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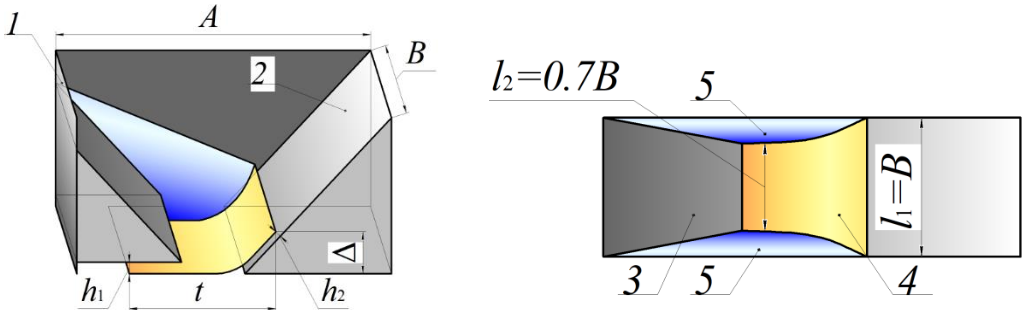
EVALUATION OF HYDRODYNAMICS QUALITY IN THE USE OF GAS DISTRIBUTION DEVICES FOR NON-UNIFORM FLUIDIZATION

Intensification of transfer processes during dehydration and granulation processes of liquid multicomponent systems containing components of mineral and organic origin using the fluidization technique significantly depends on the method of interaction of gas coolant and granular material. This is especially true when obtaining granular humic organic-mineral fertilizers in a fluidized bed [1-5]. In these works is established that intensification of processes of heat and mass transfer at granulation of liquid heterogeneous systems can be reached at realization of a jet-pulsation mode of fluidization to the auto-oscillating mode [2-5] due to the special design of the gas distribution device (GDD), Figure 1 [5] without the use of mechanical pulsators.



1 – the case of the device; 2 – right grate; 3 – left grate; 4 – horizontal surface of the working plate of GDD; 5 – narrowing inserts

Fig. 1 – Construction of GDD of slit type [5].

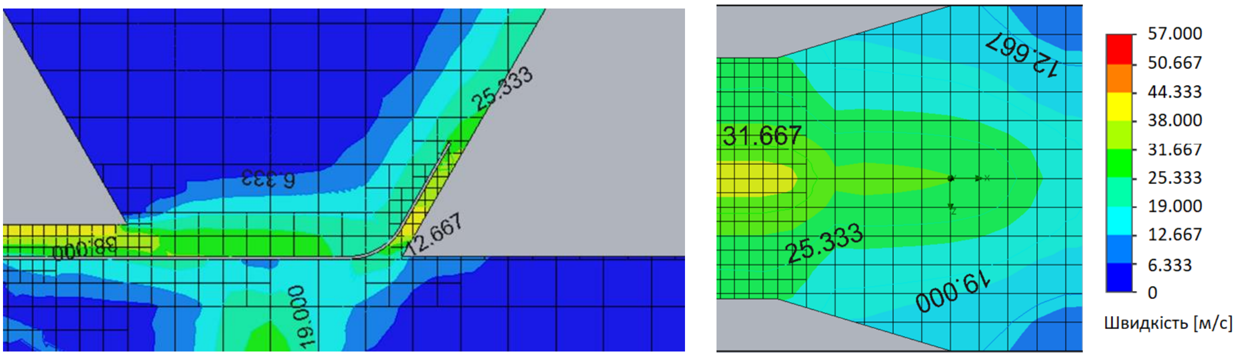
According to the results of studies of the granulation process [5] was found that on the surface of the working plate 4, Fig. 1, there are areas located near the side vertical walls of GDD 5, Figure 1, in which the gas velocity is less than 25 m/s. In these zones the risk of formation of stagnant zones with the subsequent melting of material considerably increases that will lead to a stop of the process of granulation and will limit driving force of process on temperature.

To determine the influence of the cross-sectional coefficient on the creation of zones on the surface of the working plate of GDD with a speed of at least 25 m/s, were performed simulations in the *SolidWorks 2022 SP2*.

Assessment of the quality of hydrodynamics on the horizontal surface of GDD was performed on the index of hydrodynamic activity – i_{ha} – the ratio of the area in which the gas velocity exceeds 25 m/s to the total area of the horizontal part of the working plate of the GDD – F_{total}, m^2:

$$i_{ha} = F_{25}/F_{total}, \quad (1)$$

The simulation study is presented in the form of the velocity field of the liquefying agent, fig. 2, according to the results of [5], in which non-uniform jet-pulsating fluidization was achieved (V_{gas}=0.043 m^3/s, ΔP=4 kPa).



a) vertical plane ***b***) horizontal plane

Fig. 2 – Speed fields for GDD with narrowing inserts (ΔP=4 kPa; V_{gas}=0.043 m^3/s)

In Table 1 are shown the results of virtual studies in the form of the index of hydrodynamic activity i_{ha} – the ratio of the area where gas velocity exceeds 25 m/s to the total area of the horizontal part of the working plate of the GDD. The area was measured using a dimensional grid as shown in Figure 2 with an accuracy of 2 mm.

Table 1 – The results of determining of the index of hydrodynamic activity i_{ha}

Type of GDD	φ, %		
	3.0	3.5	4.0
	Index of hydrodynamic activity $i_{ha}=F_{25}/F_{all}$		
Without narrowing inserts	0.92	0.87	0.67
With narrowing inserts	0.97	0.9	0.76

The dependence obtained by the simulation results shows that with a decrease in the parameter φ from 4.0 to 3.0%, the difference in the hydrodynamic activity index for the two types of GDD almost disappears, Table 1. These results can be used in the design of slit-type GDD for industrial equipment. In addition, reducing the cross-sectional coefficient of GDD will lead to an increase in hydraulic GDD resistance. It should also be taken to account that the modeling of hydrodynamics was made without taking into account the presence of solid granular particles in the granulator chamber and, accordingly, near the surface of the working plate of the GDD with slit-type. The final verification of these results will be performed at the laboratory stand.

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