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**INTERVIEW WITH A.N. KOVALCHUK,
DIRECTOR OF PSJC
«KHARKIV MASHINOSTROITELNII ZAVOD
«SVET SHAKHTYORA»**



PJSC «Svet Shakhtyora» is a structural unit of CORUM GROUP Company, producing equipment for mining industry: scraper conveyors and reloaders, cleaning and tunneling combines, mine substations, mine crushers, safety hydraulic clutches, head explosion proof battery lights, and methane analyzers.

Products are operated at different mining and climatic conditions in coal, shale and potassium mines.

Products are certified in keeping with the requirements of DSTU ISO 90010–2001.

Mr. Kovalchuk, your company has been successfully developing during the last three years. It increases the output of mining equipment, where welded structures make up a considerable proportion. Under the conditions, when the market of independent Ukraine has declined, how can you explain intensive development of your company?

Yes, indeed, internal market of mining equipment in Ukraine is limited, and the share of sales in the internal market has decreased. The issue of entering foreign markets became more acute, so that individual approach to each order, promptness of its fulfillment and constant communication with users are becoming ever more important.

Despite all the difficulties, we increased the range of products manufactured by our company; mastered production of cleaning and tunneling combines, and stable-hole complexes. We also started manufacturing products, earlier untypical for us, namely explosion-proof transformer substations. We are working in the field of high-potential developing plow dredging that will allow us even more expanding the niche occupied by us in mining equipment manufacturing.

During 2017, our plant manufactured 17 conveyors of different type, 15 cleaning and tunneling combines, 50 transformer substations, a large volume of spare parts for mining equipment; export accounted for 18 % of product output.

Quality, reliability and safety of our products are confirmed by the respective certificates that make them competitive in supplying both the domestic and foreign markets.

Reconstruction of production facilities has been performed under your leadership. What has been done to ensure manufacturing competitive products?

One of major investments into the equipment of «Svet Shakhtyora» plant in 2014–2017 was purchase of wire EDM machine tool Mitsubishi MV2400S+ and processing center DOOSAN DBC160 (South Korea) with Fanuk 31i-B control system (Japan). The cost of introduction of

these projects was 4.5 and 25 mln hryvnias, respectively.

With purchasing and putting into operation modern high-efficient equipment, the enterprise was able to master new technology of processing complex surfaces, improve the quality of manufactured products, reduce enterprise dependence on outsourcing, as well as create new workplaces for operators of CNC machine tools, programmers, technologists.

High-performance tools of proven manufacturers, namely Walter (Germany), Sandvik (Sweden), Taegu Tec and Korloy (South Korea), etc. are used for operation of modern equipment.



Alongside EDM machine tools, what other modern welding equipment is used?

«Svet Shakhtyora» enterprise uses equipment for automatic submerged-arc surfacing of crane wheels. Replacement of semi-automatic welding by automatic and robotic welding in fabrication of some structures of mining equipment is planned.

The achievements of your company are related to the conducted personnel policy. It is known that young people are eager to work at your company. What are the working conditions at your enterprise? What is the personnel policy?

Our philosophy is extremely simple — work so today, as to secure your future. And we are successful in many respects here. We are known, we give an opportunity to everyone who wants to get a decent, highly paid, stable job in Kharkiv.

We pay salaries in time and do not have debts. In 2017 we increased piece-rate tariffs for the basic production piece-workers by 40 % in order to achieve a competitive salary level in the labour market. For additional motivation, salaries of other personnel categories were also increased. On the whole, average salary in 2017 was increased by 35 % from 2016 level, and was equal to 9000 hryvnias.

How do you solve the issues of personnel training and development?

At the enterprise one can have professional training and retraining, and get a second profession on the job, and become a qualified professional. Due to internal resources of the enterprise 309 employees were trained, 87 workers got a related profession and 108 persons learned new professions. Total cost of investment into education and vocational training of enterprise workers for 2017 amounted to 469,544 hryvnias.

We have a mentoring system allowing newly hired employees to adapt to the workplace. Special attention is paid to young specialists. Special-purpose courses are always conducted that enable employees to develop and improve their professional level. Each employee is able to realize his potential and build a promising career.

How much attention is paid to the social sphere at the enterprise?

Our company employees are provided with an almost full social package. This, primarily, is 100 % medical insurance. We





have organized free transportation of employees by buses from the metro to work; there is a dining room and a buffet, where workers can have a full dinner.

The enterprise management provides sponsor and charitable assistance to school and preschool institutions. Every year we congratulate the first-graders of our employees on the Day of Knowledge, we give them portfolios and stationery as a start to a new life stage.

Plant management and trade union committee take care of the rest of plant workers and their families. Employees have the opportunity to stay in holiday hotels, health centers, and children — at children's health camps.

Fans of football, volleyball, darts and other sports take part in sports events organized by the enterprise.

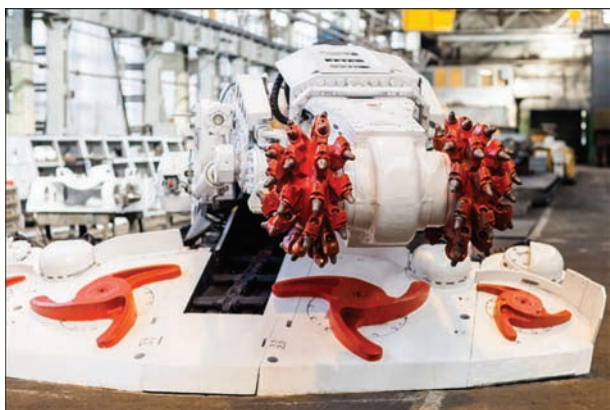
Corporate culture at our enterprise is supported by various events timed to the holidays: Day of the Machine Builder, Company Day, Knowledge Day, New Year, etc.

A youth organization was created at «Svet Shakhtyora» enterprise, which conducts intensive sports and cultural activities, and which all the interested persons can always join. In addition to fulfillment of basic guarantees, compensations and privileges provided by the Legislation and the Collective Agreement, the enterprise has a compensatory housing policy, according to which workers receive compensation payments to cover accommodation rent.

Thus, we have successfully established ourselves in the market, while maintaining the best traditions and formed new methods of work. We boldly demonstrate the ability to meet time challenges, to adopt and implement ambitious strategic objectives.

Mr. Kovalchuk, your company has expanded the geography of equipment supplies. To which countries do you supply your equipment? How do you see the company when compared with similar enterprises in the EU, China, and the USA?

In addition to the domestic market of Ukraine, CORUM GROUP Company supplies mining equipment for coal mines in Kazakhstan, and Poland, potassium mines in Belarus and shale mines in Estonia.



We are working to enter the markets of Bulgaria, Turkey, Romania, and Bosnia.

The market for mining equipment is now highly competitive. To be a competitive enterprise at the level of producers from the EU, the USA and China we have to perform a tremendous amount of work.

This is due not only to the high technical level of the equipment supplied, which must comply with the requirements of the European safety direc-

tives, harmonized standards of the EU, China and the USA, but also with logistics of delivery, and organization of service maintenance of the equipment during operation. These high requirements should be also transferred to the domestic market for its retention under the conditions of severe competition with foreign producers.

It is known that manufacturing competitive products requires scientific support. Do you plan to cooperate with the PWI, NTU «KhPI» and other organizations?

Production of competitive mining equipment requires application of modern wear-resistant thermally strengthened materials of both domestic and foreign manufacturers. Accordingly, for their successful application, it is necessary to use modern technologies that provide quality welded joints. In most cases, such information can be found in scientific papers of specialized publications, such as «Avtomaticheskaya Svarka» and «Svarshchik». When the necessary information is not there, we seek advice directly from PWI specialists.

Our company actively cooperates with various educational institutions of the city. We provide production and technological practice training at the facilities of PJSC «Svet Shakhtyora». In 2017 we had 282 students pass practical training at our enterprise, who were supervised by the staff members from high-level skilled workers.

Our company also cooperates with the National Technical University «Kharkiv Polytechnic Institute» (NTU «KhPI»). Students of the Department of Welding conduct pre-diploma practical work at our enterprise, study materials and equipment for fabrication of metal structures, i.e. get «hands-on» experience of welding production.

What makes your equipment competitive?

A long-term operational experience of the enterprise served as a basis for formation of a highly skilled group of managers and technical specialists who solve any tasks related to design, production, implementation, and service support of mining equipment.

The main components of competitiveness of mining equipment, produced by the machine-building plant «Svet Shakhtyora», are the minimum production time, product quality at the level of the European competitive price, warranty coverage, service support for the manufactured products, as well as the availability of consignment warehouses, that enables supplying equipment to the customer in a short time, and performing its maintenance.

Your enterprise can serve as an example of effective development of production. What are the main principles of organization of company production under modern conditions?

Modern market dictates its conditions and now, in order to effectively develop, it is necessary to have a flexible production, which allows mastering new products types in the shortest term.

At the enterprise, introduction of electronic document circulation and straight-through design is going on, which allows accelerating the processes of development and approval of the design and technological documentation, as well as finished product output.

Special attention is paid to improving the skills of employees, and development and support of rationalization and inventive activities. Financial interest of the team in the timely release of quality products is supported.

One of the main principles also is investing in modern high-efficient and energy-efficient equipment, as well as application of modern materials and tools in production, that enables manufacturing products within the terms, required by the customer.

Interview was recorded by V.V. Dmitrik

VISIT OF SPECIALISTS OF THE LANZHOU UNIVERSITY OF TECHNOLOGY (PRC) TO THE PWI

In the period of March 18–25, 2018, on the official invitation of the PWI authority, a delegation of welding specialists of the Lanzhou University of Technology (LUT) as well as the enterprise Lanshi visited the PWI. That was already a repeated visit followed after the earlier visit of the PWI by the LUT management. The delegation included Dr. Yu Shi and Dr. Ding Fan, the well-known scientists in China in the field of welding.

At the beginning of the meeting L.M. Lobanov, the Deputy Director of the Institute, Academician of the NASU, acquainted the guests with the history, achievements and main directions in the activities of the E.O. Paton Electric Welding Institute. Then the delegation visited the demonstration hall of the Institute, where

- development and creation of automatic expert systems for technical diagnostics of loaded parts, objects and structures (supervisor — A.Ya. Nedoseka);
- mathematical modeling in the field of evaluation of the residual life of welded structures operating under the conditions of static and dynamic loads (supervisor — O.V. Makhnenko);
- development of new welding consumables (supervisor — V.V. Golovko);
- development of plasma welding technologies, hybrid and combined processes, as well as plasma cutting (supervisor — V.N. Korzhik);
- development of equipment and technologies for welding of live tissues (supervisor — G.S. Marinsky).



During the meeting at the E.O. Paton Electric Welding Institute

it studied the main directions of the Institute research works and the results of their practical application.

Further, the Chinese specialists were offered an extensive program of a deeper acquaintance with the scientific and practical activities of the Institute in separate areas. The presentations on the following directions were heard:

- development, mathematical modeling and application of highly effective processes of activated TIG and plasma welding, including welding over the active flux layer and welding with high-frequency modulation of welding current by programmed pulses. The demonstration of welding equipment and technologies was carried out (supervisor of the works — I.V. Krivtsun);
- development and application of highly effective processes for welding titanium alloys, including a narrow gap welding (supervisor — S.V. Akhonin);
- development of detonation spraying equipment and technology (supervisor — Yu.N. Tyurin);

The Chinese specialists were provided with information about the publishing activities of the E.O. Paton Electric Welding Institute, which was presented by A.T. Zelnichenko.

At the final meeting with the specialists of the People's Republic of China, a closing conversation was held with the participation of I.V. Krivtsun, Deputy Director, Academician of the NASU, at which the supervisors of the works on the directions were also present. As a result of joint discussions, the Protocol on the visit of the Chinese experts to the E.O. Paton Electric Welding Institute, as well as the Agreement on joint cooperation (exchange of specialists, joint research projects, search for customers by the Chinese part and support for the PWI developments implemented at the industrial enterprises in China) were signed.

On the invitation of the Chinese part in October of 2018, a delegation of specialists of the E.O. Paton Electric Welding Institute will visit the Lanzhou University of Technology.

D.V. Kovalenko

METHOD OF ASSESSMENT OF METAL STATE OF WWER-1000 REACTOR WELDED BODY

The reactor body is a welded structure. The safe service of the reactor unit depends on many factors and is defined mainly by the reliability of the reactor body (RB), which has to preserve the integrity at a normal service, violation of service conditions and at design accidents.

The effect of service factors (neutron irradiation, increased temperature, cyclic loading) on metal of RB (base metal and weld metal) leads to change in metal properties, first of all, to reduction in the brittle fracture resistance. Therefore, the data about the developing of the radiation embrittlement process of RB metal are important from the point of view of safe service of the NPP.

The control of RB metal state is realized by testing the witness specimens (WS), mounted into the reactor, using the nondestructive and destructive methods. The results of the WS testing are representative for the assessment of RB metal properties only in that case, if the conditions of irradiation of specimens in the reactor and RB itself are known with a necessary accuracy, which requires making a thorough dosimetry of the neutron irradiation.

Test results of WS are the main source of information about RB metal state. Using the witness specimens the change in mechanical properties and characteristics of brittle fracture resistance is controlled. This information is required for justification of safe service life of the nuclear power unit.

Basic materials

In the nuclear power engineering of Ukraine 13 reactor units of WWER-1000 type are in service. Rated heat power of the reactor is 3000 MW, pressure of working medium (borated water) at the output of active zone is 160 kgf/cm², temperature is 320 °C, consumption of a coolant is 84000 m³/h. The bodies of reactors WWER-1000 are manufactured of low-carbon low-alloy steel of ferrite-pearlite class of chrome-nickel-molybdenum-vanadium composition. The nickel-free steel 15Kh2MFA, used earlier for bodies of the WWER-440 reactors, was not suitable for manufacture of RB of WWER-1000 by strength and technological properties. In particular, it was necessary to decrease the temperature of preliminary and concurrent heating in welding, as well as to eliminate subsequent tempering after completion of welding works with account for possibility of some lowering the tempering temperature. In this connection the bodies of reactors WWER-1000 are manufactured of 15Kh2NMFA grade steel. To manufacture the upper and bottom shells, located opposite the active zone, steel 15Kh2NMFA-A of the same composition is used, but with more strict requirements as to content of harmful impurities (phosphorus, copper and sulphur).

The reactor body consists of 7 shells, welded together by the circumferential welds. For each element of RB, an ingot of a definite weight is produced by casting, from which a proper forging is manufactured. Weight of forgings for RB of WWER-1000 is from 70 up to 115 tons. The thick-walled shells are manufactured from ingots in the hydraulic presses. An ellipsoid segment for a bottom is manufactured by a stamping method. Forgings for RB are subjected to hardening and tempering. After full heat treatment of initial billets a sample is cut out from each of them for mechanical and technological tests. Then billets are subjected to the preliminary mechanical treatment and edge preparation for welding of circumferential welds.

Welding consumables

In manufacture of RB of WWER-1000 different welding consumables are used for welding of circumferential welds: wire Sv-08KhGNMTA with flux 48NF-18M or wire Sv-10KhGNMAA and Sv-12Kh2N2MAA with flux FTs-16A. As the use of these consumables was permitted by the valid standard documentation, then the plant-manufacturers (Izhora and Atomash) performed welding of circumferential joints on the same type of RB by using different technological variants. Later, to reduce the radiation embrittlement factor, the solution was taken to refuse the applying of welding consumables with nickel content of more than 1.5 % for welds, located opposite the active zone. However, this was not already important for the power units of the NPP of Ukraine, as the bodies of reactors were manufactured earlier.

After the completion of welding of each circumferential weld the heat treatment by a high tempering mode is performed. The anti-corrosion surfacing is made inside by the automatic welding with a strip electrode of Sv-07Kh25N13 grade (first layer) and Sv-08Kh19N10G2B (second and third layers) under the flux layer at rotation of RB in a special tilter. This operation requires also the post heat treatment (additional tempering), therefore, the tempering after welding is performed together with a tempering after surfacing.

Manufacture of witness specimens

WS of base metal (BM) of RB are manufactured at the plant-manufacturer of the reactor bodies from tolerances of one of the shells, located opposite the active zone, for which the content of harmful impurities by a sum (10P+Cu) is highest, and in case of an equality of this value it is manufactured from a shell for which the content of arsenic, antimony and tin (As + Sb + Sn) is highest.

WS of weld metal (WM) and heat-affected zone (HAZ) are manufactured of an industrial reference welded joint, made at the same groove preparation, the same modes and methods of welding, using the welding consumables of the same batch as the welded joints of RB shells, located in the active zone region, passed the complex of heat treatments, as the RB itself.

In accordance with the requirements of PNAE G-7-002 and PNAE G-7-008 the control of change in properties of BM, WM and HAZ is envisaged in specimens of Charpy, Charpy with a crack and tensile specimens, namely:

- proportional ten-fold cylindrical specimens of 3 mm diameter test part for the tensile tests (T);
- test specimens for impact bending of type II by GOST 9454 for BM and type IX by GOST 6996 for WM and HAZ (Charpy specimens) (Ch);
- specimens of COD type for determination of crack resistance (Charpy with a crack) (C).

The witness specimens are placed into airtight containers, manufactured from stainless steel 08Kh18N10T. Heat removal from WS, heated by a neutron flux and gamma-irradiation, is provided by means of fillers and gaskets of aluminium or aluminium alloys. At the present time, two types of containers are used. The regular container is a cylindrical container with thick walls, withstanding the operating medium pressure without deformations. These containers are supplied by a plant-manufacturer in a set with RB. The main drawback of regular container assemblies (CA) with cylindrical containers is the high scattering of value of neutrons fluence on the WS test parts due to a high gradient of the neutron flux around the perimeter and height of regular CA. In the updated programs it is rational to use plane containers, which allow decreasing greatly the gradient of neutron flux to WS test parts, irradiated in the same container, at optimum orientation of CA.

At all the power units of WWER-1000 of the NPP of Ukraine the container assemblies with irradiated WS are mounted into a space between the upper edge of a compartment and the lower edge of a block of protective pipes into special pipes, welded-on to the upper edge of the compartment. Containers with WS are arranged into container assemblies which are mounted at the upper and lower tiers.

Results of the WS testing are representative for evaluation of RB metal properties only in that case, if the conditions of specimens irradiation in reactor and RB itself are known at a required precision. To determine the conditions of WS irradiation (fluence of rapid neutrons of energy $E \geq 0.5$ MeV and irradiation temperature) in the container with WS, the neutron-activation indicators (NAI) and irradiation temperature indicators (ITI) are mounted. NAI represent foils (thin discs) or wires of metals (chemically pure iron, niobium, copper), which are placed into the aluminium alloy capsule. As ITI, the indicators on the base of a diamond powder and fusion-type monitors of temperature, based on fusible eutectics with a melting temperature, close to a temperature of the coolant, are used. The indicators are placed in holes, made in WS or in the fillers.

Arrangement of containers with WS in CA provides the irradiation of containers of the upper tier by the neutron flux, approximately equal to the neutron flux to the inner surface of RB, and that of the lower tier is irradiated by the neutron flux of approximately 2.5 times higher, which allows determining the metal properties at the present moment and predicted period until the fuel unloading.

The terms of withdrawal of sets of witness specimens are determined from the results of investigations of specimens of the previous sets of WS, analysis of accumulated fluence of rapid neutrons at the inner surface of RB

since the service beginning and value of a critical temperature of brittleness for the predicted period. Evaluation of results of WS investigations are carried out by the comparison of predicted properties of RB materials, obtained during the WS testing, with limited admissible values, established in RB design documentation. From the results of this comparison the conclusion is made about the feasibility of safe service of RB before the unloading and testing the next set of WS or about the need in carrying out the compensating measures in case, if it is expected that during the period of time, for which the prediction is made, the controllable values of base and weld metals will come out beyond the safe limits.

In case of emergency stop of the reactor operation and its filling with a cold water (at thermal shock), the high stresses are occurred in RB. The state of RB metal is evaluated mainly by a critical temperature of brittleness T_{cr} , at which the body integrity is provided. In some cases, to avoid the brittle fracture the constant preheating of a water container up to temperature above the critical one is used.

If it is revealed during the process of reactor service that RB is subjecting to embrittlement more intensively than the metal of other similar bodies, then it is possible either to decrease the neutron flux in a preset point of RB due to, for example, change in procedure of fuel loading, or to perform a special heat treatment of the body («annealing»). In this case a powerful programmable heat source (based usually on electric heaters and filament lamps) is used. The body is heated slowly approximately up to 500 °C, held at this temperature not less than 20–40 h and then cooled slowly. Time of heating and cooling is not less than 4–20 h, maximum heating temperature is determined by the strength of concrete and structures of the reactor support elements. The cooling rate is usually lower than that in heating for decreasing stresses in the anti-corrosion inner surfacing of the body.

During metal irradiation with a neutron flux the defects are formed in a crystalline lattice. The value of defects depends on energy of the moving neutron. During decay of uranium nuclei the neutrons emission is occurred with a wide energy spectrum. At metal annealing the defects of the crystalline lattice are annihilated («dissolved») due to energy of heating, and the energy spectrum of lattice atoms is comparatively narrow and determined by the metal heating temperature. It is evident, that the probability of annihilation is higher in small defects, formed by neutrons with a low energy. Consequently, during heating the low-energy defects are most intensively dissolved in the lattice, and the defects from neutrons with a high energy are preserved. Thus, the annealing purifies the lattice mainly from low-energy defects. Moreover, the total density of defects is decreased and the values of metal ductility are increased.

Effect of brittleness decrease as a result of annealing can occur to be comparatively short. At the above-mentioned parameters of annealing the brittle fracture resistance is not recovered completely up to the initial state of the non-irradiated metal. From the system point of view, during the process of reactor operation the annealing is a comparatively short-time disturbance and the system is gradually returned into a normal state.

It should be noted that the metal heating during annealing contributes also to decrease in concentration of atoms of harmful impurities, in particular, phosphorus at the grain boundaries and increases the metal resistance to the brittle fracture.

The definite difficulties in control of the reactor body properties may be connected with insufficient number of WS, in particular, for doubling the measurements in evaluation of current and accumulated fluence of rapid neutrons. In this case, it is possible to apply the method of specimens reconstruction. It consists in the following. To the fragments (halves) of irradiated specimens after tests for impact and three-point static bending the tail pieces are welded-on, they are cut by a required size and a proper notch is made in the middle of the obtained specimen. As a result we have a specimen with a notch in the test part of the irradiated material. The main requirement to welding is a minimum power of welding to avoid the specimen overheating and violation of its properties. The electron beam welding is usually used.

In general, the accepted system of control of metal properties of the reactor body and its welds allows evaluating and predicting their properties at an acceptable accuracy and reliability. The certain drawback is the WS arrangement in the reactor. It would be more logic to place them on the body inner wall, however, it is connected with the change in design and sizes of the reactor body.

O.G. Kasatkin

Developed in the PWI

HYBRID LASER-ARC DEPOSITION
OF DIAMOND AND DIAMOND-LIKE COATINGS

SCHEMES OF THE PROCESS

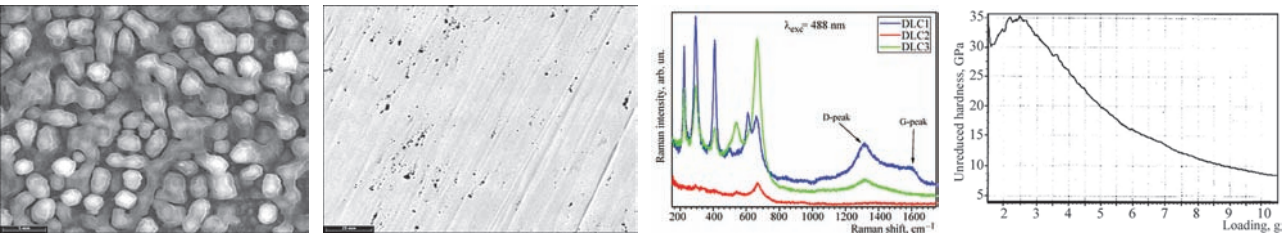


Intercoupling of plasma jet with laser radiation: CO₂-laser (2 kW), plasmatron MP-03 (2 kW)

Coaxial interaction of plasma jet with laser radiation: CO₂-laser (2 kW), plasmatron ILDP-01 (2kW)

Parameters of the processes

Types of coatings	Duration of treatment, min	Treatment distance, mm	Working gas (composition, consumption, l/min)	Material of base	Temperature of base, °C
Diamond	5–15	40–75	95H ₂ + CH ₄ 0.8–2.3	Mo, Si	600–950
Diamond-like	7–15	50–180	95H ₂ + 5CH ₄ 0.6–1.4	Steel 45, titanium alloy	100–250



Diamond coating based on molybdenum

Diamond-like coating on steel

Raman spectroscopy of diamond-like coatings

Hardness of diamond-like coatings on steel 45 at $T < 250\text{ }^{\circ}\text{C}$, $\Delta_{\text{coat}} = 0.5\text{--}7\text{ }\mu\text{m}$

PROPERTIES OF DIAMOND-LIKE COATINGS

- Coating thickness, μm — 0.3–3
Hardness/ GPa:
- on steel surface — 12–35 (hardness of base makes 2.0–2.6)
 - on surface of titanium alloy — 15–30
- Deposition rate, $\mu\text{m/h}$ — 2–25

RESULTS

- physical-mathematical model of plasma jet, which is generated by integrated laser-arc plasmatron, was developed;
- an integrated laser-arc plasmatron ILDP-01 of up to 5 kW power for coating deposition was developed;
- a process of laser-plasma coating deposition under conditions of intercoupling and coaxial interaction of plasma jet with laser beam was investigated;
- conditions of formation of diamond and diamond-like coatings were investigated;
- structure of diamond coatings on the bases from Mo and Si and structure and properties of diamond-like coatings on the bases from steel 45 and titanium alloy were investigated.

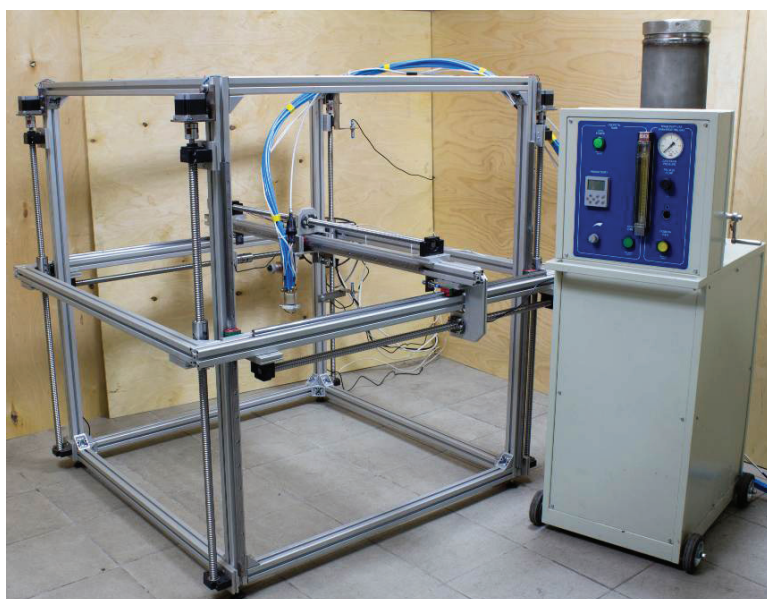
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EQUIPMENT FOR PRODUCTION OF 3D METALLIC PARTS

USING PLASMA-ARC TECHNOLOGY METHODS

Automatic versatile complex was developed for additive plasma-arc and microplasma deposition of volumetric metallic products with head movement working zone 900×900×900 mm. Joint development of PWI and «PLAZER» Company.

- > Automatic complex allows producing the volumetric metallic products using powder and wire materials.

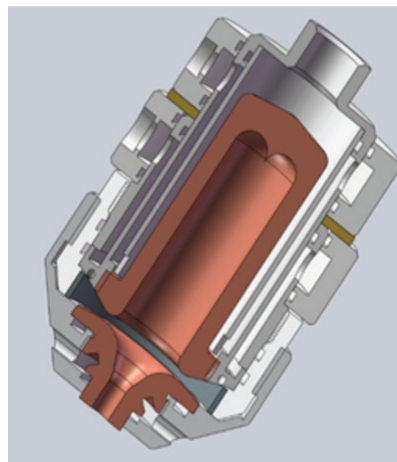
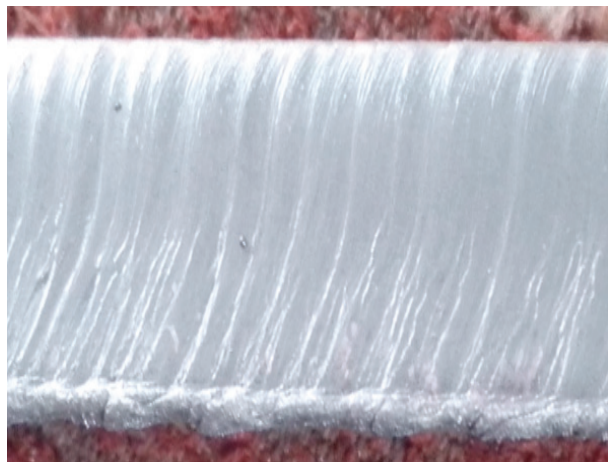


Block-modular structure of the equipment allows realizing additive production of the parts with following methods:

- > MIG-MAG surfacing
- > Plasma surfacing
- > Microplasma surfacing
- > Hybrid plasma-MIG surfacing

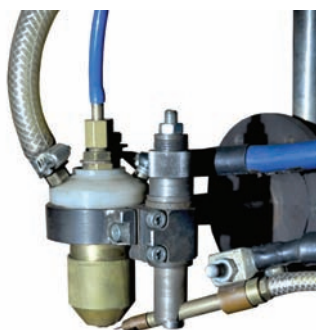
REVERSE POLARITY PLASMA-AIR CUTTING

Universal technological complex was developed for reverse polarity plasma cutting of metals, for severing of stainless steels, ferrous and non-ferrous metals of 5–200 mm thickness with direct current plasma arc. Joint development of PWI and «PLAZER» Company.



UNIT FOR PLASMA-ARC WIRE SPRAYING OF COATINGS

The unit realizes a process of plasma-arc wire spraying in argon arc with intensive concurrent air blowing.



Plasmatron of plasma-arc unit



Process of plasma-arc spraying with current-carrying wire

The unit is designed for deposition of wear resistant, corrosion resistant and special coatings by means of spraying of current-conducting materials in form of powder and compact wires of 1.6–1.8 mm diameter. Thickness of deposited coatings is 0.05–5 mm (and more). Compressed air and argon are used as working gases. Joint development of PWI and «PLAZER» Company.

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