E.O. Paton Electric Welding Institute of the National Academy of Sciences of Ukraine

International Scientific-Technical and Production Journal

The Paton WELDING JOURNAL

Issue 10 2018

Published Monthly Since 2000

English translation of the monthly «Avtomaticheskaya Svarka» (Automatic Welding) journal published in Russian since 1948

Founders
E.O. Paton Electric Welding Institute, NASU
International Association «Welding»

Publisher
International Association «Welding»

Translators
A.A. Fomin, O.S. Kurochko, I.N. Kutianova
Editor
N.G. Khomenko
Electron galley
D.I. Sereda, T.Yu. Snegiryova

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E-mail: journal@paton.kiev.ua
www.patonpublishinghouse.com

State Registration Certificate
KV 4790 of 09.01.2001
ISSN 0957-798X
DOI: http://dx.doi.org/10.15407/tpwj

Subscriptions
$384, 12 issues per year,
air postage and packaging included.
Back issues available.

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IX INTERNATIONAL CONFERENCE «MATHEMATICAL MODELLING AND INFORMATION TECHNOLOGIES IN WELDING AND RELATED PROCESSES»

IX International Conference «Mathematical modelling and information technologies in welding and related processes» — MMITWRP-2018 was held on September 10–14, 2018 in Odessa at «Kurortnyi» hotel.

The Conference was organized by the International Association «Welding».

This Conference has become traditional starting from 2002 and every two years gathers the specialists in the field of mathematical modelling of physical processes taking place in welding from different countries of the world.

45 scientists and specialists from Ukraine and Belarus as well as specialists from Germany with remote participation took part in the Conference work, which was organized in form of sessions of plenary and poster presentations.

The Conference was opened by the head of the Program Committee Prof. I.V. Krivtsun. In his speech he fixed on the problems, possibilities and tasks of mathematical modelling and theoretical analysis of the physical processes in the field of welding and related technologies.

Let's note some presentations, which give an idea of the discussed Conference topics:

• «Effect of current and arc length on characteristics of arc discharge in nonconsumable electrode welding», *Krivtsun I.V., Demchenko V.F., Krikent I.V., Kovalenko D.V.*, E.O. Paton Electric Welding Institute (PWI);

• «Modelling of residual stresses in welded joint of header to nozzle of steam generator PG-1000M», *Makhnenko O.V., Muzhichenko A.F., Saprykina G.Yu.*, PWI;

• «Mathematical modelling of heat, electro- and hydrodynamic processes in ESK of forging ingots of alloyed steels», *[1]Sibir A.V., [2,3]Medovar L.B., [1]Gubinsky M.V., [2]Polishko A.A., [2,3]Stovpchenko A.P., [2]Kolomiets D.V.*, [1]National Metallurgical Academy of Ukraine, Dnepr, [2]PWI, [3]«Elmet-Roll», Kyiv;

• «Calculaed estimation of thermal cycles in friction welding of dissimilar nickel alloys», *Zyakhor I.V., Velikoivanenko E.A., Rozynka G.F., Zavertanny M.S.*, PWI;

• «Nonstationary processes in arc plasma and welded metal in TIG welding with high-frequency current modulation», *Demchenko V.F., Krivtsun I.V., Krikent I.V., Abdulakh V.M.*, PWI;

• «Effect of preheating on thermal cycle of argon-arc welding of sparsely-doped titanium alloys», *Akhonin S.V., Belous V.Yu., Selin R.V.*, PWI;

Presentation of Prof. I.V. Krivtsun

• «Complex mathematical model of the process of plasma-induction growing of single-crystals of refractory metals», *Gnizdylo A.N., Shapovalov V.A., Yakusha V.V.*, PWI;

• «Investigation of thermal fields in reaction brazing under conditions of local heating of joint zone» *[1]Kulinich M.V., [2]Zaporozhets T.V., [2]Gusak A.M., [1]Ustinov A.I., [1]Kosintsev S.G.*, [1]PWI, [2]Bogdan Khmelnytsky National University of Cherkassy;

• «Modelling of thin-wall cylinder shells produced by additive method», *Kostin V.A.*, PWI;

• «Effect of residual welding stresses on evaluation of fracture resistance of elements of WWER-1000 reactor internals for substantiation of operation extension», *Makhnenko O.V., Kandala S.M., Savitskaya E.M.*, PWI;

• «Shape of welding current pulses optimum by force action», *[1]Demchenko V. F., [1]Krivtsun I.V., [2]Nomirovsky D.A.*, [1]PWI, [2]Taras Shevchenko National University of Kyiv;

• «Effect of mode of arc welding on formation of metastable phases in weld metal and HAZ of high-strength pseudo β-titanium alloy VT19», *Belous V.Yu., Kostin V.A., Grigorenko G.M., Selin R.V., Grigorenko S.G.*, PWI;

• «Effect of technological parameters of submerged-arc surfacing of anticorrosive layer in nozzle zone of WWER-1000 RV on distribution of residual stresses», *Makhnenko O.V., Kostenevich E.S.*, PWI;

• Mathematical modelling of wire melting and detachment of drops in arc welding», *[1]O. Semenov, [1]I. Krivtsun, [2]U. Reisgen, [2]A. Schiebahn, [2]O. Mokrov, [2]M. Simon, [2]R. Sharma, [2]P. Lozano, [2]S. Mann*, [1]PWI, [2]Institute of Welding and Joining, RTWH, Aachen, Germany;

• «Prediction of microstructure and mechanical properties in layer-by-layer formation of products from titanium alloy VT6 using EBW», *[1]Makhnenko O.V., [1]Kandala S.M., [1]Ananchenko N.S.,[2]Kovalchuk D.V.*, [1]PWI, JSC «Chervona Hvilya», Kyiv;

• «Mathematical modelling of combined process of ESR + CC for production of high-quality rail steel», *[1]Sibir A.V., [2,3]Medovar L.B., [1]Gubinsky M.V., [1]Polishko A.A.,[2,3]Lebed V.A.*, [1]National Metallurgical Academy of Ukraine, Dnepr, [2]PWI, [3]«Elmet-Roll», Kyiv;

• «Mathematical modelling of process of formation of stress-strain state in laser treatment», *Devojno O.G., Kardapolova M.A., Pilipchuk A.P.*, Belarusian National Technical University, Minsk;

• «Structural transformations in welded joints of HPP steam lines», *Dmitrik V.V., Glushko A.V.*, NTU «Kharkiv Polytechnic Institute»;

• «Prediction of peculiarities of kinetics of thermodeformed state of compact specimens of different geometry in their layer-by-layer forming on xBeam 3D Metal Printer equipment», *Makhnenko O.V., Milenin A.S., Velikoivanenko E.A., Rosynka G.F., Pivtorak N.I., Kozlitina S.S., Dzuybak L.I., Kovalchuk D.V.*, PWI;

• «Physical modelling of processes of melting, hydrodynamics and metal solidification in electroslag technologies», *Protokovilov I.V., Porokhonko V.B.*, PWI;

• «Modelling of processes of external electromagnetic effect in underwater welding», *[1]Maksimov S.Yu., [1]Prilipko E.A., [2]Krazhanovsky D.M., [2]Vinnichuk S.D.*, [1]PWI, [2]Pukhov Institute for Modelling in Energy Engineering, Kyiv.

A round-table «Processes of welding and related technologies: theoretical investigations, mathematical modelling, calculation experiment» (moderators — Acad. of the NAS of Ukraine I.V. Krivtsun and Prof. V.F. Demchenko) was held during the Conference.

In his speech I.V. Krivtsun noted that one of the key problems of modern industrial production is improvement of existing and development of new high-performance technologies of joining and processing of metallic materials. Among them there are, for example, such technological processes as fusion welding, surfacing, coating spraying, heat treatment of surface, arc refining of steels. At current stage of development of welding and related technologies solution of this problem is impossible without detailed investigation of collection of physical phenomena (heat, diffusion, gas-, hydrodynamic, electromagnetic, optical, etc.), taking place at interaction with welded or treated material of different sources of heat energy. This is gas-discharge, first of all arc, plasma, electromagnetic, in particular, laser radiation or their combination.

Experimental investigation of physical nature of such multifactor interaction is connected with significant difficulties, caused by high values of plasma temperature and surface of material being treated in a zone of effect of heat source, small geometry sizes of the indicated zone, high rates of investigated processes and series of other circumstances. Besides, received experimental data, as a rule, reflect cumulative result of effect of the whole complex of physical processes taking place in a system «heat source-material being treated» at that to detect a role of each of them in formation of resulting effect appears to be sufficiently difficult problem. Therefore, in the recent decades the methods of theoretical investigation, including development of mathematical models, as well as appearing with development of computer engineering numerical methods and packets of application programs for complex computer modelling of physical processes in welding and material processing attract more and more attention of the specialists. Such an approach allows significantly reducing the expenses connected with performance of large amount of expensive full-scale experiments, since provides the possibility of sufficiently quick and relatively cheap qualitative and quantitative analysis of the processes taking place in the considered system, for wide range of conditions and parameters of mode of welding or treatment, characteristics and properties of welded or treated material. Besides, what is particularly important, numerical modelling allows investigating the effect on a predicted result of the technological process of each of considered by model physical phenomena separately and, thus, determining the optimum ways and methods of improvement of technology and equipment under study for its realization.

V.F. Demchenko stopped on those tendencies, which take place in the field of mathematical modelling of welding and related processes in the recent years. In particular, he noted that there is increase of number of researches using standard packets of the application programs for integration of mathematical physics equations.

Proceedings of MMITWRP-2018 Conference will be published till the end of 2018. These proceedings as well as proceedings of the previous eight International Conferences MMITWRP can be ordered in the editorial board of «The Paton Welding Journal» or get in e-form in open access on website of the Paton Publishing House http://patonpublishinghouse.com/rus/proceedings/mmw.

The next, X International Conference «Mathematical modelling and information technologies in welding and related processes» is planned to be carried out in Odessa in September 2020.

Dr. A.T. Zelnichenko

LLC «TM.WELTEK»:
25 Years in the World of Flux-Cored Wires

In 1993 the staff of the E.O. Paton Electric Welding Institute organized an enterprise, the objective of which was restoration of flux-cored wire production in Ukraine. The new enterprise rented an unused shop on flux-cored wire production at OJSC «Dneprometiz» (City of Dniepr), which was put into operation already in 1964.

Owing to the efforts of engineering-technical personnel and workers of the shop, production was restored and manufacturing of a large range of new modern grades of flux-cored wires was mastered. Here, the physical and moral wear of the equipment was a bottleneck, leading to high cost of labour and material resources, increasing the consumption of materials and cost of flux-cored wire manufacture, and did not ensure the required labour efficiency. The main shop equipment (4/250 drawing mills) was designed for producing flux-cored wires of 2.5–3.6 mm diameter, that did not meet the modern industry needs.

For this reason, the enterprise implemented a set of measures for repair and upgrading of old equipment and purchase of new equipment, in particular, lines for flux-cored wire production, including double mill 2/500 for producing large diameter wires (4.0–6.0 mm), two six high mill 6/250 and eight high mill 8/250. All these mills are fitted with improved forming devices and storages. Production of flux-cored strips was restored. Furnaces for drying raw materials and flux-cored wire baking and, packing complex were purchased, and charge preparation compartment was upgraded.

Availability of such equipment allowed optimizing the technology of producing flux-cored wires of 1.0 up to 6.0 mm diameters, developing and producing a number (more than 90 grades) of modern, often unique domestic welding and surfacing flux-cored wires, including those for spraying.

Modern forms of product delivery to DSTU ISO 544 have been mastered by now: cardboard drums with packed wire weight of 150–300 kg; frame drums R 415 an R 435; plastic spools S 200 and S 300 and a number of specific variants of packing, made by customer request.

As to their purpose and technical characteristics, the flux-cored wires of WELTEK grade are not inferior to products of leading foreign companies that is confirmed by their acceptance by many enterprises in Ukraine and abroad. For instance, flux-cored welding wire designed for welding low-carbon and low-alloyed structural steels has passed testing in keeping with European Directive No.305/2011 (System 2+) in the field of building components and received CE marking. Testing was performed by TUF Division Rheinland Industrie Service GmbH (Germany).

Controlling bodies of Ukraine on ecology, fire safety, labour safety, etc. issued permission documents for conducting the production activity of the enterprise.

Flux-cored wires of WELTEK trade mark are used in the most diverse sectors of industry: in railway enterprises, works of mining-metallurgical complex, plants producing metal structures, machine-building plants, in shipbuilding, etc.

A.A. Golyakevich