Podium session

Assessing Heat Transfer through Walls of Packed Bed Reactors by an Innovative Particle-Resolved Approach

Bernhard Peters[1], A. Estupinan[1], X. Besseron[1], A. Mouhmadi[1] and M. Mohseni[1]

bernhard.peters@uni.lu

[1] Université du Luxembourg, Faculté des Sciences, de la Technologie
et de la Communication, 6, rue Coudenhove-Kalergi, L-1359 Luxembourg, Luxembourg

Packed beds are frequently applied in the chemical processing industry for a variety of processes such as absorption, tripping, distillation, and catalytic reactors. Understanding and optimizing the heat transfer through both internal and external reactor walls is important in order to decrease the cost of running the equipment. Due to the complexity of packed bed reactors, heat transfer is mainly assessed through experiments and derived empirical correlations that obviously depend on the operating conditions and include a degree of uncertainty. Therefore, the objective of the current contribution is to present an accurate numerical approach to determine heat transfer between particles of a packed bed in contact with reactor walls. It relies on the novel technique referred to as Extended Discrete Element Method (XDEM) and is based on a coupled discrete and continuous i.e. Lagrange-Euler numerical simulation concept. An outstanding feature of the numerical concept is that each particle in addition to its position and orientation in time and space is described by its thermodynamic state e.g. temperature and reaction progress. Available positions of particles allow determining contact areas between particles and walls for heat transfer. Walls are resolved by a traditional CFD approach that predicts the spatial and transient temperature distribution within walls based on energy conservation. Thus, both thermal losses through reactor walls and heat transfer in tabular reactors are evaluated with a high degree of accuracy also dependent operating conditions. The approach has been validated with measurements for packed bed reactors and very good agreement has been achieved.