

TO THE 65th ANNIVERSARY OF THE WELDING EQUIPMENT AND TECHNOLOGY CHAIR OF THE PRIAZOVSKY STATE TECHNICAL UNIVERSITY

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The work of the Welding Equipment and Technology Chair of the Priazovsky State Technical University during 65 year is analysed. Challenges of the Chair in training of specialists in welding and cutting of metals are considered.

Keywords: *welding production, higher education, specialisation, scientific developments*

The Chair of Welding Production Equipment and Technology was founded in 1946 at the Zhdanov Metallurgical Institute (since 1994 – Priazovsky State Technical University). The key task of the Chair was to train specialists in welding and cutting of metals. At that time, the Ilyich Iron and Steel Works completed preparation for commissioning of its pipe welding shop 1 founded by the initiative and with the direct participation of Prof. Evgeny O. Paton.

Engineer A.Ya. Shadrin was appointed in 1946 to be the first acting head of the Chair. At that same year A. Shadrin was replaced by Associate Professor P.S. Elistratov, Candidate of Technical Sciences. The first diplomas in a new speciality were defended in 1947. The first five graduates of the Chair (D.P. Antonets, A.A. Filchakov, K.I. Korotkov, Yu.N. Grishchenko and D.A. Rogovin) became great authorities and organisers of welding production, and two of them (D.P. Antonets and D.A. Rogovin) defended their candidate theses.

In August 1952, K.V. Bagryansky was elected to be the head of the Chair. With his arrival the Chair widened and strengthened its contacts with the E.O. Paton Electric Welding Institute, N.E. Bauman Moscow State Technical University, Kiev Polytechnic Institute and many enterprises of the city and country. The welding building was constructed with the assistance of Boris E. Paton. That allowed the level of training of specialists to be improved and the Chair to become one of the leading chairs of a welding profile. Such talented educational specialists and scientists as Associate Professors, Candidates of Technical Sciences Z.A. Dobrotina, D.S. Kassov, G.S. Kuzmin, and teachers P.F. Lavrik, A.A. Filchakov, V.A. Muratov and V.T. Sopin, were working together with K.V. Bagryansky. Since 1968 the Chair has started training welding engineers in new speciality «Metalurgy and Processes of Welding Production».

In the 1960s the Chair swiftly developed its scientific activity. In these years the process of sub-

merged arc welding of nickel by using ceramic flux was successfully applied at the «Bolshevik» factory in Kiev (the work was supervised by Dr. G.S. Kuzmin). The method for submerged arc welding and surfacing of copper alloys by using ceramic flux, which was applied to advantage at metallurgical works of Ukraine, had been developed under the leadership of Associate Professor D.S. Kassov. Associate Professors V.Ya. Zusin and A.D. Korneev developed the method for submerged arc welding of aluminium under a layer of flux which was used for welding of elements of current-conducting bus-bars at the Bratsk Hydroelectric Power Station. The process of submerged arc surfacing by using ceramic flux was applied to repair forming rolls and machine parts at the Metallurgical Works in Rustavi (Georgia), Ilyich Iron and Steel Works and «Azovstal» in Mariupol, Enakievo Iron and Steel Works and Ust-Kamenogorsk Ore Mining and Processing Enterprise (Kazakhstan). Associate Professor A.A. Filchakov managed investigations on development and application of new grades of electrodes at «Azovmash», and Associate Professor K.A. Olejnichenko headed development of the procedure for quantitative estimation of harmful emissions in welding. Also, they offered recommendations for improvement of working conditions of welders.

30 candidate of technical sciences theses and one doctoral thesis were prepared and defended at the Chair during a period of 1955–1980. In those years the following books were published: manual «Theory



Team of the Welding Equipment and Technology Chair of the Priazovsky State Technical University



Visit to the Welding Equipment and Technology Chair by people's deputy B.A. Olijnyk (from left to right): senior teacher V.P. Semenov, Chair Head V.A. Royanov, Rector of the Priazovsky State Technical University V.S. Voloshin, B.A. Olijnyk, Pro-Rector A.P. Chejlyakh

of Welding Processes» by K.V. Bagryansky, Z.A. Dobrotin and K.K. Khrenov, which was three times re-issued, textbook «Calculation and Design of Welded Structures» by A.N. Serenko, M.N. Krumbolt and K.V. Bagryansky, monographs «Welding of Nickel and Its Alloys» by K.V. Bagryansky and G.S. Kuzmin, and «Ceramic Fluxes for Welding and Surfacing» by K.V. Bagryansky.

In 1971 the Branch R&D Surfacing Laboratory was arranged at the Chair. The purpose of the Laboratory was to develop new surfacing technologies and consumables for reconditioning and repair of parts of metallurgical equipment. The Laboratory was headed by Associate Professor, Candidate of Technical Sciences V.N. Matvienko.

From 1973 till 1979 the Chair was headed by Candidate of Technical Sciences A.N. Serenko. Research on static and dynamic strength of welded joints and structures was carried out, and efforts on investigations of single-pass welding of 40 mm thick and thicker steels with programming of the welding process were launched during that period. The investigation results were summarised in candidate of technical sciences theses by V.A. Shaferovsky and A. Skshipchik (Poland), and found practical application at «Azovmash» and «Zaliv» Ship Yard.

In 1980 the Chair was headed by L.K. Leshchinsky. New ceramic fluxes and flux-cored wires for electric



Students of the Chair at the Surfacing Laboratory

arc surfacing of forming rolls and parts of the metallurgical equipment were developed in collaboration with the Branch Surfacing Laboratory.

Investigations were conducted to study surfacing and welding processes using strip electrodes by the submerged arc method. The investigation results were applied at machine building and metallurgical enterprises, and were summarised in the candidate of technical sciences theses by Yu.V. Belousov, V.I. Shchetinina, V.N. Matvienko, V.P. Lavrik and A.V. Zarechensky. The Chair was active in upgrading of equipment for automation of the surfacing processes and control of the deposited metal quality. Results of these efforts were covered in the doctoral thesis by S.V. Gulakov.

Research in the field of plasma hardening of parts, including after surfacing, received intensive development. The research results are presented in monograph «Surface Plasma Hardening» by L.K. Leshchinsky, S.S. Samotugin, I.I. Pircha and V.I. Komar.

Since 1985 the Chair has been headed by Doctor of Technical Sciences, Professor V.A. Royanov, honorary member of the Donetsk State Engineering Academy. Material resources of the Chair were expanded and strengthened, and disciplines on robotisation of welding production were included into the education process with his participation. Computation facilities and new information technologies are used in classes to prepare term papers and diploma projects. Flux-cored wires for electric arc metallising, which are widely utilised at Kiev Association «Kievtraktor-detal», at vehicle repair enterprises of Poltava, Tashkent and other cities, were developed. The investigation results were generalised in the candidate of technical sciences thesis by E.V. Vojtsekhovsky and doctoral thesis by V.A. Royanov. The intensive work is performed on application of elements of the Bologna Education Process. The credit-modular education system is introduced. The method learning school-books for self-education of students were developed and published. And curricula are continuously improved.

S.V. Gulakov, V.A. Royanov, L.K. Leshchinsky, A.D. Razmyshlyayev, S.S. Samotugin and A.N. Serenko defended their doctoral theses at the Chair during a period of 1998–2001. A.N. Serenko was given the rank of Professor. The doctorate courses were instituted, where two persons working for the doctor's degree are completing now their theses. The Special Board on defence of candidate and doctor of technical sciences theses in speciality «Welding and Related Processes and Technologies» is working at the Chair.

Manuals «Welding. Introduction into Profession» (A.N. Serenko, V.A. Royanov), «Formation of Defects in Welding and Related Processes», «Defects and Quality in Welding and Related Processes» (V.A. Royanov, V.Ya. Zusin and S.S. Samotugin), «Welding and Surfacing of Aluminium and Its Alloys» (V.Ya. Zusin and V.A. Serenko), «Repair of Machines by Welding and Related Technologies» (V.A. Royanov)

nov, G.G. Psaras and V.K. Rubajlo), and monograph «Magnetic Control of Weld Formation in Arc Welding» by A.D. Razmyshlyaev, stamped by the Ministry of Education and Science, were prepared and published during the last three years.

During the 65 years period the team of the Chair educated about 6000 engineers, including for the countries of Europe, Asia, Africa and Latin America, and 42 candidates and 8 doctors of technical sciences defended their theses. The Chair published over 30 manuals and monographs, and 760 scientific papers. Over 280 developments are covered by the author's certificates and foreign patents.

Graduates of the Chair A.D. Chepurnoj, T.G. Kravtsov, V.Ya. Zusin, V.I. Shchetinina and V.N. Kalianov successfully defended their doctoral theses. Many graduates became recognised specialists in the field of welding production and headed industrial enterprises of Ukraine, Russia and other countries: A.V. Savchuk, Doctor of Economic Sciences and Chairman of the Board of «Azovmash»; Doctor of Technical Sciences A.D. Chepurnoj, L.P. Khadzhinov, Director General of «Zaporozhtransformator», K.Kh. Kazmiridi, Director General of «Pozhzhashchita», etc.

At present, three professors — doctors of technical sciences, ten associate professors — candidates of technical sciences, one senior teacher and one assistant are working at the Chair. The Chair has been accredited as corresponding to level IV by the Commission of the Ministry of Education and Science of Ukraine. It trains specialists in professions «Technology and Equipment for Welding» and «Welding Units».

Specialists of the Chair take part in activities of International Association «Welding». Along with traditional cooperation with chairs of the higher education institutes of Moscow, St.-Petersburg, Chelyabinsk, Yekaterinburg, Tbilisi, Minsk, Mogilyov and other cities of the former Soviet Union countries, the Chair has established contacts with higher education institutes and organisations of «far-foreign» countries, such as the Institute of Welding in Gliwice (Poland), University of Miskolc (Hungary), Harbin Institute of Technology (China), etc.

The Chair meets its 65th anniversary with active and creative work on improvement of training of the staff for national economy of the country and development of research in the field of welding and related processes and technologies.

INFLUENCE OF HARDFACING TECHNOLOGY AND HEAT TREATMENT ON STRUCTURE AND PROPERTIES OF METAL DEPOSITED ON CARBON STEEL BY LN-02Kh25N22AG4M2 STRIP ELECTRODE

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Possibility for improvement of structural state of fusion zone metal in hardfacing of carbon steel by LN-02Kh25N22AG4M2 strip electrode was investigated. The recommendations on selection of heat treatment modes were provided for improvement of structure and properties of this zone.

Keywords: arc hardfacing, strip electrode, carbon steel, bimetal, corrosion-resistant layer, fusion zone, microstructure, thermocyclic treatment, mechanical properties

Bimetal structures are widely used in manufacture of equipment for chemical machine building. One of the traditional methods of obtaining of bimetal billets is automatic arc hardfacing of corrosion-resistant layer on low-carbon steel, performed by single strip electrode of 0.5–0.8 mm thick at the width of 60 mm with fraction of the base metal not more than 15–20 %.

Presence of the residual stresses and structural inhomogeneity in fusion zone are specific peculiarities of the hardfaced bimetal. These factors promote appearance of new or development of existing microcracks that can result in loss of working capacity

of the part under hard operation conditions of equipment in chemical industry.

Selection of reasonable modes of hardfacing and heat treatment of the deposited metal can help to achieve specific positive effect on reduction of the residual stresses and homogenizing of the chemical composition.

The aim of present study is to investigate influence of modes of hardfacing and heat treatment on structure and mechanical properties of the bimetal layer.

Electric arc hardfacing was carried out on templates from steel 20 of 400 × 600 × 15 mm size by LN-02Kh25N22AG4M2 strip electrode of 0.5 × 60 mm section with 48-OF-10 flux without preheating at current of hardfacing $I_{hf} = 750\text{--}800$ A and arc voltage