TECHNOLOGY, MACHINE-BUILDING, GEODESY

UDC 621.91.01/02

CARTRIDGE TOOLHOLDERS AND BORING HEADS FOR HIGH-PRECISION HOLES TREATMENT

ANDREW GERASIMOV, NIKOLAI POPOK
Polotsk State University, Belarus

The analysis of cartridge tool holders and boring heads constructions was done, the constructions of micrometer adjustment of blades were considered, models and results of stress, displacement and safety factor for split bushing are shown.

One of the perspective ways of boring tools constructions development is using the principle when they are made from different modules. When we use this principle we increase the safety during their work and maintenance conditions by reducing the amount of module constructions. In addition the using of this modules in projecting reduce time and labor content for engineer this constructions, give the opportunities for using new methods of engineering.

Special attention is given for the constructions of micrometer adjustment and movement of cutting blades assemblies, cartridges and cutting blocks as well.

In connection with that there was the task to design block and module boring heads with micrometer blade adjustment for surfaces treatment that make it possible to:

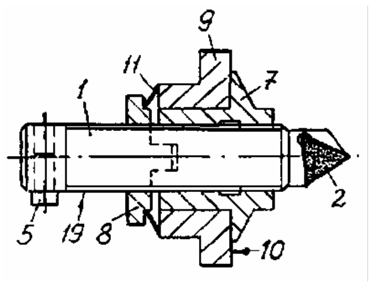
- reduce the boring tooling variety that are used and thereby to reduce the cost for tool production;
- produce boring heads at the enterprises that are located in Belarus.

Foreign analog. Modern boring tool system includes: boring heads, single-point tool or cartridge tool holders (blocks or modules) for holders or block-module boring tool systems.

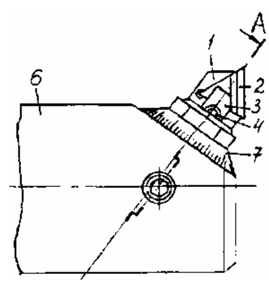
The major manufacturer of those tools at territory of CIS is JSC "Vint" (Russian Federation) [1]. The manufacturer offers hole boring systems in which are used single-point or double-point tool cutting blocks, tool holders for cutting tools mounting, cylindrical pilots with reducing bushings for cutters' mounting, cylindrical pilots for microbors' mounting.

The analyses of the patents. During the analyses of the patents of the boring heads were found out the next inventions.

In [2] is shown a boring head (Fig. 1), that consist of micrometer screw that is used as a tool holder1. On one end of the tool holder 1 is done a slot for a cutting blade 2, that is fastened for instance by clamping 3 with a help of screw 4 and on another end is based a key 5. The key 5 has an opportunity to slide by key slot of the cylindrical pilot 6 and prevents the spinning of the tool holder 1 round his axis. Index plate 7 and bushing 8 are joined with the tool holder 1 by thread. Index plate 7 is installed in body 9 with turning capacity. On the face of the body 9 for the accurate adjustment of the tool holder 1 the vernier 10 is done. Between bushing 8 and the body 9 the springing element 11 is installed.



a)



b)

Fig. 1. Boring head. Sectional drawing (a) and assembly (b)

In boring head [3] the generation of the radial oversize in thread is made automatically by installing the boring head body into the cylindrical pilot. It could be done because the boring head that includes the body with the vernier, the index plate and the tool holder, with a shape of a micrometer screw on, one side of that is fastened a cutting blade and on the other side is fastened a key. The tool holder is joined by thread with two nuts, which are separated in the axial direction by springing elements. One of the nuts is inflexibly joined with index plate and another is fixated in the body with a C-ring.

During the projecting process and development of the new boring instruments with micrometer adjustment of the cutting blade the main task was to solve the problem with clearance adjustment (to reduce for the necessary value) in the thread connection of the boring head. It was revealed that some factors that influence on the clearance value: the parameters of the slots on the bushing body and the stresses of prior pressing or wedging (for prior oversize).

For the purpose of estimation of slots influence on the accuracy of the thread connection was done the plan-matrix of the complete factorial experiment (CFE). In our case there were three factors: width of the slot, step and depth of the slot. To reduce the number of models we used two levels of each factor. Thereby we had 8 models [4]. The plan-matrix of CFE is shown in table 1.

Table 1 – Plan-matrix of CFE

№	Width, mm	Step, mm	Depth, mm
1	0,5	1	18
2	0,5	2	18
3	0,5	2	21
4	0,5	1	21
5	1	1	21
6	1	1	18
7	1	2	18
8	1	2	21

For bushings estimation during it's stressing according to the plan-matrix of the experiment was done eight models and their analysis (Fig. 2).

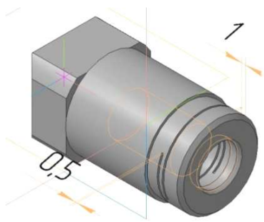


Fig. 2. Solid model of the bushing

All models were divided into final elements with a help of KOMPAS 3D V13 SP1 APM FEM library while stressing them were gotten data about stresses, displacements and safety factors of models. The results were shown as distribution maps of stresses, displacements and safety factors (Fig. 3).

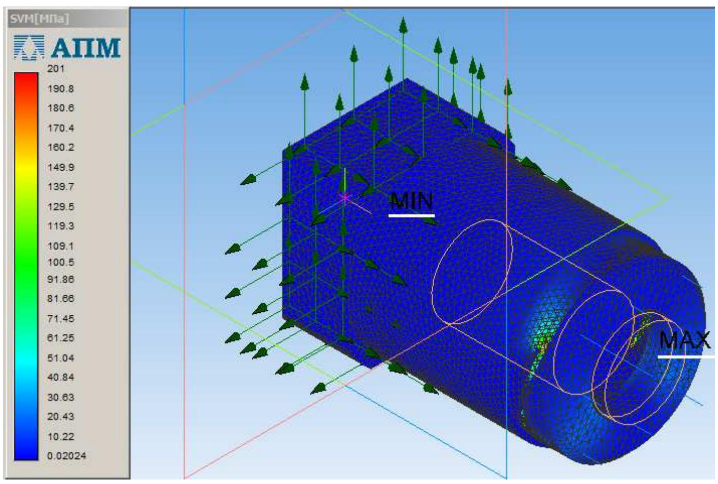
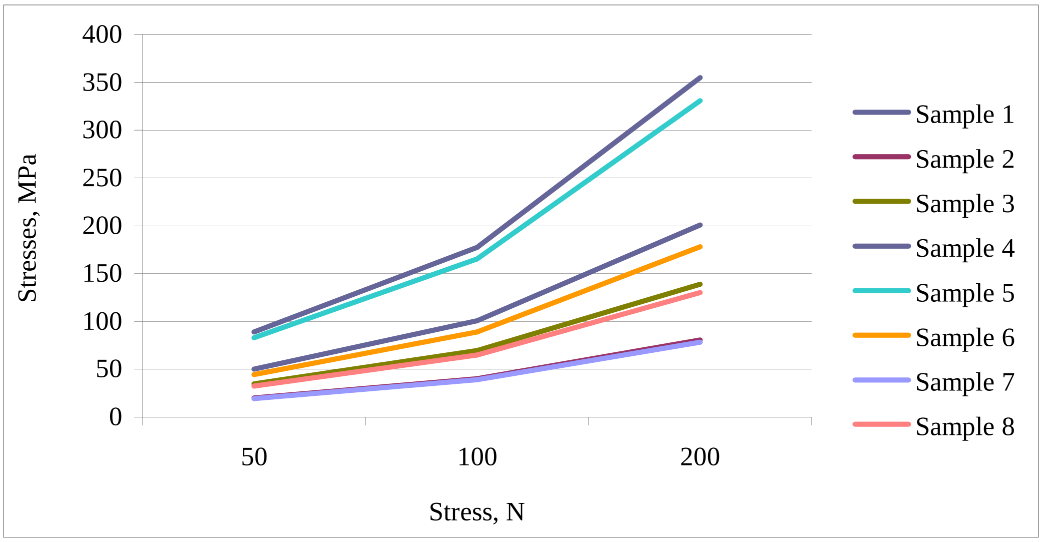
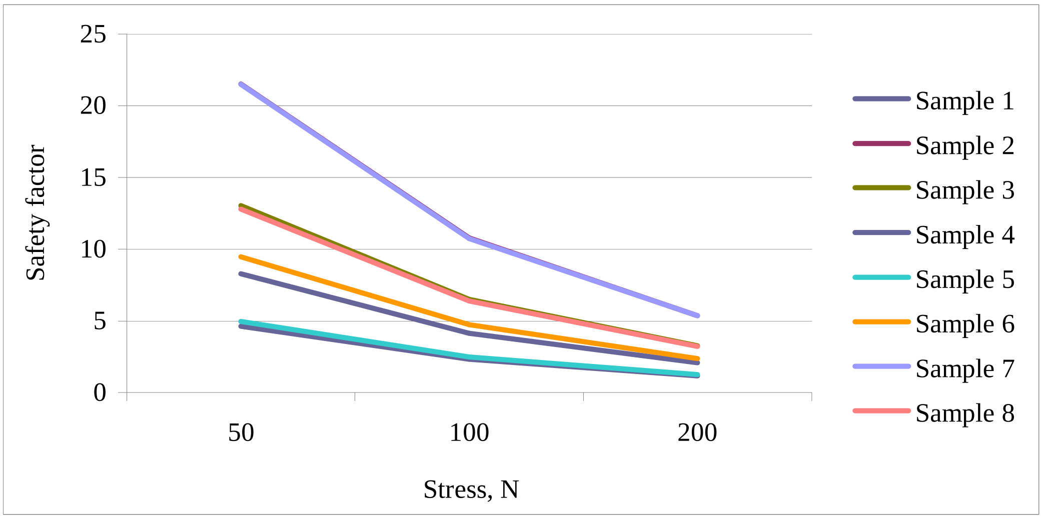


Fig 3. Example of distribution map of stresses

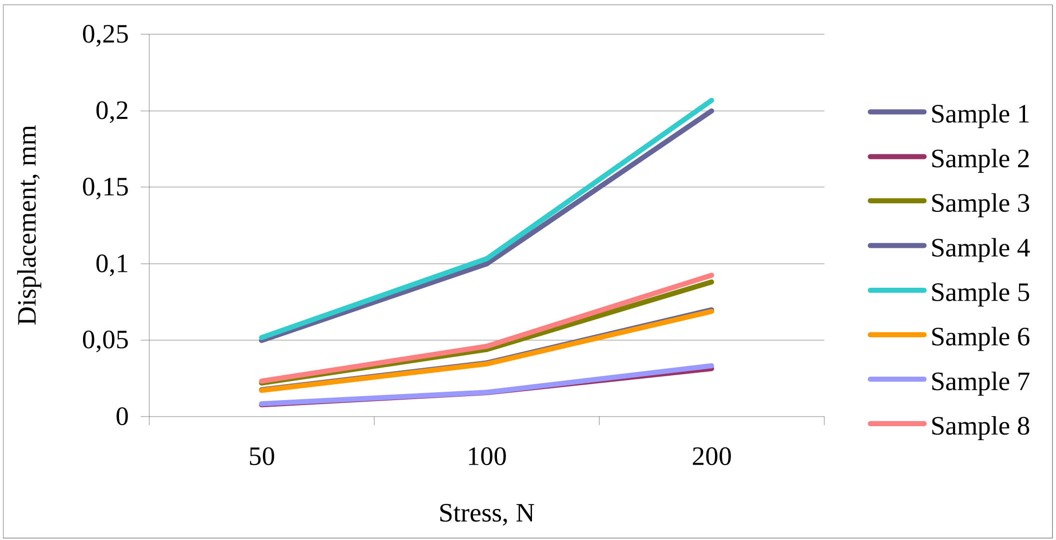
The results of distribution maps analysis is shown on fig. 4.



a)



b)



c)

Fig. 4. Dependence of stresses (a), safety factors (b) and displacements (c) in split bushing from stress

It is evident from these dependences that the most acceptable for the further experiments are samples 3, 5, 6 and 8, because they don't have so many stresses, because that could cause very high value of safety factor. From all this factors we choose the most rational sample 5, because it has the highest level of displacements and secures the minimum clearance in the thread connection at any stress.

During the projecting of new boring heads and cylindrical pilots the foreign products of the world's leaders of instrumental industry, the analyses of the patents were done. The prior investigations of construction were done, the best results had the split bushing that had width and step of the slot twice longer then thread pitch and depth of the slot was 4/5 of bushing diameter. In further experiments we plan to ascertain which of the methods prior resize (pressing or release) is better for in thread connection and when the clearance in the thread connection will be at its minimum level.

REFERENCES

1. Universal technological tool system./ «Vint" catalogue (RF), 2008.
2. Patent № 2349426 RF, МПК В23В29/034. Boring head.
3. Patent № 2270077 RF, МПК В23В29/034. Boring head.
4. Planning of the experiment in technical research. Vinarsky M., «Technic», 1975, 168 p.

UDC 665.658.26

KINETIC REGULARITIES OF THE DIESEL FUEL HYDRODESULFURIZATION AT THE L-24/6 UNIT

SERGEY VELIKOV, SERAPHIMA POKROVSKAYA
Polotsk State University, Belarus

In accordance to Technical Regulations of the Customs Union TR TS 013/2011, the marketing of the diesel fuel class lower than K5 will be prohibited in the Republic of Belarus from the 1st of January 2015. The K5-class diesel fuel is produced on L-24/6 unit of JSC Naftan since 2012. The results of the study of the unit operation are presented in this article.

Hydrotreating is the process of the heteroatoms (S, N, O) removing from the feed by the hydrogenation of sulfur compounds, nitro compounds and oxygen compounds. Simultaneously the hydrogenation of unsaturated and polycyclic hydrocarbons occurs; the metal atoms also are removed [1]. The requirements of the technical, normative and legal documents limit the sulfur and polycyclic aromatic hydrocarbon content. It is not difficult for JSC Naftan to achieve the requirements for the latter due to the nature of the feed. To reduce the sulfur content to 10 ppm (environmental class K5), a deep modernization of equipment is required. With this aim the new reactor block has been built at the L-24/6 unit, which is the part of the Complex of Hydrotreating, Mild Hydrocracking and Rectification.

Since the main goal of the hydrotreating process is to remove sulfur compounds, the kinetics of the desulfurization reactions is studied in this research. The process takes place in an axial multibed reactor. The molecules of liquid and partially vaporized feed react with hydrogen molecules on the catalyst surface. In this reactor the Albemarle's catalyst system is loaded. This system is a combination of inert compounds, auxiliary low-active catalysts and main Cobalt Molybdenum hydrotreating catalyst KF-757. The scheme of the reactor is shown in Fig. 1.

The kinetics of the hydrotreating process is influenced by many factors, such as the reaction temperature, the time that reactants contact with catalyst, hydrogen partial pressure, total system pressure, boiling range of the feed, hydrosulfide partial pressure, uniform distribution of liquid flow through the reactor section, catalyst life-cycle, etc. [2] Some parameters are uncontrollable; some are nondescript in commercial unit conditions. The control of hydrotreating process primarily carried out by temperature change in the reaction zone. The temperature is a part of the Arrhenius equation – one of the main chemical kinetics equations [3]:

$$k = A \cdot e^{-\frac{E_a}{RT}},$$