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粮食水分结合能与热风干燥动力解析法

Analytical study of grain moisture binding energy and hot air drying dynamics

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中文摘要:

为揭示粮食中水分蒸发耗能特征, 基于不可逆热力学分析方法, 把水分迁移的现象看作是一定数量的能量迁移, 建立水分结合能解析模型, 给出了水分结合能随温度、含水率变化规律, 清晰地呈现了粮食在高水分段水分蒸发受物料的限制作用很小, 而在低水分段水分结合能随温度升高显著降低的特征, 研究结果为解析粮食二段降速干燥过程、合理匹配干燥温度提供了依据和分析方法, 为揭示干燥质驱动机理, 制订科学的能效评价标准, 合理的干燥装备系统设计补充了技术基础理论。

英文摘要:

Abstract: In order to explore the characteristics of energy consumption for drying grain, the moisture migration potential and its characteristic function in grain were determined by the method of irreversible thermodynamics. Analytical models of moisture binding energy were established by considering the moisture migration as a certain amount of energy transfer. Analytical methods of drying force and quantitative evaluation of energy consumption in grain drying were applied to analyze changes of moisture binding energy with temperature and moisture. The result showed that evaporation from grains with high moisture content was little affected by grain features, and moisture could be mostly dried in normal air. Moisture binding energy of grains with low moisture content was significantly decreased with increasing temperature. It indicated that low moisture grain dried at high temperature was inexpensive, on the contrary, increasing the temperature of grain did not improve energy consumption for moisture evaporation in high moisture grain. This study provided valuable information for analyzing the two-stage drying process and drying temperature in grain drying, revealed the driving mechanism of drying mass and the exergy, established exergy transfer model of high moisture grain, analyzed the change laws of exergy value, and proposed a scientific evaluation standard for energy efficiency and the reasonable design of drying system.

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