INDUSTRIAL ENGINEERING

DOI https://doi.org/10.30525/978-9934-26-109-1-8

IMPROVING THE RELIABILITY OF CUTTER KNIVES BY IMPROVING THE MANUFACTURING PROCESS

Babanov I. G.
Ph.D, Associate Professor,
Department of Catering Technology
Higher Education Institution «Open International University
of Human Development 'UKRAINE'»

Dolomakin Yu. Yu.
Ph.D, Associate Professor,
Department of Machines and Apparatuses
for Food and Pharmaceutical Productions
National University of Food Technologies

Babanova O. I.
Senior Lecturer at the Department of Machines and Apparatuses
for Food and Pharmaceutical Productions
National University of Food Technologies
Kyiv, Ukraine

In the meat processing industry, cutters equipped with a set of sickle-shaped knives are widely used, which have low indicators of durability and reliability, primarily due to their design and technological imperfection. Cutter knives are wear parts, but the issue of their restoration is practically unexplored.

Analysis of designs allowed to identify shortcomings in the operation of the cutter L5-FKB and ensure the modernization of this unit of equipment, namely modernization of the tensioning device of the drive mechanism. Also, in the meat processing industry there is an unfavorable situation when there are no progressive methods and appropriate equipment for the production of this type of cutting tools that meet modern requirements. Thus, the problem of improving the reliability of knives and providing them cutter, is very urgent.

The purpose of the study is to modernize the tensioning device of the drive mechanism, which will improve the quality of minced meat and increase the reliability of cutter knives by improving the manufacturing technology and restoration.

Results. It was found that during the operation of the cutter knives are intensively worn under the influence of a complex of physical-mechanical and chemical effects with the active participation of the processed product. The dominant defects are cutting edge wear 57% and blade breakage 41% as a result of significant bending loads. Series cutter knives are characterized by low reliability indicators due to their design and technological imperfection. In addition, Cutter knives after use are practically unusable for restoration.

Elimination of drawbacks inherent in serial cutter knives is based on their structural and technological improvement and consists in scientific substantiation of multilayered construction which allows, by using 40X13 steel with hardness HRC 56 as outer layers, and 40X13 steel with hardness HRC 24 as inner layers, to reduce stressed state of products and thereby to increase reliability and durability indicators, and also to provide possibility of cutting tool restoration. By analyzing the indicators characterizing the quality, it was found that: the microhardness of the cutting part of the experimental knives is higher than the serial knives by 24%, which confirms the hypothesis about the possibility of strengthening the blade. The inner layer of the experimental knife has an impact toughness of 82 J/cm^2, which contributes to its resistance to bending loads; macro- and microstructural studies of cutter knives indicate the absence of visible microcracks along the blade contour and rivet holes, as well as the strengthening of the blade structure.

Tensioning device (fig. 1), which it is proposed to install, consists of a roller mounted on rolling bearings fixed on the axle. The axle is fixed in the tensioner housing. The roller is moved and the belt transmission is carried out with the help of traction fixed in the rack by means of a pin. The roller is made of fluoroplastic F-40, ensures its durability. The body of the clamp is mounted on an axle connected to the cutter body.

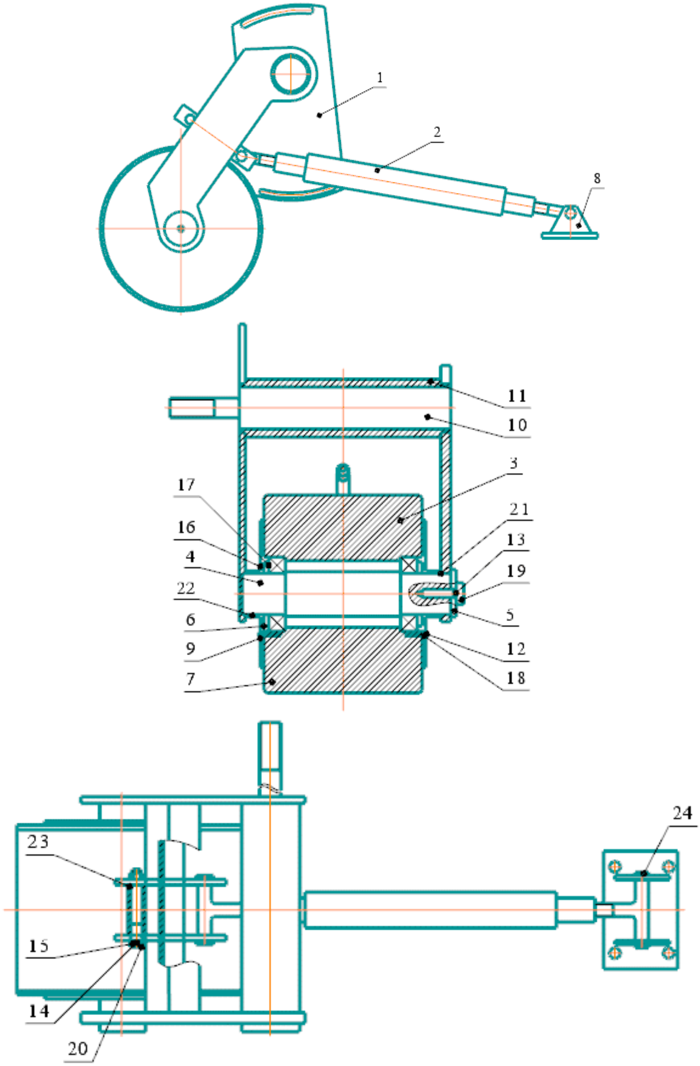

Fig. 1. Modernized clamp:
1 – the body of the stretching annexe; 2 – rod; 3 – roller; 4, 10 – axis; 5 – ring; 6 – cover; 7 – lug; 8 – support; 9 – gasket; 11 – duct; 12, 13, 14 – bolt; 15 – locknut; 16 – cuff; 17 – bearing; 18, 19, 20 – collar. 21, 22, 23 – cartridge; 24 – pin

Operational tests established that the service life of the experimental knives increases by 62%, and it was found that the greatest resistance to blunting is characteristic of multilayer knives with a sharpening angle of 12-G-150. Blades are characterized by improved performance characteristics: in resistance to blunting by 42%, in productivity by 30%, energy consumption by 23%, quality of minced meat by 30% compared with serial analogues. Economic calculation showed that the modernization of the cutter L5-FKB is expedient, as the economic effect is achieved by improving the quality of products.

References:

1. Гутуев М. Ш., Пахарев А.В. Исследование процесса эксплуатации ножей куттеров / В сб. науч. трудов. «Молодые ученые СГАУ им. Н. И. Вавилова Агропром комплекса Поволжского региона». Саратов: Издательство СГАУ им. Н.И. Вавилова, 200. С. 239-243.