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The project is conceived to form the basic know-how for the spreading of the biomass co-generation technology. The aim is the formation of a real-scale permanent lab able to bridging the gap between research and industrial application of the biomass gasification technology. Here is reported the numerical modeling of the process, regarded as a tool able to identify the influence of different parameters on the operation of the gasifier. The analyses presented is divided in two steps: Syngas Formation and Tar Condensation analysis

Woodchip downdraft gasifier for cogeneration installed at the University of Parma Campus:
200 kW_{th}
20 kW_{el}

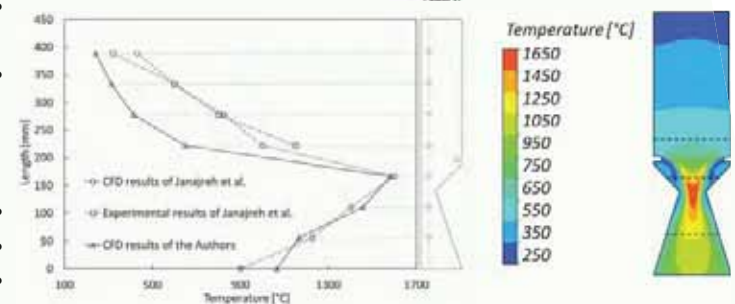


SYNGAS CONVERSION ^a

- Design and optimization of gasifiers increasingly rely on of CFD
- Determination of numerical model able to simulate all the phases of the gasification process

Computational Model

- DPM + Chemical Reactions
- Validation of model on literature test case¹
- Application to real-scale gasifier

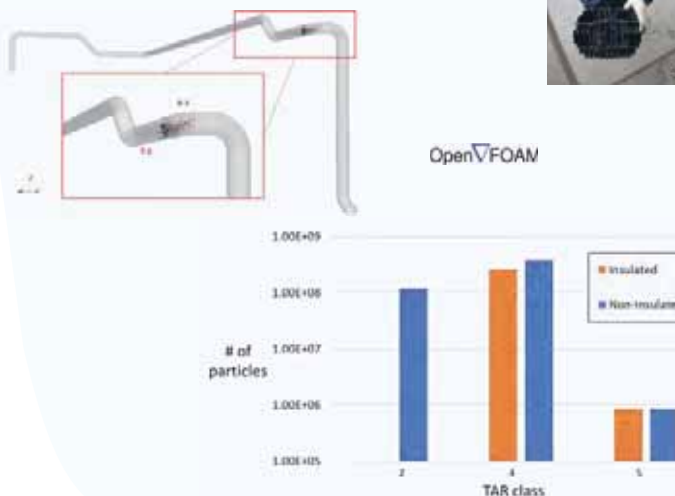


TAR CONDENSATION ^b

- Among the biggest problems in biogas application, as it causes fouling, efficiency loss and unscheduled stops
- Composition-dependent condensation modeling to match the exact syngas (ECN-Thersites²)
- Determination of areas affected by deposition in order to schedule the cleaning and to focus on specific sections to reduce the down-time of the system

Computational Model

- Lagrangian particle tracking & mesh morphing
- Application to fuel supplying duct of gasifier @ UNIPR campus
- Effect of insulation



REFERENCES

- ¹Janajreh, Isam, and M. Al Shrah. "Numerical and experimental investigation of downdraft gasification of wood chips." *Energy Conversion and Management* 65 (2013): 783-792.
- ²Thersites, the ECN tar dew point site, <http://www.thersites.nl/tardewpoint.aspx>, accessed: 2018-12-31



GASIFICATION OF LIGNOCELLULOSIC BIOMASSES IN SMALL CUTTING COGENERATION SYSTEMS FOR THIRD PARTY SECTOR

PUBBLICATIONS

- ^aVulpio, A., Casari, N., Morini, M., Pinelli, M., & Suman, A. (2019). Numerical Investigation of a Wood-Chip Downdraft Gasifier. In *E3S Web of Conferences* (Vol. 113, p. 01002). EDP Sciences.
- ^b Casari, N., Pinelli, M., & Suman, A., Morini, M., & Candido, A. Deposition of syngas tar in fuel supplying duct of a biomass gasifier: a numerical study. *Fuel*, under review.