הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע״ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

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E503, North Campus(GTIIT)

Zoom: https://gtiit.zoom.us/j/93745865902

Multiscale modeling of biomass-sand binary fluidization and biomass-coal co-combustion in an ironmaking blast furnace

Zihao Ma

MSc Seminar

Advisor: Prof. Xi Gao, Prof. Moshe Sheintuch
1. Department of Chemical Engineering, Guangdong Technion-Israel Institute of Technology, China
2. Department of Chemical Engineering, Technion-Israel Institute for Technology, Israel

Biomass derived from agricultural residues, forest waste, and municipal solid waste represents a sustainable energy source with unique properties that significantly impact its behavior in industrial processes. Optimizing biomass utilization requires the development of accurate computational models with corresponding experimental validation. This research developed multiscale simulation methods to investigate biomass behavior in two distinct industrial applications: fluidized bed systems and blast furnace ironmaking.

In the first work, a coarse-grained Superquardic discrete element method combined with computational fluid dynamics (CG-SuperDEM-CFD) was developed to investigate how particle shape and mass fraction affect biomass-sand fluidization dynamics. The model validation utilized high-speed camera image processing techniques, with detailed analysis of key parameters including pressure fluctuations, bed expansion characteristics, particle distribution patterns, and bubble formation behavior. Results demonstrate that both particle shape and mass fraction significantly influence fluidization quality, while providing essential validation data for non-spherical particle simulations.

In the second work, a multiscale CGDEM-CFD model was established to simulate biomass-coal co-combustion processes in blast furnace raceway and coke bed regions. Following validation with laboratory and industrial measurements, the model was applied to analyze the effects of biochar properties, blending ratios, and operational parameters. Simulation results reveal that increased biomass proportions enhance coal combustion efficiency while moderately reducing biomass burnout due to heat competition. Operational conditions further impact combustion performance by affecting devolatilization processes and particle movement patterns.