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REPORTING CONFERENCE ON PROGRAM «RESOURCE»

On January 22, 2016 at the E.O. Paton Electric Welding Institute the reporting conference on the results of fulfillment of the fourth stage of the target integrated Program of the NAS of Ukraine «Problems of Life and Safe Operation of Structures, Constructions and Machines» («Resource») in 2013–2015 was held. In the work of the Conference more than 100 scientists and experts from different institutions and organizations of Ukraine participated.

The Conference was opened by L.M. Lobanov, the Academician of the NASU. He reported that to fulfill this Program, which consisted of 9 sections and included 126 projects, 25 institutes of 8 Departments of the NASU were involved. The part of the works was devoted to implementation of results of the previous stages of the Program to the corresponding industrial branches of Ukraine and the further improvement of monitoring of technical state of critical objects.

The following review papers of the scientific supervisors of the sections on the main results of Program «Resource» were delivered:

- V.V. Kharchenko, the Corr. Member of the NASU, Chief of Section «Development of methodological fundamentals of evaluation and life extension of structural elements of objects of increased danger and aerospace engineering»;
- Z.T. Nazarchuk, the Academician of the NASU, Chief of Section «Development of methods and new technical means of nondestructive testing and diagnostics of state of materials and products of long-term service»;
- Prof. M.S. Khoma, the Deputy Chief of Section «Development of methods of protection of structural elements of the objects of long-term service against corrosion»;
- V.N. Voevodin, the Corr. Member of the NASU, Chief of Section «Development of effective methods for evaluation and service life extension of objects of nuclear power engineering»;
- A.A. Dolinsky, the Academician of the NASU, Chief of Section «Improvement of reliability and service life extension of power equipment and systems»;

Speech of Prof. V.V. Panasyuk

- A.Ya. Krasovsky, the Corr. Member of the NASU, Chief of Section «Creating of systems for monitoring of technical state of pipelines and objects of gas and oil industry»;
- L.M. Lobanov, Chief of Section «Improvement of reliability and service life extension of bridges, building, industrial and transport structures»;
- K.A. Yushchenko, the Academician of the NASU, Chief of Section «Development of technology of repair and restoration of structural elements of the objects of increased danger for their service life extension»;
- V.V. Panasyuk, the Academician of the NASU, Chief of Section «Preparation and issue of standard documents and scientific-and-technical manuals on the problems of life evaluation of objects of long-term service».

In the process of projects fulfillment of the Program the important scientific, technical and practical results were obtained. Let us represent some of them.

For the branch of railway transport within the frames of the integrated Project, fulfilled by the Institute of Ferrous Metallurgy, Physical-and-Technological Institute of Metals and Alloys and H.V. Karpenka Physico-Mechanical Institute, the new wear-resistant steel for railway wheels and the methods for determination of their service life at the presence of the damaged rolling surface defects of dent type were developed. The laboratory metallurgical complex was created, which allows manufacturing the experimental specimens being constant by chemical composition, nonmetallic inclusions and harmful impurities. The parameters of hot deformation meet the requirements of industrial production of wheels and are different from the base steel by the reduced carbon content and the use of technologies of dispersion nitride and solid solution strengthening by manganese and silicon. A significant increase in the service life and reliability of the wheels is predicted.

The specialists of Physical-and-Technological Institute of Metals and Alloys proved that the increase in life of high-current sliding contact is based on the application of inserts based on copper with alloying additions of iron, chromium and carbon, which provide the increased tribological properties at lower wear of the contact wire. The technological equipment was created, experimental specimens and inserts were manufactured, investigations of their properties according to the needs of Company «Ukrzaliznytsya» were carried out. In cooperation with the enterprise, which manufactures the contact plates of pantographs, the technological recommendations for industrial mastering of production of the proposed contact parts were developed used in the railway transport.

I.M. Frantsevich Institute of Problems of Materials Science developed the technologies for manufacture of elements of friction pairs of powder composite materials with the increased service life for braking devices of the rolling stock of railway transport. The complex of laboratory and bench tests of physical-mechanical and tribotechnical characteristics of the produced materials of metal–glass system and the pilot-industrial approbation of the developed technology in the plant conditions was carried out, the preparations for their serial production began.

The system for control of process of flash-butt welding of rails under stationary and field conditions was created, which increases the service life and reliability of railway tracks. It allows also detecting the deviation of parameters and preventing their exceeding of the normative tolerances, that stabilizes the welding process and improves the quality and longevity of welds. The system passed testing under the industrial conditions, and is implemented in the rail-welding enterprises of «Ukrzaliznytsya».

The complex of technical means for automated ultrasonic flaw detection of railroad tracks was created using the updated information technologies. The mathematical software of microprocessor units and means of interactive interaction of operator with control organs of the ultrasonic rail flaw detector was developed. The comprehensive investigation of the designed mechanical and electronic units of the detector on the specimens with different types of defects was carried out. The pilot model of the automated ultrasonic flaw detector was created for application in railway economy of Ukraine for detecting defects in the rails of track.

For the branch of pipeline transport the causes for fracture of circumferential welded joints of main gas-and-oil pipelines were investigated. It was established that they are caused by the presence of technological defects, mainly corrosion due to a low quality of assembly-welding and maintenance works. The level of mechanical properties of welded joint metal, considering the long operation of oil-and-gas pipelines, is sufficient and can not be considered as the causes for their fracture. The recommendations regarding elimination of the causes of defects and prevention of fracture of circumferential joints during service were provided.

The first domestic equipment for low-frequency ultrasonic testing of state of technological pipelines and other long objects without scanning their surfaces was created. Its essential advantage is a long-range action and efficiency of diagnostics of long objects in the places, where other methods are unsuitable, as, for example, underground where pipelines cross roads

and railway tracks, as well as pass across the rivers and other obstacles. The testing and adaptation of the equipment was carried out as applied to the industrial conditions. It was established that it provides an increased sensitivity to corrosion-erosion damages, and as to accuracy of determination of distance to the defects it corresponds to the best foreign analogues.

PWI developed the system of continuous acoustic-emission monitoring of technical state of high-temperature components of the power equipment. It allows determining the preliminary fracture load of material under the real operating conditions of structural elements on the basis of acoustic emission data at any time irrespective of operation period and variations in temperature. The system was put into industrial operation for monitoring of steam pipelines of hot steam overheat of power unit No. 1 of Kiev Central Heating Plant-6. The works are also conducted regarding its application for the continuous monitoring of the boiler drum at Kiev Central Heating Plant-5.

The complex of technical measures for high-frequency and optical-acoustic diagnostics of composite structural elements of aerospace engineering was created. The complex includes ultrahigh-frequency reflectometer of millimeter range of wave lengths, optical-acoustic interference correlator and software for detection of delaminations and other inner defects in the composites in real time. The investigation of defects detection in the composite specimens of multi-layered and cellular structure was carried out. The testing of the developed complex of technical means of ultrahigh-frequency and optical-acoustic diagnostics is planned in the industrial conditions at State Enterprise «Antonov» and Design Bureau «Yuzhnoe».

The technology of diagnostics using the method of electronic shearography of aircraft structural elements of metallic and composite materials was developed. Its effectiveness is confirmed by research works both on test specimens, as well as on full-scale elements of fuselage lining of the aircraft wing. It can be used in manufacture of structures, as well as during their operation and maintenance. Nowadays, the technology is introduced for diagnostics of aircraft equipment components at Company «Antonov».

The hybrid technology was developed, which combines EBW and FSW for restoration of life of aerospace engineering structures made of aluminum and magnesium alloys. The standard series of tools and methodology of preliminary treatment with friction and stirring of the surface layers were developed, which allow obtaining a fine-grained structure of alloys, and significantly improving the strength of joints after EBW. The hybrid technology is implemented at Company «Motor-Sich».

The total expected economic effect from implementation of the results of the projects of Program «Resource» amounts to tens of millions UAH per year. In general, many other useful results were obtained from the projects. These results are challenging and give grounds about the practicability of the further work of the Program at the next stage.

The materials of Program «Resource» can be found in the open access on the link: *http*://patonpublishinghouse.com/ compilations/ Resource2015.pdf.

Dr. A.T. Zelnichenko, PWI

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