A method of experimental study of the operation of technological material distributors

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Abstract: In this article, the use of technological materials in order to clear the road surface of snow and ice in a relatively short time and to reduce the number of road traffic accidents when the height, diameter, rotation speed and delivery speed of the spreader disk of the MAN special road machine are different. indicators of sprinkling density were compared. The experiment conducted on the interaction between the operating modes of the working bodies and the spreader of technological materials made it possible to choose and justify the parameters for the distribution of technological materials on the road surface to eliminate freezing and slippery conditions in the winter season. The values of theoretical and experimental data were determined and compared during the experiment on the interaction of the spreading disc parameters. During the experiment on the interaction of the parameters of the material supply mechanism, the values of theoretical and experimental data were determined and compared. Thus, according to the data obtained from the experimental study, the design parameters determining the speed of the material conveying mechanism and the speed of the machine, which determine the design parameters of the specified proportionality coefficient (a), showed that the value calculated by the speed of the material conveying mechanism and the speed of the machine exceeded the theoretical value by an average of 3%.

1 Introduction

In the Republic of Uzbekistan, transportation is mainly carried out by car on highways. The main work on cleaning and maintenance of roads takes place in the winter season. Winter maintenance challenges are associated with the metamorphism of snow, its compaction, and subsequent transformation into snow-ice and ice, which poses a hazard to vehicles and pedestrians.

In different countries, road services use technological materials (sand-salt mixture) to eliminate winter snow and ice. The use of technological materials makes it possible to clear the road surface of snow and ice in a relatively short time and reduce the number of road traffic accidents.

Special machines are used for spraying technological materials. During the period of large-scale localization in the republic, the distributor of this technological material was

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introduced to the production of the truck production project of the German company "MAN" in the Samarkand region.

As a result, road services are provided with modern equipment for road surface cleaning and maintenance. In order to further increase the effectiveness of supplying technological materials and spraying, it is necessary to carry out research aimed at justifying and choosing the parameters of the interdependence of the bodies performing this work.

Special machines are used for spraying technological materials: devices for loading and spreading technological materials have equipment that is permanently mounted on vehicle chassis or trailers or can be quickly detached. It depends on the correct selection of the parameters and working modes of the working units that carry out the effective distribution and spraying of technological materials, and this is a very urgent task in increasing the economic and material efficiency and ensuring the safety of movement. [1-10].

2 Experimental technique

The methodology of conducting experiments for the distributor of technological materials includes the determination of the working modes of the working bodies and the interaction of their parameters.

Technological materials are spread out from the center of the disc, rotating at a certain angular speed along the ribs, overcome the resistance on the surface of the disc under the influence of centrifugal forces, move to the outer edge and reach a certain distance and fall on the surface of the carriageway. . In different machines, disc diameters can vary from 0.60 to 0.70 meters, and the rotation speed can vary from 200 to 600 rpm.[10, 11, 12, 13]

This method is designed for pre-installed devices. Based on this, the height of the spreading disc $\mathrm{H}_{д}$ and the diameter of the spreading disc $\emptyset_{д}$ remains unchanged in terms of construction and the speed of rotation of the spreader disc $\omega_{д}$ and material delivery V_{TM} speed changes.

To conduct an experiment, you need the following:

- distributor of technological materials;
- 2 m^3 of homogeneous technological material (sand-salt mixture with a grain size of up to 8 mm);
- a flat, dry, clean area reserved for movement;
- dry, windless alternative weather;
- service safety and duties of experimenters.

When determining the parameters of the spreading disc, measurements are made: the height of the disc, the diameter of the disc and the rotation speed of the spreading disc (Figure 1).

To find the height of the spreader disc, measurements are taken with a tape measure, from the surface of the road surface to the top plane of the disc, and to find the diameter of the spreading disc, measurements are taken with a tape measure. From one edge of the disk, the lower plane is transferred from the center of the axis to the other edge of the disk.

To find the rotation speed of the spreader disc, the measurement is made at the bottom of the disc by placing the tachometer in its center. The rotation speed of the spreader disc was measured in three operating modes: minimum, average and maximum. All modes should be recorded in relation to the control system.

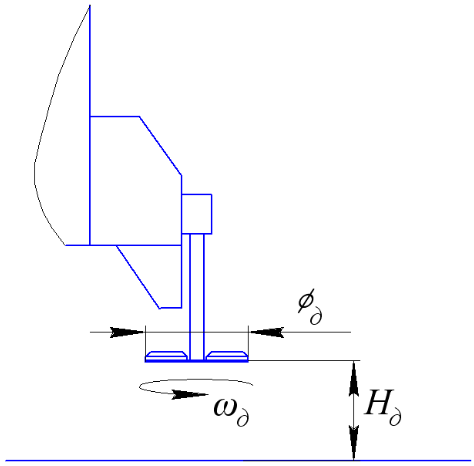


Fig. 1. Parameters of the spreading disk: $\omega_д$ is angular velocity of the spreading disc; $\emptyset_д$ is the diameter of the spreading disk; H_∂ is the height of the spreading disc.

When determining the parameters of the technological material delivery mechanism, the following measurements are taken: the width of the scraper, the opening amount of the hatch door and the speed of the delivery mechanism (Fig. 2).

The width of the eaves and the size of the opening of the skylight door are measured from the sides of the measuring area with a tape measure. To find the speed of a process material delivery mechanism, measurements are made in seconds by measuring one complete revolution of the mechanism from the mark, then dividing the revolution of the mechanism by the elapsed time *(V_{TM}= S/t)*. Measure the speed of the delivery mechanism in three operating modes: minimum, average and maximum. All modes must be recorded in relation to the control system.

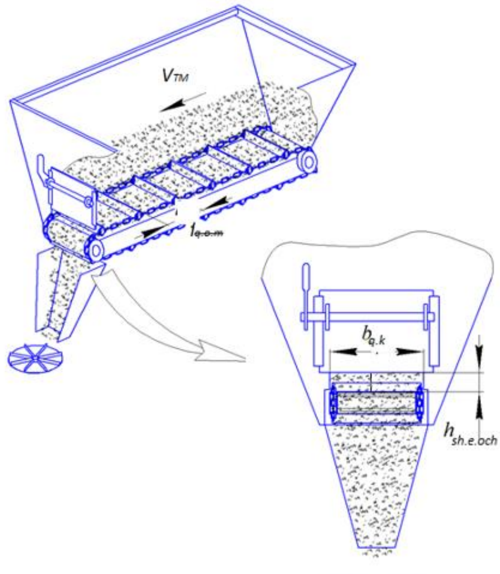


Fig. 2 Structural parameters of the Kyrgyz conveyor: V_{TM} is the speed of the technological material delivery mechanism; $b_{qk}$is the width of the scraper; $h_{sh.e.och}$ is the opening amount of the skylight door; $l_{q.o.m}$ - the distance between the scrapers.

After all geometrical and speed measurements are performed, 2 m3 of technological material (sand-salt mixture with particle size up to 8 mm) is loaded into the hopper. The mixture in the hopper is evenly distributed horizontally.

In the field where the experiment is conducted, the distributor of technological materials is installed in the position shown in the picture (Fig. 3). The vertical axis of the spreading disc axis must correspond to the specified length along the axis of movement.

After installation, the machine is immobilized to prevent it from moving by itself.

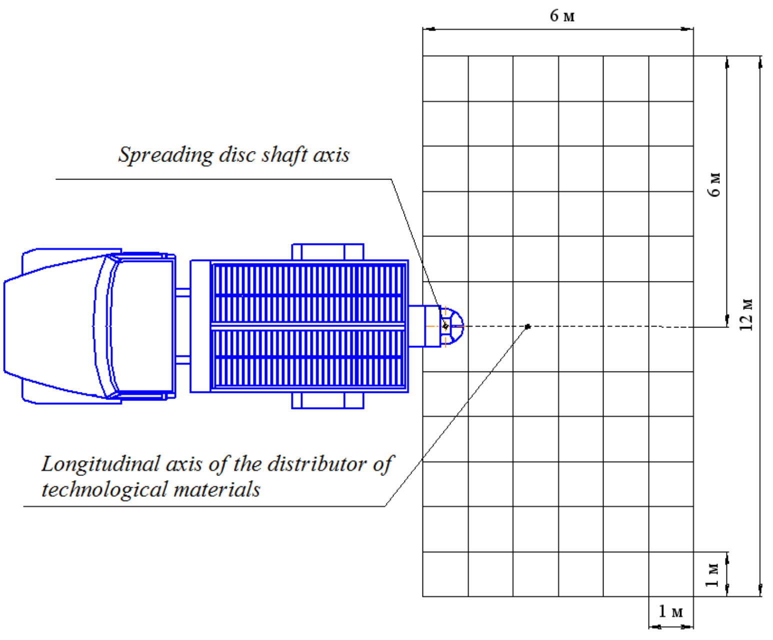


Fig. 3. Installation of technological material distributor in the experimental area

Sprinkle $S_{s,k}$ angular velocity of the spreader disk in an experiment to determine the width $\omega_{д}$, diameter of the spreader disc $\omega_{д}$ and the height of the spreader disc $H_{д}$ parameters should be compared.

In this case, spreading the disc $\emptyset_{д}$ parameters and the height of the spreading disk $H_{д}$ and the amount of opening of the sliding door does not change, that is, it will not change, because the experiment is carried out in the distributor of technological materials. $\omega_{д}$ the angular speed of the disk is variable in parameters.

During the experiment, the spreading disc is changed at the minimum, average and maximum speed, and the speed of the material conveyor is changed sequentially at the minimum, average and maximum. This mode of operation lasts from 30 to 60 seconds, after which the sprinkling of technological materials is completely stopped. Measurements are made to find the spread width by measuring the trace of the spread width. We enter the received measurements in the data table.

S_{sk} The effect of the amount of process material delivered is not taken into account when finding the spreading width, based on this, V_{TM} the speed of the material delivery mechanism does not change. The amount of technological material provided mainly affects the determination of sprinkling density ρ.

The main machine for conducting experiments to determine the density of seeding ρ, $V_м$ speed parameters, material delivery speed V_{TM} and the angle of the spreading disc $\omega_д$ speed should be compared.

In this experiment, all obtained parameters should be compared by three values.

The main machine of sprinkling density ρ, $V_м$ depending on the speed, $V_м$=0 is done. So, the car $V_м$=0 at the angular velocity of the propagating disk over a period of 60 seconds $\omega_д$ and material delivery speed V_{TM} when different, the indicators of sprinkling density ρ are compared.

In the first case, the experiment is carried out by setting the spreading width and material delivery mechanism to small values with a time of 60 seconds. After being carried out and stored for a specified period of time, it is completely stopped and the density of sprinkling ρ is determined by collecting and weighing the material in the field. (Figure 4).

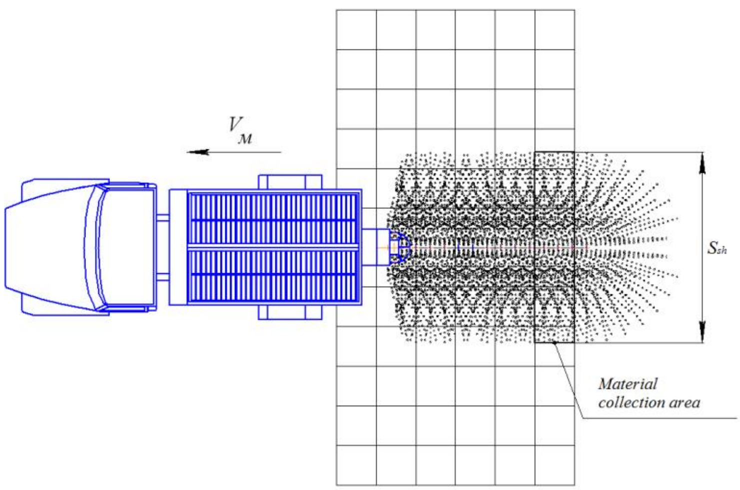


Fig. 4. Collecting materials from the seeded area

In the second and third cases, the experiment is repeated in the same sequence with a change in average and maximum values in accordance with the spreading width and material delivery mechanism.

Next, sprinkling S_{sk} width value with each speed, delivery of average and minimum materials V_{TM} the experiment is continued by changing the speed.

Since finding the seeding density ρ also depends on the speed parameter of the machine, the speed of the machine $V_м$ value is calculated for three speeds of 5 km/h, 10 km/h and 15 km/h. For this we use the following formula.

$$\rho = \frac{\sum m}{60 \cdot S_{sk}} \cdot V_м; \mathrm{g/m^2}$$

here, $\sum$m - Total mass of materials collected in the area, grams;

S_{sk} - width of sprayed technological material, m;

$V_м$ - speed of the main machine, m/sec.

3 Results and Discussion

The experiment conducted on the interaction between the operating modes of the working bodies and the spreader of technological materials made it possible to choose and justify the parameters for the distribution of technological materials on the road surface to eliminate freezing and slippery conditions in the winter season.

Measurements were made to determine the parameters of the spreader disc, the height of the spreader disc $H_д$, diameter of the spreader disc $\emptyset_д$ and disk rotation speed $\omega_д$ (Table 1) is included in the table.

Table 1. determine the parameters of the spreading disk

№	**Parameter name**	**Amount**	
1	The height of the spreading disc is mm.	525	
2	The diameter of the spreading disk is mm.	600	
3	The speed of rotation of the disc is rpm (revolutions per/ minute).	Minimum	200
		Average	300
		Maximum	400

The width of the scraper when determining the parameters of the delivery mechanism b_{qk}, the opening height of the skylight door $h_{sh.e_{och}}$ and delivery mechanism V_{TM} speed.

Table 2. Determining the parameters of the delivery mechanisms

№	**Parameter name**	**Amount**	
1	The width of the scraper is mm.	470	
2	The opening height of the sliding door, mm.	60	
3	The distance between the edges is mm.	920	
4	Material delivery speed m/s	Minimum	0,0126
		Average	0,0226
		Maximum	0,0339

Measurements obtained in the performed experiment are sprinkling of technological material S_{sk} Spread the width of the spreading disc $\omega_д$ made it possible to determine the speed dependence.

Table 3. Determine the disk speed

№	**Disk speed**	**Sowing width, m.**	
		Theoretical results	**Experimental results**
1	Minimum	4,84	4,4
2	Average	7,24	6,7
3	Maximum	9,66	9,1

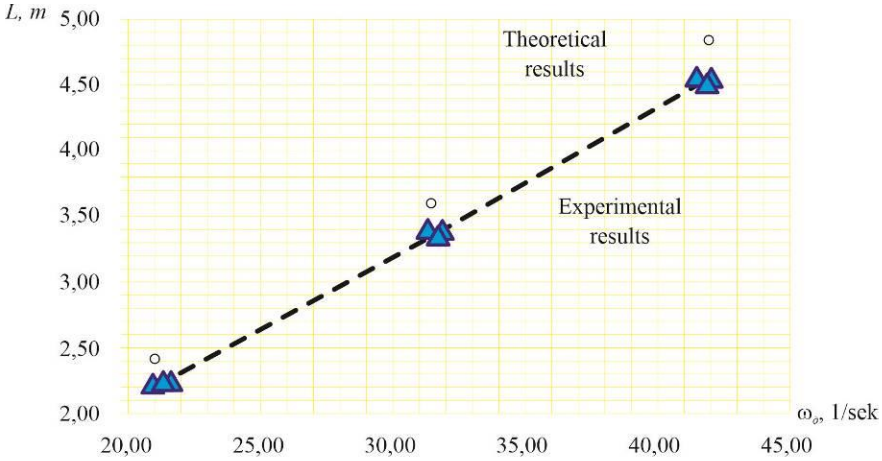


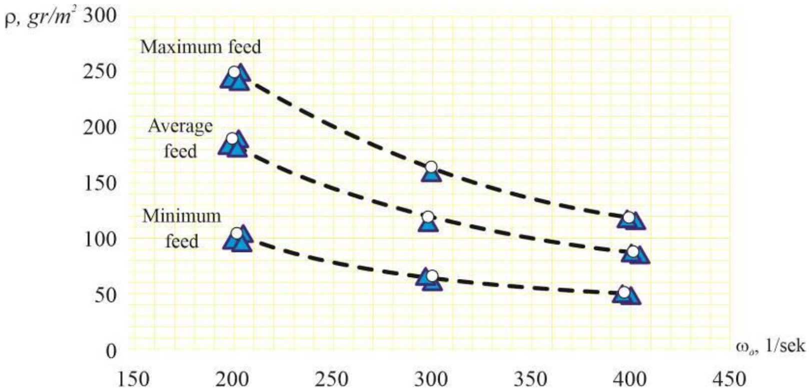
Fig. 5. Spreading disc in transfer of theoretical and experimental method $\omega_д$ speed of sprinkling of technological material S_{sk} width dependence graph

As can be seen from the obtained data, it was found that the calculated theoretical obtained data had an average error of 7% from the obtained experimental data for three speeds of the spreading disk.

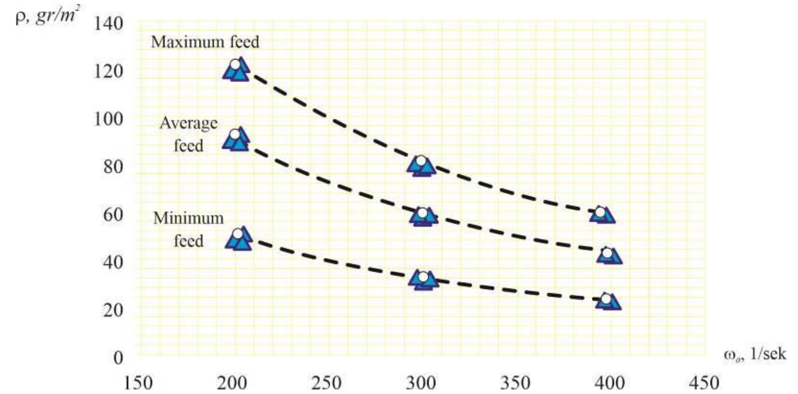
When conducting an experiment to determine the seeding density ρ, the parameters of the rate of delivery of materials V_{TM} and the angle of the spreading disc $\omega_д$ car speed V_M =0.

Since the sprinkling density ρ also depends on the speed parameter of the machine, in the experiment, using the formula, we determined the sprinkling density of the technological material corresponding to the speed value of the machine with three different V_M speeds of 5 km/h, 10 km/h and 15 km/h.

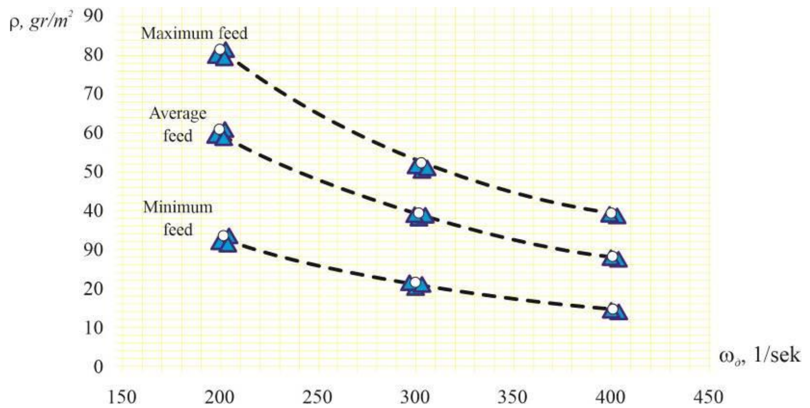
Based on the obtained results, the speed of the main machine VM, the speed of the transmission mechanism VTM and the angular speed of the spreader disk are determined according to the seed density ρ comparative correlation graphs were constructed $\omega_д$.



a) V_M =at a speed of 5 km/h;



b) V_M =at a speed of 10 km/h;



g) V_M =at a speed of 15 km/h.

Fig. 6. Machine V_M speed increase, V_{TM} drive speed and spreader disc angular speed ω_∂ graphs of the dependence of sprinkling on the density ρ.

According to the obtained data, it was found that the calculated theoretical data exceeds the experimental data obtained for three speeds of the transmission mechanism with an average error of 3%.

From the information obtained on the delivery mechanism, we can say that $h_{q.e_{och}}$ an increase in the opening height of the sliding door affects the amount of technological material per m² unit, thereby changing the speed proportionality coefficient (a) obtained in formula 1. Based on this, $h_{q.e_{och}}$ increasing the opening of the sunroof ρ can be adjusted to the required spraying density.

4 Conclusions

Experimental studies and evaluation of their results were discussed.

1. In order to select the parameters of the spreader of technological materials during the review of the object of experimental research, the spreader of technological materials produced in our country MAN CLA 18.2804x2BBCS45 machine was selected.

The measurement work required for this distributor of technological materials, as well as the tools used to determine its parameters, were determined.

2. An experimental methodology was developed to determine the parameters of the spreader disc and to determine the parameters of the material delivery mechanism. Also, in

the methodology, it was carried out to develop the place and conditions of the experiment in the spreader of technological materials, to determine the distribution width and density of spraying of technological material in different parameters.

3. Using the developed experimental research methodology, an experiment was conducted to determine the interaction between the parameters of the spreading disc and the material delivery mechanism.

The values of theoretical and experimental data were determined and compared during the experiment on the interaction of the spreading disc parameters.

Thus, according to the data obtained from the experimental study, the width of the sprinkler has the minimum, average and maximum values: 4.4; 6.7 and 9.1 meters and the values of theoretical calculations: 4.84; 7.24 and 9.66 meters. The comparison of calculations showed that the theoretical calculation increased by an average of 7% from the experimentally obtained calculation. Existing inconsistencies in the indicators may be due to the non-compliance of the technological material, its moisture condition and the formation of compacted dense lumps during the experiment.

During the experiment on the interaction of the parameters of the material supply mechanism, the values of theoretical and experimental data were determined and compared. Thus, according to the data obtained from the experimental study, the design parameters determining the speed of the material conveying mechanism and the speed of the machine, which determine the design parameters of the specified proportionality coefficient (a), showed that the value calculated by the speed of the material conveying mechanism and the speed of the machine exceeded the theoretical value by an average of 3%.

This inconsistency in indicators can occur due to the fact that the hopper is allowed to be overloaded, due to the incorrect removal of these design parameters, as well as accumulated condensation that affects the stoppage and delay of the delivery mechanism. may be related to the mass of the process material.

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