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XI МІЖНАРОДНА НАУКОВО-ПРАКТИЧНА КОНФЕРЕНЦІЯ

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CONDITIONS FOR DOUGH KNEADING AUTOMATION

Summary: The conditions of baking, macaroni and confectionery dough mixing are investigated. Management of processes of dough at work of kneading machines allows to achieve the set technological purposes. The algorithm of finding the necessary energetic characteristics of the kneading machine is formulated. The indicators of energy impact of kneadinging machine at mixing on structural components of compound raw materials and dough are determined. As a result of the research it was possible to clarify character, mode of energy inputs and method of energetic influence of kneading machines on the stirred raw materials and dough.

Problem statement. Perfection of technologies of bakery, macaroni and confectionery products is oriented on improvement of their quality. This approach corresponds to tendencies of development of automatic and automated control of dough processes. One of the effective methods of improvement of the dough structure is intensification of machining at mixing, which allows influencing its structure [1].

Enumeration of solved tasks. The study of energy inputs, character, mode and method of influence of kneading machines on the stirred raw materials and dough determines its rational parameters of kneading and fermentation. The methodological problem is complicated by the fact that today there are no uniform approaches describing the theory of dough. The theoretical and experimental studies were based on fundamental works aimed at the development of the dough theory.

A statement of the essence of research. The analysis of processes of energy influence of kneading organ and other power transmission devices of kneading machine on the compound components of raw materials and dough is conducted. Introduction of automatic and automated control of mixing processes in dough theory determines the directions of innovations in these technologies. Dough includes the following technological suboperations:

- Supply of compound components of raw materials in the working capacity of the kneading machine;
- Energy impact when mixing to the original components of the brew;
- Brew process;
- Additional energetic impact in the wake of Brew;
- Energy impact during mixing dough;
- Dough standing;
- Additional energetic impact during dough mixing

The variety of technological purposes, the uniqueness of physical-mechanical and chemical-structural properties of the compound components of raw materials and dough form specific requirements to the applied technologies of kneading. This determines the regularity of the search for effective schemes of energy impact of kneading machines during their work. They are presented as an algorithm:

Technologies of bakery, macaroni and confectionery products
↕
Energy impact of mixing and power transmission organs kneading machine
↕
Dough Mixing Machines
↕
Mixing Processes
↕
Specified technologically sound level of dough homogeneity

This approach allows to find the necessary energetic characteristics of the kneading machine in its operation more precisely. It is able to further develop more efficient designs of kneading machines. Directions of energy impact indicators kneading machine at mixing, presented in the table.

Table

Performance of kneading machine at mixing

№ p/p	Name	Characteristics
1.	Energy consumption at mixing.	**A** — work for one turnover of the kneading body, Dg/ob; $\mathbf{A_1}$ — work on assigning kinetic energy to particles in the period of kneading of compound test components, Dg/ob; $\mathbf{A_2}$ — The work spent on moving the messily organs of the kneading machine, Dg/ob; $\mathbf{A_3}$ — The work spent on heating the structural components of the dough and interacting with them parts of the kneading machine, Dg/ob; $\mathbf{A_4}$ — Work influencing particle movement and contributing to the change of molecular-energetic characteristics of the test, Dg/ob; $\mathbf{E_{gid}}$ — The energy derived from the hydration of the test components, Dg/ob.
2.	The nature of the impact.	$\mathbf{A_{UD}}$ — The amount of work of specific energy costs in mixing, Dg/g; $\mathbf{A_5}$ — work, by during dough preparation, Dg.; **Q** — The amount of heat transferred during dough preparation, Dg.; $\Delta\mathbf{U}$ — Change of internal energy of dough, Dg.;
3.	Exposure mode.	**n** — Frequency of rotation of the kneading blade of the kneading machine, min^{-1}; $\boldsymbol{\tau}$ — kneading time, c.; **m** — mass of the test components located in the working Chamber of the kneading machine, kg.
4.	Method of impact.	**Q** — The performance of the kneading machine, kg/ch; **N** — Total cost of power of the kneading machine, kBt.; $\boldsymbol{\eta_1}$, $\boldsymbol{\eta_2}$ — Total coefficient of useful action of actuators of kneading machines, units, ed.
5.	Uniformity of the dough.	$\boldsymbol{\rho_т}$ — average density of dough, kg/m^3; $\mathbf{c_т}$ — average heat capacity of dough, kDg/kg; $\boldsymbol{\mu}$ — average viscosity of the dough, ed.
6.	Commodity assessment of the results achieved.	$\mathbf{A_{cf}}$ — The coefficient of efficiency of use of kinetic and potential energy, ed.; $\mathbf{V_0}$ — The volume of dough at the beginning of fermentation, m^3; $\boldsymbol{\tau_{br\ o}}$ — duration of fermentation brew, ch.; $\boldsymbol{\tau_{BR\ t}}$ — duration of fermentation of dough, ch.

As a result of researches it was possible to clarify character, mode of energy inputs and method of energetic influence of kneading machines on the stirred raw materials and dough at mixing. The prospect of improving the automation of kneading technology is to find a reduction in the cost of dough. Achieving a technologically sound level of test homogeneity is a key component of these studies.

Conclusions: In theses the conditions of baking, macaroni and confectionery dough mixing are defined:

- Directions of automatic and automated control of dough processes are established.
- The variants of optimization of energy parameters, increase of efficiency of kneading machines, testoprigotovitelnyh of periodical and continuous actions are determined.

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