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CONSOLIDATION COEFFICIENTS IDENTIFICATION OF SOLID-LIQUID EXPRESSION FROM SOFT PLANT MATERIALS

Solid-liquid expression of biological materials is an important unit operation in the food, chemical,energy and related industries, which is used for the extraction of vegetable oils, dehydration of fibrous materials, dewatering of waste water sludge and so forth. During expression, the porous layer formed by a whole grain or fragmentized material is subjected to compression in industrial presses . Such compression can be carried out under constant or variable parameters. Raw biological materials contain liquid filled cells, hydrated cell walls, micro-channels between cells and intercellular spaces containing air, i.e. are a porous media with different types of pores and channels [1].

In this paper we consider the sliced cellular particles containing liquid as a porous layer subjected to unidimensional pressing. The liquid flows occurs inside the particles of intraparticle space, outside the particles of extraparticle space and between these two spaces. The sliced particles are rectangular parallelepipeds separated by the porous network. The layer of sliced particles is considered as a double-porosity medium. The extraparticles network forms the first porosity with low storage capacity and high hydraulic permeability. The sliced liquid containing particles form a second porosity with high storage capacity and low hydraulic permeability. Flow occurs separately through the two porosities and between them.

Numerical modeling and parameter identification based on the proposed direct and conjugate problems are conducted. Figure 1 illustrates the process of convergence model curves dimensionless liquid flow distribution at the outlet of the compressed water-containing particulate layer on the measurement surface z = 0 to the observation curve for implementing stepwise procedure of identification consolidation coefficients in extraparticle and intraparticle spaces, and respectively. The values of the input parameters, the properties of the particles and the observation data taken from [2], since this work is the development outlined in these results.

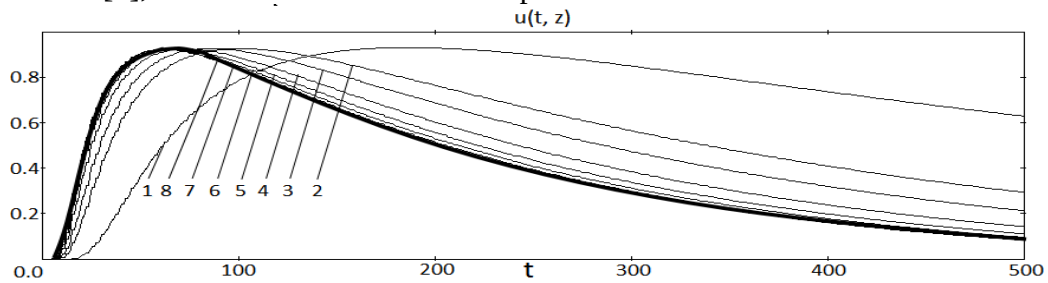

Figure 1 - Process of convergence model curves dimensionless liquid flow distribution at the outlet of the soft plant materials

Conclusion. In this work the coefficients identification problems of solid-liquid expression from liquid containing plant materials of micro-porous particles using residual functional, taking into account the total liquid flow changes on the measurement surface is formulated. Highly productivity methods of identification problems implementation based on the analytical solutions of the direct and inverse problems is proposed. Numerical identification of consolidation coefficients in extraparticle and intraparticle space versus time for different layer sections was done for real plant material with two different compressibility-permeability characteristics corresponding to different degrees of tissue destroying.

1. Schwartzberg, H.G. Expression of fluid from biological solids. Separation and Purification Methods, 1997.- 26 (1), 1–213.

2. Petryk M., Vorobiev E. Numerical and Analytical Modelling of Solid-Liquid Expression from Soft Plant Materials. AIChE J. Wiley USA., 2013 - 59(12), 4762–4771.