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EXPERIMENTAL RESEARCH OF THERMAL AGENT VELOCITY AND LOCAL RESISTANCE COEFFICIENTS IN HEAT EXCHANGE

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Abstract
In the article, the speed of the heat agent in the heat exchange process and the local resistance coefficients in the drum dryer for drying mineral fertilizers were experimentally studied, and the program of experimental research was carried out in order to determine the parameters determining the high intensity of heat exchange.

Keywords: Heat exchange, drum dryer, drying, U-shaped nozzle, heater, inlet velocity, outlet velocity, resistance coefficient.

Introduction

In the global chemical industry, scientific research is being carried out on the production of highly effective types of mineral fertilizers, on ensuring drying on the basis of high-quality and energy-saving technology [15]. In this regard, analysis of drying devices and modes, identification of problems; elimination of re-drying of a large part of the product by optimizing the granulometric composition of the product; Special attention is being paid to the experimental research of the effect of the construction and placement of the internal nozzles of the drying apparatus on the direction of movement of the product and thermal aerodynamics [18].

the same time , scientific and research work is being carried out on the improvement of technologies and machines for drying mineral fertilizers intended for food, chemical, cotton processing and related industries, which are compact, cheap and intended for export [22].

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LITERATURE ANALYSIS AND METHODOLOGY

to check the results of the theoretical studies and determine the parameters that determine the high intensity of heat exchange with low energy consumption using a two-part U-shaped tube for the drum dryer, the following activities were included in the experimental research program :

– development and manufacture of laboratory equipment for conducting experimental studies;
– study of the effect of material temperature depending on the types of slag ;
– Experimental study of heat agent speed and local resistance coefficients in a trolley drier ;
– research of the hydraulic resistance of the drum equipped with a two-part U-shaped nozzle ;
– study of the effect of the speed of the heat agent on the temperature of the material ;
– study of the dependence of material temperature change on the number of drum revolutions ;
– to study the dependence of the change of material moisture on the number of drum rotations and work efficiency .[25]

RESULTS

The following limits of variable factors for conducting studies, the slope of the material discharge part of the nozzle R = 15, 30 and 45 ^{o} , the number of heat exchange zones is 5, the number of nozzles in one row is 10 (nozzles are arranged in a checkerboard row according to zones b), the speed of the heat agent (air) coming out of the radiator is y= 1.4÷14.2 m/s, the efficiency of the device Q $_{unm}$ = 0.18÷0.46 kg /s, the angle of inclination of the dryer drum relative to the plane a= 2.24gr adus (according to the technological regulations), [7] the frequency of rotations of the dryer drum was set n= 4 revolutions/min [9],[6].

The above variables were changed in sequence and the heat agent at the inlet and outlet of the drum speed values and consumption were determined experimentally [24]. Each experiment was repeated 5 times and arithmetic mean values were selected. Results of experiment 1.1; Tables 1.2 and 1.3. [27].

Table 1. The slope in the material discharge part of the nas a dka When R =15 ^{o}

No	C a lorifer shiberi grade	Access speed	Output speed	Resistance coefficient
Product filling coefficient is 0.18 kg/s				
1	90 ^{o}	14.2	4.23	3.35
2	75 ^{o}	10.55	3.16	3.33
3	60 ^{o}	7.15	2.12	3.37
4	45 ^{o}	5.62	1.72	3.29
5	30 ^{o}	2.60	0.77	3.35
6	15 ^{o}	1.40	0.41	3.36
				Average 3.34
Product filling coefficient is 0.32 kg/s				
1	90 ^{o}	14.2	4.04	3.51
2	75 ^{o}	10.55	3.02	3.49

3	60 º	7.15	2.01	3.56
4	45 º	5.62	1.59	3.52
5	30 º	2.60	0.73	3.54
6	15 º	1.40	0.39	3.53
				The average is 3.52
Product filling coefficient is 0.46 kg/s				
1	90 º	14.2	3.78)	3.75
2	75 º	10.55	2.83	3.72
3	60 º	7.15	1.91	3.74
4	45 º	5.62	1.51	3.75
5	30 º	2.60	0.69	3.73
6	15 º	1.40	0.37	3.76
				The average is 3.74

Table 2. The slope in the material discharge part of the nas a dka When R = 30 º

No	C a lorifer shiberi grade	Access speed	Output speed	Resistance coefficient
Product filling coefficient is 0.18 kg/s				
1	90 º	14.2	3.03	4.68
2	75 º	10.55	2.26	4.66
3	60 º	7.15	1.52	4.70
4	45 º	5.62	1.21	4.62
5	30 º	2.60	0.55	4.68
6	15 º	1.40	0. 30	4.67
				Average 4.66
Product filling coefficient is 0.32 kg/s				
1	90 º	14.2	2.93	4.84
2	75 º	10.55	2.18	4.82
3	60 º	7.15	1.46	4.89
4	45 º	5.62	1.15	4.85
5	30 º	2.60	0.53	4.87
6	15 º	1.40	0.28	4.86
				Average 4.81
Product filling coefficient is 0.46 kg/s				
1	90 º	14.2	2.79	5.08
2	75 º	10.55	2.08	5.05
3	60 º	7.15	1.41	5.07
4	45 º	5.62	1.10	5.09
5	30 º	2.60	0.51	5.06
6	15 º	1.40	0.27	5.08
				Average 5.07

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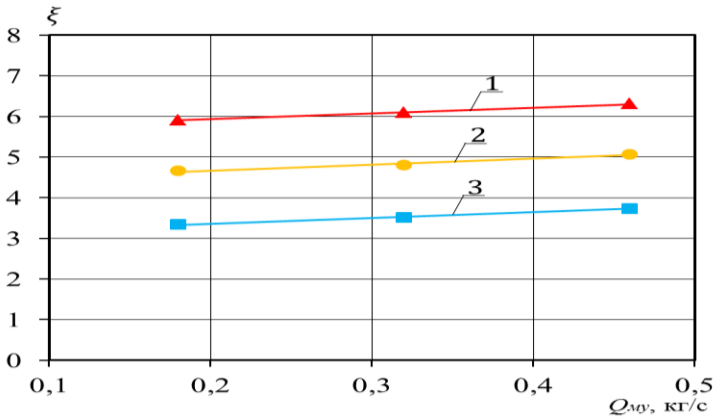
Table 3. The slope of the material discharge part of the nozzle When $R = 45^{o}$

No	C a lorifer shiberi grade	Access speed	Output speed	Resistance coefficient
Product filling coefficient is 0.18 kg/s				
1	90^{o}	14.2	2.39	5.92
2	75^{o}	10.55	1.78	5.90
3	60^{o}	7.15	1.20	5.94
4	45^{o}	5.62	0.95	5.86
5	30^{o}	2.60	0.43	5.92
6	15^{o}	1.40	0.23	5.93
				Average 5.91
Product filling coefficient is 0.32 kg/s				
1	90^{o}	14.2	2.33	6.08
2	75^{o}	10.55	1.74	6.06
3	60^{o}	7.15	1.16	6.13
4	45^{o}	5.62	0.92	6.09
5	30^{o}	2.60	0.42	6.11
6	15^{o}	1.40	0.22	6.10
				Average 6.09
Product filling coefficient is 0.46 kg/s				
1	90^{o}	14.2	2.24	6.32
2	75^{o}	10.55	1.67	6.29
3	60^{o}	7.15	1.13	6.31
4	45^{o}	5.62	0.88	6.32
5	30^{o}	2.60	0.41	6.30
6	15^{o}	1.40	0.22	6.33
				Average 6.31

In order to check the correctness of the conducted experiments, a graph of the dependence of the resistance coefficient on the performance was built (Fig. 1) [8].



1st work productivity 0.18 kg/s; 2-work productivity 0.32 kg/s;
3-work productivity 0.46 kg/s;

Fig. 1. Dependence of the coefficient of resistance on performance.

DISCUSSION

Applying the least squares method to the conducted experiments, the following regression equations were obtained, and the correlation (R) errors were determined for each point of the graphical connections separately. [3], [14] From the obtained values, it seems that the experimental error did not exceed 5% [29].

1st work productivity 0.18 kg/s;

$y = 1.4286x + 5.6462 \quad (R^2 = 0.9967)$ (1)

2-work productivity 0.32 kg/s;

$y = 1.4643x + 4.3781 \quad (R^2 = 0.9766)$ (2)

3-work productivity 0.46 kg/s;

$y = 1.4286x + 3.0762 \quad (R^2 = 0.9967)$ (3)

It can be seen from the given graph that the increase in the coefficient of filling the product to the drum leads to an increase in the coefficient of resistance in the apparatus [22] . In addition, the increase of the product discharge angle of the two-part U-shaped nozzle by 15÷45 ^{o} causes an increase in the material film coefficient on the cross-sectional surface of the drum, and this, in turn, causes a further increase in the resistance coefficient 15],[27].

CONCLUSION

Therefore, taking these factors into account when determining the hydraulic resistance in the apparatus can be considered as a parameter that determines the effective use of the heat agent.

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