 ISSN 2362-0412

Meshfree-Based Numerical Modelling of Plant Tissue Shrinkage under Localised Moisture Content Variation

H.C.P. Karunasena[a], R. M. Charith Malinga[b], Y. T. Gu[c] and Wijitha Senadeera[d]

[a]*Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, University of Ruhuna*
[b]*Department of Chemical and Process Engineering, Faculty of Engineering, University of Moratuwa*
School of Chemistry, Physics and Mechanical Engineering, Faculty of Science and Engineering, Queensland University of Technology

[a] *chaminda@mme.ruh.ac.lk*

Abstract

Dried plant food products are of high commercial importance due to the ever increasing demand in the consumer market. In order to improve the product quality and process performance, fundamental understanding on the underlying mechanisms of plant food tissues is essential. In this regard, numerical modelling has a very high potential to be involved in the prediction of structural characteristics of food products under different processing conditions. However, the complexities involved in the heterogeneous plant tissue structure restrict the applicability of most popular grid-based numerical modelling techniques such as Finite Element Methods (FEM) or Finite Difference Methods (FDM), in this context. Particularly, the limitations become more critical when the tissue structure undergoes large deformations and phase change phenomena during drying, in the presence of localised moisture content variations. As an alternative to the grid-based techniques, this work investigates the applicability of a novel meshfree-based numerical modelling approach to simulate dried plant tissue structural deformations, particularly when the localised moisture content variations are present. The technique involves Smoothed Particle Hydrodynamics (SPH) and Discrete Element Method (DEM). Simulation results are presented on apple tissues, implying that the tissue shrinkage is critically influenced by the cellular moisture content variation at different regions of the tissue.

Keywords: *Food drying, Meshfree methods, Moisture content, Plant tissue, SPH*