



THE 80th ANNIVERSARY OF THE CHAIR OF WELDING PRODUCTION OF NTUU «KIEV POLYTECHNIC INSTITUTE»



Evgy O. Paton, the founder of the Chair, and his sons Vladimir (*left*) and Boris (*right*) near new universal automatic welding machine TS-17 (1949)

In 1935, on the initiative of Evgeny O. Paton, the outstanding scientist and engineer, the academician of the UkrSSR, the Chair of Welding Production was founded at Mechanical Faculty of Kiev Polytechnic Institute, and preparation of mechanical engineers on specialty «Equipment and Technology of Welding Production» was organized. The need in education of the specialists of such a profile was caused by the requirements of intensive development of the domestic industry, transport, construction and many other branches of the national economy. By transferring the students from other specialties the first groups of students were formed for educating the welding engineers at the second and third years of study. The first graduation of engineers of welding specialty (17 persons) took place in 1938, and within 3 years 104 welding specialists were educated and trained.

Many research workers of the Electric Welding Institute of the Academy of Sciences of the UkrSSR, organized in 1934, took an active part in the educational process at the Chair in those years, in particular, V.I. Dyatlov, V.V. Shever-

nitsky, A.M. Sidorenko, F.E. Sorokovsky. For teaching the profile disciplines the staff members from other chairs of the Institute were also invited. Among them the Ass. Profs I.P. Trochun and N.V. Pines, the Assistant G.K. Blavdzevich, and M.M. Bort, the Chief metallurgist of the aircraft plant. The required number of rooms for educational process and research works was allocated for the Chair. At that stage the formation of new engineering specialty «Equipment and Technology of Welding Production» took place. For the first time the methodological grounds for education and training of welding engineers were developed, including an integrated system of education based on close relation between the educational institution and production.

From the beginning of its foundation the Chair was headed by the Academician E.O. Paton. However, his high duties as the Director of Electric Welding Institute impeded his work in KPI, and in 1938 he was forced to leave the institution, further he still continued to render a comprehensive assistance to the Chair, permanently embodying the originally laid idea of affinity and cooperation of both organizations.

Evgeny Paton was an outstanding scientist and teacher, and that fact had a rather beneficial effect on the quality of preparation of the welding specialists. In those years as the basis of educating the welding engineers E.O. Paton laid the important methodological principles consisting in need of combining the theoretical and practical training of students, subordinating the content of the training specialists to the practical problems of welding production, high requirements to the work of students over the educational material, in extensive use of modern achievements of science and technology of welding for education. The scientific and pedagogical staff of the Chair carefully preserves these principles even at the present time.

In 1938, the Ass. Prof. V.L. Ulasik became the head of the Chair. The outbreak of the war in 1941 interrupted education of welding specialists. KPI was evacuated to Tashkent. Many teachers, staff, postgraduate and undergraduate students were mobilized, some of them moved to the plants producing defensive products. Due to



Unveiling of monument Evgeny Paton at NTUU «KPI»

the absence of teaching personnel the education of welding production engineers in Tashkent was not carried out.

In 1944, after return of KPI from evacuation to Kiev, the Chair of Welding Production immediately resumed its activity. From July to November 1944 the Chair was headed by Prof. G.I. Pogodin-Alekseev, and then from the end of 1944 to 1947 by the Ass. Prof. I.P. Trochun, and for a short period in 1947, by the Ass. Prof. M.N. Gapchenko and the Assistant M.M. Bort. There was a strong lack of qualified scientific and pedagogical staff. Nevertheless in short terms the staff members and the students of the Chair managed to restore the classrooms and laboratories destroyed during the war. The Chair was equipped with the necessary welding equipment. As a result, in fact, the new educational and laboratory facilities were created with total area of about 700 m². The first post-war graduation of mechanical engineers on specialty «Equipment and Technology of Welding Production» was held in 1947. It became possible due to the great contribution of Prof. K.K. Khrenov, who headed the Chair from 1947 to 1957. After K.K. Khrenov the Chair was headed by Prof. I.P. Trochun (1957–1967) and Prof. V.I. Dyatlov (1967–1969). Since 1965, at the Chair the education and training of electromechanical engineers on specialty «Electrothermal Equipment» with the

specialization in electric welding installations was opened.

In 1969, to the position of the Head of the Chair (as a combining job) Prof. B.S. Kasatkin, the Head of Department of the Electric Welding Institute, was invited, who headed the Chair until June 1972. This event contributed to the significant widening and strengthening of comprehensive and creative cooperation between the Chair and the E.O. Paton Electric Welding Institute, especially in the field of scientific research. The contractual research works and training of scientific personnel were essentially boosted through postgraduate courses and competition. At the same time, the difficulties associated with the limited educational, laboratory and scientific base of the Chair were noticeable more significantly.

In the early 1970s, the Government of Ukraine took the decision to found the Educational Center for the joint training and improving the qualification of welding engineers on the facilities of KPI and PWI. The new educational and laboratory building (now the 23rd building of the National Technical University of Ukraine «KPI») of 6000 m² area was built. In September, 1977 the Chair moved to the new educational and laboratory facilities, equipped with the modern equipment and devices. For educational work the PWI leading scientists G.I. Leskov, A.I.



Chvertko, A.G. Potapievsy, V.R. Ryabov, V.N. Zamkov, V.E. Moravsky, V.I. Makhnenko, B.A. Movchan, A.A. Rossoshinsky et al. were invited to the Chair on the terms of a combining job.

Since 1972 to 1974, the Chair was headed by Prof. M.N. Gapchenko, and since 1974 it was headed by Prof. I.R. Patskevitch.

From 1962 to 1978, under the supervision of V.P. Chernysh the works on creation of methods of magnetic control of solidification of weld pool metal (V.P. Chernysh, V.V. Syrovatka, I.V. Malinkin, V.D. Kuznetsov et al.) were carried out at the Chair. The obtained results confirmed the possibility of active influence on the process of primary solidification by electromagnetic stirring of weld pool and showed that stirring leads to refinement of weld metal structure, and change in depth and shape of penetration.

In 1978, from the Chair of Welding Production the Chair of Welding Equipment was detached under the directorship of Prof. V.P. Chernysh, where the works on the control of solidification of weld pool metal by the magnetic influence were continued, further developed in the works of Prof. R.N. Ryzhov, Dr. V.A. Pakharenko et al.

From May, 1989 to April 27, 2015, the Chair of Welding Production was headed by Prof. V.M. Prokhorenko (the graduate from the Chair in 1962).

In 1991, from the Chair of Welding Production the Chair of Restoration of Machine Parts was detached, which by that time was headed by the Ass. Prof. V.M. Dukhno, and from October, 1993 it was headed by Prof. V.N. Korzh. It was charged with preparation of specialists on specialty «Equipment and Technology for Improving Wear Resistance of Machine Parts». At present time the Chair is called the Chair of Surface Engineering and is headed by Prof. V.D. Kuznetsov.

On the basis of the Chair of Welding Production in 1975 the Welding Faculty resumed its work, whose dean until 2002 was Prof. A.M. Slivinsky, the graduate of the Chair of Welding Production in 1960. Since 2002 until now the Welding Faculty is headed by Prof. S.K. Fomichev, who headed the Chair of Electric Welding Equipment since 2001.

Today the Faculty consists of three special chairs: Welding Production, Electric Welding Equipment and Surface Engineering. The Faculty prepares bachelors in the direction «Welding», as well as specialists on «Equipment and Technology of Welding Production», «Welding Machines», «Equipment and Technology of Increasing Wear Resistance and Restoration of Machine Parts», and masters in the field of welding science and technology on the basis of bachelor preparation. Currently, about 400 students are studying at the Faculty. Besides the education

of students of the Faculty the scientists carry out a wide range of scientific research on the most relevant and advanced directions.

On the territorial facility of building of the Welding Faculty, the Welding Training Center was founded in 1977, where the UNIDO workshop and courses for improving the qualification of domestic specialists in the field of welding and non-destructive testing of welded joints and training courses for welders-workers were opened. The Chair of Welding Production takes also an active part in the work of the Educational Center. At the moment this direction is actively realized in the program of double diploma – International Welding Engineer (IWE), International Welding Technologist (IWT) and International Welding Inspector (IWI) (according to standard DSTU ISO 14731:2008). This diploma is realized on the basis of the Welding Faculty and the teachers of the chairs of the Welding Faculty form the working group on training specialists on the basis of laboratories of the Chair.

At the end of 1994, on the initiative of A.M. Slivinsky, the Dean of the Welding Faculty, and the Ukrainian Welding Society according to the general resolution of the National Academy of Sciences of Ukraine and the Ministry of Education of Ukraine, the Ukrainian Committee for Welder Certification (UCWC) was founded. Its technical director was V.T. Kotik, the Ass. Prof. of the Chair of Welding Production. During the period of the UCWC activity, more than 700 experts were trained and certified, and more than 230 commissions on certification of welders were opened in Ukraine. The database on certifying commission and certified welders (annually certified about 10,000 persons), created by the UCWC, provide a rapid control of the certification processes as well as obtaining the information on the status and dynamics of development of welding production in Ukraine. Thus, the system of welders certification in Ukraine demonstrated its necessity, relevance and effectiveness, providing the high quality of welding works.

Since the moment of its foundation the research work gained the extensive development at the Chair. The postgraduate courses were organized and successfully operate. The postgraduate students and many staff members of the Chair defended their theses for candidate of technical sciences degree. The teachers of the Chair published a number of books, which received a wide recognition. At the Chair the steadily developing research directions were formed. In particular, the staff members of the Chair under the general supervision of Prof. K.K. Khrenov carried out a number of works related to the investigation of welding arc (V.E. Moravsky, G.B. Serdyuk,



Staff members of the Chair of Welding Production (September, 2015)

G.V. Vasiliev, L.A. Byalotsky). In 1949, K.K. Khrenov published fundamental monograph «Electric welding arc», which became the first summarized work on the subject. These works on study of arc discharge were continued on a new qualitative level with the use of electronic oscillography of arc in order to study the transient processes (L.A. Zhdanov, V.L. Kovalenko). The results of these investigations are reflected in the thesis for Cand. of Tech. Sci. Degree of V.L. Kovalenko (2013). As a result, a new complex criterion for evaluation of stability of existence of arc discharge was proposed, which includes power and technological characteristics of the arc, the features of existence of alternating current arc were explained.

The other demanded direction of research activity of the Chair was the creation of new original slag systems for ceramic fluxes and development of their compositions intended for welding and surfacing, as well as the technology of manufacture of ceramic fluxes (D.M. Kushnerev, I.M. Zhdanov, M.P. Grebelnik et al.). The results of investigations on the development and application of ceramic fluxes are described in monograph of K.K. Khrenov and D.M. Kushnerev «Ceramic fluxes» published in 1954. The works were continued in 1970–2015 by A.M. Slivinsky, V.N. Kopersak, V.I. Prokhorov, V.T. Kotik, O.A. Gaevsky, L.A. Zhdanov and N.M. Strelenko. During that time the unique ceramic flux for welding the metal after oxy-fuel cutting (A.M. Slivinsky, V.T. Kotik), fused flux AN-44 for

welding of low-carbon steels of increased strength (A.M. Slivinsky, V.M. Prokhorov, B.N. Kopersak), fused flux AN-69 for surfacing (A.M. Slivinsky, L.A. Zhdanov), agglomerated flux ANK-45 (jointly with the PWI Department) and flux ANK-73 for surfacing (L.A. Zhdanov, N.M. Strelenko) were developed. The results of the work are reflected in numerous publications and protected by the copyright certificates and patents of Ukraine.

The development of original technologies for surfacing of cutting tool, worn-out parts of machines and mechanisms are also an important direction of work of the Chair of Welding Production. The works of V.D. Kuznetsov, N.A. Gorpenyuk, Yu.A. Yuzvenko, M.S. Samotryasov and B.N. Gorpenyuk should be noted.

The important works on theoretical problems of welding were performed under the supervision of V.I. Dyatlov, who defended the thesis for Dr. of Tech. Sci. Degree on these directions in 1963. They include original developments in the field of theory of freely expanding and contracted welding arc, calculations of conditions of automatic submerged arc welding, electrode metal transfer and a number of other investigations. The theoretical models of V.I. Dyatlov on arc processes, electrode metal transfer, metallurgical interaction in submerged arc welding did not lose their relevance even today. Prof. V.I. Dyatlov dealt not only with fusion welding, but also with solid-state welding. At the Chair under his supervision the thesis for Cand. of Tech. Sci.



Degree on diffusion welding in the glow discharge of magnetic and nonmagnetic steels was made by D.I. Kotelnikov, who later defended the thesis for Dr. of Tech. Sci. Degree on the same subject.

Under the supervision of M.N. Gapchenko at the Chair a number of works was carried out aimed at the study of weldability, brittle fracture of metals and modernization of technology of welding steels and alloys. The results of investigations are summarized in monograph of M.N. Gapchenko «Brittle fractures of welded joints and structures», as well as in his thesis for Dr. of Tech. Sci. Degree defended in 1969. Later the investigations of technological strength and weldability for nickel alloys, stainless and high-strength steels were continued by A.A. Slivinsky. The results of these investigations in 1998–2015 were published in numerous articles, including foreign ones, and they were also included into educational book «Weldability of structural materials».

The works in the field of gas-flame treatment of metals, carried out under the supervision of M.M. Bort and A.D. Kotvitsky, gained a great development in 1950–1960. Especially the oxygen cutting of metal of large thicknesses at low pressure, pack cutting of metal, development of the whole series of installations for cutting the round profile, hot crops of steel casting, hot rolling, etc. should be noted. The fundamentally new types of cutters were created, which found a wide application in industry. The development of plasma welding, surfacing and cutting of materials was headed by M.N. Gapchenko. The significant results were obtained under the supervision of V.N. Korzh in the field of creation of equipment and technologies for welding using hydrogen-oxygen flame. The results of these investigations formed the basis of the thesis for Dr. of Tech. Sci. Degree of V.N. Korzh defended in 1991.

The works in the field of welding stresses and deformations were developed under the supervision of I.M. Zhdanov and I.P. Trochun, who developed the simple and descriptive methods for engineering calculations of welding stresses and deformations in metal structures. The main results of these investigations are presented in monograph of I.P. Trochun «Inner forces and deformations in welding». The investigations of thermal deformation processes in welding (the works of I.M. Zhdanov, I.M. Chertov, E.A. Korshenko, V.M. Prokhorenko, A.S. Karpenko, V.N. Korzh, B.V. Medko, A.K. Gonchar et al.) were intensively developed in the 1960s, carried out under the supervision of I.M. Zhdanov. The main directions of research are the study of regu-

larities of formation of deformations and stresses in welding process, regularities of brittle fracture, creation of new experimental methods of investigations and devices, development of methods for reducing residual stresses and deformations.

The results of investigations of influence of stress-strain state of welded structures on brittle fracture of welded joints are reflected in the thesis for Dr. of Tech. Sci. Degree of V.M. Prokhorenko «Methods for calculating stress intensity factors and crack opening in welded joints with account for residual stresses», the defence of which was held in 1989. The further investigations of stressed state of welded structures were carried out in the direction of development of new engineering methods of calculation based on the modern conceptions about the kinetics of deformations in welding. The result of these studies was the thesis for Cand. of Tech. Sci. Degree of D.V. Prokhorenko. The research results described above were partially included into educational books «Stresses and deformations in welding» by B.S. Kasatkin, V.M. Prokhorenko, I.M. Chertov, as well as «Stresses and deformations in welded joints and structures» by V.M. Prokhorenko, D.V. Prokhorenko, published, respectively, in 1987 and 2009. In the recent years the study of stress-strain state in welding is successfully continued by the young generation of researchers D.V. Prokhorenko and A.A. Perepichaj using numerical methods of mathematical modeling based on finite element method. In particular, they carried out modeling of stress-strain state of the main pipeline at the site of repair of crack-like defect, study of thermomechanical processes in surfacing the weld on the surface of a semi-infinite body, calculation of stresses and deformations for different technological schemes of welding of butt joints of thin metal. One of the results of these studies was the thesis for Cand. of Tech. Sci. Degree of A.A. Perepichaj.

In the 1980s, at the Chair the new scientific directions appeared. Under the supervision of I.R. Patskevitch the development of matters of the technology of welding cast iron and investigations of surface phenomena in welding was started. The wettability and leaking of different pairs of liquid metals in isothermal and non-isothermal conditions were studied. The effect of external influences on the mentioned phenomena was determined. The results of these works are described in monograph of I.R. Patskevich, V.R. Ryabov and G.F. Deev «Surface phenomena in metals during welding» (1991). Their works were continued by V.P. Bojko, who created a unique experimental installation for investiga-



tion of high-temperature processes of wetting and interphase interactions at the gas–slag–metal boundary. According to the results of research works the numerous papers were published. The methods of increasing the accuracy of producing welded structures were intensively developed under the supervision of I.M. Zhdanov. The works were continued by V.V. Lysak. According to the results of the work the thesis for Cand. of Tech. Sci. Degree was defended and an original method for welding of thin sheet material was developed.

Many interesting results were obtained by V.V. Batyuk with the staff members of the Chair (B.A. Bobin, S.N. Minakov, I.N. Grisha et al.) in the direction of development of devices and technology of non-destructive testing of residual welding stresses in different welded structures.

The investigations in the field of temperature conditions of weld pool and electrode metal drops were carried out by V.M. Dykhno and S.M. Getmanets, and later they formed the basis of thesis for Cand. Tech. Sci. Degree and made a significant contribution to the study of heat content of electrode metal drops and pool in argon arc welding.

Since the late 1980s, at the Chair under the supervision of S.K. Fomichev a large complex of works was carried out to improve the corrosion resistance of welded structures, the materials of these investigations formed the basis for the thesis for Dr. of Tech. Sci. Degree defended by him in 1994. Since 1987, at the Chair under the supervision of I.P. Belokur the matters of flaw detection and quality control of welded joints are intensively developed. The results of research works in this direction are reflected in his thesis for Dr. of Tech. Sci. Degree, defended in 1991, and in his numerous publications.

Since the 1990s, at the Chair the direction is actively developed associated with the development of CAD systems of technological processes of fusion welding using the computer technology. Under the supervision of I.F. Korinets and with the participation of V.P. Bojko and Yu.I. Okhaj the mathematical models for melting of steel and titanium base metals, solid and flux-cored wires and heating of covered electrode were developed. As a result, the original methods of calculation of conditions of mechanized and automatic arc welding in shielding gases and under flux were developed.

Modern scientific and technical directions of the Chair of Welding Production. The research directions of the Chair were formed in the close creative relationships with the PWI, with the participation of not only the leading scientists

of the Institute, but also Boris E. Paton himself. Prof. B.E. Paton, the Director of the PWI and the President of the NAS of Ukraine, personally assisted in solving the problems of material and technical base, training of scientific personnel of the Chair and solving the strategic tasks of development of welding production. Below the basic problematic directions of work of the Chair are considered.

Technologies and metallurgical processes in electric arc welding:

- creation of theoretical models for calculation of gas phase composition, effect of welding consumables on composition of weld metal, content of gases and nonmetallic inclusions in it during arc welding on the basis of physical thermodynamic modeling;

- investigation of metallurgical processes in welding and development of new fused agglomerated fluxes and flux-cored wires for welding and surfacing;

- study of weld metal tendency to crack formation on the basis of technological samples;

- investigation of arc discharge in welding and its technical characteristics on the basis of complex factors of stability and transient processes using synergic power sources;

- investigation and modeling of features of pore formation in welding;

- modeling of thermal processes of electric arc welding;

- investigation of influence of thermal deformational cycles of welding on phase composition and structure of welded joint metal;

- technological features of welding using modulated current with synergic regulation of arc;

- creation of mathematical models of base and electrode metal melting in arc fusion welding and optimization of welding processes in shielding gases on their basis.

Stresses and deformations in welding:

- modeling and calculation of welding stresses, deformations and displacements of elements of welded structures using finite element method basing on the modern computer technologies;

- study of influence of technological schemes of welding on residual displacements of longitudinal axis of welded structures and development of optimal technological sequence of their welding;

- modeling of stress-strain state of welded structures for beam and arc welding methods;

- determination of energy input of thermal straightening of welded one-dimensional structures using engineering calculation methods.



Diffusion welding and brazing of metals, alloys and composite materials:

- mathematical modeling of thermal deformation processes during diffusion welding and brazing;
- development of technologies of diffusion welding and brazing with the controlled stress-strain state;
- investigation of influence of surface modification by highly-concentrated energy flows on properties of diffusion-welded and brazed joints;
- creation of new materials for producing diffusion-welded and brazed joints.

The active development of the direction is provided owing to the support of the PWI management and staff members, in particular, K.A. Yushchenko and I.V. Krivtsun, the Academicians of the NASU, V.F. Khorunov, the Corr.-Member of the NASU, and the staff members of the National Shipbuilding University (Nikolaev). The great contribution to the performance of works on control of stress-strain state in the process of producing joints in the solid state was made by V.I. Makhnenko, the Academician of the NASU, and to producing of metal-ceramic joints by O.K. Nazarenko, the Corr.-Member of the NASU.

Many of the graduates of the Chair became prominent workers of science and welding production. Among the graduates from the Chair there are many candidates and doctors of technical sciences. In this article it is difficult to mention the names of all the prominent graduates of the Chair. We only note that many of them became the academicians of the NASU and managers of large enterprises and organizations.

In the period of 2005–2015, a significant breakthrough in raising the scientific potential of the Chair and Welding Faculty in general was done. This became possible due to the implementation of a target program of preparation of Candidates and Doctors of sciences, signed by Prof. B.E. Paton and M.Z. Zgurovsky, the Academician of the NASU, the Rector of NTUU «KPI», and is realized at their active support. In the frames of this program at the Welding Faculty 5 Doctors and 10 Candidates of Technical Sciences were prepared.

Recently, the Chair has a fruitful cooperation with well-known companies Fronius Ukraine and Binzel Ukraine GmbH, as well as the PWI Pilot Plant of Welding Equipment and Pilot Plant of Welding Materials, where our graduates are working. These companies are equipping the laboratories of the Chair with innovative equipment, provide information stands and welding consumables, carry out lectures-presentations on

the latest achievements in the field of welding production. The students visit these enterprises with a great interest.

The staff members of the Chair take an active part in the development of international cooperation. In particular, Prof. V.V. Kvasnitsky, Ass. Profs L.A. Zhdanov and A.A. Slivinsky, and the Head of the laboratory A.A. Grinyuk take an active part in the international projects of the Chinese-Ukrainian E.O. Paton Welding Institute. The joint research and educational programs with the Belarusian State University, Otto-von-Guericke University Magdeburg (Germany), Federal University of Uberlandia (Brazil) and organizations of other countries, are actively carried out.

During 80 years the Chair of Welding Production prepared thousands of highly-skilled specialists, who played an important role in development of welding science and production. Our graduates successfully work not only in Ukraine but also in many other countries like Germany, USA, Canada, Russia, Australia, New Zealand and Israel.

Students of the Chair in its history. Many glorious pages to the history of the Chair were written down by its students. They worked actively in the student construction brigades in Tyumen, Sakhalin and other regions of the former Soviet Union and also in Czech Republic.

In 1985–1987, the specialized student brigades of the Chair participated in the large-scale scientific and technical experiment on the construction of pipelines of polyethylene pipes for gasification and water supply of towns of Novoodessa district of Nikolaev (Ukraine) region. This was a good example of fruitful cooperation of the Chair with the PWI, when the students under the supervision of teachers participated in the implementation of developments of the scientists.

The students of the Chair participate constantly in the Ukrainian student competitions on welding and occupy the first and prize places in the individual and team standings. The master and postgraduate students deliver papers at the annual scientific conferences. In 2010, our team occupied a prize place at the All-Ukrainian engineering competitions and represented Ukraine at the European competitions. The Chair was always famous by its activists, who participated in organization of the Faculty Days — edition of the multi-issue student newspaper, organization of broadcasting in our building, creation of the student library of several thousand books on welding. The students of the Chair contribute to the victories of sport teams of the Faculty in football, basketball, shaping and achieve high results in individual sports like track-and-field



athletics, wrestling, boxing, gymnastics, weightlifting, sport archery. The best students of the Chair as to the results of study, research and social works receive scholarships of Evgeny O. Paton and Boris E. Paton, as well as scholarships of the Rector of NTUU «KPI» and the mayor of Kiev.

At different times many foreign students from China, Iran, Vietnam, Cuba, Poland, Hungary, Bulgaria and other countries studied at the Chair. Our Ukrainian students in their turn have an opportunity to study abroad. We have a double diploma programs with Otto-von-Guericke University Magdeburg and the Federal University of Uberlandia. More than a dozen of our students have already received the master diplomas of Ukrainian and German sample, as well as Ukrainian and Brazilian sample. In the recent years the staff members of the Chair were essentially renewed. It was joined by young and perspective personnel. Over the last 10 years the staff members of the Chair defended 6 theses for Cand. of Tech. Sci. Degree, and at the present time most of the teachers are the associate professors of the Chair. The Chair is headed by Prof. V.V. Kvasnitsky.

Participation of the Chair in development of defense industry of Ukraine. From the moment of foundation of the Chair its staff members under the supervision of Evgeny O. Paton took an active part in the work on defense subjects. The graduates of the Chair worked in the defense industry and contribution of welders to creation of tank and other machinery in 1941–1945 is well-known. Such assistance has become urgent as well in our days.

Since September, 2014, the initiative group of the staff members and students of the Welding Faculty under the supervision of Dr. A.A. Slivinsky (students A. Suprun, E. Bilytsky, post-graduate student A. Bogach, staff member S. Nestulya, Ass. Prof. L. Zhdanov et al.) is carrying out works on manufacture and assembly of protective anti-cumulative screens for armored vehicles of the ATO forces.

Due to cooperation with the Central Research Institute of Armament and Military Equipment of the Armed Forces of Ukraine into the design of screens and technology of their manufacture a number of improvements was introduced. The screens successfully passed ballistic tests at the site of the Ministry of Defence of Ukraine. The application for a patent was drawn up and the works on adoption of the screens of the given type for the armament are carried out. Today by the efforts of students a single production in the



Assembly of anti-cumulative screens on armored personnel carrier BTR-80 of the Armed Forces of Ukraine in the ATO zone by the Chair staff members

mechanical workshop of the Welding Faculty was developed into a serial production of screens at one of the enterprises of Kiev. At the moment, the Faculty carries out a complete design and technological support of the screens manufacture, a set of technical documentation on the screens for the main models of light-armored vehicles of the AFU – BTR-80 and BMP-2 was developed.

During combat missions of the AFU, under the enemy fire, due to anti-cumulative screens mounted on armored vehicles the lives of many military men were saved. The staff members of the Chair received official thanks from the AFU command.

By the specialists of the Welding Faculty the protective screens were manufactured and installed on armored vehicles of the mobile units of special operation forces of Ukraine. The cooperation with the Ukrainian defense enterprises on working out the technological recommendations on welding of armor steels of foreign production and vibration processing of welded armor structures was arranged.

At the present time the further investigations on the processing of working elements of the screens are carried out to improve the effectiveness of protection and guarantee the destruction of the warhead of anti-tank ammunition.

The staff members of the Chair of Welding Production of the National Technical University of Ukraine «Kiev Polytechnic Institute» celebrate the 80th anniversary, being fully resolved to conduct a high-level preparation of welding specialists for the independent state of Ukraine.

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NEW WELDING WIRE MANUFACTURER IN UKRAINE



A.N. Alimov,
Technical Director of Company VITAPOLIS

Manufacture of special-purpose metal structures from high-alloyed corrosion-resistant, high-temperature, heat-resistant and high-strength steels is developing at a faster pace all over the world. This is due to advance of technology in petrochemical industry, power engineering, construction industry, intensification of transport operation, and designers' desire to reduce the weight and overall dimensions of metal structures. Consumable-electrode arc welding, gas-shielded welding and submerged-arc welding still remain the main technologies in fabrication and repair of such metal structures.

The structure of Ukrainian manufacturers of welding wires for all arc welding processes, also those for stick electrode manufacture, includes only manufacturers of wires from low-carbon and some low-alloyed steel grades. Production of special-purpose wires: high-alloyed corrosion-resistant, heat-resistant, nickel-based, high-strength, etc., was absent in Ukraine until recently. All the above-mentioned types of wires were imported from China, India, Russia, Italy and other countries.

In 2010, a group of enthusiasts from Boyarka (Kiev suburb) took a decision to set up modern manufacture of special-purpose welding wires in their facility. The group included graduates of Welding Chair of Kiev Polytechnic Institute, having experience of working at PWI and in welding consumable production, businessmen and financial people. After detailed study of Ukrainian market of high-alloyed corrosion-resistant, high-temperature and other special wires (including welding wires), preparation of detailed business plan, selection of production area, preparation of engineering lines and communications, the team began implementation of the project. During project preparation the most recent advances of the technology of wire product processing were analyzed, namely features of wire rod preparation for drawing, influence of various types of drawing tools and process materials on the quality of the produced wire, kinds of finished wire surface treatment to meet the expectations of consumers, used to working with wire, complying with the requirements of European and US standards. At this stage of project preparation, special attention was given to power efficiency of production process, as well as minimizing or complete elimination of adverse environmental impact of future production. Technological scheme and set of equipment for process lines were selected only on the basis of achieving maximum possible consumer characteristics of finished wire.

As a result of analysis of equipment supplier proposals, one main manufacturer — well-known company Lamnea Bruek, and several sub-suppliers of a number auxiliary devices from Germany, Italy, Austria, USA and India, were selected from a number of potential manufacturers, proceeding from detailed technological scheme of production. It should be noted that various auxiliary devices are key elements of the technological chain in manufacture of high-alloyed and special-purpose wires. Without these specialized additional devices the drawing line can only support production of general-purpose wires.

All the potential manufacturers and suppliers of process equipment were first inspected (visiting and auditing the production), in order to obtain information on the engineering level and service properties of the proposed equipment, its reliability, ease and safety of service. Finally, it was possible to combine in one production line all the best currently known engineering solutions in manufacture of special-purpose wires.





Start of production was organized by VITAPOLIS company, which began manufacturing marketable wire in July, 2015. The wires were assigned registered KHORDA trade mark.

When putting the line into operation, we performed commissioning work, using Sv-08GS and Sv-08G2S wire rods. Testing of produced general-purpose wires showed that these wires produced by our process scheme, in terms of their welding-technological properties are in no way inferior to such known wire grades as AristoRod 12.50 (ESAB) and EMK-6 Top (Boehler).

Our production line is capable of preparing for drawing and cleaning in a sound and highly reproducible manner the surface of wire rods, having difficult-to-remove or slight unforeseen contamination, possible deviations of diameter, ovality, etc. Here, already at the inlet of the first drawing block, the rod surface has characteristic uniform metal luster, as after grinding by an abrasive tool. Ovality of wire leaving the first drawing block with rotating die, is not more than 0.01 mm, and its surface is super smooth. Further wire drawing is performed with application of water-soluble stearates of sodium, calcium and drawing tools of Bremer and Paramount companies. Finish preparation of drawing tools is performed in our die shop in Bremer semi-automatic machine.

Remains of drawing lubricant are removed from the surface of finished wire by hot water at high pressure, which is followed by further polishing of the wire and covering its surface with a thin layer of antifriction current-conducting coating, containing corrosion inhibitor. Finished wire is wound on standard consumer reels of 200, 300 or 415 mm diameter, packed into plastic bags and cardboard boxes. At the request of the customer, the wire can be additionally packed into vacuum bags.

It should be noted that manufacture of a wide range of special-purpose wires, including those designed for welding low-alloyed and high-strength steels, high-alloyed corrosion-resistant and heat-resistant steels, nickel-based alloys and armour steels, requires close monitoring and control of all the technological process stages.

For these purposes, testing and measuring laboratory is functioning at VITAPOLIS enterprise from the first days of its operation. The laboratory includes a range of equipment and set of devices for mechanical testing, chemical analysis, metallographic examination of raw materials and finished products. Welding-technological testing section is fitted with stations for gas-shielded semi-automatic welding and mechanized submerged-arc welding.

Before the start of production, we paid special attention to training production personnel, realizing that even in the best equipment high-quality products with appropriate consumer properties can be produced only in the case of its operation by trained, qualified workers. Our engineers provided detailed descriptions of all the elements of technological process, working in close contact with equipment manufacturers, technologists from Germany, Sweden and Austria. After competitive selection process, all the workers had production training directly in our Enterprise, in accordance with developed technological and operating manuals. Personal responsibility of each worker for the performed technological operation was introduced, with recording and documenting of the performed operations. Quality management system, corresponding to ISO 9001, is in force at the Enterprise.

In October 2015, VITAPOLIS presented their products at the International Exhibition «Arms and Safety-2015» (Kiev), which aroused considerable interest of representatives of defence industry enterprises of Ukraine and a number of foreign countries.

By now, the first orders have been fulfilled for supplying welding wires to «Frunze Elektrod», «Gefest» and other companies. At present the Enterprise production facilities allow producing about 100 tons of welding wire of 15 different grades per month. Company investment program envisages putting into production about 30 more wire grades in 2016.

A.N. Alimov, VITAPOLIS

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