WORKSHOP

"ENERGY EFFICIENCY DAY @ AGH"

May 31St 2019, Krakow, Poland

Workshop Organiser:

AGH
Faculty of Energy
and Fuels

Workshop location: AGH, Faculty of Energy and Fuels, Building D-4, Classroom 118

Confirmed speakers: Prof. Oliwier Sawodny, Stuttgart University, Germany, Prof. Jacek Leszczynski and MSc Dominik Grybos, AGH, Poland.

WORKSHOP AGENDA

Time	Speaker, title
10:00 – 10:10	Welcome and short introduction
10:10 – 10:45	**Prof. Oliwier SAWODNY**, Institute for System Dynamics, University of Stuttgart, Geramy E-mail: oliver.sawodny@isys.uni-stuttgart.de **System Dynamics for Energy Efficiency in Pneumatics**
10:45 – 10:55	Discussion
10:55 – 11:30	**MSc Dominik Grybos, Prof. Jacek LESZCZYNSKI,** AGH University of Science and Technology, Faculty of Energy and Fuels, Department of Hydrogen Energy, E-mail: jale@agh.edu.pl **Double Transmission and Double Expansion approach for an increase of energy efficiency in compressed air sytems**
11:30 – 12:00	Discussion and Close

Short speaker biographies and presentation abstracts

Professor Oliwier SAWODNY

Pneumatic drives are in industrial automation systems very common. Under the perspective of energy efficiency pneumatic drives normally are seen as disadvantageous in comparison to electric drives. But, in fact the comparison between the different technologies is a challenging task and very often aggregated numbers mislead. In the talk at first a method is presented in a neutral view on the thermodynamics and the related efficiency numbers. As a second step a detailed view not only on the drive system but on the overall pressurized air net is discussed in deriving system dynamic equations for all components and thereafter analysing the net. The results are methods for sizing the net. The sizing idea is transferred to the dimensioning of the drives. Several optimization approaches are discussed to fulfil this task.

Short-Bio:

Professor Sawodny received his Dipl.-Ing. degree in electrical engineering from the University of Karlsruhe, Karlsruhe, Germany, in1991 and his Ph.D. degree from the University of Ulm, Ulm, Germany, in 1996. In 2002, he became a Full Professor at the Technical University of Ilmenau, Ilmenau, Germany. Since 2005, he has been the Director of the Institute for System Dynamics, University of Stuttgart, Stuttgart, Germany. His current research interests include methods of differential geometry, trajectory generation, and applications to mechatronic systems. He received important paper awards in major control application journals such as Control Engineering Practice Paper Prize (IFAC, 2005) and IEEE Transaction on Control System Technology Outstanding Paper Award (2013). He is a senior member of IEEE and senior editor of Mechatronics.

Professor Jacek LESZCZYNSKI

Jacek Leszczynski is a Full Professor at AGH University of Technology, Faculty of Energy and Fuels, Department of Hydrogen Energy, Cracow, Poland. He worked over twenty five years in project grants, industrial applications and academic programs that concern the following main scientific activities like modelling of complex systems and energy efficiency. He has been Principal Investigator and Research Coordinator on applied research and development projects at around 35 M€ including three successful EU project grants. His scientific activity includes modelling techniques of complex systems involving compressed air systems, energy efficiency, energy harvesting systems and devices, mechanics/flows of granular materials, fractional derivatives, population balance and DEM techniques, soft magnetic materials and inductive elements operating in high frequency bandwidth, as well as management of R&D groups oriented industrially. Summarizing educational background, he supervised many MSc theses from Energy Engineering, Computational Science, Mathematics and Environmental Protection and two PhD theses from Mechanical Engineering. He is an active member and expert of many scientific organizations, like National Centre of Research and Development, IEEE and the EU. He acts as Subject Editor of Applied Mathematical Modelling Journal (USA).

Double Transmission and Double Expansion approach for an increase of energy efficiency in compressed air systems

The main purpose of this work is focused on increasing the energy efficiency of pneumatic machines. We have proposed a more holistic approach – i.e. cyclical storage of exhaust air from selected outlets of an industrial– scale arbitrary pneumatic machine manufacturing. In this way, we use a double transmission and double expansion approach that utilise the otherwise – wasted energy accumulated in the air supplying such a machine, and thus we compensate for the complexity and over-scaling of this machine in the industrial scale. Here, we demonstrated a device that converts the stored energy into electricity. We have made analysis of thermodynamic cycles and then we discovered that utilisation of the exhaust air reduces the demand for gauge pressure in dead volumes. Thus, DTDE reduces the amount of air energy in such dead volumes. In order to illustrate energy savings we proposed two environmental factors - reduction of air consumption factor and reduction of the compressor's energy consumption - being able to asses DTDE approach. Such factors one may use to analyse electricity consumption by the compressor, as well as to decrease its time of operation. Industrial tests have been performed in order to demonstrate how to reduce the carbon footprint in sustainable manufacturing. In addition, we analysed Closed Cycle (CC) and Exhaust Air Re-circulation (EAR) technologies that utilise the air power collected from compressed air, which expands through muffles. In order to describe novelty and original approach we determine the following highlights:

- Double Transmission and Double Expansion (DTDE) approach has been supplemented with a new calculation method.
- Two environmental factors have been proposed that to assess the carbon footprint in sustainable manufacturing.
- New concepts as Closed Cycle (CC) and Exhaust Air Re-circulation (EAR) have been demonstrated.