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传递现象

冷冻干燥过程相迁移和相分布的孔尺度网络模型与模拟

刘永忠[1];赵雁飞[1];陈三强[1];孙皓[1]

西安交通大学环境与化学工程学院化学工程系[1]

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摘要 构建了51×51二维孔-喉网络模型对冷冻干燥过程的升华干燥阶段进行模拟。与传统的连续介质模型相比，孔网络模型的特征是具有跟踪干燥过程中物料内部的干燥前沿和相分布的能力。采用网络模型预测了牛肉和火鸡肉的干燥曲线，并模拟了不同冻结速率的火鸡肉在干燥过程中形成的相分布。讨论了模型的计算特性，并分析了孔径分布对相分布特性的影响。结果表明：网络模型可较好地预测升华干燥阶段，可在孔尺度上揭示干燥过程的动力学机理，将为准确地判断升华干燥与解析干燥的转变点提供理论计算基础。

关键词 冷冻干燥；网络模型；模拟；孔径分布；相分布

分类号

Simulation of transport processes and phase distributions during freeze-drying by pore-scale network modeling

Abstract

A 51×51 pore-throat network model was proposed to predict the primary drying stage of the freeze-drying process.The unique feature of the network model was the ability to track the evolution of drying front and phase distributions during drying.The drying curves of turkey meat and beef were simulated to verify the model.The characteristics of phase distributions during freeze drying of turkey meat samples frozen at different freezing rates were investigated.The computational characteristics of the model and the effects of pore size distributions on the phase distribution were analyzed and discussed.The simulation results showed that the model was capable of predicting the drying curves well during the primary drying stage.The pore-scale network model would provide insights into better understanding of drying dynamics at the pore level.It would serve as the theoretical foundation for rigorously determining the transition point from primary drying stage to secondary drying stage.

Key words freeze-drying；pore-scale network model；simulation；pore size distribution； phase distribution

DOI:

通讯作者 刘永忠 yzliu@mail.xjtu.edu.cn