 22MnB5 provided with an AlSi coating. The sheets made of steel 22MnB5 were subjected to heat treatment, cleaning with isopropyl alcohol, roughening and etching in similar configurations. The adhesive bonding process was performed applying one-component epoxy adhesive (used in the automotive industry).

Zbigniew Techmański, Mariusz Stępień, Jacek Stępień – Analysis of Selected Properties of Induction Welded Seamed Tubes

DOI: *10.17729/ebis.2021.5/3*

The article discusses research work concerning an innovative welding technology enabling the continuous joining of steel tubes using the high-frequency induction heating process. The article focuses primarily on issues related to weld formation, particularly as regards the formation of the heat affected zone (HAZ), enabling the obtainment of the proper angle of a material flow line (referred to as the upsetting line), appropriate proportions of the HAZ and the ferritic line. The proper performance of the technological process enables the obtainment of a high-quality joint (tube seam) superior to that obtained using previous solutions and satisfying safety-related requirements concerning pipelines used in the transport of liquids and gases characterised by low operating pressure. The results presented in the article were obtained in metallographic tests of the joints. The test results revealed the obtainment of joints characterised by required quality.

Janusz Rykała, Maciej Różański – Plasma Transferred Arc (PTA) Cladding and TOPTIG Cladding of Tubes Made of Steel 13CrMo4-5

DOI: *10.17729/ebis.2021.5/4*

The article presents test results concerning the effect of a cladding method and technological process parameters on geometrical properties and dilution of overlay welds. Test overlay welds were deposited on tubes made of steel 13CrMo4-5. The chemical composition of the filler material used in the deposition process corresponded to that of alloy Inconel 625. The study involved the performance of macro and microscopic metallographic tests of the overlay welds as well as the identification of related dilution. The study also included hardness measurements involving the cross-section of the overlay welds as well as tests of the chemical composition of the overlay weld surface (paying attention to the maximum content of iron in the overlay weld, which should not exceed 5%). Adopted PTA and TOPTIG cladding parameters enabled the satisfaction of the maximum criterion related to the acceptable content of iron in the overlay weld, ensuring the stability of the cladding process and the invariable geometry of the overlay welds around the entire tube circumference.

Mirosław Łomozik – Microstructure, Toughness and Hardness of a Simulated HAZ in Steel S1100QL and of the HAZ of an Actual MAG-Welded Joint Made Using a Metallic Flux-Cored Wire

DOI: *10.17729/ebis.2021.5/5*

Simulation tests discussed in the article involved structural steel S1100QL having a yield point of more than 900 MPa. The simulations included single (Tmax = 1250°C) and double welding thermal cycle (Tmax = 1250°C + 600°C, Tmax = 1250°C + 760°C and Tmax = 1250°C + 900°C) as well as cooling times t8/5 = 3, 5 and 10 s. Specimens with the simulated heat affected zone (HAZ) were subjected to impact strength tests performed at a temperature of -40°C and +20°C, Vickers hardness tests (HV10) and microscopic metallographic tests (involving light microscopy). Test results were presented in diagrams and photographs. Related comparisons included results of the structural, hardness and toughness tests of simulated HAZs with analogous results obtained during the actual repair welding of a MAG-welded joint made of steel S1100QL. The final part of the article contains discussion concerning the test results and the statement concerning the obtainment of the significant conformity of the phase composition and the morphology of the microstructure as well as the average hardness values of the HAZ areas obtained in the simulations and those of the HAZ area obtained in the actual

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