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The Prospect of Processing Industrial Waste

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Abstract:

The article presents the results of research and development of technology for obtaining prototypes of metal-ceramic filter materials based on iron powder from rolled scale "Uzmetkombinat". The operational and mechanical properties of the obtained samples are given.

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In our country (Uzbekistan), the Uzbek Metallurgical Combine (Bekabad) accumulates tens of thousands of tons of rolled scale from year to year, and therefore it is advisable to use this waste for the needs of the national economy [1]. To solve this problem, studies of rolling scale "Uzmetkombinat" were carried out. To do this, a batch of 250 kg scale was selected from the dumps of the rolling shop, which had a wide range of fractional composition, mainly from 5 to 0.01 mm, as well as large pieces up to 35 mm in size stuck to each other.

In order to obtain a homogeneous fractional composition of the rolling scale, grinding was carried out on a ball mill for 2 hours at full load, then the fractional composition was averaged on a vibrating sieve with a cell size of 0.1 mm (№ 65). Samples of rolled scale from three different locations of this batch were selected for the study. The scale was studied by X-ray phase analysis on DRONE - 2 [2]. To facilitate the analysis of the radiograph shown in Figure 1, the positions of the corresponding peaks are shown in strokes (bar chart). The analyses showed that the scale mainly consists of FeO (wustite) - 80%, Fe_3O_4 (magnetite) - 15%, γ - Fe_2O_3 (maghemite) - 5%.

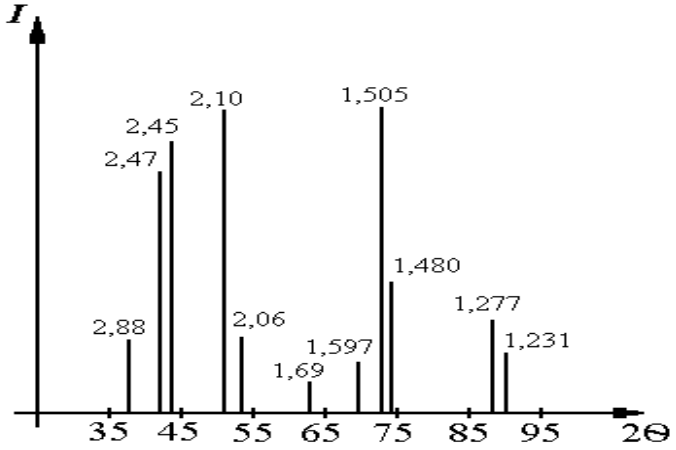

Fig. 1. Conditional radiograph of rolling scale of “Uzmetkombinat”

The results of the analysis of the variable composition of scale, carried out by a resteno-fluorescent metol on the EP – 2000 OXFORD (England) device with a sensitivity of 0.01%, indicate a significant content in the scale and, consequently, in the rolled metal of Mg (0.163%), Al (0.225%), Si (1.50%), Cr

(0.193%), Mn (0.702), Ni (0.238%), Cu (0.305%), Mo (0.475%), which they have a significant impact on the mechanical properties of products.

Scale recovery was carried out on a hydrogen 3-zone furnace as follows: the rolled scale dried at a temperature of 150 °C was loaded into boats measuring 500x500 mm, which were made of stainless steel. The scale was placed in these boats with a thickness of 15 mm and loaded into the furnace. The temperature of the furnace in the 1th zone was 450, in the 2nd zone - 750 and the 3rd zone - 890 ° C. The boats moved against the flow of hydrogen at a speed of 10 mm/min. The reduced iron powder was a solid spongy mass 15 mm thick, stuck to the bottom of the boat. When tapping with a hammer on the boat, it crumbled into small pieces and into powder. The iron powder and sponge mass obtained in this form were ground in a ball mill at full load - 250 kg. After grinding, sieving was carried out on a vibrating sieve with the dimensions of the sides of the cells 0.3 mm (№. 67).

Samples of recovered powders from three different locations of this batch were selected for the study. Figure 2 shows a conditional radiograph of iron powder. The analyses showed that the obtained iron powder complies with GOST 9849 - 86 but the PJVZ brand. The granulometric composition of the jelly powder and its shape were determined by microscopic analysis [2]

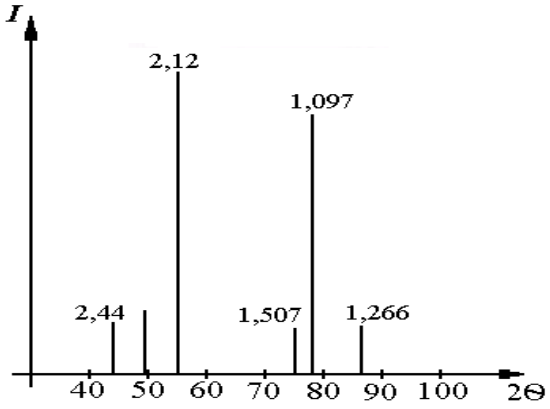

Fig. 2. Conditional radiograph of iron powder

To determine the suitability of iron powders in the national economy, a filter material for cleaning motor oils was made from them. To determine the

mechanical and filtering properties of the material, rods were made. In the manufacture of the bars, the following composition of the charge was selected: iron powder with a particle fraction of 0.15 - 0.065 mm - 90% of the charge weight, 10% copper to impart strength and plasticity to the material, and 3% ammonium chloride as a pore-forming agent [3].

The charge was prepared in the following sequence: first, all dry components were mixed, this is iron and copper powder, ammonium chloride. Mixing was carried out in a ball drum with a volume of 25 liters for 2 hours, loading - 5 kg, drum rotation speed - 150 rpm. After mixing, a 10% solution of rubber in gasoline was added to this mixture as a plasticizer, which was mixed in a screw mixer for 2 hours, loading - 5 kg. screw speed - 50 rpm.

The finished mixture was dried in a drying oven to remove gasoline for 45 min at a temperature of 90–95 ° C (ammonium chloride decomposed with prolonged exposure in a drying oven). The mixture prepared in this way was rubbed by passing it through a №. 65 sieve. Briquettes of filter bars measuring 7x7x30 mm were pressed from this charge on a 40-ton press with pressing forces of 200, 300, 400 MPa. The filling is 7, 8 and 9 grams, respectively. The finished briquettes were dried in an oven for 45 minutes at a temperature of 90 -95 °C. The dried briquettes were sintered in a 3-zone oven in a hydrogen atmosphere. The briquettes were loaded into graphite boats and a protective filling made of crocus (aluminum oxide) was poured, the boats moved against the flow of hydrogen at a speed of 10 mm / min, the furnace temperature in the 1st zone was 230 °C, in the 2nd zone – 650 °C and the 3rd zone – 1200 °C.

Figure 3 shows the microstructure of the bar, where one can see the filter pores that were formed during the sintering process, and Table 1 shows the results of testing the mechanical properties of the filter bars.

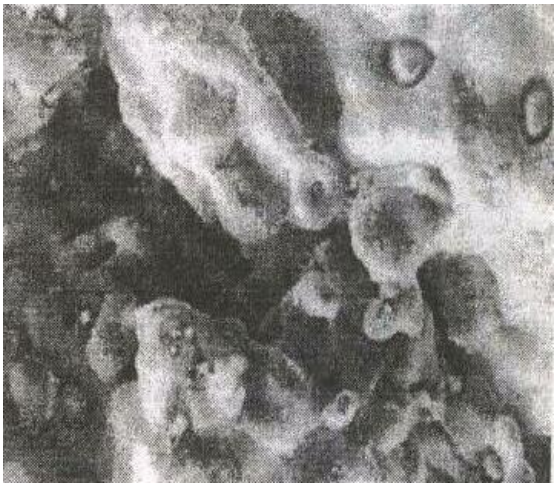

Fig 3. Bar microstructure, x1000

To test the operation of filters in real conditions, several types of filter bushings were manufactured with a size of 40x34x50 mm and a wall thickness of 3 mm. The preparation of the charge and the sintering process of the filter bushings was carried out in the same sequence as for the stack of filter material.

Table 1.

Mechanical properties of sticks from pressing force

Indicators	Pressing forces, MPa		
	200	300	400
Tensile strength at break, MPa	100	150	190
Tensile yield strength, MPa	100	130	160
Compressive strength, MPa	550	850	930
Compressive yield strength, MPa	90	120	180
Elongation at tension, %	0-1	0-1	0-1
Brinell hardness, MPa	650	650	650

The pore size of the filter sleeves was determined by the method of liquid displacement [4]. Distilled water was used as a liquid. The results of the study (Table 2) showed that, with the same pressing forces, the pore size of the milling material decreases with a decrease in the size of the iron powder particles. The same thing happens with an increase in the pressing force at the same particle sizes of iron powder [5].

Table 2.

The effect of the particle size of the initial powder and the pressing force on the pore size of the filter bushings

Iron powder particle size, mm	Pressing forces, MPa		
	200	300	400
	Pore size, mkm		
0,3-0,3	96	68	43
0,2-0,1	60	46	33
0,1-0,063	42	28	16
0,063-0,02	22	13	7
0,02-0,01	9	3	1

A filter based on iron powder obtained by reducing the rolling scale of Uzmetkombinat is more fully suitable for the manufacture of filter materials for cleaning machine oils from abrasive particles of less than 10 microns in size. Consequently, the processing of rolled scale by Uzmetkombinat into iron powder has a more fully justified prospect.

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