Instrumental cermets: their advantages in comparison with hard alloys when drilling gray cast iron

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Abstract
A modern material for the manufacture of cutting tools, which improves the quality of material processing. Tool cermets (hard alloys) and their characteristics when drilling metals.
Keywords
Cermet, wear resistance, high performance machining, cemented carbide, drilling.

The most important condition for maintaining and developing competitive production is its continuous improvement. Considering the technological systems in which metalworking is carried out, it should be noted the most important direction in the development of high-speed and high-performance processing. They differ from traditional approaches in increased productivity, accuracy and quality of the surface layer. The implementation of these processing methods is carried out in a complex and imposes certain requirements on equipment and tools.

Processing on CNC machines is perfect for high-quality and precise processing of metals, ensuring the required roughness, high quality parts, obtaining ideal surfaces, maintaining specified dimensions, and increasing labor productivity. Such a machine performs all the necessary technological operations independently, with the control of a given program.

The choice of cutting tool material is an important factor when planning a metalworking operation.

One of the most promising tool materials today is cermet.

Let's compare the cutting conditions when drilling with cermets and hard alloys of Gray cast iron.

Using MatCad, we will create the spatial responses of the carbide and cermets cutting speed model. Next, on the basis of an analytical assessment of the spatial responses of the cutting speed model with the materials under consideration, we will construct a cutting speed monogram on the feed rate and drill diameter to compare cutting conditions.

Creation of a matrix filled with the values of stochastic experimental data, displaying this matrix on the screen, calculating the decay rate with simultaneous randomization of the experimental data.

$y(x) := x^2 \cdot \sqrt{4 - x^2}$ $\quad x_H := 0 \quad x_K := 2$

$N := 10 \quad i := 0..N \quad x_i := x_H + \frac{x_K - x_H}{N} \cdot i \quad Y_i := y(x_i)$

$x =$

	0
0	0
1	0.2
2	0.4
3	0.6
4	0.8
5	1
6	1.2
7	1.4
8	1.6
9	1.8
10	2

$Y =$

	0
0	0
1	0.08
2	0.314
3	0.687
4	1.173
5	1.732
6	2.304
7	2.799
8	3.072
9	2.825
10	0

$$X := \begin{pmatrix} 3 \\ 2 \\ 1.5 \\ -0.15 \\ 2.9 \\ 0.345 \\ 12 \\ 3.45 \\ -9 \\ -0.123 \end{pmatrix} \qquad Y := \overrightarrow{y(X)}$$

$Y =$

	0
0	20.125i
1	0
2	2.976
3	0.045
4	17.661i
5	0.234
6	$1.704i \cdot 10^3$
7	33.46i
8	710.772i
9	0.03

Determination of processing modes using the Rastrigin optimization function.

$$f(\mathbf{x}) = An + \sum_{i=1}^{n} \left[x_i^2 - A\cos(2\pi x_i)\right]$$

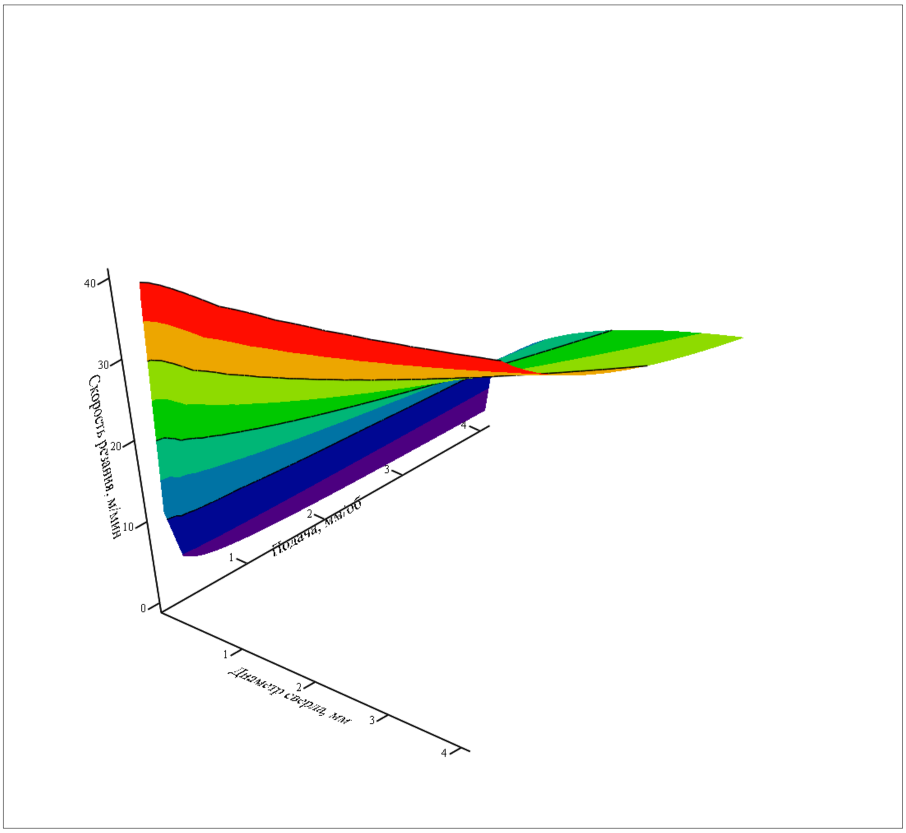
where: $A = 10$

```
Program MAX;
{ Найти максимальное число}
Uses Crt;
Var
    n,imax,i:integer;
    max:real;
    a:array[1..25] of real;
Begin
    ClrScr;
{ Ввод исходных данных }
    Write('Введите кол-во эл-в массива: '); Read(n);
    WriteLn('Ввод массива');
    for i:=1 to n do begin
      Write('a[',i,']= ');
      Read(a[i])
    end;
{ Вывод исходных данных }
    WriteLn('Кол-во элементов массива = ' ,n);
    WriteLn('Исходный массив');
    for i:=1 to n do
        WriteLn('a[',i,']= ',a[i]:4:1);
{ Расчётная часть }
    imax:= 1; max:= a[1];
    for i:= 2 to n do
        if a[i]>max then begin
            max:= a[i];
            imax:= i;
        end;
{ Вывод результатов }
    WriteLn('Максимальный элемент массива a[',imax,']= ',max:5:3);
End.
```

Gray cast iron drilling

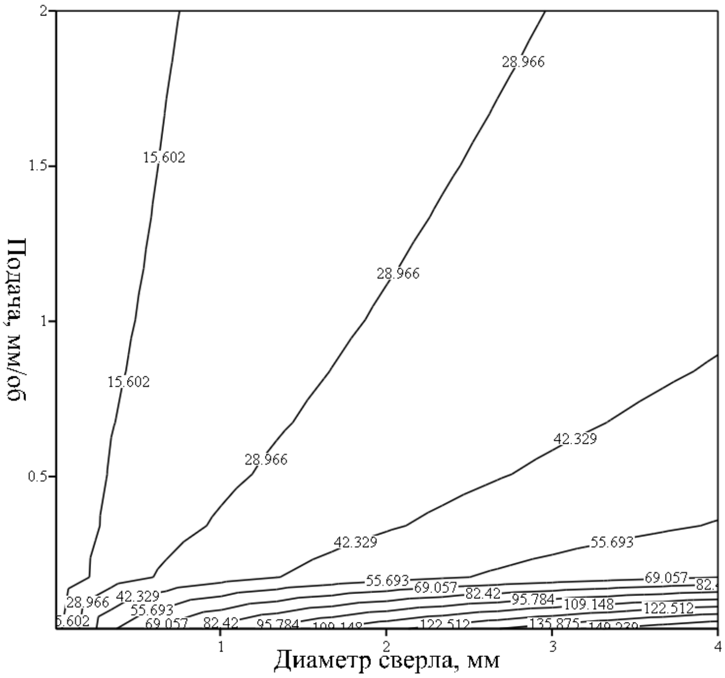
Initial analytical expression for determining the cutting speed when drilling

$$v := \frac{C_v D^q}{T^m s^y} K_v$$



v

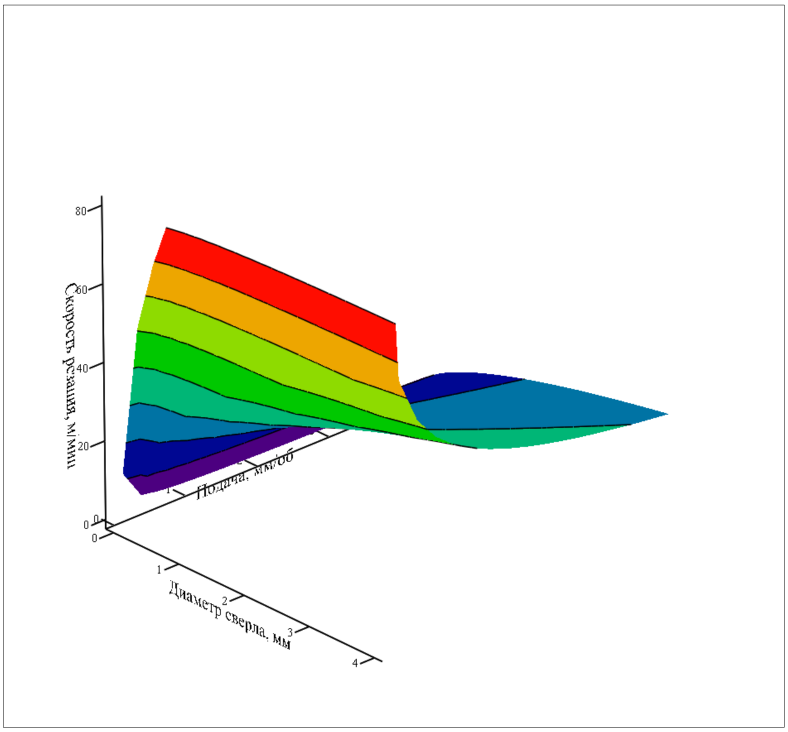
Fig. 1 Spatial response of the cutting speed model (carbide)



v

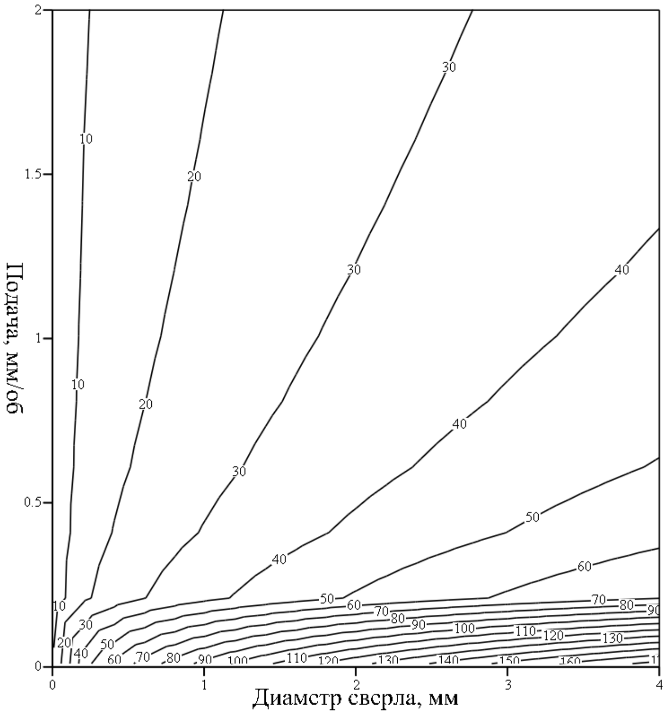
Fig. 2 Nomogram of cutting speed versus feed and drill diameter (hard alloy)

(built on the basis of an analytical assessment of the spatial response of the model, fig. 1)



v1

Fig. 3 Spatial response of the cutting speed model (cermet)



v1

Fig. 4 Nomogram of cutting speed versus feed and drill diameter (cermet)

(built on the basis of an analytical assessment of the spatial response of the model, Fig. 3)

In comparison, we see that when drilling Gray cast iron, cermets significantly outperform hard alloys in cutting conditions.

The emergence of a large range of cutting tools raises the problem of optimal choice very sharply. The task of selecting the optimal tool for the given organizational and technical conditions can be quite laborious. As a result, to reduce labor intensity, to warn against possible non-optimal solutions, it is necessary to summarize the main key points that speed up the selection process.

The sequence of the choice of the instrument is important, highlighting the main key issues that arise at various stages.

An important factor is the organizational aspect. It includes information support of technologists and engineers - economists and other interested parties with the necessary data sources. Summarizing the main sources of data required, the most important should be highlighted:

- state standards;
- catalogs of manufacturers of tools;
- electronic databases on the instrument;
- electronic resources on the Internet;
- technical reference books.

Considering the listed data sources, it should be noted that in the conditions of the rapidly developing market of cutting tools, catalogs of tool manufacturers, electronic databases on tools, interactive Internet resources have the most complete and new information. Electronic databases have the greatest ease of use, but they lack additional technical information. This problem can be solved by additional equipping the workplace with technical manuals, as well as a selection of the required information.

The electronic databases of the largest manufacturing companies (Sandvik – www.coroguide.com) are equipped with an automated search system. This greatly speeds up and simplifies the selection process, and it is also possible to quickly form orders for the selected tool. Let's note the Internet resources of the leading manufacturers of tools for high-speed and high-performance processing:

- Sandvik – www.coromant.sandvik.com/ru;
- ISCAR – www.iscar.ru;
- Mitsubishi - www.mitsubishicarbide.ru;
- Mapal - www.mapal.de;
- Kennametal – www.kennametal.com;
- Pokolm - www.pokolm.com;

- Dormer Tools – www.dormertools.ru;
- Seco - www.secotools.com;
- Prototyp - http://www.prototyp.com;
- Pramet -www.pramet.com;
- Walter -www.walter.com;
- Korloy- http://www.korloy.com;
- Titex - http://www.titex-prototyp.com.

Domestic tooling enterprises:

- KZTS Kirovograd hard alloys plant - www.kzts.ru;
- Association of manufacturers of machine tool products "Stankoinstrument" - http://www.stankoinstrument.ru.

The choice of tool firms, first of all, should be subject to the principle of comparative analysis of the tool of different firms for technical and economic efficiency.

For the design of technological processes for the machining of parts, an important stage is the choice of a cutting tool. A very large assortment of cutting tools gives us a great opportunity to choose the optimal tool for the required operations.

Looking at the analysis made, we can conclude that modern cutting tools are superior to conventional cutting parameters in terms of cutting parameters. This can be explained by the following advantages:

- use of new tool geometries;
- efficient use of cutting edges;
- very high durability;
- use of modern alloys for the manufacture of cutting inserts.

Accordingly, looking at the advantages obtained, we conclude that the modern cutting tool material cermet and its new characteristics allow the use of more optimal and high cutting conditions, which has an impact on improving the productivity of the machining process.

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