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On the Use of Powder Alloys for Friction Units

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Abstract

The data, confirming the prospects of the use of powder alloys in comparison with compact alloys, for production of details of friction units of machines: bearings of sliding and rolling, is provided. The technology of production of porous powder alloy is suggested. It provides the sliding bearing in of self-lubrication conditions. This increases the wear resistance of the bearing and guarantees a long operation cycle of the machines until the next maintenance. Modifying porous alloy SP50D5 by introduction bronze Br. 010 into the furnace charge instead of copper allowed reducing the sintering temperature, and the introduction of zinc sulfide ZnS contributed to the formation of fine pearlite in the structure of the alloy and, respectively, to the average 25% increase in the strength properties of the alloy at plasticity preservation.

The manufacturing technology of the hot-stamped powder bimetal is developed for the kinematic couple of rolling friction, consisting of high-plastic core from alloy SP30D2N3 and high-strength, wear-resistant outer layer from alloy SP80H3, the use of which will allow increasing the operational properties of interfaces of details of friction units of rolling of machines and thw equipment at the level of the serial analogs, in case of the decrease in technological costs and the cost of products.

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Keywords: powder alloy; furnace charge; antifriction alloy; friction unit; bearings of sliding and rolling; sintering; hot-forming.

1. Introduction

Now, the powder metallurgy, as the most economic method of production of products, finds wide circulation in mechanical engineering [1-5]. Machine-building powder details (gear wheels, rings, sliding bearings, brake shoes and disks of clutches and couplings, composite contacts, etc.) constitute a considerable part of the European market [1].

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Porous powder alloys widely apply in mechanical engineering to production of antifriction details in the form of plugs and inserts for work in friction units. The production technology of products shall provide their necessary service properties.

The actual task is development of technology of receipt for producing bimetallic powder materials, working layers which provide necessary performance characteristics of products (wear- and corrosion resistant, friction or antifriction properties, etc.).

The work purpose – development of technologies of manufacturing antifriction details with improved raised physics-mechanical properties of powder alloys for work in friction units of sliding and rolling.

The operability of bearings of sliding is estimated by two criteria - the average pressure pc between the axle and an insert and to the work pcν (ν – the district speed of rotation of the axle), called temperature criterion [6]. Calculation for average pressure pc guarantees a navigableset of lubricant and represents calculation on wear resistance, and calculation for pcν provides the normal thermal mode and lack of jammings.

The condition of normal operability of bearings of sliding: $p_c \leqslant [p_c]$ and $p_c\nu \leqslant [p_c\nu]$, where $[p_c]$ - allowed pressure; $[p_c\nu]$ - allowed value of criterion, depending on the properties of the materials of bearing of sliding depending on properties of material of the bearing [1]. At excess of the allowed value $[p_c\nu]$ temperature locally increases so that there is a rupture of the oil layer, and, as a result, the adhesion of surfaces of the axle and an insert.

The bearings of sliding can be manufactured by machining of workpieces of casting or hire of compact materials (antifriction cast iron, bronze, fluoroplastic, etc.). These materials and alloys have a number several disadvantages, the main of which - low working capacity in the conditions of dry and moist friction, that demands regular maintenance of the friction unit. Besides, bearings from color alloys are expensive, that limits their application.

2. Main part

In work [7] as a material to bearings of sliding gravity mixers applied the porous baked powder alloys [2]. Cost value of production of porous bearings is lower, in comparison with bearings from compact materials and alloys as there is no machining. The comparative characteristic of the properties and composition of porous and compact alloys is provided in table 1.1.

Table 1.1. Properties of antifriction compact and porous alloys.

Name, grade of alloy	Temporary resistance to a gap σ_b, MPa	Specific elongation δ, %	Maximum pressure p_{max}, MPa	Maximum speed of sliding V_{max}, m/s	The coefficient of sliding friction with lubrication/ without lubrication f	Composition
Compact materials and alloys (density-100%)						
Fluoroplastic, F-4	14- 34	250-500	0,5-0,7	0,5-1	0,04/0,08	-
Antifriction cast iron, ACHS-1	150-350	4-6	2,5-9	0,2-2,6	0,1/0,15	in accordance with GOST 1585-85
Antifriction bronze, BrO3TS12S5	180-210	5-8	4-6	0,2-6	0,09/0,12	3%Sn+12%Zn+ +5%Pb+$Cu_{(other)}$
Porous alloys (density-75…85 %)						
SP50D5	105-280	2,5-3,5	9,4	0,5-3,0	0,06/ 0,1	0,5%C+5%Cu+ +$Fe_{(other)}$
SP50D5 (modified)	180-350	2-3	11,5-14,5	0,5-2,8	0,04/0,1	0,5%C+6%Бр010 +(0,7-1,2)%ZnS +$Fe_{(other)}$

Porous alloy SP50D5 was made on the following technology [1,8,9]: preparation of furnace charge in mixers; pressing on hydraulic or mechanical presses; sintering at a temperature of 1100-1150oC. After sintering of procurement of bearings of a the billet bearings promaslivali in a heated mineral oil, as a result of pores were filled with lubricant.