

	<p>Marie Curie Actions International Research Staff Exchange Scheme</p>	<p>INNOVATIVE NONDESTRUCTIVE TESTING AND ADVANCED COMPOSITE REPAIR OF PIPELINES WITH VOLUMETRIC SURFACE DEFECTS Project acronym: INNOPIPES Project number: 318874 Project duration: 1 September 2012 – 31 August 2016</p>
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INNOPIPES European Project Mid-term Review Meeting and Workshop Sozopol, Bulgaria, 13-18 June 2014

The *Department of Mechanical Engineering* from our university, as mentioned in previous issues of our *Bulletin*, has a research team 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 7th Framework Programme, FP7-PEOPLE-2012-IRSES, *International Research Staff Exchange Scheme, Marie Curie Actions*. Vol. LXIV, No. 4/2012 of our *Bulletin* has included, within the column *International Projects and Conferences*, a general presentation of this project, together with a report from the *Kick-off Meeting*, organised in Hurzuf, Ukraine, in October 2012, soon after the start date of the project: Sept. 1, 2012. In addition, Vol. LXV, No. 2/2013 of our *Bulletin* has included a report from the *First training event* of INNOPIPES Project, which took place at the *Military University of Technology* from Warsaw, Poland, one of the project partners, in May 2013.

As recently (at Sept. 1, 2014) the INNOPIPES Project has entered its third year and therefore its second half, a *Mid-term review meeting* needed to be organised in order to analyse and discuss the results obtained so far and to better plan the future activities thus ensuring the success of our project. This important scientific event has taken place in June 2014, together with a one day *Workshop* dedicated to INNOPIPES project, in the framework of the International Conference *NDT Days 2014*, organised mainly by the *Bulgarian Society for NDT* and the *Institute*



of *Mechanics* from the *Bulgarian Academy of Sciences* (one of the eight partner organisations from INNOPIPES Project) in one of the best resorts of the Black Sea coast, the picturesque town of Sozopol, situated 35 km South of Burgas, Bulgaria. Sozopol, one of the oldest towns on the Bulgarian sea coast, founded in the 7th century BC by Greek colonists from Miletus as Apollonia, is also an ancestor of ancient, mid-century and modern Bulgarian culture.



Both events (*Workshop* and *Mid-term review meeting*) have been attended by researchers from all eight INNOPIPES partners, Universities and research institutes from third countries and EU:

- the Institute of Materials and Structures from *Riga Technical University* (RTU), Latvia (represented by the Project Coordinator, Prof. Evgeny Barkanov, also Co-Chairman of the Scientific Committee of *NDT Days 2014* Conference);
- the *Institute of Mechanics* from the *Bulgarian Academy of Sciences* (IMEch-BAS), Sofia (acting as host organisation of the event, Prof. Mitko Mihovski, coordinator of the INNOPIPES research team from IMech-BAS, being Chairman of the Scientific Committee of *NDT Days 2014* International Conference);
- the Department of Mechanics and Applied Computer Science from the *Military University of Technology* (WAT – *Wojskowa Akademia Techniczna*), Warsaw;
- the Department of Mechanical Engineering from the *Petroleum-Gas University of Ploiesti* – PGUP (represented by Prof. Gheorghe Zecheru and Assoc. Prof. Andrei Dumitrescu, coordinator of the INNOPIPES research team from our university);
- the *E.O. Paton Electric Welding Institute* (EWI) of the *National Academy of Science of Ukraine*, Kiev;
- the *V.A. Belyi Metal-Polymer Research Institute* of the *National Academy of Science of Belarus* (MPRI NASB), Gomel;
- the Research Institute for Mechanics and Applied Mathematics from the *Southern Federal University* (SFedU), Rostov-on-Don, Russia;
- the Department of Dynamics and Strength of Machines from the *National Technical University Kharkov Polytechnic Institute* (NTU KhPI), Ukraine.



In the first place, on June 13, 2014, the *INNOPIPES Workshop* has taken place as a Section of the *NDT Days 2014* Conference. After a presentation made by INNOVIA Ltd. representative

regarding the OLYMPUS equipment for Application of Guided Wave for pipe inspection, the following papers have been presented and discussed:

- Al. Alexiev, Y. Mirchev and M. Mihovski (IMech-BAS), N. Yakimovich (MPRI NASB), *Non-destructive investigation of materials on the base of epoxy resins with fillers, used for bandages of pipelines;*
- Y. Mirchev, Al. Alexiev and M. Mihovski (IMech-BAS), S. Buharov (MPRI NASB), *NDT of adhesion in bandaged pipelines;*
- A. Shekero (Paton EWI), *Development of technology for ultrasonic testing of welded pipelines using guided waves in the framework of the European project INNOPIPES;*
- V. Nekhotyashchy and A. Palienco (Paton EWI), *A method of measuring the coercive force as a possibility to ensure safe operation of structures working under pressure;*
- V. Sergienko (MPRI NASB), *Prospects of application of polymer composites for the repair of corrosion-mechanical damages of pipeline systems;*
- S. Buharov (MPRI NASB), *A study of the damping properties of polymer composites to increase resistance of pipelines to hydroimpact and vibration;*
- O. Masiuchok and R. Dmytrienko (Paton EWI), *The relationship of volume expansion cylinders with their marginal status and safety factor. Ideology destination maximum permissible residue ratio expansion;*
- A. Soloviev, N.D.T. Giang and E. Shinkarenko (SFedU), *Identification of volume defects on the surface of pipes based on a combination of FEM and artificial neural networks;*
- A. Soloviev, N.D.T. Giang and M. Chebakov (SFedU), *Identification of crack-like defects onto the surface of pipes based on a combination FEM and artificial neural networks;*
- K. Damaziak, M. Swierczewski, T. Slezak, V. Hutsaylyuk and J. Malachowski (WAT), *Investigation of a defects influence on behaviour of pipeline structure;*
- I. Vasilev, Y. Mirchev and M. Mihovski (IMech-BAS), V. Sergienko (MPRI NASB), *Calculation of damage tolerance caused by corrosion on pipelines by FEA;*
- V. Kozhushko and V. Sergienko (MPRI NASB), *The Perspectives of the Laser-Induced Ultrasound for NDT&E;*
- N. Yakimovitch (MPRI NASB), *Application of pipeline repair composites based on epoxy resin reinforced with carbon and fiberglass;*
- E. Barkanov and E. Skukis (RTU), *Characterisation of adhesive material properties via an inverse technique;*
- E. Kudina (MPRI NASB), *Advance adhesion of polymeric composites to metal in repair technology of main gas pipelines;*
- O. Larin (NTU KhPI), *Probabilistic methodology for the prediction of the reliability and lifetime estimation of the toroidal composite tube taking into account aging of the materials;*
- G. Lvov and D. Beschetnikov (NTU KhPI), *Optimal design of preload under installing composite bandages on pipelines;*
- G. Lvov and V. Okorokov (NTU KhPI), *Autofrettage of the composite high pressure vessels;*



- R. Dmytrienko (Paton EWI), *Calculation of the pipe joint and a band of the composite elastic and plastic areas. Score limit state;*
- Gh. Zecheru and A. Dumitrescu (PGUP), P. Yukymets and R. Dmytrienko (Paton EWI), *Development of an experimental programme aimed at emphasizing the consolidation effects of composite material wraps applied for the repair of transmission pipelines with volumetric surface defects* (paper presented by Assoc. Prof. A. Dumitrescu);
- M. Chebakov, E. Kolosova, A. Lyapin and A. Soloviev (SFedU), *Contact interaction of the pipeline and bandage in the presence of inclusions and nonstationary change of internal pressure;*
- A. Soloviev, M. Shevtsov and E. Kirillova (SFedU), *Identification of elastic and dissipative properties of anisotropic composite materials based on a combination of analytical solutions, FEM and genetic algorithms;*
- A. Soloviev, E. Ziborov and V. Naprasnikov (SFedU), *Identification of elastic and fatigue properties of fibre reinforced composite materials based on analytical solutions and finite element modelling.*



In the second place, the *INNOPIPES Mid-term Review Meeting* has been held on June 16 and



17, 2014. In the first day of the meeting (June 16), Prof. M. Mihovski, as the host organisation representative, and Prof. E. Barkanov, as the project coordinator, welcomed all participants of the meeting. Then, representatives from all eight participating organisations have presented the activities (work performed, research achievements, results dissemination, execution of the plan of secondments) carried out by their project teams during the first project stage (Sept. 1, 2012 – August 31, 2014).

Each partner presentation has included a description of each secondment performed by its researchers (short information, problems formulation, solutions and results, conclusions and research achievements, dissemination) and an analysis of the execution of the plan of secondments. Some small delays from the execution of this plan have been observed, most of them connected with the complex situation in Ukraine, but it has been concluded that they are not critical. In order to address this issue, several possibilities to correct the plan of secondments have been proposed and examined by the participants.

The members of the research team from PGUP have taken part so far in the following eight secondments, from which the last two are presently ongoing:

- Prof. Gh. Zecheru and Assoc. Prof. Gh. Draghici have visited Paton EWI in the period April-June 2013 where they have studied, among others, the methods for the characterization of defects and for the assessment of the residual mechanical strength of the pipelines with defects, the design procedures for composite wraps used to repair pipelines, and the methods for performing the mechanical tests on the composite materials;
- Ph.D. students M. Tanase and I. Ramadan have visited NTU KhPI in the period September-December 2013 where they have analysed the main types of composite materials used for transmission pipelines repair and the calculation methods used to determine the composite repair thickness (including FEM based methods);
- Assoc. Prof. Gh. Dumitru and Assist. Prof. A. Dinita have visited SFedU in the period February-May 2014 and they have developed a FEA model of a transmission pipeline with various defects, subjected to internal pressure loading, using their model for structural optimization of the composite repair system;
- Assist. Prof. A. Neacsu and Ph.D. student I. Ramadan have just begun a visit to SFedU at the end of August 2014 and they will return to PGUP at the end of November.



In turn, our university has been visited by three colleagues from the partner organisations: Al. Lyapin from SFedU has performed a secondment in the period, during which he has developed together with researchers from PGUP a FEA model for a transmission pipeline with defects, while Dr. P. Yuhymets and Dr. A. Klimenko from Paton EWI have been the guest of PGUP this year, in the period April-June.

In addition, Prof. Gh. Zecheru, Assoc. Prof. A. Dumitrescu, Assoc. Prof. Gh. Draghici and Prof. I. Lambrescu have participated at the *Kick-off Meeting*, organised in Hurzuf, Ukraine, in



October 2012, while Assoc. Prof. A. Dumitrescu have also taken part at the *First training event* organised in Warsaw, Poland, in May 2013. Both events have been previously presented in the columns of our *Bulletin*, as mentioned above.

The second day of the meeting (June 17) has been dedicated to the analysis of the present situation of the five Work Packages (WP) in which the project is 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 of each secondment in WP with subdivision on separate Tasks (problem formulation and research achievements), general conclusion about the work performed and future plans. The team for our university is coordinating WP 3 and its presentation has been made by Assoc. 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 training events carried out during of the first project stage, Sept. 1, 2012 to August 31, 2014). The preparation of the *Second training event*, to be organised by SFedU between 11 and 19 September 2014 (a report regarding this event will be prepared for the next issue of our *Bulletin*), has also been discussed.

