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Quality Assessment of High Mixing Equipment Based on Rotary Vane Spiral Mixer

[1]Nikolaj Petrovich Nesmeyanov, [1]Pavel Sergeevich Gorshkov,
[1]Yuliya Viktorovna Brazhnik and [2]Khalfin Marat Nurmukhamedovich

[1]Belgorod State Technological University named after V.G. Shoukhov,
Russian Federation, 308012, Belgorod, Kostyukova str. 46
[2]Institute of Platov South – Russian statement polytechnic University,
(Novotchercassk polytechnic Institute), Russia, 346428,
Novotchercassk, Prosvesheniya street, 132

Abstract: The article gives a brief description of the design of rotary spiral blade mixer for dry construction mixtures (CAS) in high-speed mode mixing. The proposed constructive solution is to install the inner surface of helices mixing drum can create additional circulating particles of dead zones along the mixer body along the entire height of the material layer in both the horizontal and vertical directions. A mathematical description of the equation, which describes the qualitative indicator of the mixer. Theoretically, the dependence allowing to describe the process of change of concentration of particulate material is a key component in this mixer, depending on the constructive and technological parameters. Studied in a pilot plant rotary spiral blade mixer to determine the reliability of the analytical relationships. The analysis of experimental studies for assessing the quality of the resulting mixture in a mixer fitted with three set helical spiral. A comparison of theoretical and experimental data quality indicator of a high-speed mixer blending mode

Key words: Dry mortar · Mixer · The quality scores

INTRODUCTION

In the current technology of dry construction mixtures (CCC) play a huge role in the development of world market of building materials. The rapid development of innovative technologies, the study of materials at the nano - level, integrated approach opens up great prospects for this industry. The main motive of production CCC is a great demand for a modified dry mix. With the ever increasing rate of growth of the housing sector, the use of dry mix is the best option in terms of quality, range and time in construction and in the decoration or cosmetic repairs. The use of dry mixes on a "filled with water and use" has made them popular in the market CAS [1,2].

The first production of the CAS should be based on receipt of the final product with high quality indicators. It is necessary to take into account that due to the development of organic chemistry and nanotechnology to create new classes of materials that combine particles with different dispersion, density, shape and ratio of composite components, which suggest an unambiguous increase in the qualitative distribution of ready-mixed components [3].

Given the requirements of today demands for quality cardiovascular system, designed spiral- vane rotary batch mixer for mixing a variety of bulk materials. The design was embodied the idea of a counter-current flow of convective stirring of the material (Fig. 1) in both the horizontal and vertical directions. Making these streams provided by coils mounted on the inner surface of the mixing tank.

Mixer (Fig. 2) consists of a cylindrical drum 2 which is cantilevered inside the rotor 3 is mounted in bearings and fixed. On this shaft are fixed two sets of blades. Each row has three blades which are rotated relative to each other by 120°. Thus they are set so that the components are miscible to throw the spiral coil 5 fixed to the inner wall of the drum. The screw has discontinuities in the plane of rotation of the rotor blades. Drum mixer mounted in

Corresponding Author: Nikolaj Petrovich Nesmeyanov, Belgorod State Technological University named after V.G. Shoukhov, Russian Federation, 308012, Belgorod, Kostyukova str. 46.

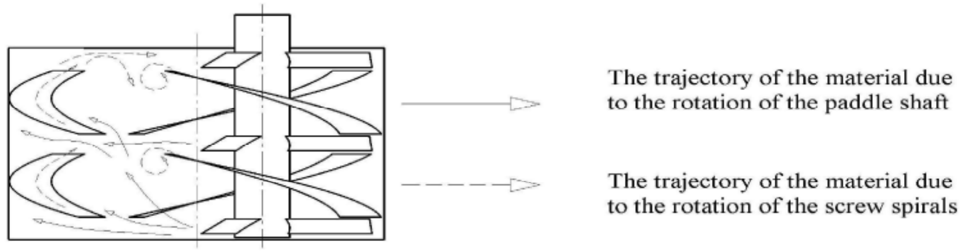

Fig. 1: The scheme of movement trajectories of the particles of the material in the rotary spiral blade mixer

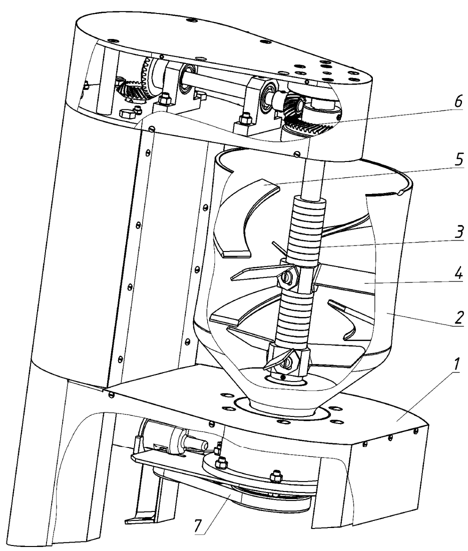

Fig. 2: The rotary spiral blade mixer for bulk materials

bearings, which in turn is fixed to the housing 1. At the top of the mixer drum fixedly cover which prevents the exit of the mixing components of the mixer drum [5,11].

The mixer works as follows: mixing components are loaded through the top hatch and fall into the drum mixer 2. Simultaneously turns the actuator 6, resulting in the rotation of a vertical shaft via a gear 7 and a drive, resulting in the rotation of the mixing drum 2 via V-belt transmission.

When the rotor 3 rotates in the opposite direction of rotation of the drum 2, the direction of rotation of the drum mixer is selected in accordance with the direction of coil windings 5. The rotation of the blade shaft 4 rise blending components and throw them into the spiral 5, thereby moving the material in vertical and horizontal directions. Thus discontinuities present in it creates turbulence of the mixture. Moving surfaces on the screw, the mixture reaches the second row of blades and moved in the vertical and horizontal directions, reaches the middle part of the spiral and moves upward. Since the mixture reaches the top of the mixer drum and is directed downwards towards the main flow of the mixture. After the mixture was stirred, it is discharged through the bottom hatch by opening the lid. After unloading, mixing process is repeated [6,7].

Thus, the proposed design allows the mixer to increase the degree of homogeneity of the final product by the initial creation of the circulation of the mixture components in both horizontal and vertical directions inside the mixer drum [11].

MATERIALS AND METHODS

Along with the established methods of complex reduction of energy costs in the preparation of dry cement mix is a combination of rational mechanical mixing process and exergy analysis of cement, it is necessary to study the process of changing its concentration in the building blends with the spiral blade mixer.

This process will be considered in the framework of the diffusion model [4], which corresponds to the flow of material from the piston movement (in relation to the subject mixer - it's the circulation of material (Fig. 3) in zone 2), complicated by lateral movement of the particles of particulate material (in relation to the subject mixer - the movement of material in the radial direction (zone 1, Figure 3)), under the authority of the law of diffusion [7]. As stated above, the basic equation of changes in the concentration of key components of the mixture can be written as follows:

$$\frac{\partial C}{\partial t} = -\bar{v}_z \cdot \frac{\partial C}{\partial z} + \frac{\overline{D_r}}{r} \cdot \frac{\partial}{\partial r} \cdot \left(r \cdot \frac{\partial C}{\partial r} \right) \quad (1)$$

where C - the concentration of a key component of the mixture;

v_z = The average speed of the circulation of material along the axis Oz;

$\overline{D_r}$ = Average value of the cross-mixing of the mixture.

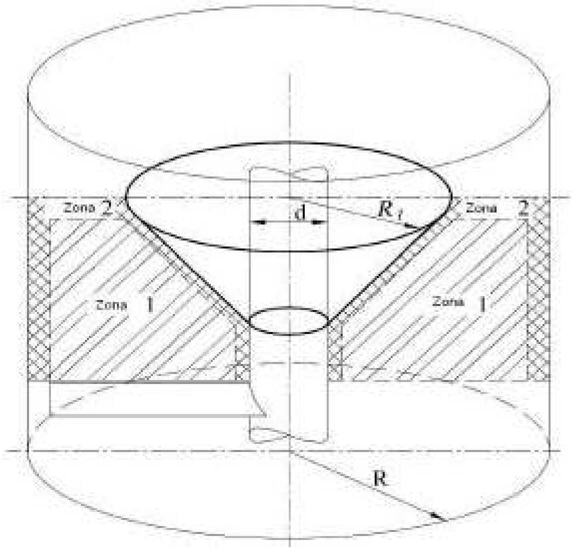

Fig. 3: The scheme of movement of the material in the areas of spiral blade mixer.

We calculate the average value *Z*- the components of the velocity vector:

$$\overline{v_z} = \frac{1}{H_0+\Delta Z}\cdot\int_0^{H_0+\Delta Z} v_z dz \tag{2}$$

Equation (2) can be reduced to the following form:

$$\overline{v_z} = \frac{1}{H_0+\Delta z}\cdot\int_0^{H_0+\Delta z}\sqrt{w^2-2\cdot g\cdot z dz} = \frac{1}{3}\cdot\frac{w^2}{g\cdot(H_0+\Delta z)}\cdot\left[1-\left(1-\frac{2\cdot g\cdot(H_0+\Delta z)}{w^2}\right)^{3/2}\right] \tag{3}$$

Then, for the period of time *t* when the steady circulation of bulk material along the axis *Oz* is traversed path 2z. According to what has been said we can write:

$$2\cdot z = t\cdot\overline{v_z} \tag{4}$$

With regard to (4), equation (1) can be reduced to the following form:

$$3\cdot\frac{dC}{dt} = \frac{\overline{D_r}}{r}\cdot\frac{d}{dr}\cdot\left(r\cdot\frac{dC}{dr}\right) \tag{5}$$

Transverse mixing ratio of particulate material is defined as the product of the velocity of the material along the radial direction by the amount of the path traversed along this direction:

$$D_r = \frac{A}{2}\cdot w\cdot r^2 \tag{6}$$

where

$$A = \sqrt{\lambda^2+1}-\lambda > 0 \tag{7}$$

If we consider that

$$\frac{d}{l} << 1 \tag{8}$$

then, according to (8), up to the value of the first order, the expression (6) can be reduced to the following form:

$$\overline{D_r} = \frac{A\cdot w}{6\cdot l}\cdot l^3\cdot\left[\left(1+\frac{d}{2\cdot l}\right)^3-\left(\frac{d}{2\cdot l}\right)^3\right] \cong \frac{A\cdot w\cdot l^2}{6}\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right) \tag{9}$$

With (9), equation (1) takes the following form:

$$3\cdot\frac{\partial C}{\partial t} = \frac{A\cdot w\cdot l^2}{6}\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right)\cdot\left[\frac{\partial^2 C}{\partial r^2}+\frac{1}{r}\cdot\frac{\partial C}{\partial r}\right] \tag{10}$$

In equation (10) we pass to dimensionless variables, according to the following relations:

$$\varphi = w\cdot t \tag{11}$$

$$\xi = \sqrt{\frac{18}{A\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right)}}\cdot\frac{r}{l} \tag{12}$$

In view of (11) and (12), equation (10) takes the form:

$$\frac{\partial C}{\partial\varphi} = \frac{\partial^2 C}{\partial\xi^2}+\frac{1}{\xi}\cdot\frac{\partial C}{\partial\xi} \tag{13}$$

The solution of equation (13) will be sought in the form of the following relationship:

$$C(\varphi,\xi) = T(\varphi)\cdot ?\ (\xi) \tag{14}$$

Substituting (14) into (13) we get:

$$?\ (\xi)\frac{\partial T}{\partial\varphi} = T(\varphi)\cdot\left[\frac{\partial^2 ?}{\partial\xi^2}+\frac{1}{\xi}\cdot\frac{\partial ?}{d\xi}\right] \tag{15}$$

If in equation (16) to separate the variables, we get the following expression:

$$\frac{1}{T}\cdot\frac{\partial T}{\partial\varphi}=\frac{1}{?}\cdot\left[\frac{\partial^2 ?}{\partial\xi^2}+\frac{1}{\xi}\cdot\frac{\partial ?}{\partial\xi}\right] \tag{16}$$

According to (16), the left side of the expression φ depends on and only on the right side of the variable ξ. This ratio can be meaningful only if the left and right sides of the equation (16) turn to some constant value. Problem to be solved within the meaning of the function (14) should be a decreasing function of changing its variables.

Based on the above it can receive the following two equations:

$$\frac{1}{T}\cdot\frac{\partial T}{\partial\varphi}=-\lambda_0^2 \tag{17}$$

$$\frac{1}{?}\cdot\left(\frac{\partial^2 ?}{\partial\xi^2}+\frac{1}{\xi}\cdot\frac{\partial ?}{\partial\xi}\right)=-\lambda_0^2 \tag{18}$$

We rewrite (18) in the following form:

$$\frac{d^2 ?}{d\xi_1^2}+\frac{1}{\xi_1}\cdot\frac{d ?}{d\xi_1}+? \ =0 \tag{19}$$

Solution of the differential equation (19) is a linear combination of cylindrical equations:

$$?\ (\xi_1)=A_1\cdot J_0(\xi_1)+A_2\cdot Y_0(\xi_1) \tag{20}$$

where $J_0(\xi_1)$ and $Y_0(\xi_1)$ are the Bessel functions of the first and second kind. Graphs of functions $J_0(\xi_1)$ and $Y_0(\xi_1)$ data are presented in Figures 2 and 3.

As can be seen from the graphs, the Bessel $J_0(\xi_1)$ function is decreasing on the interval $0\le\xi_1\le\psi_1$, here ψ_1- the first root of the Bessel function and the function on $Y_0(\xi_1)$ this interval is an increasing function. By virtue of this fact in (20) the constant A_2 need to assign the following meaning:

$$A_2=0 \tag{21}$$

Taking into account (21), relation (20) is reduced to:

$$?\ (\xi_1)=A_1\cdot Z_0(\xi_1) \tag{22}$$

With this in mind, the expression (22) takes the following form:

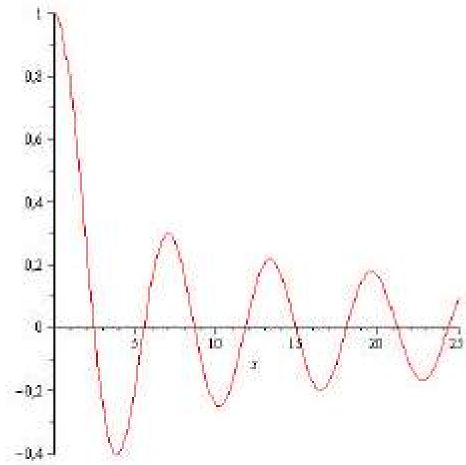

Fig. 4: Graph of function *Bessel* $Y_0(\xi_1)$

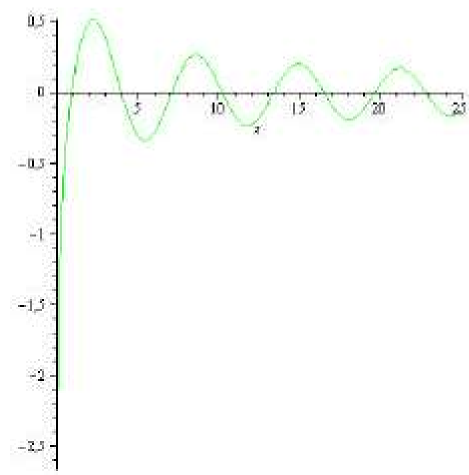

Fig. 5: Graph of function *Bessel* $J_0(\xi_1)$

$$?\ (r)=A_1\cdot J_0\left(\lambda_0\cdot\sqrt{\frac{18}{A\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right)}}\cdot\frac{r}{l}\right) \tag{23}$$

To determine the constant λ_0 need to use the following boundary conditions:

$$C(r=R)=?\ (r=R)=0 \tag{24}$$

Application of the boundary conditions (24) to (23) provides the following equation:

$$A_1\cdot J_0\left(\lambda_0\cdot\sqrt{\frac{18}{A\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right)}}\cdot\frac{r}{l}\right)=0 \tag{25}$$

By the fact that $A_1 \neq 0$, on the basis (25) we obtain:

$$\lambda_0 \cdot \sqrt{\frac{18}{A\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right)}}\cdot\frac{R}{l}=\psi_1 \quad (26)$$

We express λ_0 from (26):

$$\lambda_0=\frac{\psi_1\cdot l\cdot\sqrt{A\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right)}}{3\cdot\sqrt{2}\cdot R} \quad (27)$$

Substituting (27) into (23) yields the following results:

$$T(t)=T_0\cdot\exp\left(-\frac{\psi_1^2\cdot l^2\cdot A\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right)}{18\cdot R^2}\cdot w\cdot t\right) \quad (28)$$

Substitution of (27) gives a relation:

$$C(t,r)=C_0\cdot\exp\left(-\frac{\psi_1^2\cdot l^2\cdot A\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right)}{18\cdot R^2}\cdot w\cdot t\right)\cdot J_0\left(\psi_1\cdot\frac{r}{R}\right) \quad (29)$$

On the basis of expressions (28) and (29) of (14) takes the following form:

$$C\left(t=0,r=\frac{d}{2}\right)=C_H \quad (30)$$

The constant $C_0 = A_1.T_0$ can be determined, based on the following boundary conditions:

$$C\left(t=0,r=\frac{d}{2}\right)=C_H \quad (31)$$

Here C_H - the initial value of the concentration of a key component of a mixture of bulk material. Application (31) to (30) will be obtained by:

$$C_0=\frac{C_H}{J_0\left(\psi_1\cdot\frac{d}{2\cdot R}\right)} \quad (32)$$

Substituting the result (32) to (30) provides the following expression which describes the change in the concentration of key components:

$$C(t,r)=\frac{C_H}{Z_0\left(\psi_1\cdot\frac{d}{2\cdot R}\right)}\cdot \exp\left(-\frac{\psi_1^2\cdot l^2\cdot A\cdot\left(1+\frac{3\cdot d}{2\cdot l}\right)}{18\cdot R^2}\cdot w\cdot t\right)\cdot Z_0\left(\psi_1\cdot\frac{r}{R}\right) \quad (33)$$

Thus obtained equation (33) can describe the process of changing the concentration of a key component of particulate material in a spiral-blade mixer, depending on the constructive (*l,d,R*) and technological parameters (λ,*w,t*) and to find the distribution of concentration of the main component of dry mixture according to the time and radial position.

The Main Part: To determine the truthfulness of the analytic dependence and evaluate the effectiveness of the proposed design of the mixer is necessary to conduct experimental research and analysis of the data. These statistics will provide an opportunity to understand the processes occurring in the installation, how significant are the varied factors as well a certain process has been described theoretically and to establish the relationship between the studied parameters.

Studies carried out on a pilot plant (Figure 6) rotary spiral blade mixer, which consists of a frame, the mixing drum rotor boot lid actuator rotorus drive drum loading door and a discharge spigot.

For the experiments was chosen central composite orthogonal design FCCC 24 full factorial experiment. Determination of levels of varying factors were carried out with the help of search experiments. The data presented in Table 1.

$$\begin{aligned} V_C &= 4{,}881+0{,}025\cdot x_1+0{,}263\cdot x_2+0{,}357\cdot \\ & x_3+0{,}013\cdot x_4+0{,}483\cdot x_1^2+0{,}588\cdot x_2^2+ \\ & +0{,}497\cdot x_3^2-0{,}116\cdot x_4^2+0{,}199\cdot x_1\cdot x_2 \\ & -0{,}24\cdot x_1\cdot x_3-0{,}286\cdot x_1\cdot x_4+0{,}228\cdot x_2\cdot x_3- \\ & -0{,}061\cdot x_2\cdot x_4-0{,}12\cdot x_3\cdot x_4 \end{aligned} \quad (34)$$

By analyzing the resulting equation can be concluded that the greatest impact on the value of the coefficient of heterogeneity has a width of a spiral, as has the greatest value for the coefficient of the double- exposure [2, 8]. All the factors have a positive impact of a single factor, indicating that the growth rate of the increase in heterogeneity. The greatest impact of pair exposure has a combination of factors: the angle of

Table 1: The results of experimental studies

	Variation factor				Investigated parameters		
Experience	x_1 (δ_0, deg)	x_2 (Δr, mm)	x_3 ($n_ø$, min^{-1})	x_4 $n_{б,}$ min $^{-1}$)	q, kW•h/t	*Vc* %	σ, MPa
1	20	30	30	450	3,45	4,146	20,14
2	30	30	30	450	4,06	5,358	21,88
3	20	50	30	450	3,98	3,307	20,87
4	30	50	30	450	3,83	5,946	26,96
5	20	30	50	450	4,09	5,116	21,59
6	30	30	50	450	3,82	3,901	17,49
7	20	50	50	450	3,58	5,394	13,04
8	30	50	50	450	4,26	5,946	15,84
9	20	30	30	650	3,97	6,389	15,51
10	30	30	30	650	4,09	6,155	16,31
11	20	50	30	650	3,90	6,673	10,05
12	30	50	30	650	3,41	5,880	21,30
13	20	30	50	650	3,51	6,155	18,12
14	30	30	50	650	3,97	5,694	16,67
15	20	50	50	650	3,65	6,419	15,02
16	30	50	50	650	4,22	6,512	13,56
17	18	40	40	550	2,90	8,657	10,56
18	32	40	40	550	6,08	8,056	13,56
19	25	26	40	550	3,01	7,986	12,58
20	25	54	40	550	6,33	9,564	14,82
21	25	40	26	550	3,60	6,567	8,56
22	25	40	54	550	7,06	10,234	16,21
23	25	40	40	410	3,55	8,569	9,88
24	25	40	40	690	6,75	3,344	8,98
25	25	40	40	550	3,43	4,881	15,81

Based on the statistical analysis of experimental results obtained by the regression equation in coded form:

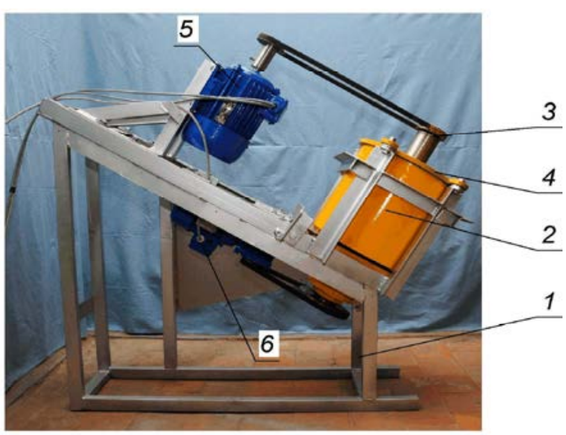

Fig. 6: The experimental setup of rotary spiral blade mixer: 1 - Frame 2 - mixing drum, 3 - rotor, 4-cover, 5 - drive the rotor, 6 - drum drive.

inclination of the helical surface and the rotor speed mixer. Coefficient having a negative value means that this combination improves the quality of the mixture. The least impact on the change in the coefficient of heterogeneity have a helix angle of the surface and the rotor speed when single exposure.

For a more detailed study and interpretation of the equation in a graphical view of this equation must be translated from the encoded form to a natural look. Then the regression equation 34 in real terms will be as follows:

$$\begin{aligned} V_C = 20{,}65 + 0{,}019 \cdot \delta_0^2 + 0{,}004 \cdot \delta_0 \cdot \\ \Delta r - 0{,}005 \cdot \delta_0 \cdot n_? - 0{,}614 \cdot \delta_0 + 0{,}006 \cdot \Delta r^2 + \\ +0{,}002 \cdot \Delta r \cdot n_? - 0{,}601 \cdot \Delta r + \\ 0{,}005 \cdot n_?^2 - 0{,}267 \cdot n_? + 0{,}032 \cdot n_p \end{aligned} \quad (35)$$

Figures 7 - 10 shows a graph of the most characteristic changes in the coefficient of heterogeneity of the studied V_C factors $\delta_0, \Delta r, n_?, n_p$.

From Figure 7 that the dependence $V_C = f(\delta_0)$ is extreme. At values of the angle of the helical surface δ_0 = 25...32° is the decrease in the irregularities and on the change in the angle δ_0 = 18...25° coefficient is increased heterogeneity of the mixture [2].

The highest values of the coefficient of heterogeneity are achieved with a minimum of a factor δ_0 equal to 18 degrees. The minimum value of V_c is attained at extreme with an average value of factor equal to 25 degrees.

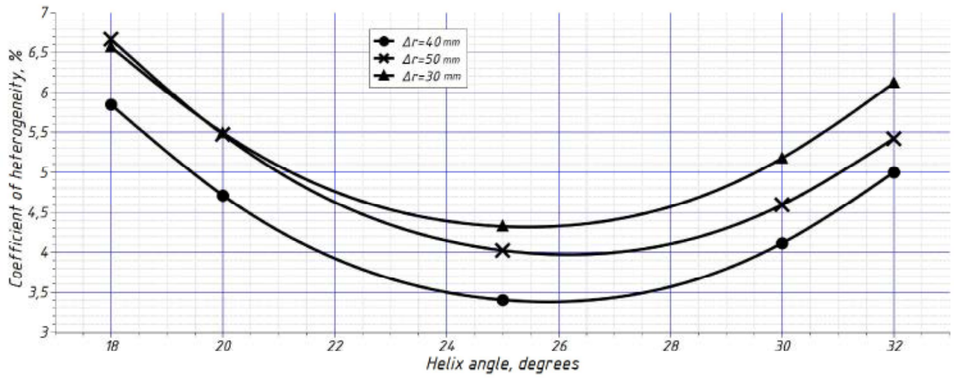

Fig. 7: The graphs of $V_C = f(\delta_0)$ at $n_p = 40\text{min}^{-1}$ and $n_p = 5850\text{min}^{-1}$.

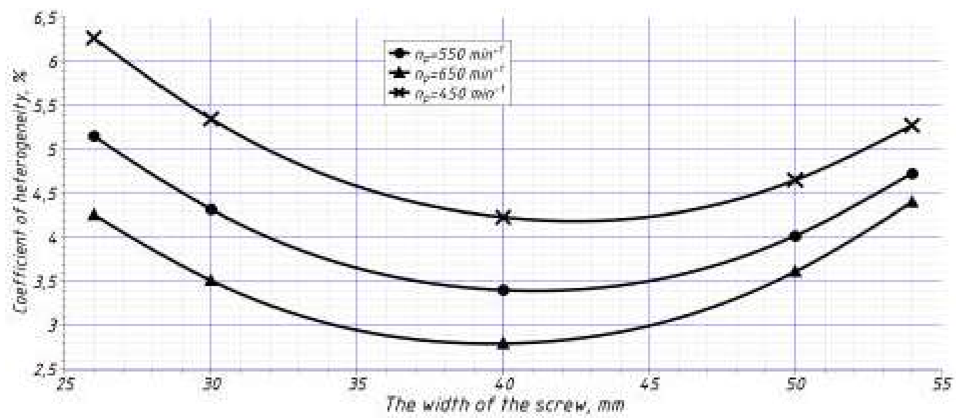

Fig. 8: Plots of the $V_C = f(\Delta r)$ at $\delta_0 = 25$deg and $n_p = 40\text{min}^{-1}$.

This heterogeneity smallest coefficient achieved with the width of the s crew r =40*mm* . Extreme dependence $V_C = f(\delta_0)$ can be explained by the fact that for small angles of the helix material is slowly moved in the axial direction and the main movement is in a separate layer between the kneading blades [2]. With the increase in the elevation angle increases and the distance to which raised the mixture components, thus increasing the circulation of material in the axial direction. The maximum circulation of material within the mixing drum is set at the angle of the helix $\delta_0 = 25°$. In this case, the kinetic energy transferred to the kneading blade material layer and is carrying out its backwater, exceeds the energy required to promote the material in a helical surface. As the angle of the helix $\delta_0 = 25...32°$ material is deceleration in the axial direction, which leads to a decrease in the circulation and as a consequence, to increase the coefficient of heterogeneity. When these angles are increased energy needed to advance material along the helical surface. This is confirmed by the graph in Figure 7. For values of the elevation angle and the higher the heterogeneity of the mixture begins to increase.

Figure 8 shows the dependence of $V_C = f(\Delta r)$ at medium settings δ_0 and n_0 . Dependence, as in the previous case, is extreme. It is worth noting that extremum point and width helix - 40 mm, the smallest coefficient of heterogeneity will rotor rotating at 650 min^{-1} and the maximum value - at a frequency of 450 min^{-1}. With the change of the screw latitude range of 26 mm to 40 mm, there is a reduction coefficient of heterogeneity. This can be explained by the fact that there is an increase volume of material committing circulation in the axial direction. In this regard, increasing the degree of convective mixing of the material that leads to reduction of heterogeneity coefficient [10].

With minimal nonuniformity ratio mixture forces acting on the material from the kneading blade and the friction material of the wall and the helical surface as well as internal friction forces are efficiently balanced.

Increasing the width of the screw of 40 mm to 54 mm leads to an increase in friction of the material of the spiral, whereby stagnation zones are formed, which increases the degree of segregation and therefore leads to an increase in the coefficient of heterogeneity. Such dependence is observed for all values of rotor speed mixer.

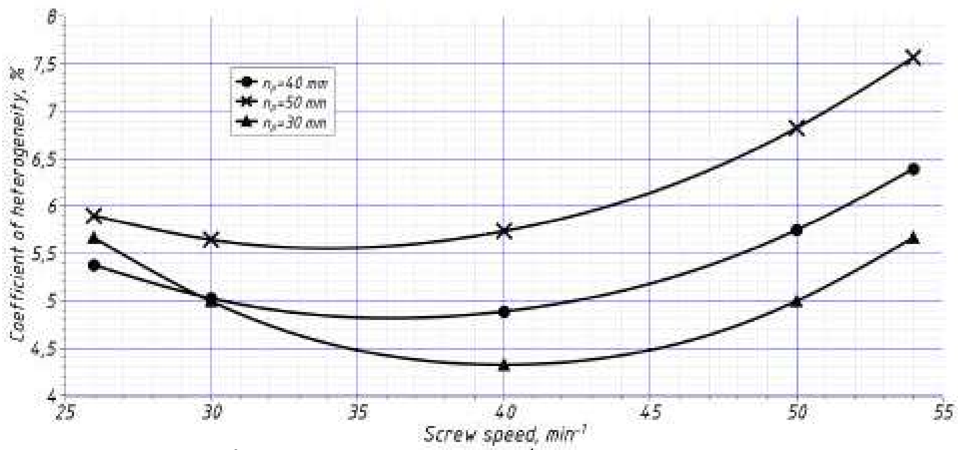

Fig. 9: Plots of the $V_C = f(n_0)$ with δ_0 = 25deg and n_p = 550min^{-1}.

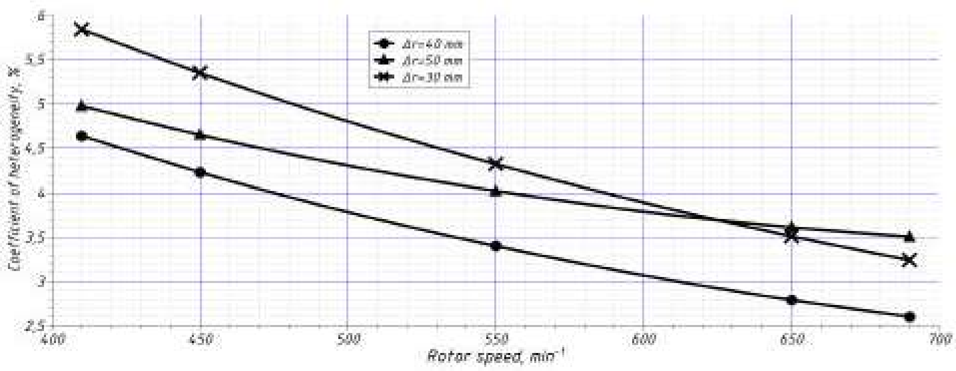

Fig. 10: Plots of the $V_C = f(n_0)$ with δ_0 = 25deg and n_p = 550min^{-1}..

The value of $V_C = f(n_0)$ is shown in Figure 9. This function has an inflection (extreme) with the number of screw speed of 35 min^{-1} and the width of the screw Δr = 40...50*mm*. When the width of the screw of 30 mm extremum point is shifted to a value of 40 min^{-1}. Most of the graphics for all values of Δr has a growing character, which indicates an increase in the coefficient of heterogeneity.

In the speed range n_0 = 26...40*mm* and 30 mm wide spiral decrease heterogeneity coefficient to a value 4.32 %. This ratio is the minimum for all values of the width of the screw. When Δr of 40 and 50 mm at a screw speed range from 27 to 37 min^{-1}, reduced heterogeneity factor slightly. This behavior depends $V_C = f(n_0)$ can be explained by the fact that the change in the number of screw speed is increased exposure to blending components of the centrifugal force that prevents movement of the material, pressing it against the walls of the drum [10]. Also, it is worth noting that increasing the screw speed is reduced when passing the pen kneading blade spiral surface, which leads to incomplete filling of the track remaining after the blade and a smaller volume of displaced material. These factors impede the circulation of the material that leads to growth factor heterogeneity.

Figure 10 shows the relationship $V_C = f(n_0)$, where throughout the graph the value is decreasing. The maximum value of the inhomogeneity equal to 5.84 % is set at the number of revolutions of the rotor 410 min^{-1} and the width of the screw 30 mm. With the increasing number of revolutions of the rotor is reduced heterogeneity coefficient to 2.6%, the width of the screw - 40 mm. This change results from the fact that at low speeds of the rotor material is compacted within the mixing drum and the material does not go into a fluidized state. This circulating material does not occur [9,10]. With increasing speed of the rotor material is fluidized and gradually begins to move over the surface of helix. This process occurs up to a speed 690 min^{-1}. With further increase in speed will be an increase in the coefficient of heterogeneity, as kneading blade passing frequency of the drum is so large that the material will not have time to get into the zone of

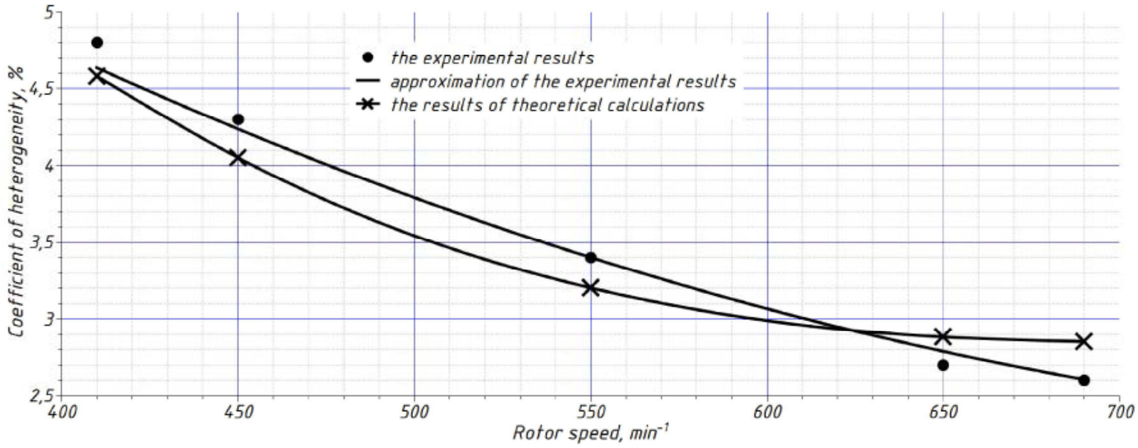

Fig 11. The dependence of the heterogeneity of the number of revolutions of the rotor

displacement kneading blade. This material will be split into several zones formed between the rows of kneading blades. Movement of the mixture components in these areas would be minimal, which creates the effect of "freezing ". However, this mode of operation, in most cases, is critical and in rotary mixers are not used.

The results obtained dependence of the heterogeneity of the mixture of the speed of the rotor during the experimental studies was compared with the theoretical studies presented by the formula 33. Graphical interpretation of the results displayed in Figure 11.

The figure shows that the greatest difference between the theoretical and experimental data is observed at the speed of the rotor $n_p = 410\text{min}^{-1}$.

CONCLUSION

The resulting experimental research results of dependence of the heterogeneity of the mixture of the speed of the rotor are compared with theoretical data. The dependence obtained on the basis of theoretical calculations has a strong exponential relationship and on the basis of experimental studies - a linear relationship.

The largest discrepancy between the theoretical and experimental results was 8 %, which exceeds the maximum permissible values.

Findings: The developed design spiral rotor - blade mixer with high-speed blending mode allows you to increase the degree of homogeneity of the finished dry mixture and reduce the mixing time by the circulation of the initial components of a mixture of dead zones along the body of the mixer. This mixer may also receive the modified dry mixtures of complex composition.

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