ТЎРЛИ БАРАБАНЛИ АППАРАТНИНГ ПАРРАКЛАРИНИ ҚАРШИЛИК КОЙФИЦЕНТЛАРИНИ ТАЖРИБАВИЙ АНИҚЛАШ

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Аннатаций: Ушбу мақолада ўтказилган експериментал тадқиқотлар натижасида, уч хил қиялик бурчагига ега янги яратилган нам чангни тозалаш барабан аппаратининг айланиш ҳаракатини таъминлайдиган пичоқларнинг қаршилик коеффициентлари ўзгарувчан газ оқими режимларида аниқланди. Қаршилик коеффициентларига қараб, пичоқларнинг айланиш сони ҳам аниқланди. Пичоқларнинг назарий қаршилик коеффициентларини ҳисоблаш учун тузатиш коеффициентининг қийматлари експериментал равишда аниқланган қаршилик коеффициентлари ва асосий параметрларга қараб аниқланди. Ушбу аниқланган параметрларга қараб, аппаратдаги умумий босим йўқотишларини аниқлаш мумкин бўлди.

Калит сўзлар: нам усул, барабан, тўр, пичоқ, қаршилик коеффициенти, айланишлар сони, қиялик бурчаги.

EXPERIMENTAL STUDY OF THE RESISTANCE COEFFICIENTS OF THE MESH-DRUM APPARATUS BLADES

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Abstract. As a result of the experimental studies conducted in this article, the resistance coefficients of the blades, which ensure the rotational movement of the newly created wet dust cleaning drum apparatus with three different angles of inclination, were determined under variable gas flow regimes. Depending on the resistance coefficients, the number of blades rotations was also determined. To calculate the theoretical resistance coefficients of the blades, the values of the correction coefficient were determined depending on the experimentally determined resistance coefficients and the main parameters. Depending on these determined parameters, it was possible to determine the total pressure losses in the apparatus.

Keywords: wet method, drum, mesh, blade, resistance coefficient, number of revolutions, angle of inclination.

ЭКСПЕРИМЕНТАЛЬНОЕ ИССЛЕДОВАНИЕ КОЭФФИЦИЕНТОВ СОПРОТИВЛЕНИЯ ЛОПАСТЕЙ СЕТЧАТО-БАРАБАННОГО АППАРАТА

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Аннотация. В результате экспериментальных исследований, проведенных в данной статье, были определены коэффициенты сопротивления лопастей, обеспечивающих вращательное движение недавно созданного барабанного аппарата для влажной пылеочистки с тремя различными углами наклона, при различных режимах газового потока. В зависимости от коэффициентов сопротивления было также определено количество оборотов лопастей. Для расчета теоретических коэффициентов сопротивления лопастей были определены значения поправочного коэффициента в зависимости от экспериментально определенных коэффициентов сопротивления и основных параметров. В зависимости от этих определенных параметров стало возможным определить полные потери давления в аппарате.

Ключевые слова: влажный метод, барабан, сетка, лопасть, коэффициент сопротивления, количество оборотов, угол наклона.

Nowadays, wet dust cleaning devices are widely used in industry. The creation of more efficient and energy-saving devices for cleaning dusty gases emitted into the atmosphere from industrial enterprises is one of the pressing issues of the present day, and we have invented a new design of a wet dust cleaning device with a dust drum and are conducting scientific research. The main indicators of wet dust cleaning devices are productivity and cleaning efficiency, and these indicators, in turn, depend on the resistance coefficients of the working and contact elements of the device. This research work presents the results of an experimental study on determining the resistance coefficients in the experimental device of a newly created dust drum device [1] .

Object and research method

The experimental device of the rotary drum apparatus created by the Department of "Technological Machines and Equipment" of Fergana State Technical University was used as the object of research. Figure 1 shows the kinematic diagram of the experimental device, Figure 2 shows a photogrammetry, and Formula 1 [1,2,3,4,5], which calculates the total pressure loss in the device, was derived as a result of theoretical research.

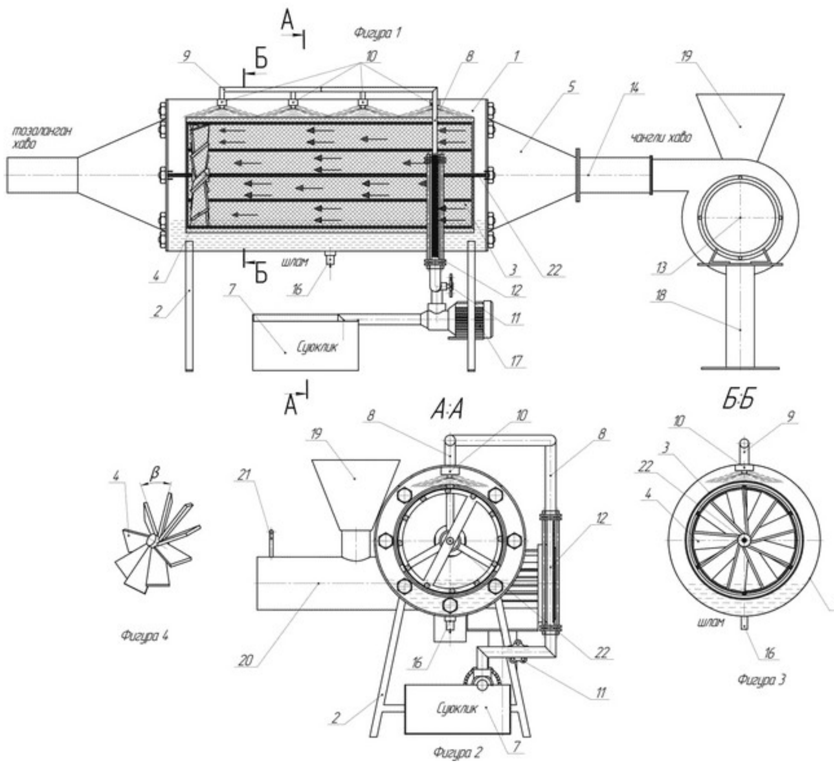

Figure 1. Kinematic scheme of the device

1-device tanasi. 2-built base, 3-type drum, 4-parrak, 5-changli gas injector conesimon tube, 6- powdered gas extraction conussimon tube, 7-water supply, , 8,9-

water supply tubes, 10-nozzle, 11-valve, 12-rotameter, 13-fan, 14-directional pipe, 15- pulverized gas extraction pipe, 16- slurry extraction pipe, 17- pump, 18- support, 19-chang bunker, 20-auger loading, 21-shiber, 22-right.

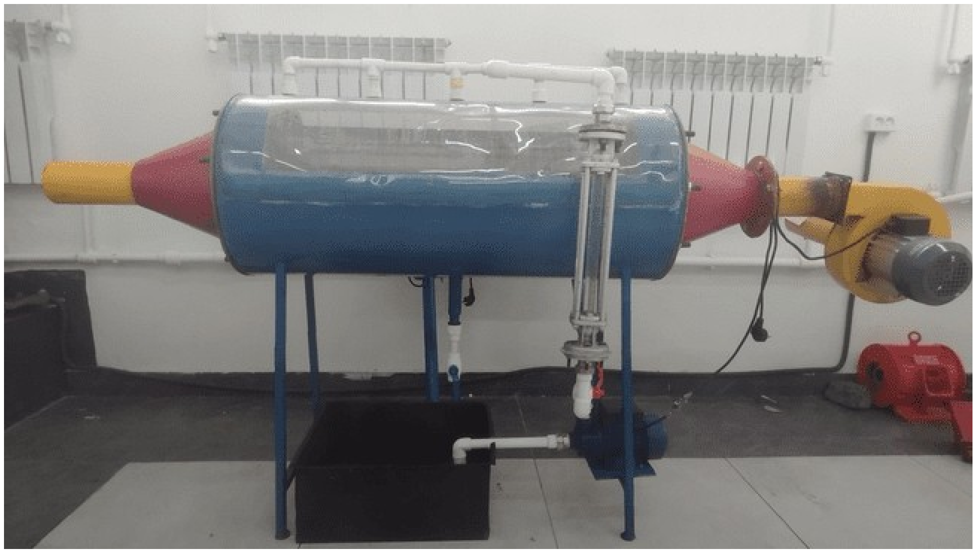

Figure 2. Photo of the experimental device.

$$P_{об} = \lambda_1 \cdot \frac{l}{d} \cdot \rho_{см} \cdot \frac{\omega_{см}^2}{2} + (\xi_c + \xi_ж)\frac{\rho_{ар} \cdot \omega_{ар}^2}{2} + \frac{4 \cdot \pi \cdot R^2}{\Delta k \cdot n \cdot a \cdot b \cdot \sin\beta} \cdot \frac{\rho_{ар} \cdot \omega_{ар}^2}{2} + \lambda_2 \cdot \frac{l}{d} \cdot \rho \cdot \frac{\omega^2}{2} \quad (1)$$

This formula 1 was derived to calculate the total pressure loss when the device is supplied with liquid and dusty gas. The main task of this article is to determine the total resistance coefficient of the device. To determine the resistance coefficient of the device, experimental studies were conducted in the absence of water spray.

From formula 1, we can write the formula that determines only the total resistance coefficient of the device as follows.

$$\xi_{об} = \lambda_1 \cdot \frac{l}{d} + (\xi_c + \xi_ж) + \frac{4 \cdot \pi \cdot R^2}{\Delta k \cdot n \cdot a \cdot b \cdot \sin\beta} + \lambda_2 \cdot \frac{l}{d} \quad (2)$$

where *λ 1* is the coefficient of friction between the pipe wall and the dust gas supply to the device, *l* is the length of the pipe through which the dust gas moves, m; *d* is the pipe diameter, m; *ξ c*- the resistance coefficient of the drum mesh, *x j is* the resistance coefficient formed by spraying liquid into the device , and it is ignored in these experimental studies because the resistance coefficients are determined without liquid supply.

For the drag coefficient of the wings *Δ k is* the correction factor, determined experimentally, *n* - number of pieces , pieces ; *a* - the length of the lateral side , m ; *b* – the slope angle of the gas flow surface , degrees; *b* - blade width, m; (see Fig. 1) *λ* 2

– coefficient of friction in the pipe for removing purified air from the apparatus; *l* - length of the pipe through which purified air moves, m; *d* - pipe diameter, m;

The results obtained.

Using equation 2, the total resistance coefficients of the apparatus are determined.

Experimental studies to determine the resistance coefficients were conducted in the following sequence.

1. A damper (movable damper) was installed on the suction side of the ventilator installed in the experimental device to change the gas flow rate. The damper was changed in the range of 30÷90 0 (in steps of 15 0), and the gas velocities exiting the ventilator and the gas flow rates depending on it were determined. When the damper was opened to 30^0, Q g =141 m^3 /h, when opened to 45 0 , Q g =282 m^3 / h, when opened to 60^0, Q g =423 m^3 /h, when opened to 75 0 , Q g =564 m^3 /h, When opened to 90^0, Q g was =705 m^3 /h.

2. In this process of experiments, a fan and a grid drum were installed in the apparatus body, and the results were obtained. The square hole size of the grid is a=0.6 mm. The gas flow rate determined above was given as Q=141÷705 m^3/h (in steps of 141 m^3/h), and the gas flow rate leaving the apparatus was determined. In this case, when the gate is opened to 30^0, Q g =115.6 m^3/h, when it is opened to 45^0, Q g =220 m^3/h, when it is opened to 60 0 , Q g =338.4m m^3/h, when it is opened to 75^0, Q g =433.8 m^3/h, When opened to 90^0, Q g = 555 m^3/h was obtained. The resistance coefficient with the screen installed in the device was determined by the difference in the determined gas consumption. To determine the difference in gas flow rates, an electronic gas velocity measuring device of the ANOMOMETER VA06-TROTEC brand was used. The resistance with the grid installed in the device coefficient was x=1.26.

3. 0,30,45 0 were sequentially installed on a grid drum with a square hole size a=0.6 mm installed in the apparatus body , and the total resistance coefficient of the apparatus was determined (see Figs. 3 and 4).

  

β=15⁰ *β=45⁰*

Figure 3 is shown below. Browsing of pages

Each of the blades installed in the screen drum was supplied with gas *at a rate of Q=141÷705* m³*/h* (in steps of *141* m³*/h*). Separate experimental studies were conducted for each blade. According to the results of the conducted experimental studies, when a blade with a slope angle of $\beta=15^0$ *was installed,* the total resistance coefficient of the device was *ξ н* = 1.81, when a blade with a slope angle of $\beta=30^0$ was installed, the total resistance coefficient of the device was *ξ н* = 1.62, and when a blade with a slope angle of $\beta=45^0$ was installed , the total resistance coefficient of the device was *ξ c = 1.42* .

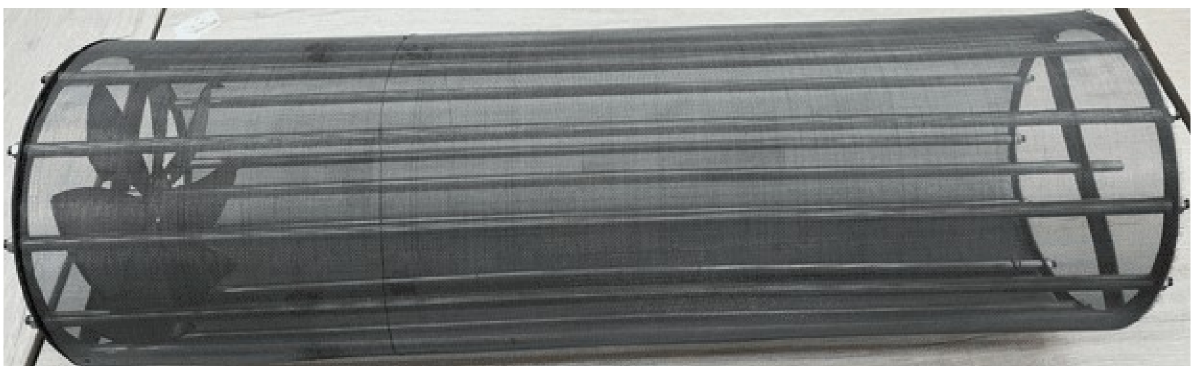

Figure 4. In the state where the screen drum is installed.

These determined drag coefficients are the total drag coefficients when the device is not supplied with fluid. Subtracting the local drag coefficients from these values gives the drag coefficients of the blades. *A) When* $\beta=15^0$ *; ξ π = 1.81-1.26=0.55 B)* when $\beta=30^0$; *ξ p =1.62-1.26=0.36 C)* when $\beta=15^0$; *ξ p = 1.42-1.26=0.16*

The results of the empirical study are presented in Table 1.

Table 1. Results obtained in the determination of the coefficients of resistance

№	A^0	Outflow from the ventilator		Grid, installed waterless condition			The leaf is not installed or watered			n cycle / minute
		$\omega_г$, м/с	$Q_г$ м³/ hours	$\omega_г$, м/с.	$Q_г$ м³/hours	ξ_0	$\omega_г$, м/с.	$Q_г$ м³/hours	$\xi_{ум}$	

α=15⁰, d=0,6мм										
1	30^0	5	141	4,1	115,6	1,22	2,7	78,3	1,8	4
2	45^0	10	282	7,8	220	1,28	5,5	155	1,81	8
3	60^0	15	423	12,2	338,4	1,23	8,1	231	1,83	12
4	75^0	20	564	15,8	433,8	1,3	11	311	1,81	16
5	90^0	25	705	19,7	555	1,27	13,7	387	1,82	20
Average cost of resistance coefficient						***1,26***			***1,81***	
α=30⁰, d=0,6мм										
1	30^0	5	141	4,1	115,6	1,22	3,1	87,5	1,61	2
2	45^0	10	282	7,8	220	1,28	6,2	174	1,62	4
3	60^0	15	423	12,2	338,4	1,23	9,3	263	1,61	6
4	75^0	20	564	15,8	433,8	1,3	12	343	1,64	8
5	90^0	25	705	19,7	555	1,27	15,3	432	1,63	10
Average cost of resistance coefficient						***1,26***			***1,62***	
α=45⁰, d=0,6мм										
1	30^0	5	141	4,1	115,6	1,22	3,5	99,2	1,42	1
2	45^0	10	282	7,8	220	1,28	6,9	197	1,43	2
2	45^0	10	282	7,8	220	1,28	6,9	197	1,43	3
4	75^0	20	564	15,8	433,8	1,3	13,9	394	1,43	4
5	90^0	25	705	19,7	555	1,27	17,6	496	1.42	5
Average cost of resistance coefficient						***1,26***			***1,42***	

3. When the impeller is installed, and water is not sprayed: ω g - gas velocity, m/s; Q_g - gas flow, m^3 */h; ξ 0 - resistance coefficient; n - number of revolutions of the screen drum, rpm.*

As a result of experimental studies, the general resistance coefficients of the blades and the device in the state where no liquid was sprinkled on the device were determined. The next task focused on determining the correction coefficients for calculating the resistance coefficients of the feathers.

$$\xi_n = \frac{4 \cdot \pi \cdot R^2}{\Delta k \cdot n \cdot a \cdot b \cdot \sin\beta} \quad (3)$$

The calculation scheme of the wing is presented in Figure 5.

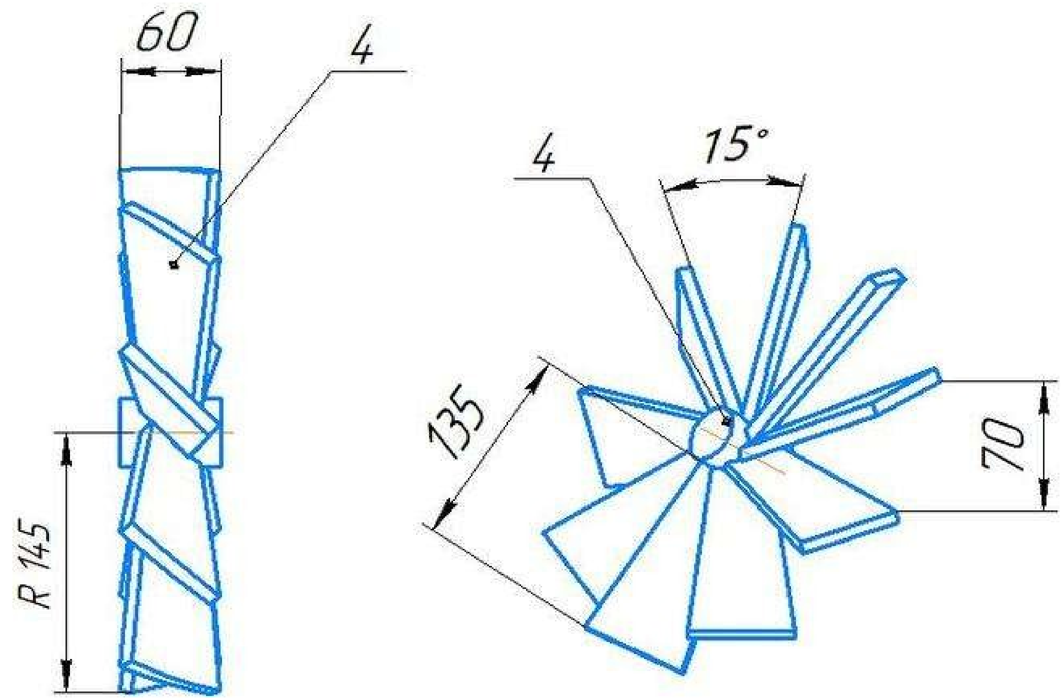

Figure 5. Parrak's calculation scheme.

The technical characteristics of the hair according to formula 3 are as follows. Blade radius, *R=145mm* , blade width *b=60mm* , number of blades *n=9* , blade side length *a=135mm* , blade angle *b* =15^0, 30^0, 45^0 The coefficient of relative resistance of the pipe is found as follows.

$$\xi_к = \frac{S_{об}}{S_\beta} = \frac{4 \cdot \pi \cdot R^2}{n \cdot a \cdot b \cdot \sin\beta} \quad (4)$$

Here, *S ob* is the total surface area of the wing disk, m 2 , and *S β is* the surface area occupied by the angular displacement, *m 2* . Substituting the values, we find the coefficient of relative drag.

When *S β* – 15^0

$$\xi_к = \frac{S_{об}}{S_\beta} = \frac{4 \cdot \pi \cdot R^2}{n \cdot a \cdot b \cdot \sin\beta} = \frac{4 \cdot 3,14 \cdot 145}{9 \cdot 135 \cdot 60 \cdot 0,26} = \frac{1821}{18954} = 0,096$$

When *S β* – 30^0

$$\xi_к = \frac{S_{об}}{S_\beta} = \frac{4 \cdot \pi \cdot R^2}{n \cdot a \cdot b \cdot \sin\beta} = \frac{4 \cdot 3,14 \cdot 145}{9 \cdot 135 \cdot 60 \cdot 0,5} = \frac{1821}{36450} = 0,05$$

When *S β* – 45^0

$$\xi_к = \frac{S_{об}}{S_\beta} = \frac{4 \cdot \pi \cdot R^2}{n \cdot a \cdot b \cdot \sin\beta} = \frac{4 \cdot 3,14 \cdot 145}{9 \cdot 135 \cdot 60 \cdot 0,71} = \frac{1821}{51759} = 0,035$$

We find the correction coefficient using the following formula.

$$\xi_{к} = \frac{\xi_{п}}{\xi_{н}} \qquad (5)$$

here $\xi\ n$ is the relative resistance coefficient of the parrack, $\xi\ n$ *is* the experimentally calculated resistance coefficient of the parracks. Putting the values into the 5-formula, we find the coefficient of adjustment of the values.

When $S\beta - 15^0$: $\xi_{к} = \frac{\xi_{п}}{\xi_{к}} = \frac{0,55}{0,096} = 6$

When $S\beta - 30^0$: $\xi_{к} = \frac{\xi_{п}}{\xi_{к}} = \frac{0,36}{0,05} = 7$

When $S\beta - 45^0$: $\xi_{к} = \frac{\xi_{п}}{\xi_{к}} = \frac{0,16}{0,035} = 5$

It is recommended to take the value of the correction coefficient in the range Δk=5÷7. The results obtained from the experimental studies were processed by a computer program, and graphs of dependence were built. (Figures 6 , 7 , 8.)

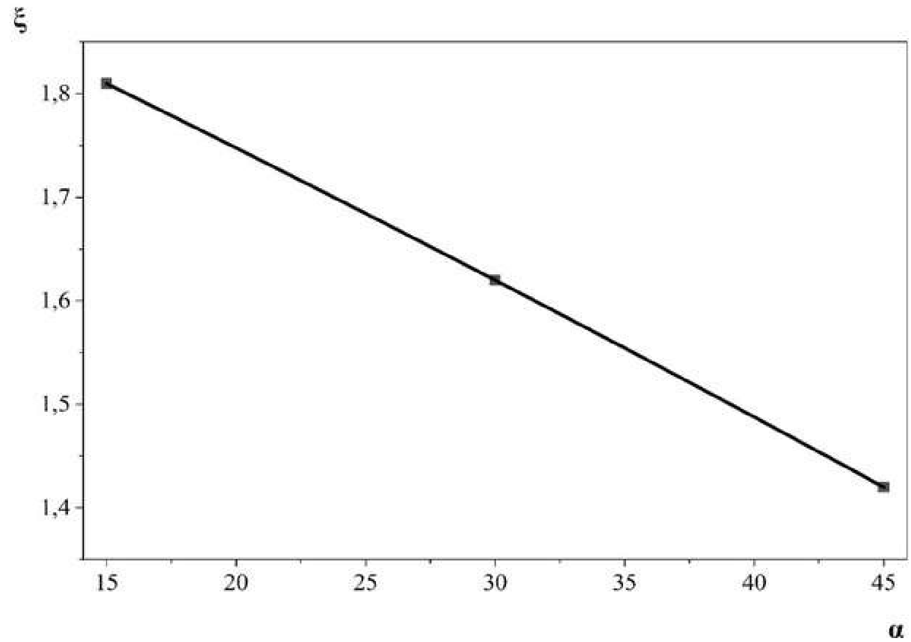

Figure 6 . Total resistance coefficient in the case of no liquid supply to the apparatus

Specified regression equations

y = -0.013 x + 2 .0067

$R^2 = 0.9998$

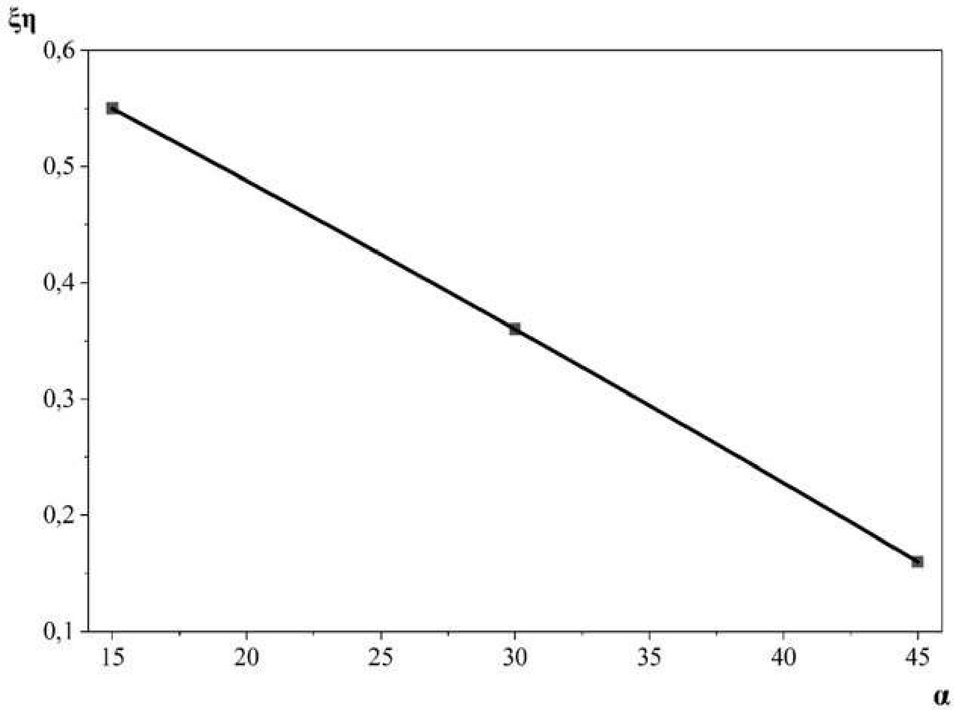

Figure 7 . The coefficient of resistance of the wings

Specified regression equations

y = -0.013 x + 0.7467

$R^2 = 0.9998$

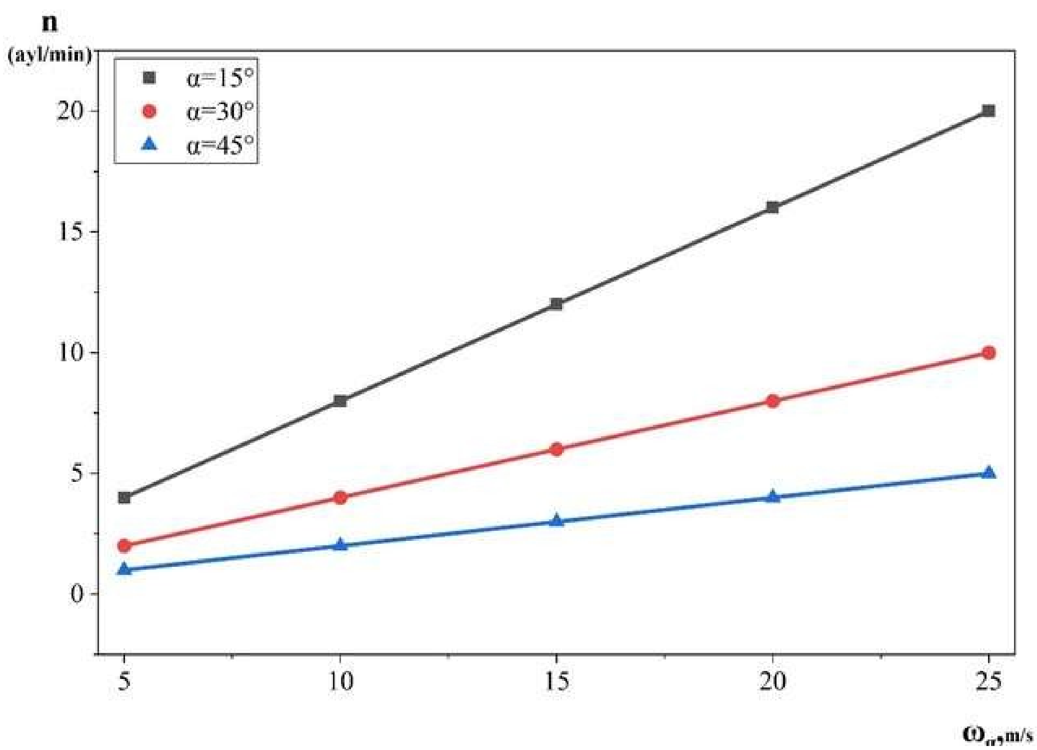

Figure 8. Gas to the speed related in case of the bird rotations of the number change schedule

Specified regression equations

$y = 0.8x R^2 = 1$

$y = 0.4x R^2 = 1$

$y = 0,2x R^2 = 1$

Conclusion. As a result of the conducted experimental studies, the resistance coefficients of the blades with three different values of the inclination angle, which provide the rotational motion of the newly created wet dust-cleaning drum device, were determined in the regimes of variable gas flows. Depending on the resistance coefficients, the number of revolutions of the blades was also determined. To calculate the theoretical resistance coefficients of the blades, the values of the correction coefficient were determined depending on the experimentally determined resistance coefficients and their main parameters. Depending on these determined parameters, it was possible to determine the total pressure loss in the device.

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