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Saad Sulttan, Sohrab Rohani

PII: S0022-0248(18)30498-6
DOI: https://doi.org/10.1016/j.jcrysgro.2018.10.012
Reference: CRYS 24785

To appear in: *Journal of Crystal Growth*

Received Date: 23 August 2018
Revised Date: 2 October 2018
Accepted Date: 4 October 2018

Please cite this article as: S. Sulttan, S. Rohani, Coupling of CFD and Population Balance Modelling for a Continuously Seeded Helical Tubular Crystallizer, *Journal of Crystal Growth* (2018), doi: https://doi.org/10.1016/j.jcrysgro.2018.10.012

Coupling of CFD and Population Balance Modelling for a Continuously Seeded Helical Tubular Crystallizer

Saad Sulttan[1, 2]* and Sohrab Rohani[1]

1. The University of Western Ontario, Department of Chemical and Biochemical Engineering, London, Ontario N6A 5B9, Canada.
2. University of Technology, Department of Chemical Engineering, Baghdad, Iraq.

*Correspondence: Saad Sulttan (E-mail: salsuway@uwo.ca)

Abstract:

A comprehensive model coupling the computational fluid dynamics with the population balance equation (CFD−PBE) for a continuous seeded mixed suspension mixed product removal (MSMPR)-helical tubular (HT) crystallizer assembly has been developed. The model accurately depicts the fluid dynamics, mass transfer, heat transfer and crystal size distribution (CSD) in the MSMPR-HT crystallizer. The crystallization system considered was to produce metastable α-form of L-glutamic acid. The PBE was discretized using a high-resolution central scheme and solved simultaneously with CFD equations in COMSOL Multiphysics® utilizing user-defined scalars. A good agreement was observed between the model and experimental data for the metastable α-form crystals of L-glutamic acid with uniform particles and a mean crystal size of 160 microns. The continuous crystallization under different stirrer speeds, saturated solution flow rates, inlet saturated solution concentrations and temperature was investigated. It was found the higher stirrer speeds, saturated solution flow rate and temperature lead to uniform distribution with smaller crystal size. Moreover, the mean crystal size becomes larger and the CSD wider when the saturated solution concentration increase.

Keywords: A1. Growth models; A2. Industrial crystallization; A2. Natural crystal growth; A2. Seed crystals; B1. Acids.