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PII: S1385-8947(18)31453-0
DOI: https://doi.org/10.1016/j.cej.2018.07.202
Reference: CEJ 19600

To appear in: *Chemical Engineering Journal*

Received Date: 22 November 2017
Revised Date: 23 July 2018
Accepted Date: 29 July 2018

Please cite this article as: C.L. Har, N. Fu, E.S. Chan, B.T. Tey, X.D. Chen, In situ crystallization kinetics and behavior of mannitol during droplet drying, *Chemical Engineering Journal* (2018), doi: https://doi.org/10.1016/j.cej.2018.07.202

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ABSTRACT

In this paper, we explain the crystallization process of mannitol during convective droplet drying based on the crystallization kinetics calculated from two mathematical models coupled with experimental investigations. A novel differential-reaction engineering approach was developed, correlating the mannitol crystallization behavior to the deviation of droplet drying kinetics at different drying temperatures. The model was compared with a conventional glass transition-based model and the evolutions of droplet saturation state, density and morphology during drying were experimentally determined, to provide a comprehensive analysis on the crystallization of mannitol as droplet drying progressed. Two crystallization stages were identified. Mannitol solids firstly nucleated and precipitated at droplet surface, and the crystallization kinetics was similar at different drying temperatures (70, 90 and 110 °C). The removal of residual moisture at the second stage was dependent on the drying temperature, with lower temperatures of 70 and 90 °C exhibiting an extended crystallization period