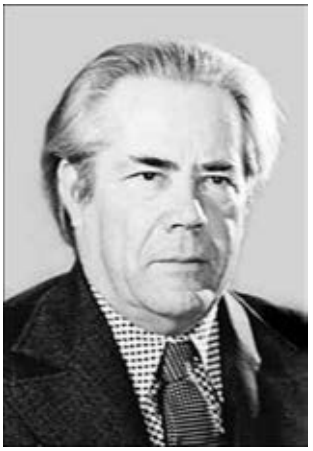
55th Anniversary of Welding Production Chair of Admiral Makarov National Shipbuilding University



A.I. Safonov

I.I. Dzhevaga

Welding Production Chair was organized in 1959. The first Chair Head was A.I. Safonov, Ass. Prof.; beginning from 1975 the Chair Head was I.I. Dzhevaga, Ass. Prof., and since 1980 the Chair has been headed by Prof. V.F. Kvasnitsky.

Chair development can be divided into several stages:

- organization and optimization of educational process (1959–1964);
- scientific formation of research team staff (1965–1974);
- comprehensive development, realization of chair staff potential and its recognition by scientific community (1975–1990);
- improvement of activity under the conditions of Ukraine's independence, broad international cooperation and European integration in the educational system, training young scientists (starting from 1991 and up to now).

The Chair's first years were particularly difficult: absence of lecturer's staff, laboratories, training-support personnel, equipment and instruments. All that created great difficulties in organizing the training process and scientific work. Owing to the activity of A.I. Safonov, I.I. Dzhevaga and M.L. Fukelman, Ass. Profs, close cooperation with production was organized from the very start of the Chair establishment, which allowed, together with local enterprises, to successfully develop and introduce new technologies. This was also promoted by objective conditions in the south of Ukraine, in particular, in Nikolaev. In October, 1953, Yuzhny Turbine Plant (YuTP) was put into operation, in 1961 «Mashproekt» for development of gas turbine engines was set up, «Okean», 61 Communard and Chernomorsky shipbuilding plants were increasing their capacities. Shipbuilding applied traditional structural materials and introduction of highly efficient welding processes was urgent. In gas turbine construction, new structural materials were applied, giving rise to a multitude of urgent and complex problems, which where solved with participation of the Chair' lecturers. Each student, starting from the third year, had his scientific theme, which he pursued together with his professor and plant engineers. Furtheron thee themes became the topics of thesis of Candidates of Science of the Chair graduates. Student scientific work was at the base of their training that is now declared in the Bologna system.

Meeting of State Examination Commission (1983). *First on the left* — Prof. B.A. Movchan

By the end of 1974 the Chair formed the scientific team, which ensured a high level of both educational process and research. By this time V.F. Kvasnitsky (1967), G.V. Ermolaev, A.I. Dremlyuga, Yu.M. Lebedev (1970) and A.I. Sa-

fonov (1973) defended their theses of Candidate of Science. The Chair maintained contacts with higher educational establishments and scientific organizations of former USSR: N.E. Bauman MSTU, PWI, Institute of Problems of Materials Sciences (IPMS), etc. Close contact with Institute of Welding of Slovenia (Ljubljana) was established. Ass. Prof. I.I. Dzhevaga, Great Patriotic War veteran, was preparing his thesis of Doctor of Science. He helped all the young lecturers to prepare their theses of Candidate of Science, and continued working at Chernomorsky Shipbuilding Plant.

In 1974/1975 academic year four groups (100 pers) of students of day department, two groups (50 pers) of evening department in Nikolaev and two groups (50 pers) of evening department in Kherson were studying in the welding speciality. The Chair had one of the largest scopes of contract work at the Institute every year. During this period about 100 post-graduates and candidates were preparing their theses.

Starting from 1975 up to 1980 the Chair was headed by I.I. Dzhevaga — the country's leading specialist on welding, surfacing, brazing of copper and its alloys to steels, whose health prevented him from completing his Doctor's thesis.

During the next years the Chair efforts enabled expanding and consolidating its facilities and by 1985 increasing the engineering and laboratory areas from 350 up to 1000 m^2. This was promoted by the fact that all the scientific activity of the Chair was conducted on the most important topics of government programs.

Several scientific directions of the Chair research were formed from the moment of its organization and started from students' work. Quality control direction started developing from introduction of ultrasonic testing of welds of ship hull structures. Furtheron this direction was expanded through development of procedures and instrumentation for testing of diffusion-welded and brazed joints, in particular those of dissimilar materials. Here we should note the great contribution of V.P. Savchenko, Ass. Prof., who organized the Laboratory of Ultrasonic Testing that predetermined appearance of new specialization in student training — nondestructive method of welded joint quality control.

The scientific direction of the accuracy of manufacture of welded hull structures, in which G.V. Ermolaev worked and defended the Candidate's thesis, was oriented to shipbuilding.

Direction of welding and related processes in gas turbine construction began in 1960 from the work on diffusion welding of high-temperature alloys with the assistance of Prof. N.F. Kazakov, the author and passionate advocate of vacuum diffusion welding process, later on Lenin prize winner, who supervised preparation and defense of more than one hundred candidate's and doctor's theses with broad industrial introduction.

30 years of the Chair team (1984). *From left to right*: Yu.I. Rusanov, Yu.M. Lebedev, B.V. Bugaenko, A.I. Safonov, Rector of N.E. Bauman MSTU, Prof. G.A. Nikolaev (*behind* — A.I. Dremlyuga), V.F. Kvasnitsky, G.V. Ermolaev, V.P. Savchenko, V.I. Lukin

Ship gas turbine construction was progressing vigorously. Several grades of new high-temperature metallic and nonmetallic materials were introduced at the plants every year. Joining these materials both in similar and in dissimilar combinations has always been problematic, and required development of new technologies of welding and related processes. The issues of controlling the quality of welding and brazing, as well as inherent stresses at joining dissimilar materials and particularly in case of component operation under thermal cycling conditions, remained unsolved. Successful solution of the above problems united the efforts of specialists of all the directions. Gradually, this work reached the all-union, and then the international level, and went beyond the limits of shipbuilding.

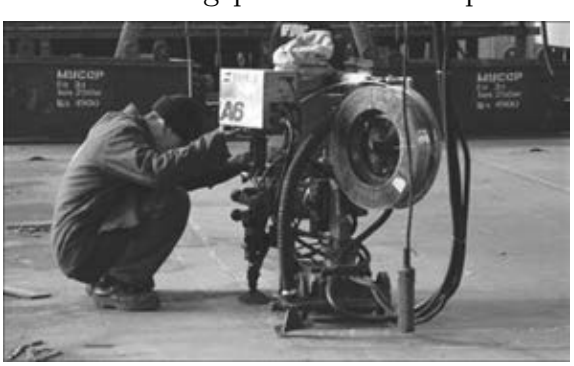
In 1979 the Scientific-Technical Council of SPA «Energia» headed by Prof. M.V. Melnikov, Deputy Director of the organization, Lenin Prize winner, Hero of Socialist Labour, having listened to the report of V.F. Kvasnitsky, Ass. Prof., on the Chair activities, takes a decision to fund the Chair work on research and manufacture of unique superhigh-vacuum process equipment, as well as manufacture of industrial MHD devices. Intensive work began on development of unique superhigh-vacuum system for welding, brazing, electron beam and ion-plasma spraying, later on included into the State Register of research facilities which are the national assets of Ukraine. Organization of standard product manufacture, in addition to development of equipment, required solving highly complicated problems of residual stresses and strains in components from dissimilar materials, including thin-walled structural elements, as well as controlling the joint quality. In 1981 we developed and put into operation the unique superhigh-vacuum unit VVU-

Superhigh-vacuum unit VVU-1D. Young scientists doing research (2012)

1D for diffusion welding, brazing and ion-plasma spraying (working chamber volume of about 4 m^3, vacuum of not lower than 10–5 Pa), fitted with a manipulator, controlled from outside. In 1983 the superhigh-vacuum unit for electron beam spraying was developed and produced. All the issues of fundamental design of the equipment were solved jointly by V.F. Kvasnitsky and G.V. Ermolaev, Ass. Profs, and the functions of Chief Builder were fulfilled by L.M. Petrenko, with whose active participation the first vacuum process unit UD-SV-DT (for welding turbine parts) was also developed and introduced at YuTP «Zarya» already at the start of 1960s. Work on welding and brazing materials and components of gas turbines, and MHD devices was included into the plan of fundamental R&D and state programs fulfilled under the Act of USSR government.

In 1985 with active support of Profs M.N. Aleksandrov, Rector, I.V. Gorynin, Director of CRI SM «Prometey», and V.A. Ignatov, Deputy on research, the Branch Laboratory of the Ministry of Shipbuilding on pressure welding and brazing of materials in vacuum (with transfer of staff and labour limits from «Prometey») was set up. V.F. Kvasnitsky was appointed the Scientific Leader and L.M. Petrenko — the Laboratory Head.

At the end of 1970s, the Chair began to actively develop the scientific direction of automation of welding production in shipbuilding,



Student during the first practical technological training at «Okean» plant

in particular as regards structures from light aluminium alloys. In 1985 Branch Laboratory of automation and mechanization of assembly-welding processes in shipbuilding was established. Dr. A.I. Dremlyuga, Ass. Prof., became the scientific leader of the direction and laboratory, who, unfortunately, passed away in the prime of his creative activity.

S.V. Dragan (1981), V.N. Khristenko (1984), A.Ya. Kaplun (1985) defended the theses of Candidates of Science. The team developed the fundamentals of welding butt and tee joints with simultaneous compensation of welding deformations by rolling of the joints with rollers. «Styk» and «Tavr» automatic machines were developed and manufactured together with Nikolaev Affiliate of CRI SBT for roll welding. Technology of roll welding was introduced in shipbuilding enterprises «Yantar», «More», «Baltia», etc.

The Chair was staffed by its own graduates who had shown an aptitude for scientific work. Thesis work was performed in the Chair laboratories, that was promoted by the substantial facilities and professionalism of the lecturers.

Starting from 1974 the Chair has been developing the scientific direction of brazing structural nonmetallic materials to metals. Contracts were made with DB «Salyut» (Moscow), Nuclear Energy Institution of AS BSSR (Minsk). Fruitful cooperation with IPMS (Kiev) was started. Profs V.I. Trefilov and Yu.V. Najdich made a great contribution to cooperation with Welding Production Chair. In 1975 the Chair, for the first time in Nikolaev, conducted the All-Union Scientific-Technical Conference «Melt Adhesion and Material Brazing», in which more than 350 scientists took part. The proceedings and abstracts were published by Conference results, and a decision was taken about issuing «Metal Adhesion and Material Brazing» Journal. Active co-operation with RI «Grafit» (Moscow), DB «Vint» (Moscow), «Energia» on introduction of investigation results in the field of joining nonmetallic materials to metals began at the same time. Technologies of joining graphite-based structural materials, ceramic materials to titanium alloys, electrical copper and stainless steels were developed. Fundamentally new technology of manufacturing of electrical brushes for electrical machines was developed. In 1979 V.M. Emelianov, Junior Staff Member of the Chair, together with IPMS staff, received AS Ukr.SSR Prize for junior scientists for a package of work on graphite brazing to metals.

The work on welding and related technologies in shipbuilding was conducted the most intensively. Candidate's theses were defended by B.V. Bugaenko (1975), V.P. Savchenko (1976), V.M. Emelianov (1980), and on high-temperature ma-

terial brazing — by N.V. Altukhov (1985), S.G. Kulik (1986), S.M. Samokhin (1987).

Welding of quenching steels was pursued by Yu.M. Lebedev and L.P. Kravchenko. In 1976 L.P. Kravchenko defended his Candidate's thesis. Ingenious laboratory systems for investigation of structural and phase transformations in metals were created. Diagrams of thermokinetic decomposition of austenite for steels of different structural classes were plotted by investigation results.

All the work at the Chair was performed in close cooperation with «Zarya», «Mashproekt» (now Company «Zarya-Mashproekt»), Nikolaev Affiliate of CRI SBT, «Energia», PWI, IPMS, «Prometey», PA «Almaz», etc. The staff of the above-mentioned enterprises and organizations made a tremendous contribution to development of vacuum technologies and equipment. Cooperation results were highly appreciated by the government by awarding the Prize of the USSR Council of Ministers in the field of science and technology (1991). The creative team included scientists from PWI, «Prometey», «Energia», in particluar three Chair graduates (V.F. Kvasnitsky, V.M. Emelianov and V.P. Nikolaenko).

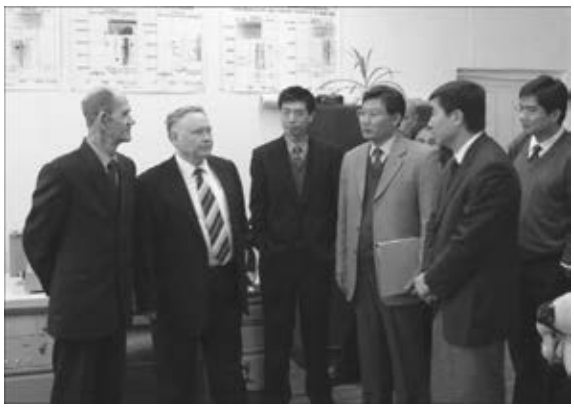
In the 1980s training of scientific personnel of the highest qualification became more intense. Ass. Profs V.F. Kvasnitsky, A.I. Dremlyuga, Yu.M. Lebedev, G.V. Ermolaev and V.N. Khristenko were doing their Doctor's theses research. In 1988 Doctor's thesis was defended by V.F. Kvasnitsky, and in 1995 — by Yu.M. Lebedev. All the developments were broadly introduced into industry.

The educational process was optimized alongside the scientific activity. With moving into the main academic building, new training laboratories were setup, and new research equipment was purchased. The modern ideas of the Bologna process were realized in 1985–1986. Scientific laboratories were widely used in the educational process, each graduate student pursued research, which were included as a separate section in the diploma project. Scope of commercial contracts increased several times, each staff member was able to increase his professional and scientific level. The staff of the Chair and laboratory was more than 50 persons. Each diploma project, in addition to research section, also had not less than three engineering calculations, including those made using the computer. Students of the Chair mastered the worker's profession of welder. In keeping with demands of the time, the following specializations were added at the Chair, starting from 2013/2014 academic year, to speciality «Welding»: welding and related technologies in shipbuilding, power equipment construction; modern pulse and vacuum technologies in welding, surface engineering and medicine; underwater welding and related technologies. All

Members of State Examination Commission (2008). *From left to right*: S.V. Dragan, G.V. Ermolaev, Yu.M. Lebedev, V.F. Kvasnitsky, Prof. G.M. Grigorenko (Commission Chairman)

the disciplines were supported by training and methodical manuals developed at the Chair. Central publishing houses published training manuals on «Fundamentals of technological design of assembly-welding shops», «Special processes of welding and brazing in shipbuilding»; monographs on «Diffusion welding of high-temperature alloys», «Welding and brazing of high-temperature alloys in shipbuilding», «Theory, technology and equipment of diffusion welding»; handbooks «Diffusion welding of materials», «Diffusion bonding of materials», «Handbook on gas cutting, welding and brazing».

The Chair met Ukraine's independence with high results in scientific and educational activities. Despite breaking up of contacts with Russian scientific organizations, enterprises and higher educational establishments, as well as decline of industrial production, the Chair not only preserved its potential, but also continued to develop. In 1992 A.M. Kostin, Junior Rresearch Member, and in 1993 — Eng. V.A. Politov defended their Candidate's theses. Talented young



Delegation of Beijing Institute of Aeronautic Materials at the Welding Production Chair (2008)

Signing of contract between Admiral Makarov NSU and Institute of Shipbuilding of China (1993)

people came to work at the Chair, who readily mastered computer technologies and systems of technological process control.

Scientific direction on new generation power sources and machines for thermal cutting is formed. For this purpose, Dr. E.N. Vereshchago, having experience of development of new samples of thransistorized power sources with improved welding-technological properties, technico-economic characteristics and electromagnetic compatibility for welding, related processes and technologies, including power sources with quasi-resonance switching principles for plasma cutting of metal and alloys of PLASMA 110iHF series, was invited from Electrical Engineering Department. The latter power source was awarded a diploma at All-Ukrainian Competition and Exhibition «Best Local Goods of 2008».

In 2006–2008 specialists of AMITI Ltd. together with the Chair, designed welding rectifiers of VDU25-401, VDU25-506 and VDU26-630 series for submerged-arc welding and surfacing (Certificate of Compliance UA1.012.0165143–06), protected by Patent of Ukraine 30840 for utility model. Patent authors S.V. Dragan, Yu.A. Yaros, A.F. Gal were awarded the diploma of winner of All-Ukrainian Competition «Invention-2008» in the nomination of «Best Invention-2008».

Presentation of Certificate of «European Welding Production Engineer» for graduates of Shipbuilding Training Center of Welding Equipment to N.P. Romanchuk, Director of «Okean» plant, by Prof. B.E. Paton, President of NASU, and Mr. Tutlis, Chairman of SLV-1 Commission (1998)

In 1994 by the decision of Cabinet of Ministers of Ukraine, the Institute was transformed into the National Shipbuilding University and received the status of higher educational establishment of the IV level. The speciality of Welding Production Chair was also certified to this level.

Within the framework of international cooperation, the Chair established active scientific contacts with higher educational institutions of China that promoted improvement of the facilities. In 1993 a computer classroom was set up at the Chair under an international contract.

In 1997 a research system for scanning electron microscopy and local X-ray microprobe spectral analysis was purchased and the respective laboratory was set up, which performs physico-chemical investigations, including those with application of high-temperature metallography. All the lecturers of the Chair have academic degrees and titles. Training of new generation of scientists was going on. In 1997 V.V. Kvasnitsky and in 2008 V.A. Martynenko defended their theses of Candidate of Science.

At the end of 1980s the Chair initiated new research direction on investigation of stress-strain state in diffusion welding and brazing of dissimilar materials, which successfully advanced in 2000s with introduction of new computer equipment and with active support and assistance of Prof. V.I. Makhnenko (PWI). In this field Candidate's theses were defended by A.V. Labartkava in 2004, M.V. Matvienko in 2013, and V.V. Kvasnitsky defended Doctor's thesis in 2010. Starting from 1995, the Chair has conducted fruitful cooperation with Training-Research Center of Welding Equipment of SLV-1 of Meklenburg-Vorpommern County. Owing to active support of Prof. B.E. Paton, President of the NAS of Ukraine, and assistance of Prof. V.M. Emelianov, People's Deputy of Ukraine, the work of the University and SLV-1 on training and certification of Welding Production Engineers in keeping with European norms was included into Interstate German-Ukrainian Program «Transform». In 1996 the University was appointed the Chief Organization on training welding production staff of all levels for shipbuilding by a joint order 96/87 of the Ministry of Education and Ministry of Mechanical Engineering of Ukraine. In 1997 the University and shipbuilding enterprises of Ukraine organized Shipbuilding Training Center of Welding Equipment, working in cooperation with SLV-1.

Winners of State Prize of Ukraine in the field of science and technology (2012). *From left to right*: K.V. Koshkin, S.S. Ryzhkov, Yu.D. Zhukov, I.V. Krivtsun, V.A. Nekrasov, G.V. Egorov, V.S. Blintsov, V.F. Kvasnitsky together with Prof. B.E. Paton (*in the center*)

Team of Welding Production Chair (2014). *Standing from left to right*: V.A. Martynenko, E.N. Vereshchago, S.V. Dragan, L.P. Kravchenko, S.Yu. Maksimov (Chairman of State Examination Commission, PWI), V.F. Kvasnitsky, A.M. Kostin, A.V. Labartkava, S.Yu. Kramarenko, G.V. Ermolaev, Al.V. Labartkava

In 1998 diplomas of European Welding Engineer were presented to the first group, consisting of 24 leading specialists of welding production in shipbuilding, including G.V. Ermolaev, V.V. Kvasnitsky, L.P. Kravchenko, Ass. Profs, by Embassador of Germany in Ukraine, Profs B.E. Paton and P.I. Seyffarth, SLV-1 Director. One year later G.V. Ermolaev, V.V. Kvasnitsky, L.P. Kravchenko also received diplomas of International Welding Engineer.

Despite the economic problems faced by Ukraine, the Chair even now continues fundamental investigations together with PWI with application of unique equipment and instruments. A number of joint research activities with funding of fundamental research from State Funds of Ukraine, Russia and Belarus have been performed just during the last five years. Investigation results are published annually in the form of papers, and are highlighted in international conferences.

Awarding the state Prize of Ukraine for 2011 to staff members of the University and PWI for shipbuilding work on «Development of versatile transport ships and oceanic engineering means» can be an example of fruitful cooperation.

An important feature of all the research work performed by the Chair is introduction of these results into industry. One of them — «Advanced technologies of development of materials and coatings in shipbuilding» — received the award of President of Ukraine for young scientists in 2013. The award was presented to Al.V. Labartkava, Junior Research Member.

Chair lecturers are actively working on publishing educational literature. Just during the last 15 years, 19 manuals and teaching aids with MESU stamp and monographs have been published, and Mechanical Engineering Encyclopedia, Volume III-4: Technology of brazing and cutting, edited by B.E. Paton, as well as more than 10 volumes of Rules of Ship Classification and Building (Official publication of Shipping Register of Ukraine) have been published with the Chair participation.

During the period of its existence the Chair has trained about 3 thousand welding production engineers. The graduates include more than 100 Doctors and Candidates of Science, Honoured Workers of Science and Technology, Honoured Workers of Education of Ukraine, members of the Royal Institute of Shipbuilding, Institute of Marine Engineering, Science and Technology, AS of Shipbuilding of Ukraine.

In 2004 the University received the status of National University, to which the Chair team has also made its contribution.

Chair formation and development was made possible owing to tremendous support and participation of numerous scientific and production teams and educational institutions, including PWI, IPMS, «Prometey», I.I. Polzunov CRI DCBT, TsNIITMash, N.E. Bauman MSTU, Problem Laboratory of diffusion welding in vacuum, MATI, Leningrad Shipbuilding and Polytechnic Institute, «Mashproekt», «Zarya», «Energia», «Grafit» and other organizations, where leading scientists and specialists were personally involved both in the educational process, and in scientific developments. Many scientists from the above mentioned and other organizations and institutes (universities) were chairmen of State Examination Commissions on Defense of Diploma Projects. Communication with them, their advice and recommendations on scientific and educational work ensured the Chair development. The team of Welding Production Chair is sincerely grateful to all those who were involved in cooperation and is hoping for its further progress.

V.M. Emelianov, B.V. Bugaenko, A.M. Kostin, V.A. Martynenko

International Conference «Welding Consumables»

On June 16–18, 2014 in Kiev, the 8th International Scientific and Technical Conference «Welding Consumables» took place at the E.O. Paton Electric Welding Institute (PWI). It was organized by PWI, International Associations «Electrode» and «Welding», as well as Society of Welders of Ukraine (SWU) and Russian Scientific and Technical Welding Society (RSTWS). By the beginning of the Conference the Proceedings were published in the form of a special issue of the journal «Avtomaticheskaya Svarka» («The Paton Welding Journal»), Nos. 6–7, 2014, where the materials of 40 papers related to four subject sections were published:

- arc welding processes: metallurgy, markets (9 papers);
- consumables for mechanized welding processes (19 papers);
- consumables for manual arc welding (7 papers);
- technologies, equipment and control in the consumables manufacturing (5 papers).

The Conference was attended by scientists and engineering and technical specialists of research institutes, higher education institutions, industrial and commercial enterprises, representatives of associations from a number of the cities of Ukraine (Kiev, Zaporozhie, Nikolaev, Kharkov, Mariupol, Sumy, Vinnitsa, Kramatorsk), and also from Russia (Moscow), Poland (Gliwice), Germany (Altlayningen). In total, there were over 80 participants.

The list of organizations and companies whose experts attended the conference included: PWI, PlazmaTek, TM.Veltek, Frunze-elektrod, SWU, RSTWS, Admiral Makarov National Shipbuilding University, NTU «Kharkov Polytechnic Institute», NTUU «Kiev Polytechnic Institute», Priazovsky State Technical University, Ekotekhnologiya, DrahtZug Stein (Germany), Zaporozhstekloflyus, Welding Institute in Gliwice (Poland), Energomashspetsstal.

The Conference was opened by a welcoming speech of Prof. K.A. Yushchenko, PWI Deputy Director. He expressed greetings to participants of the Conference on behalf of Academician Boris E. Paton, who wished the successful and fruitful conference. K.A. Yushchenko outlined the importance and relevance of the Conference topics, the necessity to organize regular meetings of scientists and experts in a number of subject directions to increase the efficiency in the welding production progress.

In total, 32 papers were presented at a plenary session within two days.

The present information was not aimed at publicizing the content of speeches in detail as it is possible to find out more about materials of papers in Nos. 6–7 of the «Avtomaticheskaya Svarka» journal («The Paton Welding Journal»). As a whole, the presentations reflected a modern range of research areas, which are carried out in the field of metallurgy and technology of arc processes of welding, surfacing and coating, an assessment of the market of Ukraine and the world market of welding consumables, development and application of welding consumables (electrodes, flux-cored and metal wires, fluxes, discrete fillers and powders) in the mechanized processes and manual arc welding, surfacing and thermal coating deposition.

The papers of Prof. O.I. Steklov (the President of RSTWS) «Assurance of integrity of welded structures and constructions at their long-term service by using the renovative technologies», Prof. V.V. Dmitrik (Head of Welding Chair of Kharkov PI) «Features of degradation of welded joint metal in steam pipelines of HPP», Dr. A.A. Mazur (Head the PWI Department) «The market of welding consumables in Ukraine and world market», Prof. Y. Nagaj (Welding Institute in Gliwice) «The role of tests and certification in development of welding consumables market in Poland and the EU countries», R. Rosert (leading specialist of DrahtZug Stein, Germany), «Application of flux-cored wires for welding under industrial conditions», and also papers of A.E. Marchenko, V.N. Shlepakov, V.V. Golovko et al. (the PWI scientists) were of a particular interest.

Great impression on the participants of the Conference was made by a videofilm, presented by V.P. Slobodyanyuk (General Director of PlazmaTek) on subject «Alternative raw materials for production of welding consumables at the present stage». He demonstrated the new integrated approaches in the development of production of covered electrodes and copper-plated wires in Ukraine, which allowed obtaining the challenging results, as every second electrode in Ukraine and the third electrode in Belarus today is produced by PlazmaTek.

During the Conference numerous bilateral talks aimed at cooperation and strengthening of cooperation with interested partners were held and continued during the final evening voyage in the Dnieper river.

A.T. Zelnichenko, B.N. Lipodaev, PWI