	<p><b>Marie Curie Actions</b> International Research Staff Exchange Scheme</p>	<p><b>INNOVATIVE NONDESTRUCTIVE TESTING AND ADVANCED COMPOSITE REPAIR OF PIPELINES WITH VOLUMETRIC SURFACE DEFECTS</b> <b>Project acronym:</b> INNOPIPES <b>Project number:</b> 318874 <b>Project duration:</b> 1 September 2012 – 31 August 2016</p>
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## INNOPIPES European Project Final Project Meeting and Workshop Gomel, Belarus, 12-15 July 2016

In the period Sept. 1, 2012 – August 31, 2016, as mentioned in previous issues of our *Bulletin* (Vol. LXIV, No. 4/2012, pp. 97-99; Vol. LXV, No. 2/2013, pp. 77-82; Vol. LXVI, No. 3/2014, pp. 101-106; Vol. LXVI, no. 4/2014, pp. 109-113), a research team from the *Department of Mechanical Engineering* of our university has been involved in the European FP7 Project No. 318874, *INNOPIPES - Innovative Nondestructive Testing and Advanced Composite Repair of Pipelines with Volumetric Surface Defects*, financed in the *7<sup>th</sup> Framework Programme, FP7-PEOPLE-2012-IRSES, International Research Staff Exchange Scheme, Marie Curie Actions*.

Because the *INNOPIPES Project* has ended, a *Final Project Meeting*, together with an *International Workshop*, have been organised in July 2016, in order to analyse and discuss the results obtained and the activities to be performed for the dissemination of the achievements of the research work performed within our project. This important scientific event has taken place in Gomel, the second largest city in Belarus, and it has been organised by the *V.A. Belyi Metal-Polymer Research Institute of the National Academy of Science of Belarus* – one of the eight partner organisations from *INNOPIPES Project*.



Gomel, first mentioned in chronicles in 1142, became a trade and crafts centre in XVI-XVII centuries, when it came under Lithuanian and then Polish rule, being annexed by Russia in 1772. During World War II, it was occupied by the Germans and 80% of the city has been destroyed. After the war, restoration of Gomel began promptly, city streets were considerably expanded, and new imposing buildings were erected.

Both events (*Final Project Meeting* and the *Workshop “Diagnostic and Repair of Oil and Gas Pipelines”*) have been attended by following researchers, representing all eight INNOPIPES partners, Universities and research institutes from seven countries:

- Prof. Evgeny BARKANOV, Project Coordinator, Dr. Alexey TATARINOV and Pavel AKISHIN from the *Institute of Materials and Structures* of the *Riga Technical University* (RTU), Latvia;
- Prof. Mitko MIHOVSKI (coordinator of the INNOPIPES team from Sofia), Assist. Prof. Alexander ALEXIEV and Yordan MIRCHEV from the *Institute of Mechanics* from the *Bulgarian Academy of Sciences* (IMEch-BAS);
- Prof. Andrei DUMITRESCU (coordinator of the INNOPIPES research team from our university) and the Assist. Professors Alin DINITA and Adrian NEACSA from the *Department of Mechanical Engineering* from the *Petroleum-Gas University of Ploiesti* (PGUP);
- Dr. Kamil SYBILSKI and Pawel BARANOWSKI from the *Department of Mechanics and Applied Computer Science* from the *Military University of Technology* (WAT – *Wojskowa Akademia Techniczna*), Warsaw;
- Dr. Petro YUKHYMETS (coordinator of the research team from Kiev), Roman DMYTRIENKO and Victor GLUKHOVSKYI from the *E.O. Paton Electric Welding Institute* of the *National Academy of Science of Ukraine* (Paton EWI), Kiev;
- a research team led by Dr. Vladimir SERGIENKO and by Dr. Sergey BUKHAROV from the *V.A. Belyi Metal-Polymer Research Institute* of the *National Academy of Science of Belarus* (MPRI NASB), Gomel, host organisation of the event;
- Prof. Mikhail CHEBAKOV (coordinator of the INNOPIPES team from Rostov) from the *Vorovich Research Institute for Mechanics and Applied Mathematics* of the *Southern Federal University* (SFedU), Rostov-on-Don, Russia;
- Prof. Gennadiy LVOV (coordinator of the research team from Kharkov) from the *Department of Dynamics and Strength of Machines* of the *National Technical University Kharkov Polytechnic Institute* (NTU KhPI), Ukraine.



On July 12 and 13, the *INNOPIPES Final Project Meeting* has been held in the conference room of *Chisto Hotel*, one of the most elegant hotels in Gomel. In the first day of the meeting (July 12), Dr. V. Sergienko, as host organisation representative, and Prof. E. Barkanov, as project coordinator, welcomed all participants at the meeting. Then, representatives from all eight participating organisations have presented the activities carried out by their research teams during the second project stage (Sept. 1, 2014 – August 31, 2016). Each partner presentation has included a description of each secondment performed by its researchers, including a short information, problems formulation, the solutions and results obtained, research achievements and conclusions, and results dissemination.

The activities of the research team from PGUP has been presented by Prof. A. Dumitrescu. The members of our team have taken part, in the period mentioned above, in five secondments:

- Assist. Prof. Adrian NEACSA and Ph.D. student Ibrahim Naim RAMADAN have visited SFedU in the period August-November 2014 and they have developed a model for the numerical testing of small scale models of gas pipelines subjected to excavator elements interference;
- Assist. Professors Cristina Maria DUȘESCU, Loredana Irena NEGOIȚĂ and Elena-Emilia OPRESCU, from the Chemistry Department of our university, have visited MPRI NASB in the period February-April 2016 and they have studied the mechanical properties of composite materials used for pipelines repair and they have proposed new materials based on acrylonitrile rubber and phenolic resins.



In turn, our university has been visited, in the same two years period, by many colleagues from the third countries partner organisations:

- Victor GLUKHOVSKIY and Grygorii BELIAIEV from Paton EWI have performed two secondments each in the year 2015, under tasks 1.4 and 4.4, while Sviatoslav MOTRUNICH and Olha BORODAI from the same institution have been in Ploiesti in the months May to July 2016, working with our specialists under tasks 2.5 and 3.4;
- Dr. Victor KOZHUSHKO from MPRI NASB visited our university in the period Dec. 2015 – Feb. 2016, participating in activities within task 2.2;
- Assoc. Professors Alexander SKALIUKH and Anna NASEDKINA, together with Rostislav NEDIN, Aleksandr CHERPAKOV, Anna MORGUNOVA, Dmitrii GUSAKOV, and Valerii CHEBANENKO, all of them from SFedU, have been the guests of PGUP this year, between the months of March and August, working jointly with researchers from PGUP to several FEA models for damaged and/or repaired transmission pipelines;
- Dr. Oleksiy LARIN, Ivan LVOV and Oleksii MARUSENKO, from NTU KhPI, visited Ploiesti in the period April-July 2016, performing joint research activities under tasks 2.3 and 4.4.

The second day of the meeting (July 13) has been dedicated to the analysis of the five Work Packages (WP) in which the project has been divided (WP 1 – Innovative non-destructive testing; WP 2 – Materials and technologies for advanced composite repair; WP 3 – Optimal design of advanced composite repair; WP 4 –



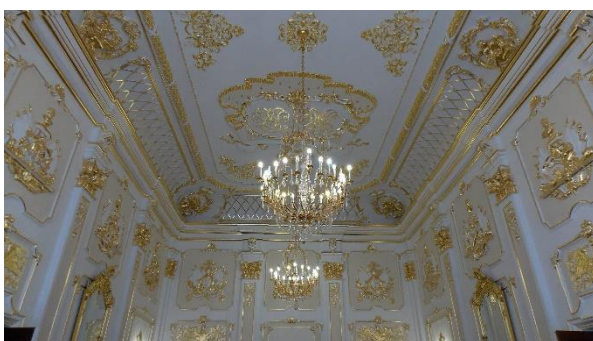
Prototype development and numerical models validation; WP 5 – Management and dissemination). WP leaders presentations have included the description (problem formulation

and research achievements) of each secondment in WP with subdivision on separate Tasks and general conclusion about the work performed. The team for our university is coordinating WP 3 and its presentation has been made by Prof. A. Dumitrescu. Analysing the obtained results, it has been concluded that the project work plan has been executed successfully and in relation to all milestones with the delivery date.

Finally, the coordinator of the project, Prof. E. Barkanov, informed the participants about the activities connected with WP 5 (project management, exploitation-dissemination of results, and events carried out during of the second project stage, Sept. 1, 2014 to August 31, 2016). The activities required for the preparation of the *Project Final Report* to be submitted to the *Research Executive Agency* of the *European Commission* in Brussels have also been discussed.



On July 13, at the end of the meeting, our kind hosts from Gomel have invited all the participants to a guided visit of the Central Park of the town, a very large and nice green area, with many imposing trees, where also the XVIII century Rumyantsev-Paskevich Palace and the Peter and Paul Cathedral (the most significant monuments in the city) are placed, and to a boat trip on the large and scenic Sozh river, that flows along the park.



On July 14, our hosts have organised a social event – a trip in the Minsk region, where we have visited two very interesting places: the *Dudutki Museum complex of ancient crafts and technologies*, an exciting trip in the world of age-old manners and occupations in villages as well as tasting of distinctive Belarusian dishes; the *Niasvizh Castle complex*, a UNESCO world heritage site – the castle is the most attractive one from Belarus and it was the former residential castle of Radziwill family, built, in its present form, in the XVIII century.

On July 15, 2016, the *International Workshop* has taken place at the headquarters of the V.A. *Belyi Metal-Polymer Research Institute* from Gomel, co-chaired by Prof. Mitko MIHOVSKI (IMEch-BAS) and Dr. Victor V. KOZHUSHKO (MPRI NASB). After a welcome speech of Acad. Prof. Nikolai MYSHKIN, Director of MPRI NASB, the following papers have been presented and discussed (most of them have been included, together with other papers describing the results of our project, in a volume with the title *Innovative Solutions for the Repair of Gas and Oil Pipelines*, edited by Prof. E. Barkanov, Prof. M. Mihovski, and Dr. V. Sergienko and published by the *Bulgarian Society for Non-destructive Testing*):

- *Assessment of mechanically stressed state in pipelines according to Russian standards*, presented by Prof. Mitko Mihovski (IMEch-BAS);
- *Maintenance of trunk pipelines in JSC “Gomeltransneft Druzhba”*, presented by Alexander Krivolapov from guest organisation *Gomeltransneft Druzhba*;
- *A system of defects repair in the linear part of trunk pipelines in JSC “Gazprom Transgaz Belarus”*, presented by Elena Kolos from guest organisation *Gazprom Transgaz Belarus*;

- *Enhancement of contrast in detection of small defects in pipes using guided waves*, presented by Dr. Alexey Tatarinov (RTU);
- *The experience in application of advanced methods of ultrasonic diagnostics TOFD and phased arrays during the building of trunk pipelines and production (mounting) pressure vessels*, presented by Alexander Ivanov from guest organisation BELGAZPROMDIAGNOSTIKA;
- *A method of reducing stress concentrators in damaged transmission pipelines*, presented by Prof. Andrei Dumitrescu (PGUP); the paper was the result of the collaboration with colleagues from SFedU, during their visit to our university;
- *Piezoelectric transducers for detection of laser-induced ultrasound*, presented by Dr. Victor Kozhushko (MPRI NASB);



- *Investigation of the mutual influence of two machined volumetric surface defects of a transmission pipeline*, presented by Assist. Prof. Alin Dinita (PGUP); this paper also resulted from the collaboration with visiting colleagues from SFedU;
- *Waves propagation in a cylindrical waveguide with periodic structures*, presented by Prof. Mikhail Chebakov (SFedU);
- *Investigations regarding the cyclic strength of pipelines with volumetric surface defects in the weld zone*, presented by Dr. Petro Yukhymets (Paton EWI); at this paper, there was also a contribution from Prof. Gheorghe Zecheru (PGUP);
- *Nitrile rubber curing of phenolic resin*, presented by Anna Sementovskaya (MPRI NASB); the paper was the result of the cooperation with the three colleagues from PGUP who have executed secondments to Gomel;
- *Investigation on composite materials used for damaged highway pipelines bandaging by low frequency resonance vibrations method*, presented by Assist. Prof. Alexander Alexiev (IMech-BAS);
- *Numerical model for focusing technique of fundamental torsional mode in pipes*, presented by Yordan Mirchev (IMech-BAS);
- *The main results of the tests of specimens with defects and bandages*, presented by Dmytrienko Roman (Paton EWI);
- *Experimental and numerical testing of small scale models of gas pipeline subjected to excavator elements interference*, presented by Pawel Baranowski (WAT); this paper was the result of a cooperation with three colleagues from PGUP, during a common visit to SFedU;
- *The optimization method of composite repair system for large area surface defects*, presented by Dr. Kamil Sybilski (WAT);



- *Weight optimization of composite bandage used for repair of pipe with volumetric surface defect*, presented by Pavel Akishin (RTU);
- *The research of ultrasonic antenna array for non-destructive testing of extended technological pipelines*, presented by Viktor Glukhovskiy (Paton EWI); the paper resulted from the collaboration with two colleagues from our university, during a visit to **PGUP**.

After the lunch break, a visit to the main research laboratories of our host institution, *V.A. Belyi Metal-Polymer Research Institute*, has been organised. Our host Institute started up as a laboratory in 1956. Its founder and first director, *Vladimir Belyi* (Academician of *National Academy of Sciences* since 1972) has united a research team to start a work in friction of non-metallic materials, physics and mechanics of polymers. At present, the Institute carries out research activities in about 50 topics yearly in the framework of state programs in both fundamental and applied spheres. It cooperates on contractual basis with 70-80 enterprises, design and research organizations in Belarus and other countries. Numerous papers and patents generalized in dozens of monographs, and Ph.D. theses have brought to the Institute excellent reputation in Belarus and abroad.

