Increase Working Efficiency by Using the Newly Created Polymer Composite Material in Pneumatic Transport

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ABSTRACT

Today, it is important to improve the modern machine-building industry, to create improved devices of technologies, machines, and mechanisms that meet modern requirements, to create competitive and import substitutes for various fields of production, to conduct in-depth fundamental research, and to solve current scientific and technical issues. Also, the purposeful use of high-performance composite polymer materials to ensure the operational reliability of cotton processing machines, and the reduction of the negative impact of the working surfaces of technological equipment on cotton surfaces through the use of new materials is one of the urgent scientific and technical problems waiting to be solved.

The supply of raw materials for cotton processing technology is carried out in cotton ginning enterprises using pneumatic transport equipment. Due to the fact that the air pipeline is a device of simple construction and does not have changeable, controlled parts, its testing is limited to determining its ability to transfer the required cotton mass per unit of time [1].

In this article, we noted that one of the promising ways to increase the service life of fan impellers is to cover them with wear-resistant (corrosion) coatings. In this regard, we prepared samples with different compositions and studied the impact of their coatings on the ventilator's performance on the basis of surface irregularities and presented the results obtained on the performance and surface irregularities.

Keywords: thermoprotective polymer, pneumotransport, fan blade, filler, surface roughness, performance, plastic, raw cotton, working surface, coating.

Introduction. It is known that the cotton production and processing industry is important to the development of the economy of Uzbekistan. In recent years, the cotton ginning industry of our Republic has been completely renovated and modernized on the basis of the state program, and modern equipment is reaching remote areas day by day. The goal of the reforms carried out in the industry in recent years is to improve the quality of the product to the level of the world market and to increase the efficiency of cotton production by reducing its cost. Product quality and cost are formed at each stage of the technological process of its processing. In this case, the stage of supplying raw materials is considered the first stage of the process. We know that large-scale technologies in the cotton industry have high energy consumption. We can increase the useful work coefficient by reducing the mass by using polymer materials or by increasing the work output.

The properties of plastic materials depend on the composition and the amount of filler added to them. By changing the amount of these substances, it is possible to obtain various compounds with predetermined properties. The most important positive properties of many thermosetting polymer materials are their resistance to water, most aggressive substances, and petroleum products. Chemical advances make it possible to obtain plastics that can work at both low and high temperatures [1, 2].

Having thoroughly studied the physical and mechanical properties of thermo-reactive polymers, we decided to expand the scope of their use.

In our country, the increase in the harvesting of raw cotton by machines has led to an increase in its contamination, not only with organic fractions but also with abrasive additives. During the processing of such cotton, abrasive particles interact with the surfaces of the working organs of the machines, which leads to their intensive wear. One of the most sensitive organs is the working wheels of pneumatic transport fans in cotton factories, whose service life is only 5-7 months [2,3-5]. Especially the edges of the wheel and the base areas attached to the disk are damaged (Fig. 1)

Figure 1. *Damage to the working surfaces of the pneumatic transport fan*.

Based on the above, it was noted that one of the promising ways to increase the service life of fan impellers is to cover them with composite polymer materials resistant to wear (corrosion). Taking this into account, we studied the adhesion and tribological properties of thermoset composite materials with different compositions of local fillers.

Methods. An air conveyor is aerodynamic equipment designed to transport products, and it fully obeys the laws of aerodynamics. In turn, aerodynamics means the dynamics of air movement, and as a science, it is separated from the sciences of hydraulics and gas dynamics. Many historical scientists and engineers laid the foundations for the emergence of this science, and among the scientists of our time are G. Cherny, G. Abramovich, A. Altshul, L. Loysyansky, D. Chisholm, H. Rakhmatullin, Yu. Shmuglevskiy, T. It was further developed as a separate branch of science by Karmans. Uzbek scientists are also conducting their research in this regard. Even so, research on work productivity and extension of service life using thermo-reactive polymer material as a coating has not been carried out [6–9].

Taking into account the dependence of our research work on surface irregularities, the surface irregularities of working and coated blades were determined using the "Micron-beta" profilometer at the Andijan machine building Institute. We tested their productivity in the private enterprise "Ven-kon air engineering", Namangan city, Namangan region. Scientific research was carried out on a high-pressure centrifugal fan.

Results. The physical and mechanical properties of the newly created thermo-reactive polymer material were tested and applied as a coating to the working surface of the film (Fig. 2).

Figure 2. Fan blade coated with a new composite polymer coating.

First, the unevenness of the working surfaces of the pneumotransport blade was measured.

First, the unevenness of the thin surface shown in Figure 1 was measured. In the initial measurement, the following parameters were obtained.

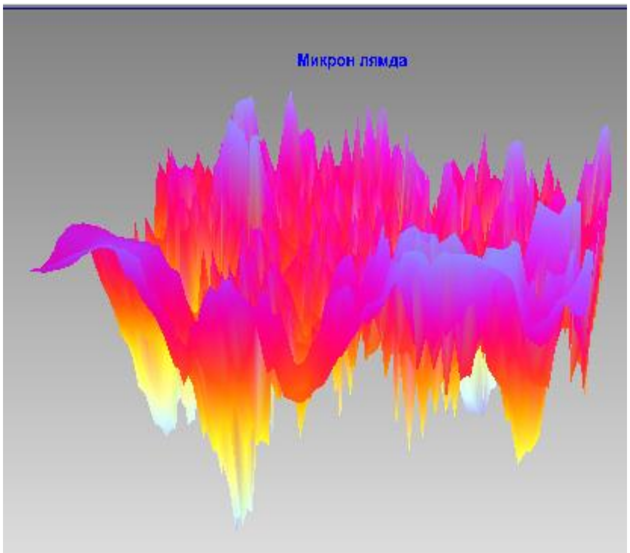

Figure 3. 3D view of surface irregularities of steel sheet.

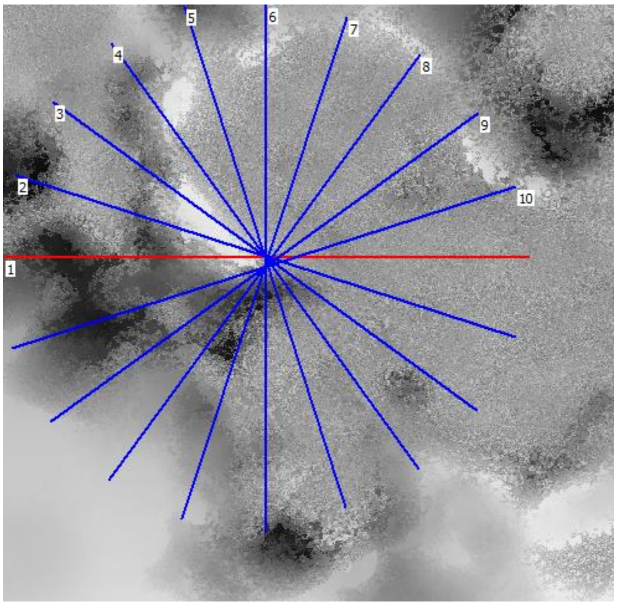

Figure 4. Surface roughness of steel sheet in directions.

Indicators of the surface roughness of steel sheet.

Table 1

Unevenness indicators	R_z	R_a	H	R_{3z}	R_q	R_{ku}	R_p	R_v	R_t
According to the 1st line	41.47	9.853	47.67	39.52	12.95	3.609	35.82	-21.22	-21.22
According to the 2st line	45.35	10.46	49.20	40.19	13.95	3.893	28.11	-42.38	-42.3.8
According to the 3st line	39.66	9.317	40.47	39.77	11.68	2.639	24.02	-28.65	-28.65
According to the 4st line	38.59	6.919	32.98	32.52	9.550	4.292	23.26	-35.78	-35.78
According to the 5st line	39.69	6.401	33.13	33.94	9.078	4.771	21.11	-37.62	-37.62
According to the 6st line	41.36	7.960	37.36	36.98	11.18	5.409	21.92	-41.98	-41.98
According to the 7st line	43.81	8.409	41.17	41.46	11.89	4.812	20.75	-40.71	-40.71
According to the 8st line	42.78	9.646	47.95	39.02	12.89	3.285	29.02	-35.50	-35.50
According to the 9st line	41.99	8.173	35.37	39.35	40.45	2.929	24.37	-28.57	-28.57
According to the 10st line	39.21	8.411	39.19	36.73	11.07	3.164	31.98	-22.73	-22.73
Average value	41.39	8.556	40.45	37.95	11.47	3.880	26.04	-33.51	59.56

Secondly, the unevenness of the thin surface shown in Figure 2 was measured, and the following indicators were obtained:

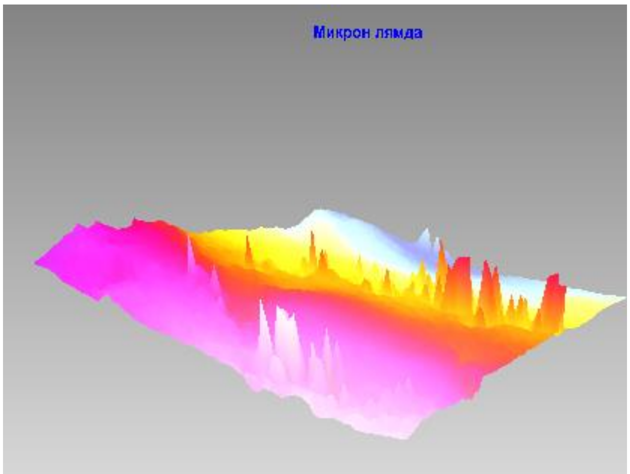

Figure 5. 3D view of the surface irregularities of the coated sheet

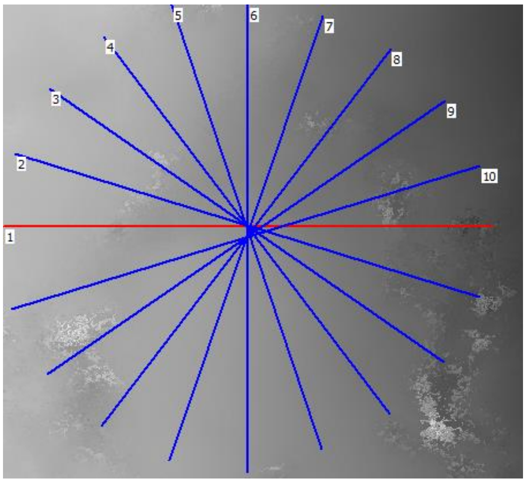

Figure 6. . Surface unevenness of the coated sheet according to directions.

Indicators of surface irregularities of the coated sheet.

Table 2

Unevenness indicators	R_z	R_a	H	R_{3z}	R_q	R_{ku}	R_p	R_v	R_t
According to the 1st line	7.318	0.745	3.076	7.754	1.121	11.16.	3.732	-7.389	-7.389
According to the 2st line	3.265	0.613	2.259	2.722	0.955	22.44	7.214	-1.812	-1.812
According to the 3st line	5.318	0.641	2.814	4.285	1.036	15.18	6.7836	-2.064	-2.064
According to the 4st line	1.610	0.667	3.025	0.803	0.8725	3.360	1.589	-2.335	-2.335
According to the 5st line	1.059	0.859	3.556	0.279	1.055	2.418	1.884	-2.389	-2.389
According to the 6st line	1.506	0.782	3.515	1.1660	0.99	2.542	2.291	-2.028	-2.028
According to the 7st line	1.114	0.565	1.943	0.770	0.648	1.853	1.283	-1.278	-1.278
According to the 8st line	3.208	1.042	4.607	3.701	1.321	3.119	2.051	-3.869	-3.869
According to the 9st line	5.299	1.325	5.312	5.779	1.651	3.137	2.659	-5.253	-5.253
According to the 10st line	4.484	0.968	3.832	5.163	1.199	2.673	3.926	-2.806	-2.806
Average value	3.418	0.821	3.394	3.242	1.085	6.790	3.341	-3.122	6.464

In the next step, we installed the blades in a pneumatic transport to check them in working condition and determined the results below by measuring.

First, the operating results of the pneumotransport ventilator operating without coating were measured and the results of the generated coated fan were measured and tabulated (Table 3).

Analytical table of the main technological indicators of VS-8m fans, the most common in the cotton cleaning industry.

Table 3

Fan status	Air spending, m^3/s	P is full pressure, Pa	R_d dynamic pressure, Pa	R_{st} static pressure, Pa	Installed power, kWt
Indicators given by the manufacturer	2.7 1.6 – 3.4	2600	54.8	2545	11
Measured results from a fan with damaged working surfaces	2.4 1.3 – 3.2	2300	48.7	2251	11
Measured results from a fan coated with a polymer coating	3.3 1.9 – 3.8	3200	67	3132	9.9

Discussion. If we compare the initially measured surface roughness, we can see the following difference in the average value

Comparative analysis of the average value of surface roughness.

Table 4

Unevenness indicators	R_z	R_a	H	R_{3z}	R_q	R_{ku}	R_p	R_v	R_t
Average value of surface roughness of steel sheet	41.39	8.556	40.45	37.95	11.47	3.880	26.04	-33.51	59.56
The average value of the surface roughness of the coated sheet	3.418	0.821	3.394	3.242	1.085	6.790	3.341	-3.122	6.464
The difference has been reduced	12.1	10.4	11.9	11.7	10.6	0.57	7.79	10.7	9.2

As can be seen from the above results, we can see that the working surface of the tube is polished differently.

In the next step, we were able to discuss the impact of these surface irregularities on performance through the measured results. If we look at the results presented in Table 4. We can see that the amount of air consumption has increased by 37.5%, which means that the work productivity has increased.

As can be seen from the obtained results, in the first two cases there was a decrease in productivity. We can see an increase in productivity and a decrease in energy consumption in the proposed coating plant.

Conclusion. In conclusion, it can be said that it is effective to use polymer composite material with a new composition, created on the basis of local fillers, on the working surfaces of pneumotransport fans. By doing this, we have achieved efficiency by smoothing a single surface roughness. In the next place, we will be able to increase the service life of the sheet. If the surface is damaged, instead of replacing the sheet, we will be able to cover the surface with a new coating.

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