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SHARPENING AND RESISTANCE OF CUTTING KNIVES FOOD MATERIALS

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Abstract: Information about raising productivity of work of cutting machines and stability of cutting tools in the result of proper organization of the process of macro- and microgeometric sharpening parameters of the edge of the cutting tools is given in the article.

Keywords: cutting tools, edge, wearing, durability, macro- and microgeometric sharpening parameters, grinding, microtooth, sharpening, hardness.

Introduction

As it is known, technical progress in mechanical engineering is inextricably linked with the development of machine-consuming branches of the national economy. The processing industry is undergoing a process of continuous improvement: the volume of products is growing, new types of food products are appearing, progressive technological schemes based on waste-free processing of raw materials are being developed, production processes are intensified, complex mechanized and automated production lines are being introduced. Accordingly, the requirements for the main indicators of the operation of food machines and apparatuses, their productivity, reliability, and the degree of automation, increase.

In the bakery and pasta industries, various designs of machines are used for cutting products and semi-finished products, differing in technological purpose, type and trajectory of movement of working bodies, structure of the production cycle, method of feeding products and other features. The technical level of the cutting equipment largely determines the technical and economic performance of the enterprise.

Main part.

Cutting is a technological process of processing by separating a material with a violation of its integrity, carried out by a cutting tool in order to give the material a given shape, size and surface quality. For food, cutting should be done without waste.

The physical foundations of cutting food materials are quite complex and they cannot be understood based on the existing ideas about the destruction of the material as a result of its crushing by the cutting edge of the tool.

Cutting food materials is studied mainly from the standpoint of establishing empirical dependences of the main parameters of the process (productivity, energy consumption, amount of waste, etc.) on factors caused by the type of material being cut, the processing mode and the cutting tool. This direction of research is important, as it allows, within the studied area of the factor space, an objective approach to the selection of rational cutting modes, characteristics of an essential cutting tool, as well as design parameters of cutting machines. However, the available empirical dependencies do not always give a satisfactory solution in terms of radical improvement of the cutting process, without sufficiently revealing the features of the interaction of the blade with the material being cut, the mechanism of destruction and the phenomena that contribute to it.

In sliding cutting, the blade micro-teeth are the main element contributing to the formation of new surfaces [1,2]. The location of the micro-teeth on the blade, their shape predetermine the cutting and resistance properties of the knives and depend primarily on the steel grade, its microstructure, sharpening modes, characteristics of the abrasive tool, etc. [3,4,5,6,7,8].

The operational reliability of knives largely depends on the wear resistance of the material for the manufacture of the cutting tool and is determined by the retention of its cutting ability for a certain time - the period of life.

Durability is the most important operational characteristic of knives, which significantly affects the performance of cutting machines, the consumption of tool materials, the laboriousness of preparing the knives for work and their resource. The durability of knives depends on the intensity of wear of the cutting edge, which is accompanied by complex irreversible phenomena in a thin surface layer.

The dominant role in this process is played by the change in the microgeometric characteristics of the cutting tool. Since the parameters of the macro and microgeometry of the blades are formed during the sharpening of the tool, and then change their value during operation, the conditions for sharpening the knives were varied in the studies and the change in the studied parameters during operation was controlled.

The design features of a thin blade (6… .25 μm) significantly impede heat removal during sharpening, which can lead to a change in the metal structure. The lack of reliable fixation of the hacksaw during sharpening, the wrong choice of the grinding wheel, the forced sharpening mode, the lack of control of the hardness of the hacksaw material leads to defects in the cutting edge, in turn, to a decrease in the cutting properties and durability of the hacksaw.

The object of the study was knife plates (δ = 0.4 mm) made of U8A steel, heat treated for a hardness of 46 - 48 HRc. The double-sided sharpening angle was 150. Sharpening was carried out on a machine model ZG71 with a circle E8 40SM26K without coolant with the dressing of the circle with a diamond pencil of type C. Lapping (fine-tuning) of the chamfers was carried out with leather wheels using GOI paste. The initial parameters of sharpening were: grinding speed - 30 m / s, workpiece movement speed - 6 m / s, grinding depth - 0.01 mm.

To describe the transverse and longitudinal microrelief of the blades, the following parameters were used: a is the width of the cutting edge, Ra is the arithmetic mean deviation of the profile, Rp is the height of irregularities at 10 points, Rmax is the maximum height of irregularities, Sm is the longitudinal pitch of irregularities along the center line, Sn is the transverse the step of the irregularities, b and ν are the indices of the support curve, γ is the angle of inclination of the irregularities.

In the experiments, a measuring complex was used, which included a scanning electron microscope, a microcomputer, and an interface unit.

The results of measuring the parameters of the microgeometry of the lamellar knives are presented in Table 1.

These data are arithmetic mean values and are characterized by the coefficients of variation: for parameters a, Ra, Rp, Rmax, Sn -

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10 - 12%, for Sm, γ - 15 - 20%. The samples indicated in the first column (see Table 1) were obtained under the following conditions:

1 - chamfer of a knife sharpened under the above modes;

2 - blade of the same sample;

3 - blade, sharpening and finishing along one edge;

4 - blade, sharpening and finishing on two edges;

5 - type 1 sharpening after 4 hours of knife operation in the AG - 3 grinder;

6 - type 1 sharpening after 48 hours of operation;

7 - sharpening and fine-tuning according to type 4 after 48 hours of work.

Table 1

Microgeometric parameters of blade knives

N\N	a, micron	R_a, micron	R_p, micron	R_{max}, micron	S_n, micron	S_m, micron	B	v	γ
1	-	2,3	4,3	9,2	-	16,3	2,3	1,8	40
2	18,3	7,9	11,8	23,2	11,2	79,1	2,5	3,2	42
3	12,9	5,6	9,3	19,8	7,1	115,1	1,8	3,0	40
4	4,6	3,2	4,7	12,4	2,8	175,8	-0,5	5,4	38
5	21,6	5,8	11,0	24,3	10,4	263,2	2,0	1,8	53
6	31,3	12,2	19,5	29,0	17,3	721,0	1,8	2,2	69
7	14,3	5,3	10,0	21,7	7,9	380,0	-0,3	9,1	48

* For the finished blades, the values of the coefficients of the straight section of the reference curve K and C.

Sharpening without lapping gives the width of the cutting edge (a) and the transverse step (Sn) several times greater than that of a blade brought along two edges. There is a one-to-one correspondence between these values when varying the modes of blade formation and the duration (T) of the knives. The same can be stated with regard to the group of altitude parameters.

The height of the micro-teeth (Rmax) on the blade is 2 - 2.5 times higher than on the chamfer. This is due to the imposition of two lateral micro-reliefs on the blade, which are formed separately when grinding the chamfers. After a running-in period and a decrease in altitude parameters during further operation of the knife (T> 0), the value of Rmax additionally increases by 15 - 40%.

The length of the longitudinal step (Sm) of the microroughness of the blade is an order of magnitude higher than the value of Sn. On the other hand, Sm on the chamfer is 5 - 8 times less than on the cutting edge. The use of finishing along one and two bevels increases Sm. During the operation of knives, Sm increases, this growth is especially noticeable (almost 10 times) for knives sharpened without finishing (sample 1).

Debugging significantly changes the shape of the reference curve of the blade, on which there is practically no curvilinear section. In the straight section, the dependences $\eta = f(\varepsilon)$ for the adjusted blades are located higher, which provides a large actual contact area with the same approach. The coefficients b and ν of the bearing surface curve vary over a wide range. The angle γ at the apex for sharpened and finished blades is, as a rule, less than 450, and for blades that have worked for 48 hours, more than 450.

Shown is a consistent decrease in the roughness of the cutting edge when finishing on one and two edges (see table. 1). So, after finishing on two edges, the height parameters of the cutting edge are reduced by 1.8 - 2 times. The rest of the parameters depend on fine-tuning to a much lesser extent. Lapping on two edges provides the sharpest blade (a = 4.6 μm) and the smallest transverse pitch (Sn).

The shaping of the cutting edge occurs due to the intersection of the microreliefs of the side surfaces, and the microgeometry indicators are influenced not only by the sharpening modes, the physical and mechanical properties of the material, but also by the forces and directions of grinding. At the initial stage of the operation of the knives, there is an intensive change in the irregularities obtained during the processing of chamfers with an abrasive tool,

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their crushing and plastic deformation. In this case, the protruding micro-teeth are destroyed and new ones are formed, different from the original ones in shape and size. The period of normal operation of the knives corresponds to the process of stationary wear and is characterized by a relatively low rate of change in the parameters of microgeometry. A reduction in the running-in period and an increase in the service life of the knives is facilitated by the finishing of the blades.

Findings.

The research results were used in the development of knives for increasing the cutting ability for cutting rusks in the production of rusks and for cutting raw pasta in the production lines for short-cut and long-tube products. Tests of cutting tools at a number of food enterprises in the city of Tashkent and Bukhara have shown the possibility of a sharp decrease in the amount of waste and rejects during cutting, a 6 - 8-fold increase in the durability of knives.

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