# EXPERIMENTAL INVESTIGATION OF PARTICLE-WALL INTERACTIONS AT DIFFERENT LENGTH SCALES RELEVANT TO ENTRAINED-FLOW SLAGGING COAL GASIFIERS

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This paper deals with near-wall particle segregation phenomena in entrained-flow slagging coal gasifiers. The recent literature has addressed the fate of char particles by assessing the relative importance of coal conversion associated with the entrained-flow of carbon particles in a lean-dispersed phase and the segregated flow of char particles in a near-wall dense-dispersed phase. The main objective of this study is to use the tool of the physical modelling in order to give a contribution in the mechanistic understanding of particle-wall interaction patterns in entrained-flow gasifiers. Different scales of investigation were pursued, relevant to study the fluid dynamic conditions which lead to near-wall particle segregation. Particle segregation regimes in the near-wall region and the micromechanical particle-wall interaction patterns on the basis of the mechanisms governing particle impact on the wall and the consequent post-impact phenomena were investigated. Experiments were carried out in a lab-scale optically accessible cold entrained-flow reactor (0.1 m ID) where molten wax was air-atomized (droplets of 10-100 μm size) into an air mainstream to simulate the fate of char/ash particles in a real hot environment. The operating conditions in terms of air mainstream and wall temperature were chosen such as to simulate the interaction of solid char particles with a solid wall ("non sticky wall-non sticky particle" regime). The partitioning of the wax particles into a dilute-dispersed phase, a dense-dispersed phase and the layered material on the wall was characterized by controlled discharge at the exhaust. The effect of atomizing air flow rate, mainstream air flow rate and reactor length onto the lean-dispersed phase fraction was studied to evaluate the effect of different gas flow conditions onto both the lean-dispersed phase fraction and the particle-wall interaction patterns. Particle-wall interactions and segregation patterns were assessed by direct visual observation and analysis of snapshots captured by a CCD camera. Furthermore, micromechanical particle-wall interaction patterns were studied by means of an appropriate experimental apparatus which permitted to record a single particle/droplet impact on a flat surface. From the analysis of snapshots captured by the CCD camera, particle-wall collision was described in terms of the particle restitution coefficient. For this kind of experiments, the effect of particle impact velocity, impact angle, particle size and temperature was investigated. In particular, the particle restitution coefficient decreased with operating conditions which promote plastic deformation upon particle impact (high impact velocity and high temperature).

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