

Abstract: Gasification of solid feedstocks is a popular methodology for the production of useful chemicals and synthetic fuels. Lately, gasification has gained popularity as a viable option for clean energy generation from coal via Integrated Gasification Combined Cycle (IGCC) plants. However, the design of gasifiers and their operation has largely been an experience based enterprise. Most, if not all, industrial scale gasifiers were designed before it was practical to apply CFD models. Moreover, gasification CFD models developed over the years may have lacked accuracy or have not been tested over a wide range of operating conditions, gasifier geometries and feedstock compositions. One reason behind this shortcoming is the failure to incorporate detailed physics and chemistry of the coupled non-linear phenomena occurring during solid fuel gasification. Moreover, in a multiphysics problem like gasification modeling, one needs to balance the effort expended in any one submodel with its effect on the accuracy of predicting some key output parameters.

Focusing on the aforementioned considerations in this seminar, I will describe the bottom-up construction of my multiphysics CFD gasification model, emphasizing the validation of the turbulence and char consumption models. The integrated model is validated with experimental data from various pilot-scale and laboratory-scale gasifier designs, further building confidence in the predictive capability of the model. Finally, the validated model is applied to conduct a sensitivity analysis on the MHI and GE gasifiers. The model is demonstrated to provide useful quantitative estimates of the expected gain or loss in overall carbon conversion when critical operating parameters such as feedstock grinding size, gasifier mass throughput and pressure are varied.

Speaker Bio: Mayank Kumar holds a BTech from IIT Kanpur and MS/PhD from MIT, all in Mechanical Engineering. His research interests include clean coal technology, energy conversion systems, turbulent reacting multi-phase flows and radiative heat transport. He also has a diverse industry experience, having worked in the Oil & Energy sector and founded a technology startup.