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FEATURES OF DETERMINATION OF GEOMETRICAL SIZES OF CYCLONES WITH SPIRAL SENDING VEHICLE AND THEIR INFLUENCE ARE ON HYDRAULIC RESISTANCE

Проаналізовано співвідношення геометричних розмірів найпоширеніших циклонів типу ЦН. Визначено співвідношення геометричних розмірів циклону з спіральним напрямним апаратом. Проведено дослідження гідравлічного опору циклонів з спіральним напрямним апаратом. Визначено вплив геометричних розмірів на величину гідравлічного опору цих апаратів.

Ключові слова: циклон, спіральний, гідравлічний опір, геометричні розміри, пиловлювлювач, витки.

Correlation of geometrical sizes of the most widespread cyclones is analysed as ЦН. Correlation of geometrical sizes of cyclone is certain with a spiral sending vehicle. Research of hydraulic resistance of cyclones is conducted with a spiral sending vehicle. Influence of geometrical sizes is certain on the size of hydraulic resistance of these vehicles.

Key words: cyclon, spiral, hydraulic resistance, geometrical sizes, dust collectors, coils.

Raising of problem. Plenty of different constructions and sizes cyclones is used in industry. The choice of construction of vehicle depends on requirements to cleaning of gas from a dust and hydraulic resistance of this dust collector, and the choice of size depends gas volumes for cleaning. For existent dust collectors vehicles plenty of various methodical recommendations is worked out on the choice of that or other vehicle depending on the type of dust [1]. The choice of size is taken to determination of diameter of cyclone depending on the volume of gas. All other structural geometrical sizes are determined as part from a diameter. However such methods allow to conduct the selection of cyclone with a spiral sending vehicle.

Analysis of the last researches and publications. Knowing a gas expense for cleaning, it is possible to define the diameter of vehicle:

$$D = \sqrt{\frac{4 \cdot Q}{\pi \cdot V_0}}, \qquad (1)$$

where Q is a by volume expense of gas, m^3/c; V_0 is fictitious speed of air in a cyclone, m/c

For the most widespread cyclones as ЦН fictitious speed is recommended scope from a 2,5 m/c a to 4 m/c.

All structural sizes of cyclones are determined as parts from his diameter. Correlations of basic sizes of the most widespread cyclones as ЦН are presented in a table.

Thus, knowing the necessary charges of gas for cleaning it is possible to pick up the necessary diameter of dust collectors vehicle.

Formulation of purpose of researches. To apply such calculation for a cyclone with a spiral sending vehicle, construction and principle of work of which it is presented it is impossible in [2], because the transversal cut of corps of vehicle has a spiral, but not cylindrical form, and an area depends not only

on the width of channel but also from the number of coils. Our task is establishment of accordance of width of spiral channel, amount of coils and diameter of outtake from his by other structural sizes, and also determination of hydraulic resistance of these vehicles.

Correlation of sizes of cyclones is as ЦН

Sizes		Part is from the internal diameter of cyclone
name	denotation	
External diameter of outtake	d	*0.6D*
Drank an internal diameter tape-hole	d_1	*0.3 – 0.4D*
A width of the entrance union coupling is in a cyclone	b	*0.2D*
Width of the entrance union coupling	b_1	*0.26D*
Height of the entrance union coupling	a	*0.66D*
Length of the entrance union coupling	l	*0.6D*
Height of cylindrical part of case cyclone	$h_ц$	*2.26D*
Height of cone of cyclone	$h_к$	*2D*

Exposition of basic material of research. For establishment of geometrical sizes of cyclone with a spiral sending vehicle it is expedient to use some correlations of sizes, what characteristic for cyclones as ЦН.

So for a cyclone as ЦН area entrance to the union coupling evened

$$S_{вх} = a \cdot b = 0.132 \cdot D^2 \tag{2}$$

The area of outtake is evened

$$S_{вих} = \frac{\pi d^2}{4} = 0.283 \cdot D^2 \tag{3}$$

The area of transversal cut of corps is evened

$$S_к = \frac{\pi D^2}{4} = 0.785 D^2 \tag{4}$$

Thus, as evidently from the higher brought dependences over of betweenness by areas entrance to the union coupling, outtake, circular space for a cyclone as ЦН folds

$$S_{вх} : S_{вих} : S_к = 0.132 : 0.283 : 0.785 \tag{5}$$

Accordingly correlation of speeds in these cuts must fold (in the m/c): (14,8 – 23,8):(6,94 – 11,11):(2,5 – 4).

For a cyclone with a spiral sending vehicle it is possible to use the higher set correlations.

Knowing gas charges and recommended speeds in an outtake it is possible to find the diameter of outtake of cyclone with a spiral sending vehicle, like, as well as for a cyclone as ЦН:

$$d = \sqrt{\frac{4 \cdot Q}{\pi \cdot V_{вип}}} \tag{6}$$

where $V_{вип}$ is the recommended speed of gas in an outtake.

Height of the entrance union coupling it is possible to define from dependence:

$$a = \frac{Q}{b \cdot V_{вх}} \tag{7}$$

where $V_{вх}$ is the recommended speed of gas in the entrance union coupling.

The amount of coils and width of spiral channel can be defined, knowing the size of area of transversal cut of spiral vehicle. The area of transversal cut of spiral vehicle can be defined on the values of gas charges and recommended value of fictitious speed:

$$S_к = \frac{Q}{V_0} \tag{8}$$

Also she can be defined as a sum of areas of transversal cut of outtake and spiral guide-vane.

$$S_к = S_{вип} + S_{сп} = \frac{\pi \cdot d^2}{4} + l_{ср} \cdot b \quad (9)$$

where $l_{ср} = \pi\left(d + 2 \cdot n \cdot b\right)$ it is length of spiral which passes through the middle of spiral guide-vane; *n* is a number of coils of spiral vehicle.

Equating right parties of equalizations (8) and (9) by accepted value of width of spiral channel it is possible to define the amount of coils of spiral, or by accepted value of coils of spiral determine the necessary width of channel.

Thickness of material which a spiral sending vehicle is made from, as a rule folds a 0,5 – 0,7 mm, in these dependences he is not taken into account, so as a substantial error he will not bring in.

An angle of slope of walls of bunker must be anymore corner of natural slopes dust; as a rule this corner is accepted by even 55 – 60˚. That is why the height of cone part for cyclones as ЦН equals correlation which is indicated in a table 1. For a cyclone with a spiral sending vehicle the height of conical part is evened

$$h_к = 2 \cdot D_к \quad (10)$$

where $D_к$ is a diameter of overhead part of cone of vehicle, which depends on parameters which determine the area of transversal cut of spiral vehicle and diameter of outtake,:

$$D_к = 2\left(\frac{d}{2} + n \cdot b + t\right) \quad (11)$$

where t=5….10 mm – technological size.

The internal diameter of the dust graduation opening is evened

$$d_1 = \left(0.3 - 0.4\right) D_к \quad (12)$$

The height of cylindrical part of spiral vehicle is determined by the corner of getting up of coils of spiral, but not less than $2{,}26D_к$:

$$h_ц = l_{ср} \cdot tan\alpha \quad (13)$$

where б is a corner of getting up of coils of spiral.

For determination of influence of geometrical parameters on hydraulic resistance research of cyclone was conducted with a spiral sending vehicle with the different amount of coils of spiral and breadthways spiral channel.

Researches conducted by means of CFD – programs (Computational Fluid Dynamics), which are intended for the computer analysis of tasks hydraulics a gas dynamics which in connection with powerful development of computer technique and software extended possibilities of numerical analysis substantially. Such programs belong to this class, as Cosmos Flow Simulation, Fluent, Flowvision et al. CFD of -program oneself was well shown during scientific researches in different industries of industry. The defects of packages of applied hydraulic gas dynamics software is universality of software, which results in a volume, that the features of work of cyclone are examined by an incomplete measure. However applications of CFD of -programs can considerably shorten time of planning and research of new constructions of vehicles, cast aside on the stage of planning in good time unsuccessful constructions.

For research in the program SolidWorks the solid models of cyclones were created with a spiral sending vehicle with the different amount of coils of spiral and breadthways spiral channel. Methods of realization of computer researches in the module of Flow Simulation and him a mathematical structure over is brought in [3].

For a calculation set next maximum terms:

1) Flow openings – by volume expense is open on an exit from a vehicle (she was changed thus, that fictitious speed of gas in a vehicle folded a from 2,5 to 4.0 m/of c).
2) Pressure openings is pressure of environment.
3) Wall is the real wall.

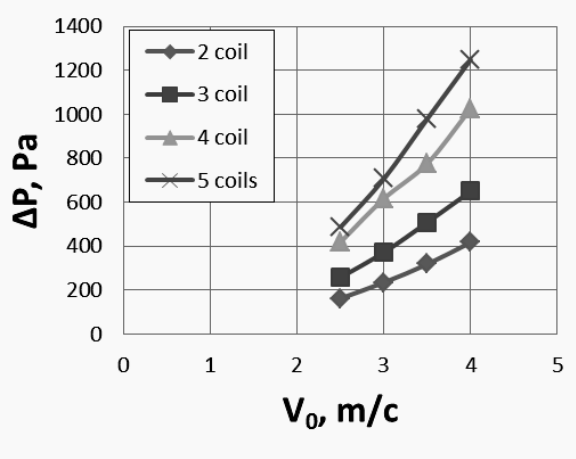
For determination of influence of coils of spiral of vehicle on hydraulic resistance changed their amount from 2 to 5. The width of spiral channel was changed by a from 30 to 100 mm. Computer researches were conducted for a case when cyclones work on the line of suction. The angle of slope of the entrance union coupling and overhead spiral lid to the plane of transversal cut of cylindrical part of cyclone for all vehicles presented 15˚.

On rice. 1 and 2 presented dependences of hydraulic resistance on the number of coils and different width of spiral channel at the different values of fictitious speed (gas charges).

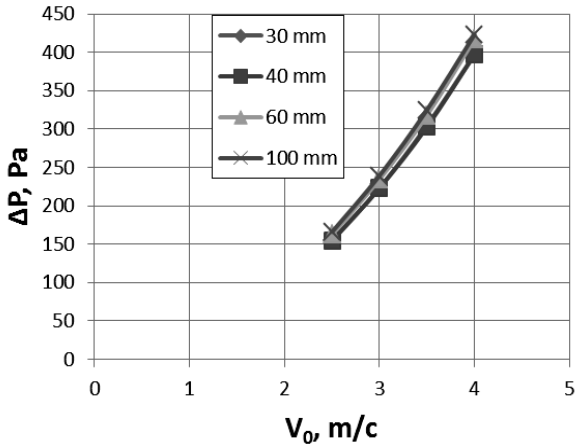
As evidently from lines. a 1 amount of coils substantially influences on hydraulic resistance of vehicle. With the increase of coils from 2 to 5 hydraulic resistance grows almost in three times. It is necessary to mark, that the increase of number of coils brings to the increase of time a stay over of gas in a vehicle which in turn can result in the increase of efficiency of work.

Graphic arts are on rice. 2 specify that the increase of width of channel increases hydraulic resistance insignificantly. The increase of width of channel conduces to the increase of gas volumes, but width of channel a more than 100 mm it is not recommended to use because a further increase can result in the decline of efficiency.

It is not recommended to use vehicles with the amount of coils more than 4 because a relation is for such vehicles $\frac{\Delta P}{\rho} > 740$



Rice 1. Dependence of hydraulic resistance of vehicle is on fictitious speed at the different values of number of coils (the width of the entrance union coupling for all vehicles is evened a 60 mm)



Rice 2. Dependence of hydraulic resistance of vehicle is on fictitious speed at the different values of width of the entrance union coupling (the amount of coils for all vehicles is evened 2)

Conclusions. Correlation of geometrical sizes is certain for a cyclone with a spiral sending vehicle. The results of researches of hydraulic resistance testify for the approved vehicles, that the amount of coils of vehicle strongly influences on hydraulic resistance, and width of coils – insignificantly. Beside the purpose to use vehicles with the amount of coils more than four.

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