STUDY ON THE MOVEMENT OF DOUGH IN MACHINES WITH CONTINUOUS OPERATION

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REZUMAT. Articolul a analizat problema unei etapele în fabricația de pâine și produse de panificație. Este modelată mişcarea aluatului în mașina pentru frământare şi creştere. Bazat pe analiza. rezultatelor este posibila utilizarea metodei în optimizarea fabricației mașinii pentru frământat cu funcţionare continuă. Se examinează procesul de modelare a mişcării aluatului din interiorul cuvei de fermentare, în scopul determinarii parametrilor optimi.

Cuvinte cheie: fermentația aluatului, metode de modelare, uniformitate.

ABSTRACT. The article discussed the problem of one of the stages in the production of bread and bakery products. It is modeled the movement of dough in the machine for kneading and rising. Based on the analysis of the results it is possible their use in optimizing the constructions of the machines for kneading with continuous operation. It is examined the process of modeling of the movement of dough inside the fermentation tank in order to be determined the optimal parameters.

Key words: dough fermentation, modeling, motion, uniformity

1. INTRODUCTION

The quality of bread products depends as on the used raw materials and the process of preparation. Substantial factor for the quality of the incoming to the consumer products are also the conditions of their storage, and the used packaging materials and packages. At the contemporary stage of progress of the production, practically all the stages of making of bread are studied [1]. But there is still a stage of the process of producing, which needs additional investigation [2, 3, 4]. This is the fermentation of dough in the time when there are imparted definite physical properties to the dough and added substances, which determine the flavor, aroma and color of the ready product.

In spite of the sufficiently deep investigations of the regularity of the fermentation process, currently it is not originated general theory of the process and the work of machines for kneading and rising.

2. SUMMARY

The basis of statistics, the most frequently seen tanks are flow-through elongated horizontal tanks, having semi-cylindrical or rectangular cross-section. It is approved the term trough in the branch. The first prototype serves as a model for many modifications of fermentation tanks for dough-preparing machines with continuous operation, used some decades and its scheme, which is still used in the baker's industry. Sufficiently simple as construction fermentation tank are made in the bakeries unaided, in their mechanical workshops, and its proportions often are determined intuitively or on the basis of the experience of exploitation of previous equipment. On the proportions of the construction often influences the free space in the workshop.

The basic task of the fermentation tank is to provide stay of the ferment or the dough in the course of 3-4 hours, in which to ensure continuity, and similarly to provide stability of the properties of the produced dough.

On the uniformity of the flow influence some factors: friction on the walls of the tank, angle of the slope of the tank (it is used the attraction of gravity to set the dough in motion down to the tank), presence and parameters of work of the mechanisms-screw, moving the dough down the tank.

In this aspect, the determined parameters of the optimal construction of the fermentation tank are multi-factoral task, requiring complex method of approach for study.

At the present time it does not exist device, which can give simple data for the behavior of the dough in the different sections of the mass, in particular in the corpulence of different depth and in the near-wall frontier layer. For that reason for receiving clear pattern of the passing processes it is necessary to be used computer methods for modeling, which allow receiving of numerical data for the parameters of the process of motion of the dough in different spots of the tank. In the progress of our work it was used the program packet FlowVision, which allows the observing of the flow of fluids in machines and apparatus and receiving the values of the velocity, pressure, power and dissipative characteristics in all spots of the working tank.

The basic task of the present research is to be studied the dependences of the movement of the dough down the tank in dependence on the angle of the slope of its lowest wall towards the horizon. In progress of the work it was modeled tank for fermentation of dough with screw in the range of stagnancy (fig.1.). The range of variation of the angle was chosen from 0 to 5 degrees.

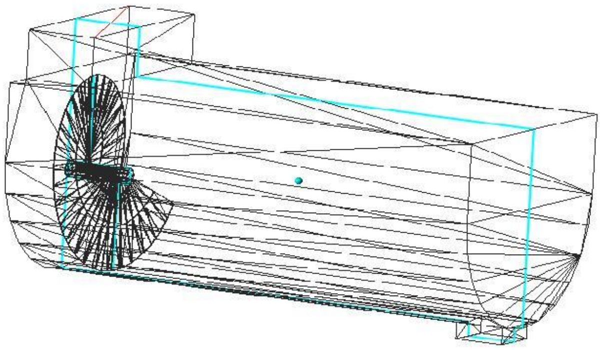

Fig. 1. *3D – model of the tank for dough fermentation*

The variation step of the slope angle of the bottom is accepted to be 1 degree. On fig. 2 are represented in a diagram all models in section.

In purpose to be received the velocity values for different layers of the dough mass, there were chosen three levels of depth: on the surface, on the half depth and on a insignificant distance from the bottom.

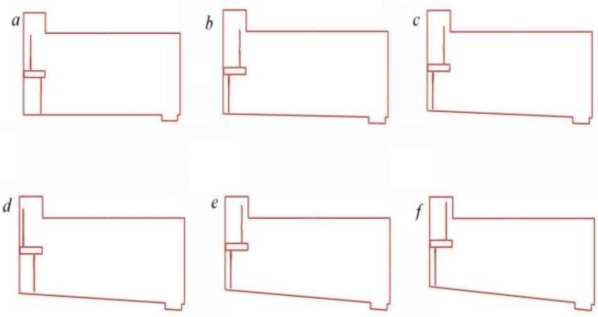

Fig. 2. *Experimental models with different slope angles: a - 0°; b - 1°; c - 2°; d - 3°; e - 4°; f - 5°*

Distribution of the velocity on the dough surface.

On fig.3 are represented the drawings for the velocity variation of the dough down the tank in depth of 5 cm.

There are all the models of velocity variation at the beginning of the tank, which are caused from the influence of the rotating screw, which reacts the mass relatively unsteadily depending on its angle of rotation. It does not depend on the angle of the bottom of the tank, that’s why it is not rendered an account of it in our research.

Analysing the drawings, can be made the conclusion: the character of variation of the velocity and its absolute quantity depend on the slope angle insignificantly. But, with the increasing of the angle, the velocity decreases. It can be explained this way: the deeper layers of the dough move to the exit more actively.

At the end of the tank (upon the final outlet) the longitudinal velocity decreases to zero. In return of that it appears vertical, which vector has down direction.

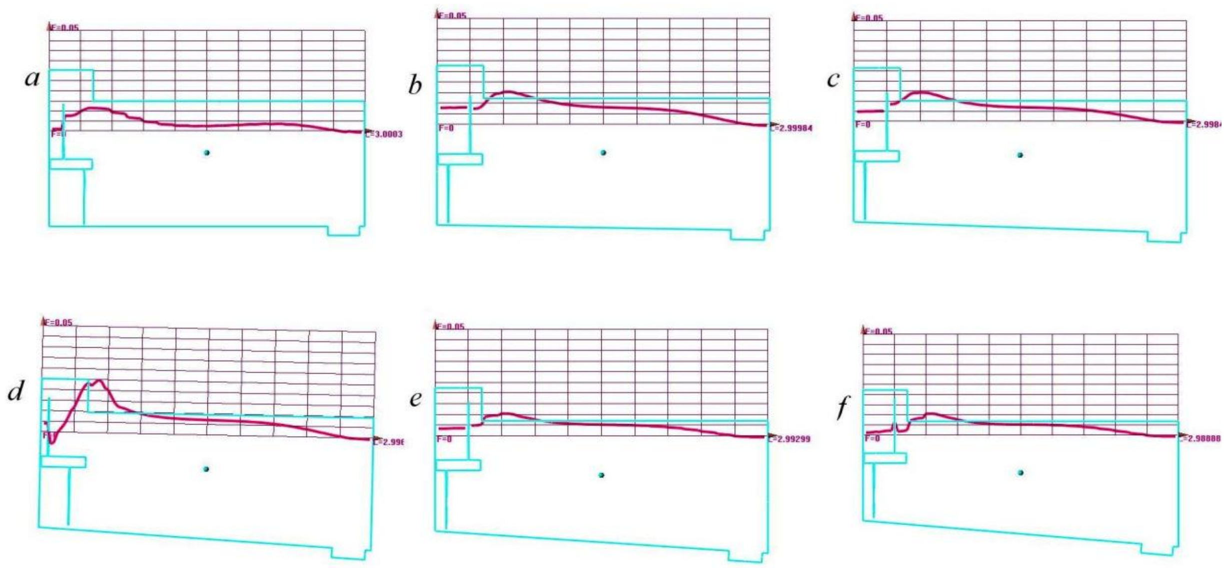

Fig. 3. *Distribution of the dough velocity around the surface*

Distribution of the velocity in the middle of the dough flow.

On fig.4 are represented drawings for the velocity variation at movement of the dough down the tank in the middle layer, found out at regular intervals from the bottom and the surface.

Analysing the drawings, can be made the conclusion: the presence of slope of the bottom of the tank, in the same direction as the movement of the dough, increases the velocity of movement in the middle layers of the dough.

Comparing fig. 3 and 4, it should be made the conclusion, that with the move away from the surface, the velocity of movement of the dough down the tank picks up.

The numerical mean of the velocity hesitates around the value 1 cm/s.

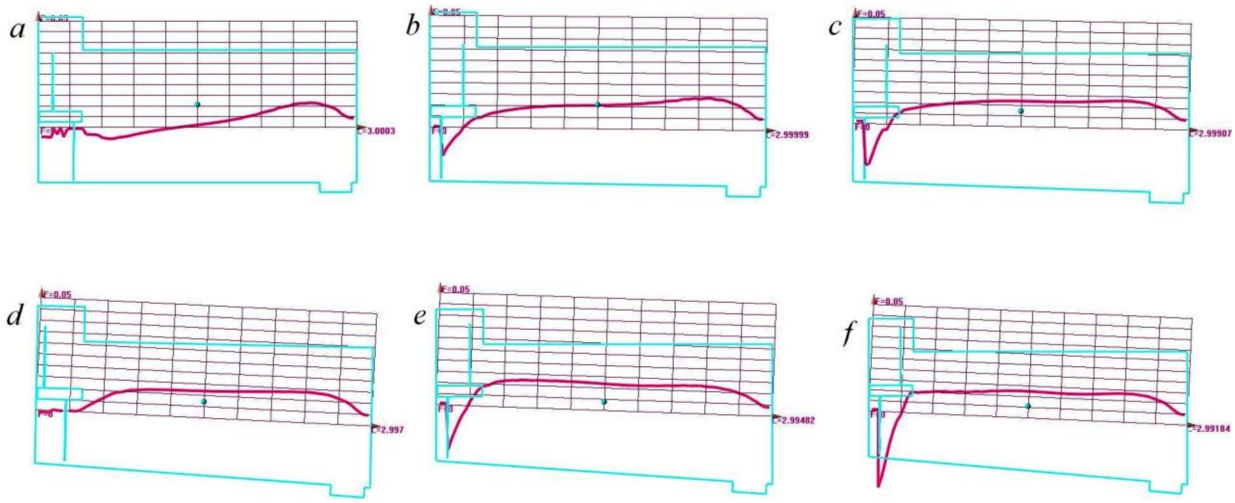

Fig. 4. *Distribution of the dough velocity in the centre of the flow*

Distribution of the velocity at the bottom of the tank.

On fig.5 are represented the velocity variations of the dough movement down the tank in the near-wall boundary layer. The distance to the bottom of the tank is equal to 5 cm.

In this conditions considerable effect on the character of movement has the closeness of the bottom – roughness of the surface, which prevents the dough flow.

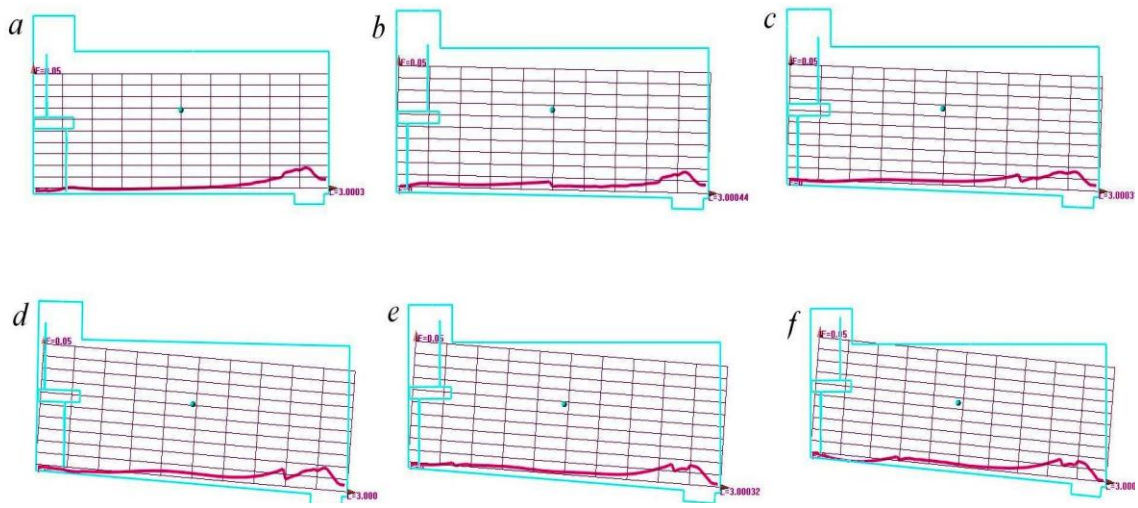

Fig. 5. *Distribution of the dough velocity at the bottom of the tank*

Analysing the drawings, can be made the conclusion: The velocity of dough movement on the length of the tank near the bottom is practically constant. The acceleration of the movement comes only near the outlet.

The presence of slope influences positively on the dough movement down the tank.

3. CONCLUSIONS

From the results of the carried out modeling can be made the following conclusions.

The velocity of dough movement at different depths considerably differs.

From the velocity of dough movement on the surface it can not be judged exactly for the average velocity of the flow.

Major influence on the velocity of movement has the closeness of the walls and the bottom of the tank. As it is shown from the models with different proportions, made before, the best perspective has the tank with greatest width.

The presence of screw at the initial section of the tank spreads disturbance in the steadiness of the dough flow, sometimes stops the dough flow or even reverses its direction.

The use of the gravitational forces for setting the dough in motion (slope of the bottom of the tank) is characterized with uniform effect. The main positive result is in the presence of biggest slope, and the quantity angle in the investigated range does not considerably influence the character of movement of the dough.

The use of the got data from the model experiments reveals new opportunities for further elaboration of the constructions and the work of the fermentation equipment.

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