COMBUSTION WEBINAR

Engines for Polygeneration

Speaker: Dr. Burak Atakan, University of Duisburg-Essen

Time: Jan. 16th 2021

10 am EST; 4 pm Paris; 10 pm Beijing.

Meeting: *Zoom*

Registration (required):

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Biography

Dr. Burak Atakan is currently a full professor for thermodynamics and Chair of Engineering Thermodynamics, department of Mechanical and Process Engineering at University of Duisburg-Essen. He received his Diploma in chemistry from University of Heidelberg and PhD in 1992 also from University of Heidelberg. Before he joined University of Duisburg-Essen, he was a research scientist and at DLR and Bielefeld University, and obtained his Habilitation in physical chemistry in 2000. Prof. Atakan received Benningsen Foerder Prize of the State of North Rhine-Westphalia in 1997. He is a Fellow of the Combustion Institute. He is in the Editorial board of the Energy section of Applied Sciences and was in the Editorial board of Open Journal of Thermodynamics.

Abstract: Natural gas and biogas are both consisting of large amounts of methane and are predominantly used for energetic usage, while around 5 % are used for chemical conversion in chemical industry. The methane usage will continue for many years to come, while both conversions take place with non-optimal efficiencies. One approach to overcome these low efficiencies is to use piston engines as chemical reactors for a combined production of work, heat, and useful chemicals like syngas (H2/CO) or acetylene. Such a polygeneration process is quite fuel rich, and thus, due to low flame speeds, a kinetically controlled homogeneous charge compression ignition process (HCCI) is preferable. This leads to the problem that methane is quite inert and measures are needed to ignite it after compression. High initial temperatures, high compression ratios, or different additives can help to overcome the inertness and can lead to ignition in such engines. These systems were analyzed with respect to the chemical kinetics, the thermodynamics, and the exergo-economics; in addition concepts for energy recuperation and product separation were developed and analyzed. In total, it is found from theory and from experiment that the combined process is in many cases preferable in comparison to separate processes for energy conversion and chemical conversion, but some challenges remain, like the relatively high amounts of additives needed for ignition. The concept can be expanded further towards using the piston-cylinder system as a compressor to convert mechanical energy in endothermal reactions to chemical energy for chemical energy storage, as will be explained. Results and ideas from several cooperation partners within the DFG research unit 1993 'Multifunctional conversion of species and energy' will be presented..

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