

PROTECTION OF WORKING BLADES OF AXIAL SMOKE SUPPERS FROM GAS ABRASIVE WEARING

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ANNOTATION

This article presents the results of research and theoretical information on the use of axial vacuum cleaners DOD-41-500 in dust-coal boilers of power units with a capacity of more than 300 MW, their restoration, the effectiveness of restoration methods, wear rates, combined restoration technologies, the most wear-resistant materials, quality control.

Keywords: smoke exhaust, abrasive wear, erosion, gas abrasive wear, surfacing.

ЗАЩИТА РАБОЧИХ ЛОПАТОК ОСЕВЫХ ДЫМОХОДОВ ОТ ГАЗОАБРАЗИВНОГО ИЗНОСА

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АННОТАЦИЯ

В данной статье представлены результаты исследований и теоретические сведения по применению осевых пылесосов ДОД-41-500 в пылеугольных котлах энергоблоков мощностью более 300 МВт, их восстановлению, эффективности методов восстановления, скоростям износа, комбинированным технологиям восстановления, наиболее износостойким материалам, контролю качества.

Ключевые слова: дымоудаление, абразивный износ, эрозия, газоабразивный износ, наплавка.

Energy units of the CIS countries, using coal as fuel", are equipped with DOD 41-500 smoke collectors for flaring exhaust gases'. Power 300 MW The use of dust collectors of power units -co'in DOD-31.5 and DOD-41 o'smoke collectors'of steel boilers is usually accompanied by intensive abrasive wear of the blade apparatus (Fig. 1-).

The technical characteristics of the DOD 41-500 smoke extractor are presented in Table 1.

Table 1

DOD 41-500 Smoke Extractor Technical Specifications

Pointer name	Value
Diameter of the impeller, m	4.1.
Engine (synchronous) rotation frequency, max, rpm	500
Installed engine power, kW	5,000
Sucking capacity, m ³ /hour	1445000
Permissible Moving Medium Temperature, °C	200.
Permissible dust content of the mobile medium, g/nm ³	0.5
Mass of the impeller in the first and second stages, kg	5500

Yo'blades of the guide apparatus, consisting of replaceable nose parts and rotary covers, are also prone to dust wear, but their service life is 2 - 2.5 times greater than the service life of the working bladesko'p. Armor 'compared to other elements of the flow part of the smokestack (8-10po'lat sheets) serves the longest. At the same time,,armor'is most intensively worn (up to 3-4 mm per year) under the covers of the shovels.

Due to the wear of the working blades, a decrease in the supply of the exhaust fan leads to the need to accelerate its operation. This is achieved by rotating the blades of the guiding apparatuses to -30°, which significantly increases the vibrational stresses and contributes to the formation of fatigue cracks, which in some cases leads to the breakage of the working blades. In this regard, research work was carried out at the "Yangi Angren TPP" to increase the wear resistance of DOD-41 axial exhaust fans. The study of block operation showed the following. With unlimited block power, the wear of the working blades of the exhaust fan is approximately 60 mm (about 10%). When the chord decreases by 20%, the power of the block decreases by 5-7% due to insufficient traction force. With a gas dust content of 1.2 g/m³, unprotected working blades wear 60 mm along the chord after 800-1200 hours of operation. The main direction of increasing the resource of fume hoods, in addition to increasing the efficiency of flue gas cleaning, is the use of various methods of blade reinforcement.

Before starting the work on reinforcing the blades, the natural vibration frequency of the blades was measured, and the root zone of the working blades' inlet edge was checked for the presence of fatigue cracks. With a crack depth of up to 1.0 mm, they were selected with abrasive

tools. After sampling, they were welded to a greater depth using UONI 13/55 electrodes. In deeply developed cracks, the scapula is incised.

To determine the most wear-resistant material, T-590 electrodes were tested with coatings in the form of plates made of KBX-45, chromium boride granules, PP-AN170 powder wire, VK-6 hard alloys, "sormaite," as well as T15K6 hard alloy and TiNi titanium nickelide, and coatings coated with plasma and gas-powder coatings with self-fluxing alloys. The thickness of the deposited layer after cleaning was not less than 4-5 mm at the tip of the blade and 3 mm at the outlet edge (Fig. 2). The hardness of the surfaced layer was measured according to the control surfacing sample and was at least 58 - 61 HRC.

Practice has shown that the wear of the inlet edge has the greatest impact on the overall wear of the blade. By protecting the inlet edge from wear, it is possible to reduce the wear of the working blade's outlet surface.

The wear of the blades increases sharply from the moment a wedge is formed at the entrance edge at an angle of 60°. Along the entire height of the edge, such a wedge is usually formed after 400-600 hours of operation of the unprotected working blade. The rectangular shape of the blade tip increases the wedge formation time by 30-40%, thereby extending the service life of the blades. Taking this into account, during surfacing and cleaning, the tip of the blade was given a rectangular shape.

Quality control of surfacing was carried out visually. Sections, unwelded areas, large slag inclusions, and cracks reaching the base metal along the entire thickness of the deposited metal were not allowed. The part at the outlet edge, coated on the working surface, is protected in such a way as to ensure a smooth transition from the base metal to the coated metal along the gas flow direction. Otherwise, during operation, the metal of the blade under the surfacing will wear out, forming a "pocket."

Experiments with protective surfacing of the blades of DOD-41-500 exhaust fans with individual electrodes and plasma spraying along the entire height of the inlet edge showed that fatigue cracks are formed in a zone 100 mm wide from the blade root. In one fume hood, the number of cracked blades reached up to 30%.

In this zone (maximum stress zone), electric arc surfacing of the working blade inlet edge with wear-resistant electrodes and powdered wires leads to a decrease in the fatigue strength of the metal. During surfacing, the base metal heats up to a temperature above 1500°C. In this case, grain growth occurs in the boundary zone, which reduces the plasticity of the metal. Alloying the base metal of the blade with molten coated metal increases strength and breaks the crystal lattice of the base metal, which also reduces the fatigue strength of the blade metal. Compressive stresses in the surfaced metal reach high values. Under the influence of alternating

sign loads, destruction (vibration) occurs mainly in the more brittle surfaced metal, and the resulting crack spreads to the base metal. In this case, the natural frequency of the blade's oscillations decreases, which contributes to its entry into the hazardous zone of the resonant frequency.

It should be noted that the part of the blade's inlet edge at a distance of 100 mm from the base is in a highly stressed state during operation, therefore, strict requirements are imposed on the protective coating: the heating and melting of the base metal should be minimal, there should be no cracks in the deposited metal, the wear resistance of the coating should be sufficiently high, i.e., 3-4 times higher than the wear resistance of the blade. The surfaced metal must withstand alternating sign loads acting on the tip of the blade in this zone. All these requirements correspond to argon-arc surfacing with alternating layers of hard alloy VK-6 and steel grade 12X18N10T (Fig. 2, c). For effective protection of the root zone of the working blades, the design of the protective cutter, shown in Fig. 3, was developed. The incisor protects the pre-root area of the scapula for at least one year.

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Installation of new cutters is carried out by a team of two people for 1-1.5 hours. The experience of their use in DOD-41-500 axial exhaust fans has shown the effectiveness and reliability of such separators. Cutters are installed with argon arc surfacing of the root zone (which increases the effectiveness of protection) and without surfacing it. The nature of wear of the working blades with a protective coating of the DOD-41-500 axial fume hoods installed in the boiler.

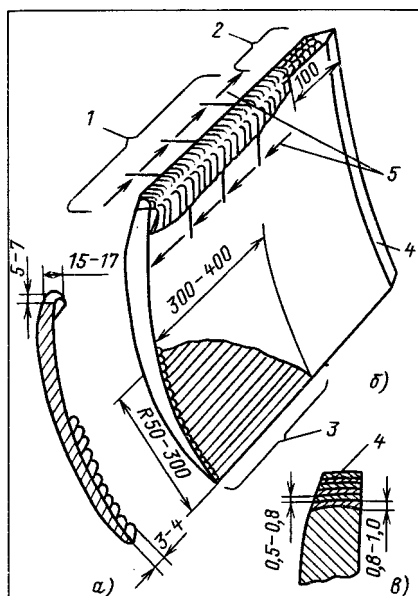


Figure 2. Diagram of combined surfacing of the working blade of an axial exhaust fan (before welding to the wheel):

a - cross-section of the blade with directed inlet and outlet edges; б - working blade; в - cross-section of the blade inlet edge in the argon-arc surfacing zone; 1 - zone of surfacing with KBX, PP-AN170 electrodes; 2 - zone of argon-arc surfacing; 3 - zone of semi-automatic surfacing with PP-AN170 electrodes; 4 - alternating layers of hard alloy VK-6 and steel 12X18N10T

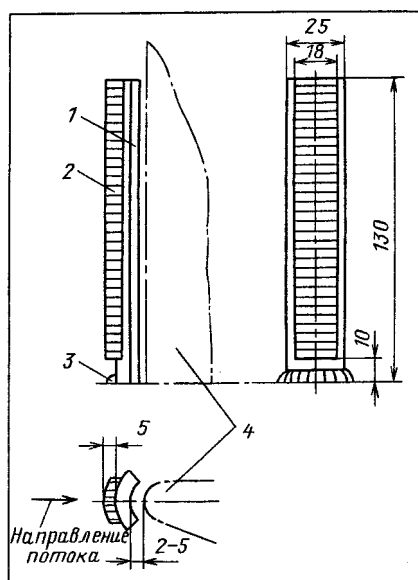


Figure 3. Diagram of the protective cutter and its installation in front of the working blade:

1 - cutter (part of the pipe with a diameter of 32x6 mm); 2 - wear-resistant surfacing; 3 - welding joint of the cutter; 4 - working blade;

1 - new blade; 2 - after 700 hours; 3 - after 2000 hours; 4 - after 4800 hours; after 5 - 5500 hours

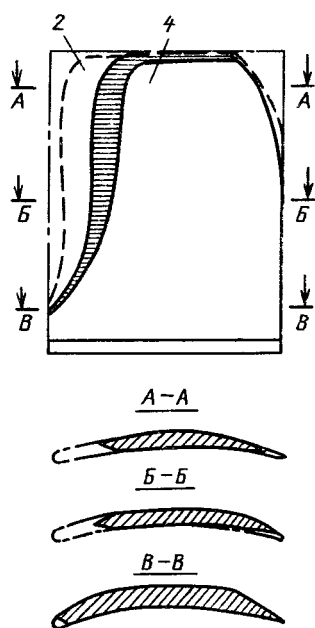


Figure 1. Change in the contour of the working blades of the DOD-41-500 axial smoke extractor of coal dust boilers during operation:

The power unit (with residual dust content of flue gases from 2 to 15 g/m³) is shown in Fig. 4.

In addition to the known surfacing materials, non-tungsten surfacing materials were developed and tested to protect the tip of the working blade in the DOD-41 smoke extractor: tubular electrodes filled with SgV2 granules with a stabilizing coating and additional rods in the form of steel pipes filled with SgV2 granules (Fig. 5). Tests were conducted by comparing hard alloy coatings (additional material) with VK-6 and KBX-45 electrodes. Sections with a length of 150 mm from the end of the inlet edge were deposited on eight working blades.

The results of industrial tests of surfacing for 2100 hours are presented in the table. It was established that surfacing materials based on granulated chromium boride are technologically efficient under repair conditions, and the surfaced layers with them are more wear-resistant compared to other surfacing materials.

This is explained by the following. In gaseous wear (with ash particle sizes from 3 to 80 μm), the structure of the welded bonding metal is of great importance. If the hardness of the binder metal is not less than the hardness of ash particles, the surfaced metal exhibits good resistance to gas-abrasive wear.

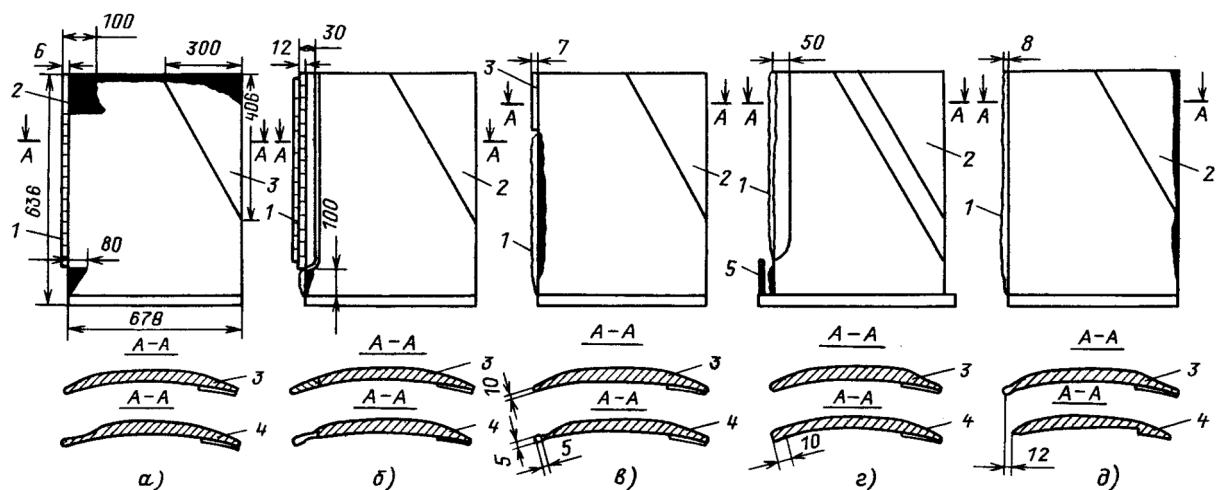


Figure 5. Wear of the working blades of the DOD-41 smoke extractor with a protective coating:

a - soldering and surfacing of plates; 1 - T5KYU hard alloy plates; 2 - surfacing with "sormaite" alloy and T-590 electrodes;

b - soldering and surfacing of plates: 1 - T5KYU hard alloy plates; 2 - surfacing with T-590 electrodes; 3 - initial profile; 4 - profile after 9970 hours of operation

v - surfacing with electrodes and soldering of plates: 1, 2 - surfacing with PP-AN170 and T-590 electrodes; 3 - welding of TiNi alloy plates; 4 - profile after 4500 hours of operation

g - electrode surfacing: 1 - PP-AN170 electrodes; 2 - carbon electrodes; 3 - initial profile; Profile after 4 - 10,000 hours of service

d - surfacing: 1 - with tubules with CBC; 2 - T-590 electrodes; 3 - initial profile; Profile after 4 - 10,000 hours of service

Surfacing material	Method s and mode of surfacing	Source	Hardness of surfaced material, HRC	Thickness of the deposited layer, mm	Working blade width, mm	
					Before trial	After 2100 hours of work
Pipe electrodes with a stabilizing coating 8 mm diameter'	Electric arc, 120 A	current	71.	3 - 4	580.	580.
Steel tubes filled with SgV2 granules with a diameter of 6 mm	Argon- arc, 80A	current	73.	3.	578.	576.

VK-6 hard alloy rod with a cross-section of 5x5 mm	Argon-arc, 120A	current	61.	2.5	578.	570.
Granular KBX-45 electrodes with a diameter of 5 mm	Electric arc, 120 A	current	58.	3 - 4	580.	530

Otherwise, during the intensive wear of the binder metal, the hardest particles of borides and carbides will crumble.

Of the currently produced surfacing materials, the powder wire grade PP-AN170 is the most effective. The least effective protection is surfacing with T-590 and T-620 electrodes.

Plasma spraying with self-fluidizing alloys is effective only when the exhaust gases are low in dust (close to sanitary standards).

Hard alloy plates of the Pobedit type are practically wear-resistant, but the technology of their fastening, especially the closure of joints between the plates, creates significant difficulties.

Protection of the inlet edges by surfacing with materials from PP-AN 170 and KBX, if it corresponds to the scheme shown in Fig. 2, is most effective with the mandatory installation of protective cutters.

The main factor ensuring the reliability of the operation of working blades is the quality of their manufacture according to factory drawings and compliance with the welding technology. Numerous cases of cracks appearing on the working blades of axial smokestacks during operation indicate the need for input control of the quality of preparation and welding of the working blades, as well as periodic monitoring of the condition of their near-root zone during operation for the presence of fatigue cracks.

When repairing the flow part of the exhaust fan, the nose parts of the guide blades are restored by surfacing with welding electrodes, and then by surfacing with T-590 and T-620 electrodes. The covers of the lower guide blades wear out faster than the upper ones. Their positions are swapped. Worn-out parts of the armor are being replaced. [3]

In conclusion, it should be noted that the protection of working blades from wear is an important measure, saving material, time, and labor costs.

To manufacture new working blades for the DOD-41-500 exhaust fan, 4 tons of metal are required to replace the worn blades, and 300 kg of electrodes are needed to weld the blades to the wheels. Labor costs in this case are approximately 400 man-hours. Rotor replacement takes from 3 to 7 days.

References

1. Depreciation of working blades of vacuum cleaners and strengthening coatings to increase wear resistance // Universe: technical sciences: electronic. scientific journal. Ergashev M. [and others]. 2021. No. 1 (82). URL: <https://7universum.com/ru/tech/archive/item/11181>
2. Combined surfacing of mining equipment parts // Kenjayev T.N. Abralov M.A., Ergashev M., Raufov L.M. INTERNATIONAL CONFERENCE "INNOVATIVE TECHNOLOGIES OF MINING AND PROCESSING OF MINERAL RESOURCES," GMT - Buston-2023. P. 94-96.
3. On the protection of the working blades of axial manifolds from gas-abrasive wear // NOVIKOV Yu. N., Engineer, Mosenergoremont. REPAIR AND MODERNIZATION OF EQUIPMENT. URL: <https://leg.co.ua/arhiv/generaciya/o-zaschite-rabochih-lopatok-osevyh-dymososov-ot-gazoabrazivnogo-iznosa.html>