CFD-DEM Simulation of a Continuous Tablet Coating Process at Different Scales

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Key Words: *Multiphysics Problems, CFD-DEM Coupling, Heat and Mass Transfer,*

Tablet coating is one of the most simulated processes in pharmaceutical industry [1], [2]. This is mainly due to two reasons: first, it is a widely used unit operation and secondly, tablets themselves are relatively large particles. Simulating the industrial scale process is easy and fast to realize compared to other processes at this scale. Traditionally, large-scale drum coater systems are loaded with hundreds of kilos of tablets and rotate at relatively low rotation rates (Fr<<1). This leads to several hours of batch processing in order to obtain sufficient coating uniformity. Furthermore, air flow inside the drum coater can be neglected because it does not influence the tablet movement, further simplifying the simulations.

The ConsiGma™ coater from GEA is a semi-continuous tablet coater which can be integrated into the GEA ConsiGma™ continuous processing line. The ConsiGma™ coater operates with low drum loads (up to 7 kg) but very high rotation rates (Fr~1) and spray rates leading to significantly shorter process times in the range of a few minutes. In order to stay flexible with regard to different drum loads there are interchangeable drum sizes (80, 160 and 320 mm). To achieve better coating results and increase mixing, the tablets are jetted away from the rotating drum wall by so-called air knives in order to form a stable, gravity-free cascade. In contrast to traditional large-scale drum coaters, the air flow needs to be considered to accurately simulate the coating process in the GEA ConsiGma™ coater.

A model to simulate the coating process in the ConsiGma™ coater using CFD-DEM is presented. The eXtended Particle System (XPS) is used for the DEM simulation and is coupled to AVL Fire® for the CFD[3]. The validity of the simulation results, as well as the method for modeling the drag including the non-sphericity of the tablets, are shown. Different approaches for quantitative and qualitative validation of the simulations will be presented. A computational design of experiment will be performed in the GEA ConsiGma™ coater to evaluate different process settings as well as the impact on the coating mass distribution, heat and mass transport inside the coater and mass throughput, respectively.

This work was funded through the Austrian COMET Program by the Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT), the Austrian Federal Ministry of Economy, Family and Youth (BMWFJ) and by the State of Styria (Styrian Funding Agency SFG).

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