УДК 681.12

I. S. Stepanova
O. V. Vlasenko

REGULAR THERMAL MODE IN HETEROGENIC LIQUID SYSTEM BIOLOGICAL ORIGIN

Vinnytsia National Technical University

Анотація

Досліджена система «вода в кільцевому об'ємі – тонка циліндрична металева стінка – гетерогенна рідка система біологічного походження в циліндричному об'ємі» в умовах нестаціонарних теплових процесів. Доведена можливість існування регулярного теплового режиму в даній системі, що дозволяє проводити подальше вдосконалення методів прогнозування інтенсивності теплообміну в складних середовищах.

Ключові слова: двофазна система, багатокомпонентна суміш, інтенсивність теплообміну, продукт, термічна обробка, логарифм надлишкової температури, регулярний тепловий режим.

Abstract

The system "water in a circular volume - a thin cylindrical metal wall - a heterogeneous liquid system of biological origin in a cylindrical volume" under conditions of non-stationary thermal processes is investigated. The possibility of the existence of a regular thermal regime in this system is proved, which allows further improvement of the methods of forecasting the intensity of heat transfer in complex environments.

Key words: two-phase system, multicomponent mixture, heat transfer intensity, product, heat treatment, logarithm of excess temperature, regular thermal regime.

Introduction

For dairy production, a high degree of complexity of production processes is associated with the production of multi-product products. Heat treatment of milk is a complex range of temperature modes for products and intermediates in technological processes.

Therefore, for the use of a heterogeneous liquid biological system, its in-depth study is required. The creation of methods for determining the intensity of heat exchange of dairy products is a promising direction for the introduction of energy-efficient technologies in the food industry.

Research results

For the rational use of scientific advances in the food industry, it is necessary to have reliable information on the thermophysical properties of the products used, namely, their changes in heating, cooling, storage, transportation, etc. The choice of the method of heat treatment mode depends on the knowledge and the possibility of analyzing the thermophysical properties of products [1].

A sour-milk product is a product that is produced by fermentation of milk, cream, whey with the help of special leaven. Sour milk is called milk, which is sweetened by lactic acid bacteria present in the product. In our research work we use acidic milk that has a dense consistency, sour taste, used in cooking for dough preparation, or as a drink [1].

Sour-milk products are multifaceted and multicomponent media. Multicomponent environments are called heterogeneous systems, which consist of a pseudo-solid dispersion medium (components, phases), separated from each other by a developed surface of division [2].

In the work, the heating of sour milk was carried out on a pilot plant according to the method described in [3]. Two series of experiments were carried out, the first duration was 25 minutes, and the second - 24 minutes. In both experiments already after 1100 - 1200 c honey milk began to be divided into whey and cheese mass.

In [4] the process of cooling (or heating) the solid, the difference between the temperature of the solid and the temperature of the environment at the initial moment has the same sign. Under such conditions, the nonstationary process of cooling (heating) the body can be divided into two stages: the initial stage (tensile) and the stage of the regular regime.

Conducting the experiment is carried out in this way [3]. In a metal capacity of 800 ml, a test mixture is poured, with a temperature of 10 ° C; in an experimental installation in a circular volume - hot water in the amount of 2500 ml, with a temperature of 80 ° C. A container with a mixture is placed in an experimental installation, covered with an insulated lid and is located there until the temperature difference ± 5 ° C in both fluids.

In carrying out two series of studies, it was found that the regular thermal regime in sour milk exists before and after the restructuring of the structure.

The table presents the results of experiments for the system "water in a circular volume - a thin cylindrical metal wall - a heterogeneous liquid system of biological origin in a cylindrical volume" for water and two series of experiments of a complex mixture (sour milk).

Table

Experiment	q, kW / m2	$K_{експ}$, W / (m2 ·K)	m, (c^{-1})
Water	6,1	220	0,0045
Sour milk I	4,9	144	0,0021 / 0,004
Sour milk II	4,2	-	0,0021 / 0,004

In the table: m = (lnυ1 - lnυ2) / (τ1 - τ2) = const - the rate of cooling of the liquid mixture in cylindrical volume, c-1; υ1, υ2 - average volume of excess liquid temperature in a cylindrical volume according to the time τ1, τ2, ° C; q, cup is the heat flux density and the heat transfer coefficient through a thin cylindrical metal wall in the ring channel to water, sour milk I, and sour milk II, respectively, in a cylindrical volume, W / m2, W / (m2 · K).

In the table m is shown for sour milk I and II only for a period of time there is still no stratification of sour milk for whey and cheese mass particles and after.

It has been established that for the water in a cylindrical volume, the heating rate m remains constant during the experiment series. For sour milk I and II, in the period τ <(1100 - 1200) c - m = 0,0021 = const, under conditions τ> (1100 - 1200) with the heating rate increases from m = 0,0021 to m = 0,004 and remains constant until the end of the experiment. Sour milk is spread over whey and cheese mass.

Conclusions

The system "water in a circular volume - a thin cylindrical metal wall - a heterogeneous liquid system of biological origin in a cylindrical volume" under conditions of non-stationary thermal processes is investigated.

The analysis of experimental data showed the possibility of implementing a regular thermal regime in this system, which allows to increase the reliability of predicting the intensity of heat transfer in complex environments.

The fracture of straight lines lnυ = f (τ) characterizes the beginning of the transformation of sour milk into a two-phase medium of serum - cheese mass.

REFERENCES

1. Ginzburg A.S. thermophysical characteristics of food products: directory / A. S. Ginzburg, M. A. Gromov, G. I. Krasovskaya. - Moscow: food industry, 1980. - 288 p.
2. Tkachenko S.Y. Heat-mass exchange and hydrodynamics of multicomponent media: a manual / S. Y. Tkachenko, n. D. Stepanova; Vntu. - Vinnitsa: Vntu, 2017. - 110 p.
3. Tkachenko S.Y. New methods for determining the heat transfer intensity in organic waste processing systems: monograph / S. Y. Tkachenko, N. V. Pishenin. - Vinnitsa: Vntu, 2017. - 148 p.
4. Kondrat'ev G. M. Regular thermal regime / g. M. Kondrat'ev. - Moscow: 1954. - 408 p.

Степанова Ірина Сергіївна – кандидат філологічних наук, доцент кафедри іноземних мов, Вінницький національний технічний університет, Вінниця.

Власенко Ольга Володимирівна – аспірант кафедри теплоенергетики, Вінницький національний технічний університет, Вінниця, e-mail: olgakytsak7@gmail.com.

Stepanova Irina Sergeevna - *candidate of philology science, Associate Professor, Department of Foreign Languages, Vinnytsia National Technical University, Vinnytsia.*

Vlasenko Olga Vladimirovna – postgraduate student, Head of the Chair of Power Engineering, Vinnytsia National Technical University, Vinnytsia, e-mail: olgakytsak7@gmail.com.