

Abstract

A theoretical model characterizing the drying behavior of ibuprofen and naproxen in a co-rotating twin screw hot melt extruder was developed and simulated. The wet drug was modeled as a rectangular slab of drug and water. The model was used to study the effects of initial to external temperature ranges (293.15 – 298.15 K and 298.15 – 323.15 K), initial moisture/water content as a percent composition of drug to water (50/50 and 96/4), dry air flowing above and/or below the slab, volumetric flow rate of air (0.5, 1, 5, 10, and 15 m³/h), equipment/slab size (ZSK 18 Extrusion System (Coperion) and Micro 27 Extrusion System (Leistritz) extruders) and drug type (ibuprofen and naproxen) on the drying behavior. COMSOL Multiphysics, a modeling software package, was used to simulate the drying process for a period of 12 hours. Concentration and temperature profiles at the center of surface, base, and center of the slab were analyzed, as well as the overall moisture content over time.

Temperature range was determined to not affect the drying process. The system with a higher initial moisture content had a greater residual moisture content than the system with a lower initial moisture content. However, the drying curves indicated that extension of the drying period would not further reduce the moisture content. Drying was overall faster when drying air was passed above and below the slab. Drying was also determined to have a direct relationship with the flow rate of air. Both drugs investigated dried fastest in the ZSK 18 sized slab. Drug type, however, did not affect the drying process.

The optimum conditions for the drying process include airflow on both the top and the bottom of the slab, a ZSK 18 sized slab, and an air flow rate of 15 m³/h. Definitive conclusions about the impact of the other parameters investigated require further investigation into the effect of a wider range of temperatures, initial moisture contents, and drug types.