

Experimental and model-based investigation of twin screw granulation: towards more profound process knowledge

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Twin-screw granulation (TSG) is a promising technology for continuous wet granulation, as it achieves mixing by a combination of screw configuration and process settings (e.g. feed rate, screw speed, etc.) to produce a certain end-product specification in a short time. However, to optimise and control this new technology, understanding of the mixing and the dominating granulation sub-processes is needed. This study is an initial step in combining experimental observations and mathematical models for gaining such knowledge regarding continuous twin screw granulation. The residence time distribution (RTD) in a TSG provides interesting information to understand its mixing behaviour. However, in order to predict the mixing precisely, modelling of the RTD is desirable. In this study, an analytical model based on classical chemical engineering method for dynamic transport modelling was developed. The simulation data were compared with the experimental residence times obtained from near infrared chemical imaging to validate the model (Fig. 1.a). In addition, the change in GSD and dynamics along the TSG barrel in order to understand the function of individual screw modules and their interaction was investigated experimentally. Dynamic image analysis was performed to evaluate the changes in size of granules sampled from different locations in the barrel. The results from the two studies have been utilised to develop a population balance model (PBM) for a continuous TSG (Fig. 1.b). The focus is on the modelling of the rate processes considered dominant in the kneading element regions of the granulator, namely aggregation and breakage. The results demonstrated by this experimental and modelling study will be further used as a basis for development of multi-dimensional PBM involving particle properties (size, porosity and saturation etc.).

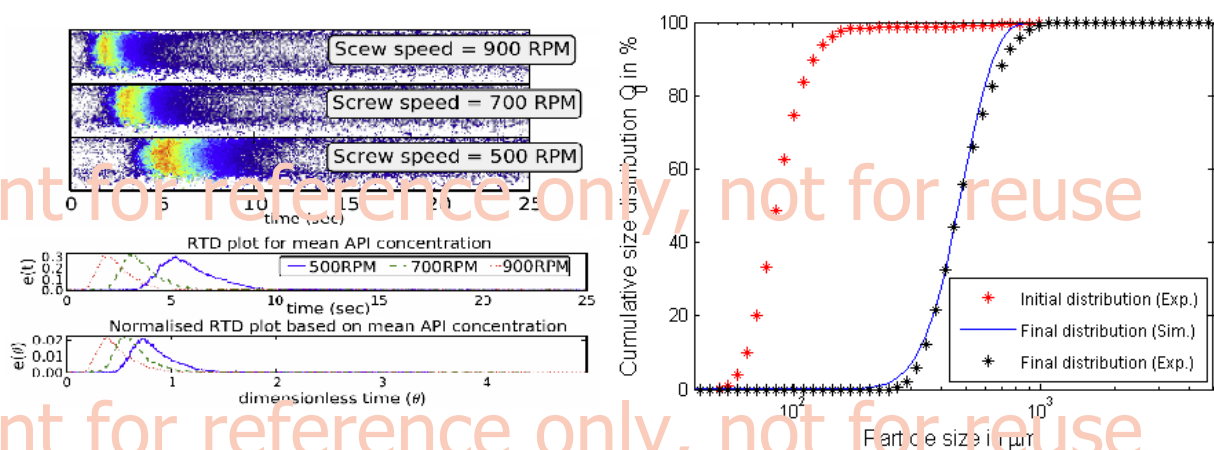


Figure 1: (a) NIR chemical map of API to measure residence time distribution and (b) verification of particle size distribution predicted using PBM