EXPERIMENTAL RESULTS OF WEARING REASONS OF THE DOD-41-500 EXHAUSTER AND INCREASING WEAR RESISTANCE

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ABSTRACT. The article discusses the causes of wear of the impellers of the smoke exhauster DOD 41-500. The operating conditions, existing methods for restoring and strengthening the surface of rotor blades are studied. To increase the service life of rotor blades, a method of combined surfacing is proposed, which has a small heat-affected zone, high adhesion strength to the surface of rotor blades.

KEYWORDS: smoke exhauster, abrasive wear, erosion, gas abrasive wear, surfacing.

The power units of the former CIS countries, which use coal as fuel for the removal of flue gases, are equipped with DOD-41-500 smoke exhausters. The temperature of the flue gases at the inlet to the diffuser of the smoke exhauster is in the range of 200-230 ^{0}C. Depending on the fraction and weight of solid particles, the trajectories in many cases do not coincide with the direction of the gas flow in the flow part of the smoke exhauster. As a result of collision with the surfaces of the working blades, guide vanes and protective armor of the body, solid particles contribute to the gas-abrasive wear of the surfaces.

The collision of particles, causing erosion of the surface of the working blades, worsen the aerodynamic characteristics of the smoke exhauster. The appearance of pitting on the surface and, as a result, a change in the shape of the blades has a decisive influence on the aerodynamic characteristics of the smoke exhauster.

The characteristics of the operating conditions of the smoke exhauster are mainly influenced by the change in the geometry of the blades and the flow path. The impact has a strong influence on the radial and circumferential distribution of particles after each fixed, working and guide vanes installed along the flow.

Bounces of particles from the surfaces of the blades change their trajectory and speed, moreover, the speed of solid particles after each bounce can be different from the speed of the total flow. If we take into account that the density of solid particles can still differ from each other, then the rebound trajectories also differ from each other.

The technical characteristics of the smoke exhauster DOD41-500 are given in **Table 1.**

Table number 1.

Parameter name	Meaning
Impeller diameter, m	4.1
Engine impeller speed (synchronous), max, rpm	500
Installed engine power, kW	5000
Suction capacity, m^3/h	1445000
Maximum temperature of the transported medium at suction, ^{0}C	200
Maximum dust content of the transported medium, g/nm^3	0,5

Mass of the impeller of the first and second stages, kg	5500

The flue gas stream contains solid ash particles of various shapes and sizes. The particle fraction varies depending on the operating conditions and is in the range of 0.5-3.0 mm. The presence of solid particles and a high flow rate of the outgoing gas is accompanied by intense erosive-abrasive wear of the flow part of the smoke exhauster, especially the blade apparatus. Erosion-abrasive wear in this case is also called gas-abrasive wear. [1,2]

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Calculation of erosive-abrasive wear of blades is a very difficult task. Wear depends on many factors, such as changes in the geometry of the blades during operation, the characteristics of the particles, the material of the blades, on the mode of operation, the difference in speeds in the axial, circumferential and radial directions, etc. The angle of impact of the particles along the flow with the surfaces of the stationary, guide vanes and vanes of I and II stages.

As a result of wear of the blades, the performance of the smoke exhauster decreases and a change in the operating mode is required by turning the flaps of the guide vanes at an angle of -25 ... 30^0.

Operation in this mode increases vibration stresses and contributes to the appearance of fatigue cracks. Significant deterioration of the vibration state and the associated development of fatigue cracks can lead to breakage of rotor blades.

The leading edges of the rotor blades and the reverse side of the trailing edges are subjected to intensive wear. The wear of the inlet edge leads to a change in the trajectory of the flow of exhaust gases, a change in the performance and vibration state of the smoke exhauster.

Observations of the operation of smoke exhausters have shown that when the blade chord is worn up to 60 mm, which is approximately 10% of the total chord length, the operating power of the unit can not be limited. A decrease in the chord of more than 110 mm causes a decrease in the operating power of the power unit by 6-8%, which is an average of 20 MW. The decrease in operating power is due to the lack of draft of smoke exhausters.

The frontal parts of the fixed blades and the armor of the flow part at the installation sites of the rotary flaps are also subject to wear by rebounding particles of the flow.

The rate of wear of the leading edges of the blades is strongly affected by the content of solid particles in the gas flow. Factory-made blades during the combustion of coal from the Angren deposit wear out by 60-70 mm along the chord in an average of 1000 hours. **-fig. 1.** With the formation of a wedge-shaped section with an angle at the top of more than 50^0, the wear intensity begins to increase.

During the period of operation of blocks 3000-4000 hours, wear accelerates due to a change in the profile of the blades - **fig. 2.**

Fig.1.
Wear of the working blade after 1800 hours of operation.

Fig.2.
Wear of the working blade after 4200 hours of operation.

The wear of the input edges leads to a change in the trajectory of the exhaust gases. A change in the flow trajectory entails wear of the peripheral part of the blade and the trailing edges of the blade. The amount of wear along the height of the working blade reaches 65-75 mm, trailing edges 20-30mm.

Currently, in the CIS countries, depending on the state of the blades, various methods are used to restore dimensions and harden surfaces. In particular, in the power system of Russia and Kazakhstan, plasma spraying with SNGN alloy, surfacing with KBKh, T-590 electrodes, PP-AN170 flux-cored wire, argon-arc surfacing, and soldering of T15K6 hard-alloy plates are used. Restoration and hardening with welding electrodes T-590 is widely used because of the ease of surfacing on the surfaces of blades with aerodynamically twisted profiles. Such welding does not provide effective surface protection. [3,4]

Operating experience of restored and hardened blades showed that a significant heat-affected zone, a difference in thermal expansion coefficients, and heat removal conditions after surfacing can cause fatigue cracks. In the zone of maximum stresses, the fatigue strength of the metal decreases. High values of compressive stresses in the deposited metal with alternating stresses can lead to the destruction of the blades.

In order to increase the service life of the blades, experimental work was carried out on the surfacing of worn areas by combined surfacing.

It is known that when welding with electrodes with a thick coating at high currents, small-drop metal transfer is observed with rare short circuits of the arc gap. Surfacing with T-590 electrodes in this case leads to a significant increase in the heat-affected zone and deterioration of mechanical properties in the base metal-coating transition zone. [3,5]

The increased hardness of the deposited metal upon impact of solid particles on the surface of the blade leads to chipping of the metal section.

To reduce the influence of the heat-affected zone, to improve the surface quality of the deposited metal, experiments were carried out with combined surfacing. With combined surfacing, the deposited metal consists of a layer that provides ductility and adhesion strength to the blade metal and a hard wear-resistant layer.

At the beginning, a series of rollers are applied with MP or ANO electrodes. The distance between the rollers is 7-9 mm. Next, the rollers are applied with the T-590 or T-620 electrode between the previously applied rollers. Combined surfacing under the same conditions as in conventional surfacing with T-590 electrodes provides jet fine-drop metal transfer. Jet fine-drop transfer is provided by increasing the area of the arc by previously applied rollers. The heat-affected zone is reduced, the quality of the deposited surface is improved. [3,6]

More than 700 kg of electrodes are needed to install new two-stage rotor blades. The total duration of repair work when replacing rotor blades is 14-16 days.

CONCLUSION:

1. Surfacing with wear-resistant electrodes does not provide a sufficient service life of smoke exhausters. The increased hardness of the deposited metal increases its brittleness, and the heat-affected zone increases.
2. To improve the performance properties, restoration work and hardening surfacing during the repair of smoke exhausters are recommended to be performed by combined surfacing.
3. The profile of rotor blades must be restored according to factory drawings in order to avoid the negative impact of repair work on operating conditions.

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