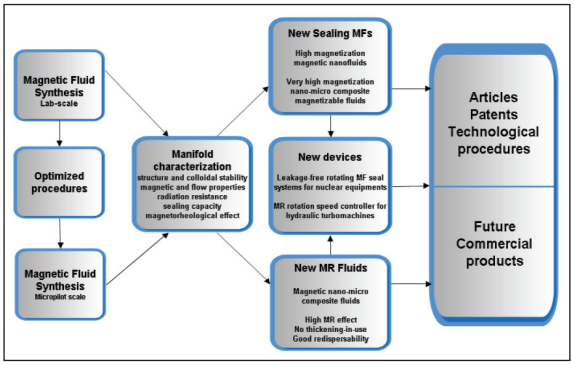
High magnetization magnetic nanofluids and nano-micro composite magnetizable fluids: applications in heavy duty rotating seals and magnetorheological devices MagNanoMicroSeal

Goal of the project:
The project is oriented to the extension of performances of rotating seals and adaptive motion control devices to meet the requirements of several well-defined new applications, by high and very high magnetization sealing fluids and new type of magnetorheological fluids to be synthesized.

Short description of the project:
The project concept and objectives are illustrated schematically in figure bellow.



The workflow is organized along the following main directions: lab-scale and micropilot scale synthesis of high magnetization and radiation resistant magnetic nanofluids and nano-micro composite fluids for heavy duty (high pressure and/or rotation speed, contaminated medium) rotating seal and semi-active magnetorheological motion control applications; advanced structural, magnetic, rheological, magnetorheological characterization of the new magnetizable fluids; accelerated (irradiation) ageing and sealing capacity tests; design, manufacturing and experimental testing of leakage-free rotating seals for nuclear equipments and magnetorheological rotation speed controller devices for hydraulic turbomachines. The new rotating seal and motion control systems for nuclear and hydraulic equipments offer better quality than usual solutions have, will help to gain new market shares and open technological advantages over traditional manufacturing routes. The seal systems proposed for nuclear equipments offer much higher level of environmental protection over traditional sealing units due to the leakage- free property of magnetic fluid rotating seals, increasing the commercial value of the solutions proposed.

Project implemented by:
Romanian Academy – Timisoara Branch (project coordinator), University „Politehnica" of Timisoara (partner 1), SC ROSEAL SA Odorheiu Secuiesc (partner 2) and National Institute for R&D in Electrical Engineering ICPE-CA Bucuresti (partner 3).

Implementation period:
July 23, 2012 – July 23, 2015

Main objectives of the *MagNanoMicroSeal* project are (O1) Synthesis and manifold characterization of magnetizable fluids for high pressure and heavy duty rotating seals and magnetorheological devices and, respectively, (O2) Design, fabrication and testing of leakage-free magnetofluidic rotating seal and magnetorheological(MR) control devices for well defined applications/ exploitation conditions.

Results:
The main results of this project refer to the elaboration of the following *technological procedures:*
•synthesis of high magnetization sealing fluids;
•synthesis of nano-micro structured magnetorheological fluids;

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Albert EINSTEIN

and qualification procedures:
•magnetic nanofluids for sealing applications in nuclear equipments;
•magnetic nanofluids for rotating seals for nuclear equipments.

The project results will be disseminated through publications in leading scientific journals, through presentations at national and international scientific meetings. Also, the involved procedures, technologies, devices and know-how are favourable for patent applications, as well as for development and exploitation by the industrial partner from the project.

The contributions of **„Politehnica" University of Timisoara (Partner 1)** to this project refer mainly to complex magnetic, rheological and magneto-rheological analyses of the magnetic sealing fluids and nano-micro structured magnetorheological fluids.

Fields of interest:
Physico-chemistry of magnetic nanoparticle synthesis; know-how and procedures for synthesis of over 50 types of magnetic nanofluids(MNFs) and nano-micro composite magnetizable fluids; accelerated ageing test procedures for organic compounds; magnetic, rheological, magneto-rheological and thermal investigation methods for the properties of magnetizable fluids; design and manufacturing of rotating seal devices; investigation of swirling flow phenomena and evaluation of effects on the performances of hydraulic turbomachines.

Financed by:
The Ministry of Education, Research, Youth and Sports (MECTS) - Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI) through the PN II Program Partnerships in Priority Areas, *Collaborative applied research projects.*

Research team: the project research team consists of 43 researchers, engineers and technicians lead by **Dr. Ladislau VÉKÁS**, the director of the *MagNanoMicroSeal* project (Romanian Academy Timisoara Branch).

The „Politehnica" University of Timisoara (Partner 1) research team in this project consist of 6 researchers and 2 research assistants, as follows:
Assoc. Prof. Dr.-Eng. Floriana D. STOIAN, project responsible for Partner 1, Phys. Oana MARINICĂ, Assist. Prof. Dr. -Eng. Mat. Sorin HOLOTESCU, Assoc. Prof. Dr.-Eng. Nicolae CRAINIC, Assist. Prof. Dr. -Eng. Andreea DOBRA, Assist. Prof. Dr. -Eng. Adelina HAN, Res. Assist. Florica BĂLĂNEANU, Res. Assist. George GIULA.

Research centre: The research activities for „Politehnica" University of Timisoara (Partner 1) are carried out at the **Research Centre** for Engineering of Systems with Complex Fluids in the Magnetometry Laboratory, Rheology Laboratory and Numerical Simulation and Parallel Computing Laboratory.

Applicability and transferability of the results: The technological progress is strongly evidenced by future commercial products planned for the industrial partner SC ROSEAL SA: 16 new type of magnetically controllable fluids, 1 prototype and 3 functional models of magnetofluidic devices for nuclear and hydraulic power engineering.

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