Temperature and Heat Flow Analysis in a Drying Chamber Through Finite Element Method

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Abstract Food production sectors have changed, transitioning from micro-enterprises and traditional, family-run operations to enormous investments and highly sophisticated industrial processes. However, the raw materials for food manufacturing are still derived from local farming or fishing. Thus, advancements in food technology are necessary to minimize spoiling, where it can reduce the strain on employees in processing food quickly. It is well recognized that the drying process of food, particularly fruits, is an essential production operation in the industry. The current drying technique is time and costly, as it takes several hours for the food or fruit to dry completely. Understanding the drying phenomena requires heat flow and temperature distribution studies within a drying chamber. It is expected that, by understanding the influence of design parameters on a drying chamber, it would be possible to use it more efficiently and enhance output. The aim of this study is to analyze the food preserving using the method of conventional drying through temperature and humidity observation, by modelling the behavior of temperature and heat flow inside a drying chamber through Finite Element Method and validate the modelled condition with a commercially available drying chamber. A specific FEM modelled is designed and tested with various parameters to understand the heating behavior, along with actually drying process with the commercially available drying chamber. From the study, various fruit/food/material has variety of drying rate due to surface properties (pore size, thickness etc.). From the FEM analysis, from the increasing heat flux, heating effective range increases because of increasing heat flow rate. Decreasing fin gap, heat flux requirement decreases because of increasing heating effectiveness, yet material cost increases, plus with decreasing inlet air speed will decrease the heat flux requirement, but will increases the drying chamber heating time to reach the required temperature.

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