INFLUENCE OF MIXERS PARAMETERS ON DOUGH KNEADING PROCESS

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Abstract: In this paper we studied the main factors influencing the quality of dough and kneading process. Particular attention is given to the variation of dough resistance opposite working body during the kneading process. As a result it is proposed an original method of working body speed control depending on the readiness of the dough into any stage of the proceedings.

Introduction

Baking technology is one of the most important branches of the food industry. Like any branch of the national economy it faces a number of quite present problems, as follows:

- new technologies obtaining with optimal energy consumption;
- the manufacture of high quality and ecologically pure products, which meets international standards;
- finished products cost reduction, etc.

Given that one of the main bakers' operations that affect products quality is dough preparing and namely its kneading, we have made a study of mixer operation indicating some proposals for solving the mentioned problems.

Results and discussions

In the baker production, dough kneading presents one of the decisive operations that affect the quality of the finished product.

From literature and practice is well known that the efficiency and quality of the kneading process are influenced by the following parameters of the mixer:

- physical and rheological properties of dough;
- shape and surface of the working tool;
- movement trajectory of the working body;
- bowl shape;
- kneading period;
- working tool speed, etc.

The shape and surface of the working tool influence the degree of homogeneity of the dough. The body shape is more sophisticated and its surface is smaller, the less interference is training by itself and homogeneous dough is obtained, so elastic, plastic, stretches and does not break easily. But still decreasing surface cannot be done indefinitely because mixing process requires an additional loss of energy and time

Movement trajectory of the working path and bowl shape also influences the homogeneity of the dough mixing. The bowl must be so shaped that the interaction between dough and work body is possible at any point of it.

Dough's quality is directly related to mixing time. So if the kneading period of the dough is too short, it does not get the required rheological qualities and conversely, excessive dough mixing destroy its structure and involve a loss of mechanical properties. Influence of the working path speed in dynamics is well studied and shown in the literature. [2]

Figure 1 shows the change in dough's resistance opposing the blade movement during kneading at blades speed of 115 min^{-1}. From the graph it is observed that once increasing the kneading duration τ, resistance properties first reaches its maximum and then decreases but plastic properties grow continuously. The obtained curves were used to determine the optimal duration of dough kneading, corresponding to its maximum resistance opposing blade movement.

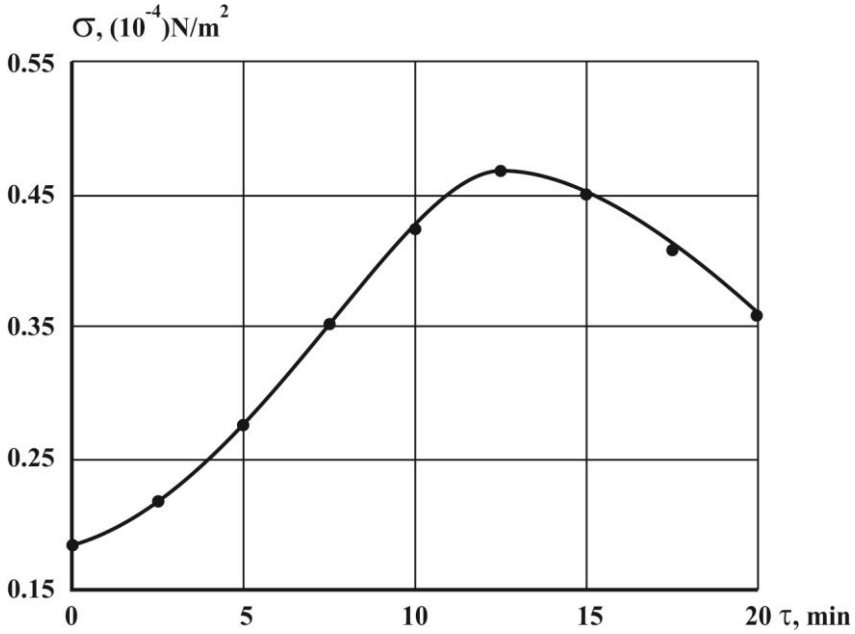

Fig. 1. Variation of working tool resistance during dough kneading. Humidity 30 %, working tool speed 115 min^{-1}

In the first phase, mixing, is enough a relatively slow speed of working tool and further in the second phase, the kneading itself, with dough viscosity increasing is recommended to speed up the working tool.

Currently increasing working tool speed is achieved by two methods [3]:

- the first method involves equipping mixer with a gearbox that is driven by machine operator. In these machines speed variation occurs discrete and the transition from one gear to another is determined with considerable error;
- the second method provides slow change of speed in time, by a well determined program. This method is advantageous because it reduces the energy consumption and increases the quality of dough, but still directing function of time provides no change in the dynamic properties of dough due to raw material quality.

To remove this drawback we propose a mixer with a construction which provides working tool speed control not as a function of time, but in function of the variation of physical and mechanical properties of the dough.

This is achieved by equipping mixer with a dough viscosity variation fixation. With viscosity increasing it is also increased the flow of electrical current in the electric motor. Variation in intensity is recorded by a current transformer; the drive signal is transmitted so changing the gear ratio of the mixer.

The machine is equipped with a mechanism for automatically disconnecting before starting the softening phase of the dough. The mechanism is based on recording the maximum engine load and its stop over some time.

The proposed automating of the kneading process allows the following:

- automatic working tool optimal speed maintaining any time of the process;
- timing of electric motor disconnection time;
- automatic disconnection of electric motor with achieving maximum product quality;
- work volume reduction;
- kneading period reduction;
- energy consumption reduction.

Conclusions

Due to human influence factor exclusion, the optimization of working tool motion, as a function of dough preparing degree, assures the final products best quality. The same time, avoiding of working tool motion deviation, involves a considerable energy consumption.

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