UNIVERSITY OF GUELPH, SCHOOL OF ENGINEERING
ENGG*6160 ADVANCED FOOD ENGINEERING, F'2008

Calendar description

Application of heat and mass transfer, fluid flow, food properties and processing constraints in the design and selection of food process equipment. Development of process specifications for the control of the flow of heat and moisture and associated microbial, nutritional and organoleptic changes in foods. Food system dynamics and process development.

Objectives

1. To develop process conditions for unit operations such as dehydration.

2. To describe conceptually the basic transfer mechanisms and provide several approaches to the reduction of transfer resistances for given heat, mass, or momentum processes, as restricted by product considerations.

3. To identify the physical and chemical basis for food component orientation in food materials and the changes in physical structures which result from treatments.

4. To select a food product, process and/or analysis approach in which the property is significant and justify the selection in terms of principles for similar model systems.

5. To select reasonable indicators of microbial, nutritional, and organoleptic quality for a given product and process; and to identify the major areas of process uncertainty for a given product-process and to outline a program for improved process definition and control.

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Text

Advanced Food Engineering Notes by G.S. Mittal

Topics

1. Modeling and Simulation
2. Modeling based on Mass and Energy Balances
   - Mass Balances, Energy Balances, Mass Transfer Basics
   - Matlab
   - Process modeling and simulation
     - (i) Pasteurization of a beverage in a can
     - (ii) Temperature profiles of particulate solids in liquid during pasteurization
3. Modelling Food Processes Involving Transport Processes
   - 3.1 One Dimensional Mass Transfer in an Infinite Slab
   - 3.2 One Dimensional Mass Transfer in an Infinite Cylinder
   - 3.3 Two Term Model
   - 3.4 One Dimensional Mass transfer with Concentration dependent Moisture Diffusivity–Infinite Slab
   - 3.5 One Dimensional Heat and Mass transfer with Concentration dependent Diffusivity–Infinite Cylinder

3.6 Modeling Mass transfer by Diffusion and Convection in an Infinite Slab
3.7 Modeling Mass transfer by Diffusion and Convection n an Infinite Cylinder
3.8 Modeling Mass transfer by Diffusion, Convection and Depletion by Chemical Reaction in an Infinite Slab
3.9 Modeling Mass transfer by Diffusion, Convection and Depletion by Chemical Reaction in an Infinite Cylinder
3.10 Frozen food transport in insulated containers - modeling and simulation

4. Cooking and Frying Processes
4.1 Introduction
4.2 Frying
4.3 Dielectric and microwave drying
4.4 Osmotic drying
4.5 Roasting
4.6 Cooking of a Spherical Product--modeling and simulation
4.7 Modeling the deep-fat frying of spherical food products
4.8 Crust formation dynamics and quality kinetics during meatballs frying
4.9 Modeling and Simulation of Low-fat Fried Foods with Edible Coatings

5. Food Quality Modeling
5.1 Thermal Softening of Potatoes and Carrots
5.2 Selection criteria of meat emulsion fillers based on cooking kinetics and filler properties
5.3 Kinetic Modelling of Quality Changes of Fruits and Vegetable in Storage
5.4 Food Quality Modeling: Optimizing Smokehouse Process Conditions for Meat Emulsion Cooking
5.5 Meat Quality Kinetics During Beef Carcass Chilling
5.6 Color Kinetics During Beef Carcass Chilling

6. Process Optimization
6.1 Product development process and process flow charts
6.2 Process flow charts
6.3 Linear Programing
6.4 Dynamic Programing

7. Process Modeling and Design
7.1 Blanching
7.2 Heat and Mass Transfer in Spherical Biological Products
7.3 Simulation of Heat Transfer in an Apple during Air Cooling
7.4 Modelling of a Scraped Surface Heat Exchanger (SSHE)
7.5 Dynamic Simulation of a Nonlinear Model of a Double-Effect Evaporator
7.6 Two Dimensional Heat Transfer Through A Can During Thermal Processing
7.7 Heat and Mass Transfer During the Washing of Cottage Cheese Curd
7.8 Heat Transfer During Cheese Brining
7.9 Beef carcass chilling--heat and mass transfer modelling and simulation

Evaluation

Assignments (25%) and Project (25%)	50%
Examination I	25%

Examination II (Final) 25%

Reference material

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