Vacuum contact drying of crystals: Multi-scale modelling and experiments

Martin Kohout¹, Alan P. Collier² and Frantisek Stepanek¹,*
¹Department of Chemical Engineering and Chemical Technology
Imperial College London, London SW7 2AZ, United Kingdom
²GlaxoSmithKline Ltd.,
Temple Hill, Dartford, Kent DA1 5AH, United Kingdom

Abstract
A methodology for multi-scale modelling of the unit operation of vacuum contact drying has been developed, with the aim of parameter transfer from the laboratory scale to the pilot-plant scale. Models at three hierarchical levels – (i) lumped-parameter model of the unit operation, (ii) distributed-parameter model of heat and mass transfer in a particle bed of given size and geometry, and (iii) particle-scale model of heat and mass transfer for the estimation of effective transport properties – have been formulated and solved. Experimentally measured drying rates in a laboratory-scale vacuum dryer have been analysed using volume-averaged temperature profiles evaluated from the continuum model, and the effective heat-transfer coefficients have thus been obtained.

Keywords: drying, heat transfer, mass transfer, multi-scale modelling, particle systems.

* Author to whom correspondence should be addressed: f.stepanek@imperial.ac.uk