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INSTITUTE OF WELDING

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Summaries of the articles

M. Różański, S. Stano, A. Grajcar – Effect of Braze Welding Parameters on the Structure and Mechanical Properties of Joints Made of Steel CPW 800. Part 1: Arc Braze Welding

DOI: 10.17729/ebis.2016.6/1

Presently, the reduction of kerb weight consists in the replacement of previously used structural materials with new ones, characterised by more favourable operating parameters. Advantageous mechanical properties of steel elements are primarily obtained through precise hot treatment performed after cold rolling or, in cases of hot-rolled products, through thermo-mechanical treatment. When subjected to welding, the above-named materials reveal high sensitivity to intense thermal cycles accompanying welding processes. The article presents the results of technological tests concerning the effect of arc weld brazing on the structural and mechanical properties of joints made of multiphase steel CPW 800.

J. Nowacki, A. Sajek – Numerical Simulation of the Thermal Cycle of the PAW-MAG Hybrid Welding of Advanced High Strength Steels

DOI: 10.17729/ebis.2016.6/2

The research described in the article was concerned with the possibility of determining time $t_{8/5}$ using the Finite Element Method. The research-related tests involved a joint made of AHSS S960QL using the PAW-MAG method. Values of time $t_{8/5}$ were compared in relation to characteristic zones of the joint and constant heat input values. Differences in cooling rates related to the diversified geometry of a joint and the asymmetric distribution of heat proved significant. The research involved the identification of possibilities offered by the Finite Element Method involving space modelling in the examination of the thermal history of any welded joint area. The comparison of the analysed manner of determining time $t_{8/5}$ with traditional measurement and analytical methods revealed the significant advantage of the FEM consisting in the accurate and complete induction of a cycle in the entire cross-section of the joint in contrast with experimental contact and non-contact methods averaging the measurement on the joint surface or only in the weld axis. In view of differences related to time $t_{8/5}$ reaching 1.5 seconds in the joint area and the very narrow range of the tolerance concerning the value of the cooling time of AHSS, the Finite Element Method involving the use of space modelling was recognised as a necessary tool when designing welded joints made of Advanced High Strength Steels.

J. Czuchryj – Effect of a Gap between Elements Being Joined on the Fatigue Service Life of Joints Welded on a Steel Backing Strip

DOI: 10.17729/ebis.2016.6/3

In accordance with standard PN-EN ISO 9692-1, when making welded joints using a backing strip, the maximum distance between elements being joined should amount to 15 mm. In certain cases, the use of a gap greater than the normative one could be technically justified. The above-presented issue inspired tests aimed to identify the influence of a gap between elements being joined on the operational service life of these joints. The tests involved the adoption of a fatigue criterion. The article describes results of fatigue tests along with related conclusions.

P. Laska – Application of Active Thermography in the Quality Control of Laser–Welded Overlap Joints

DOI: 10.17729/ebis.2016.6/4

The article presents possibilities of using active thermography as a non–destructive method verifying the quality of laser-welded joints made of steel sheets. The article presents the testing methodology and the preparation of test joints as well as describes a new test rig currently implemented in the company. Thermographic images obtained in the tests were subjected to image analysis processing performed to identify the maximum "temperature" gradient distribution in the test joints. The thermographic image analysis results were verified by cross-sectional macroscopic tests performed in accordance with currently valid standards. The results obtained in the tests confirmed that the method developed and implemented in the company can be successfully applied when assessing the quality of laser-welded lap joints. The article also includes a brief description of SITECH Ltd.

B. Łeśko – Tests of Hot Crack Resistance Using the Transvarestraint Tests – Specialist Automated Test Rig

DOI: 10.17729/ebis.2016.6/5

The significance of the Transvarestraint test as one of the most reliable tests enabling the assessment of the susceptibility of materials and welds to hot cracking when exposed to imposed strains aimed to assess the susceptibility of steels and welds to solidification cracking as

well as research-related needs inspired Instytut Spawalnictwa to develop, design, provide related software and implement an automated test rig examining hot crack susceptibility using the above-named method. The article presents the design and operation of the test rig. The adopted design and software solutions make the station user friendly as regards the entering of all data and welding head movement trajectory as well as the recording of data and measurement results in the form ready to print and archive. The solution also ensures the obtainment of the repeatability of the entire technological process.

L. Tuz, K. Pańcikiewicz, Ł. Rakoczy, Z. Żurek – Evaluation of the Microstructure of 600 and 617 Nickel Alloys Subjected to Arc Welding

DOI: *10.17729/ebis.2016.6/6*

The paper presents results concerning an assessment of the microstructure 600 and 617 nickel alloys. Test alloys delivered as plates were exposed to welding arc applied in the TIG method. The assessment involving the microstructure of the fusion zone, heat affected zone and of the base material was performed using light microscopy and scanning electron microscopy. The results revealed significant differences in the structures of the fusion zone in 600 and 617 alloys resulting from various chemical compositions as well as from the significant segregation of the alloying elements between dendrites and interdendritic zones.

A. V. Moltasov, P. N. Tkacz, S. I. Motrunicz – Effect of Shunting Zone Plastic Strains on Bend Force during the Butt Welding of Rings

DOI: *10.17729/ebis.2016.6/7*

The article is concerned with the development of an analytical method enabling the calculation of force used for the bending of a ring-shaped product during the butt welding allowing for the presence of plastic strains in the shunting zone. The research involved the investigation of principles governing the plastic-elastic strain of curvilinear bars subjected to bending and the development of theoretical foundations enabling the identification of displacements in such bars. The research-related investigation led to the obtainment of analytical equations combining bend force with movements of welding machine fixing clamps, geometrical parameters and physico-mechanical properties of a ring-shaped product material subjected to welding. Using a number of frames as an example, it was demonstrated that plastic strains significantly affected the value of bend force. The calculation results concerning the volume of bend force obtained using the above named analytical method converged with the results obtained using numerical calculations. Appropriate formulas were used to describe the boundaries of elastic and plastic areas of the shunting zone subjected to bending during butt welding. The research resulted in the determination of the critical value of bending force, the exceeding of which led to the deformation of the required geometrical shape of a ring-shaped product subjected to welding.

A. Sawicki, M. Haltof – Representation of the Effect of Plasma Column Disturbances on the Static and Dynamic Characteristics of Arcs Described by the Modified Pentegov Model. Part 2: Modelling the Effect of Rapid Disturbances on Electric Arc Characteristics

DOI: *10.17729/ebis.2016.6/8*

The article presents universal functions approximating quasi-static characteristics of electric arc with undefined and defined ignition voltage. The above named approximations take into consideration the effect of disturbances on an arc column. The approximations were used to create a modified mathematical Pentegov model of arc characterised by high and low rate of disturbance changes. The simulation of processes in a circuit with electric arc involved the use of the modified Pentegov model with one and two-parameter rapid disturbances. The authors demonstrated the efficiency of the developed modifications of the Pentegov model.

G.M. Grigorenko, W.A. Kostin, W.W. Golovko, W.W. Zukov – Effect of Nanoparticles on the Structure and Properties of Welds Made of High Strength Low-Alloy Steels

DOI: *10.17729/ebis.2016.6/9*

The article presents test results concerning the structure of welds made of high strength low-alloy steel 14HGNDC which, in the molten state, was provided with nanoparticles of various refractory compounds including oxides, carbides and nitrides (TiC, TiN, SiC, VC, NbC, TiO_2, Al_2O_3, MgO and ZrO_2). The performed tests revealed the effective use of the nano-oxides of titanium (TiO_2) and zirconium (ZrO_2) enabling the obtainment of high mechanical properties of the weld metal (R_m -708 MPa and 621 MPa, KCV_{-20} – 60 J/cm^2 and 72,9 J/cm^2, a – 21 and 19%). The use of a Gleeble 3800 welding cycle simulator made it possible to determine the dependence between temperature ranges of transformations, amount of structural constituents and types of modifying nanoparticles.

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