Lowering the obstacles for SMEs to adopt multi-physics biomass furnace simulations by providing a cloud based solution

H. Rusche[1], B. Peters[2], X. Besseron[2], A. Rousset[2], R. Lukoševičius[3], L. Paukštaitis[3], L. Narbutas[3]

1) Wikki GmbH, Ziegelbergsweg 68, 38855 Wernigerode, Germany, h.rusche@wikki-gmbh.de
2) Université du Luxembourg, 2, avenue de l'Université, L-4365 Esch-sur-Alzette, Luxembourg, bernhard.peters@uni.lu
3) Enerstena UAB, Ateities ave. 30A, 52163 Kaunas, Lithuania

Biomass as a renewable energy source continues to grow in popularity to reduce fossil fuel consumption for environmental and economic benefits. The combustion chamber of a biomass furnace is typically equipped with a forward acting grate that transports the fuel (e.g. wood chips) through the combustion chamber. During the pyrolysis step, the fuel releases hydrocarbons which are burned in the gas phase above the grate. The simulation therefore requires a hybrid four-way coupling between the Discrete Element Method (DEM) and Computational Fluid Dynamics (CFD) complicating the setup, execution and post-processing.

Many manufacturers of biomass furnaces are small to medium sized enterprises (SMEs). Although such simulations could be an important element in the digitalization of their business, the adoption of such technologies requires substantial investment in computer hardware, software licenses and last but of least training of engineering staff. The Cloudifacturing EU project (www.cloudifacturing.eu) aims to democratically boost the competitiveness of such manufacturers by supporting a set of applications where technological and commercial scalability is considered from the beginning. The simulation of biomass furnaces has been selected as one of them.

The core simulator used in the application is based on the extended discrete element method (XDEM) developed at the University of Luxembourg. For the CFD part, FOAM-extend is utilised. The computational work-flow will include a domain-specific user interface based on MS Excel, validation of the input, geometry and mesh generation, case set-up, execution in an high-performance computing (HPC) environment as well as automated reporting and post-processing. The work-flow deals with the DEM and CFD domain in a consistent and unified manner.

The presentation will outline some challenges of biomass furnace simulations, describe the computational work-flow and the choice and design of the user interface. Initial results for Enerstena's biomass furnace will be presented. It will demonstrate how manufacturing SMEs are empowered to compute and solve problems that cannot be tackled without Cloud and HPC technology, making them more competitive by reducing development times for innovative products with better performance.