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DETERMINATION OF CONTACT PRESSURE IN A STAMP

ОПРЕДЕЛЕНИЕ КОНТАКТНОГО ДАВЛЕНИЯ В ШТАМПЕ

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ABSTRACT
Materials for forced formation of a weld root are presented. The estimation of possibility of manufacturing of ceramic backings from silicate materials is given.The basic conclusions received as a result of laboratory experiments.
KEYWORDS: *abrasive, hardening, wear resistance, durability, boring.*

АННОТАЦИЯ: *Повышение долговечности деталей, работающих в условиях интенсивного абразивного износа при высоких контактных давлениях, в частности пластин штампов для формования изделий из мелкодисперсных абразиво-содержащих смесей, путем упрочнения рабочей поверхности является актуальной научно-технической задачей.*
Ключевые слова: *износостойкость, боковая пластина, передняя пластина.*

DISCUSSION

In the broadest sense, ceramics are products of inorganic materials (for example, clay) and their mixtures with mineral additives, sintering of powders of the starting materials or materials based on them when manufactured under the influence of high temperature with subsequent cooling. The advantage of ceramic materials is that their stocks are practically unlimited. That is why in ceramics it is possible to use the widest range of composite materials, the components of which can differ significantly in their composition and properties, and the resulting products with fundamentally new properties. This circumstance has opened up broad prospects for the use of ceramic materials in mechanical engineering, since components that differ in the highest temperature characteristics, elastic moduli, and chemical stability are used to create it. In this regard, engineering ceramics, in contrast to art, sanitary, construction, electrical, radio ceramics, in which one or two of the above properties are preferred, requires a more complex, advanced, and therefore more expensive technology in economically and industrially sound volumes [4].

Thus, the process of creating ceramic materials for mechanical engineering in recent times has gone beyond laboratory research. Nevertheless, many experts are cautious about the complexity of

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the technology for manufacturing engineering ceramics, in particular, ceramics made from transformation hardened zirconia with bending strength up to 2200 MPa or from recrystallized (densely sintered) silicon carbide, which up to 2000K retains the same strength as and at room temperature.

Reducing the cost of products through the use of materials from local raw materials: introducing the ceramic mass of cheaper clay of the Angren rock and Navai field chamotte and reducing the amount of expensive materials imported from foreign countries.

This is achieved by the fact that the porcelain component, which smoothes the surface, is additionally introduced into the lining composition for forming the back side of the weld containing quartz sand, and Angren and Navava rocks are used as the main component in the following ratio of components, wt.%

Abrasive components:
Kaolin (Angren Rock) 56-59%
Pegmatite (Nava Field Chamotte) 17-19%
Porcelain component 10-12%
Quartz sand (Kuvasay rock) 8-10%

Porous clay Kaolin of Angren origin is the basis of ceramic tiles and a binder for fireclay and quartz sand. The content of porous clay kaolin in ceramic tiles of 55-59% increases the refractoriness of ceramics to a temperature of 1400^{0}C [2].

Consequently, the need to summarize the results of the development and use of ceramics in various fields of engineering is already present.

Improving the reliability and durability of machines is one of the main problems of modern engineering. The economic significance of this problem is obvious.

As shown by statistical analysis, the main reason for the failure of machines is not their breakdown, but the wear of moving joints and working bodies under the influence of friction. When designing a new machine, the engineer always relies on the most critical parts for strength, while practically no movable mating is checked for wear resistance. When designing and operating machines, the most effective means of reducing wear, taking into account specific working conditions, are not always used.

During friction, fundamental changes occur when the surface volume of the material is in contact with movable joints. These changes determine the wear process and the magnitude of the friction force itself.

When processing ceramic materials, the pressure of the abrasive particles of the mixture being compacted when they are moved relative to the side and end walls of the mold during pressing is a big influence on the wear of the stamp plates.

When forming ceramic products, first of all, it is important to determine the pressure necessary to obtain high-quality raw material. Raw material from compacted particles of sand-clay mixture after pressing should retain its shape during transportation, drying and firing in the absence of cracks and chips. Therefore, the pressure created during pressing should guarantee the formation of raw materials with certain strength characteristics. This is ensured by compaction of the mass and an increase in adhesion between them.

When pressing ceramic products, it is necessary to create a pressure of at least 10 ... 25 MPa. With increasing pressure on the mixture, the working plates of the stamp experience intense abrasive action, which leads to wear of their working surfaces and cause a decrease in the quality of the molded products. It is important to establish the nature of the pressure distribution of the compacted mass on the side and end plates of the stamp, since they will be most intensively subjected to wear during compaction and knocking of raw material from the mold [4].

Uneven wear of the plates along the height gives reason to assume that the stress distribution in the sealed mass will also be uneven when the punch of the stamp moves. Knowing the magnitude of the force required for compaction, it is possible to identify the distribution of pressure along the height of the side and end plates of the stamp to predict their wear resistance.

According to studies of the stress state of a die for pressing granular ceramic or silicate material in cross section, it looks like a rectangle with a length l and width m (Fig. 1) [1]. Distributed load q from the punch of the stamp acts on the upper surface of the material being sealed. A diagram of the compaction of a mixture in a mold with a height h is shown in (Fig. 1, a), and the forces and stresses acting on the elementary volume of a mixture with a height of dh enclosed between parallel planes I-I and II-II are shown in the diagram (Fig. 1, b).

The vertical stresses σ_h will be variable in height h, while the stress distribution is assumed to be uniform on horizontal sites (planes I-I and II-II) of the selected volume of the mixture. Considering that, the stresses σ_y are distributed uniformly along the length l and they determine the pressure on the side plates of the stamp, and the stresses τ_y lead to the appearance of friction forces F_{fr} on the side sections of the selected element of width m.

Considering the equilibrium of the selected elementary element under the action of forces (Fig. 1, b), the magnitude of the acting forces can be represented as follows:

$$P_{\text{в}} = \sigma_h \cdot l \qquad (1)$$

where P_B is the force acting on the upper plate of the stamp.

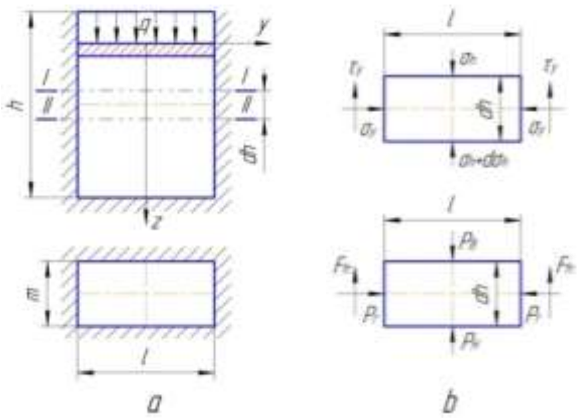

Figure 1. Schemes for compaction of the abrasive mixture and the resulting stresses: a - sealing scheme; b - a diagram of the stresses and forces acting on the elementary volume of the mixture.

$$P_H = (\sigma_h + d\sigma_h)l \qquad (2)$$

Where, P_H is the force acting on the lower plate of the stamp.

$$P_r = \sigma_y \cdot dh \qquad (3)$$

Where, P_r is the force acting on the side plates.

$$F_{fr.} = \tau_y \cdot dh$$

Where, $F_{fr.}$- is the friction force on the side plates.

Assuming that $\tau_y = f_{fr.} \cdot \sigma_y$ we get:

$$F_{fr.} = f_{fr.} \cdot \sigma_y \cdot dh \qquad (4)$$

Where, f_{fr} is the coefficient of friction of the compacted mass on the surface of the stamp plates.

The dependence between σ_y and σ_h can be represented in the form according to [1]:

$$\sigma_y = k \cdot \sigma_H \qquad (5)$$

Where, k is the lateral pressure coefficient.

The average value of the coefficient of lateral pressure, in our case, the value of k mainly depends on the coefficient of internal friction and are determined:

$$k = 1 + 2f_{fr}^2 - 2f_{fr}\sqrt{1 + f_{fr}^2} \qquad (6)$$

Using dependence (5), we write:

$$P_r = k \cdot \sigma_y \cdot dh \qquad (7)$$

Hence the friction force:

$$F_{\text{тр.}} = f_{fr.} \cdot k \cdot \sigma_y \cdot dh \qquad (8)$$

Given that, the mass acting on the allocated volume of height dh is negligible compared to the external pressure created by the punch, therefore, it is neglected.

The adhesion strength of the particles of the mixture with each other depends on the properties of bulk mixtures and the pressure q_ε that occurs during compaction of the mixture is determined by the formula:

$$q_\varepsilon = \frac{C}{tg\varphi} \qquad (9)$$

Where, C - cohesion of the particles of the compacted mixture, *MPa*; $\varphi -$ is the angle of internal friction of the particles of the mixture being compacted.

The equilibrium equation of the allocated volume in the projection onto the vertical Z axis (Fig. 1, b).

$$P_B - P_H - 2F_{fr.} = 0 \qquad (10)$$

Substituting the values of forces from equations (1), (2) and (8) and dividing respectfully by *l*, we obtain:

$$\sigma_h - \sigma_h - d\sigma_h - \frac{2f_{fr}}{l}k\sigma_h dh \qquad (11)$$

From here, dividing the variables we get:

$$\frac{d\sigma_h}{\sigma_h} = -\frac{2f_{fr}k}{l}dh \qquad (12)$$

Given that $\frac{2f_{fr}k}{l} = B$, we write:

$$\frac{d\sigma_h}{\sigma_h} = -Bdh \qquad (13)$$

After integrating equation (13), we obtain:

$$\ln\sigma_h = -B \cdot h_i + c' \qquad (14)$$

Where, c'- integration constant. For $h = 0$ and $\sigma_h = q_P + q_\varepsilon$, we find:

$$c' = \ln(q_P + q_\varepsilon).$$

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h_i - is the current coordinate measured from the plane of the plate being compacted; q_p - is the pressure of the punch on the mixture being compacted.

After transformations (14) we get:

$$\sigma_h = (q_P + q_\varepsilon) \cdot e^{-Bh_i} \quad (15)$$

Substituting the values of q_ε and B in equation (15), we obtain the vertical stress in the form:

$$\sigma_h = (q_P + \frac{C}{tg\varphi}) \cdot e^{-\frac{f_{fr}k}{l}2h_i} \quad (16)$$

The horizontal voltage is determined by:

$$\sigma_y = k \cdot \sigma_h = k \cdot (q_P + \frac{C}{tg\varphi}) \cdot e^{-\frac{f_{fr}k}{l}2h_i} \quad (17)$$

On the side plates there are tangential stresses:

$$\tau_y = f_{fr.} \cdot k \cdot \sigma_h = f_{fr.} \cdot k \cdot (q_\Pi + \frac{C}{tg\varphi}) \cdot e^{-\frac{f_{fr}k}{l}2h_i} \quad (18)$$

To determine the pressing conditions, it is necessary to establish the relationship between the magnitude of the deformation along the height of the stamp and the stresses in the volume of the mixture being compacted.

Using equation [3], we write:

$$q_\text{п} = \alpha \cdot k_y^\beta \quad (19)$$

Where, α is the empirical coefficient (depends on the properties of the mixture being compacted), MPa; k_y is the compaction coefficient; β is an exponent which is determined experimentally.

$$k_y = \frac{\Delta h}{H} = \frac{h-H}{H} \quad (20)$$

Where, Δh - precipitation of the mixture, mm; H - the height of the compacted briquette (product), mm; h - the height of the filling mixture (limited by the height of the mold), mm.

Substituting expression (19) into equations (16), (17) and (18), and denoting $\gamma = -f_{fr}k\frac{2h_i}{l}$, we obtain:

$$\sigma_h = \left[\alpha \cdot k_y^\beta + \frac{C}{tg\varphi}\right] \cdot e^\gamma; \quad (21)$$

$$\sigma_y = k\left[\alpha \cdot k_y^\beta + \frac{C}{tg\varphi}\right] \cdot e^\gamma; \quad (22)$$

$$\tau_y = f_{fr.} \cdot k\left[\alpha \cdot k_y^\beta + \frac{C}{tg\varphi}\right] \cdot e^\gamma; \quad (23)$$

The dependences (21), (22), and (23) obtained above make it possible to single out factors affecting the magnitude and distribution of stresses during the pressing of the abrasive mixture of Angren rock. Firstly, these are dimensional factors, which include: the filling height of the mixture *h*, the pressing length *l* and the amount of settlement *Δh* which characterize the deformation during compaction. Secondly, factors characterizing the state of the material being compacted: OS - an indicator of the compression curve of compression of the mixture (determined experimentally for various compositions of powder mixtures); β - also an indicator of the compression curve, depending on the properties of the mixture being compacted; *C* is the adhesion of the particles of the mixture being compacted (it is a characteristic of the material's cohesion) k is the coefficient of lateral (spacer) pressure. Thirdly, the friction coefficient $f_{fr.}$ of the mixture material on the side plates of the stamp during pressing and the angle φ of the internal friction of the particles of the mixture material to be compacted.

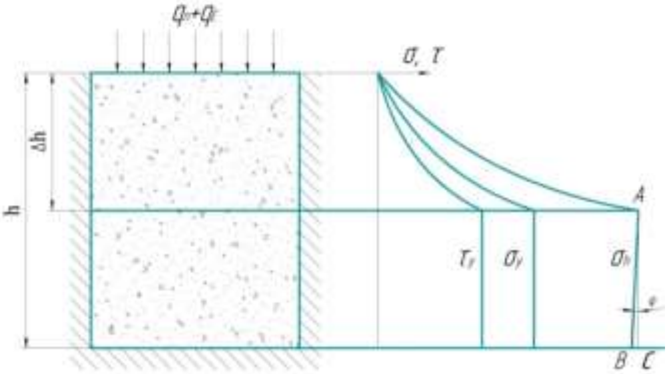

Figure 2. Scheme of stress distribution during compression of the mixture.

Thus, the value of the coefficient of friction of the mixture on the side walls of the stamp is important for pressing. An analysis of the obtained dependences shows what factors can be varied to reduce the unevenness of pressing and equalize the pressure of abrasive particles on the side plates to increase their wear resistance and the quality of the molded products.

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REFERENCES

1. *Igonin V.A. Technological support of a wear-resistant surface layer of stamp plates for molding products from finely dispersed abrasive mixtures / Penza, 2010. - 192 p.*
2. *Help decision on the grant of a patent for the invention No. IAP20170480 UZB, No. 01-08 / 3131 dated December 3, 2018. The composition of the lining for forming the reverse side of the weld / S.M. Yusupov, A.E. Sotvoldiev, R.Kh. Erkaboev.*
3. *Garshin A.P. Ceramics for mechanical engineering / M.: Publishing house "Nauchtekhlitizdat", 2003. - 384 p.*
4. *Kragelsky I.V. Fundamentals of calculations for friction and wear / M .: "Engineering", 1977. - 526 p.*