

Abstract topic category: Continuous Manufacturing

Preferred mode of presentation: Oral

Experimental investigation of residence time distribution in twin-screw granulation

Ashish Kumar^{a,b}, Jurgen Vercruyse^c, Maunu Toiviainen^d, Panouillot Pierre-Emmanuel^d, Mikko Juuti^d, Valérie Vanhoorne^c, Krist V. Gernaey^d, Thomas De Beer^{b,1}, Ingmar Nopens^{a,2}

a. BIOMATH, Dept. of Mathematical Modelling, Statistics and Bioinformatics, Faculty of Bioscience Engineering, Ghent University, Coupure Links 653, B- 9000 Gent, Belgium

b. Laboratory of Pharmaceutical Process Analytical Technology, Dept. of Pharmaceutical Analysis, Faculty of Pharmaceutical Sciences, Ghent University, Harelbekestraat 72, B-9000 Ghent, Belgium

c. Laboratory of Pharmaceutical Technology, Dept. of Pharmaceutics, Faculty of Pharmaceutical Sciences, Ghent University, Harelbekestraat 72, B-9000 Ghent, Belgium

d. Optical Measurement Technologies, VTT Technical Research Centre, Kuopio, Finland

e. Center for Process Engineering and Technology, Department of Chemical and Biochemical Engineering, Technical University of Denmark, 2800 Kongens Lyngby, Denmark

The residence time distribution (RTD) in a twin-screw granulator (TSG) contains interesting information about mixing and different granulation rate processes such as growth and breakage during granulation. In this study, near infra-red (NIR) chemical imaging was used to characterise the impact of process (feed-rate (MFR) and screw-speed (N)) and equipment parameters (number of kneading discs (NK) and stagger-angle (SA)) on the RTD. Moreover, mean residence time (MRT) and variance values were calculated and used to characterise the macro-mixing in the axial-direction through the Péclet number (Pe) and number of equally sized stirred tanks (n) from Tank-in-series (TIS) model. Results showed that MRT of powder in the barrel were mostly influenced by N, followed by NK and SA. The mixing regime reflected by Pe and n showed that MFR and SA, although having much less effect on MRT, played a significant role in macro-mixing at high barrel filling conditions (low N and high MFR), reflected by almost doubling of n (from 10 at 30° to 22 at 60°). The latter indicates an increase in axial segregation. These results contribute to the understanding of back-mixing in TSG and form the basis for improved physical models of twin-screw granulators.

¹ Shared last authorship

² Email: Ingmar.Nopens@ugent.be