раствора. Дальнейшее совершенствование выбранного научного направления следует проводить в направлении разработки математических моделей оценки уровня загрязнения рабочих зон возле угольного штабеля.

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DUST FROM COAL TRAINS: REDUCING OF ENVIRONMENTAL POLLUTION IN WORK PLACES NEAR RAILWAY

Introduction. Coal trains have sensitive impact on environmental pollution [1-7]. Emission from trains causes pollution of working places near the railway, pollution of ballast layer and also results in cargo loses. Intensive emission takes place along the first 300-500 km run of coal train. That is why the problem of coal dust reduction is still of great interest. To solve this problem different methods are used [1-3]. For example: watering of coal surface, usage of special solutions which cover the coal surface , usage of covers, canvases, formation of special coal pile shape in the wagon etc. Every method has its advantages and its disadvantages but the process of finding convenient and not expensive methods is still going on.

Emission from coal trains depends on many factors [3-7], many of them are out of control during coal transportation. **The goal**

of the study performed was evaluation of additional boards application for reduction of coal dust emission from the wagon. As one of the main factors, which influence the coal dust emission, is the local wind velocity (velocity near the coal surface) we decided to reduce the coal dust emission by reduction this factor. To reduce velocity it is necessary to influence the aerodynamic regime near the coal surface in the wagon.

Fig. 1. Coal dust emission from the wagon

Experimental setup. We carried out experiments at the laboratory of Hydraulics and Water Supply (*National University of Railway Transport named after academician V. Lazaryan*) using not expensive equipment. The goal of the experiments was visualization of contaminated zone near the models of the coal wagon with different form of additional boards. Sketch of experimental setup is shown in Fig. 2.

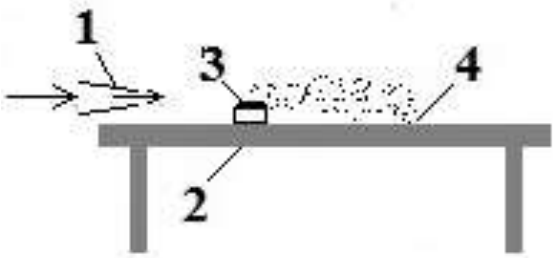


Fig. 2. Sketch of experimental setup: 1 – fan; 2 – table; 3 – model of the wagon; 4 – contaminated zone.

The model of the wagon was made in scale 1:100 and this model represented the real wagon № 12-1592. As the dynamic criteria, the Reynolds number was used. The air velocity during the experiments was 7,5-17,4 m/sec. During the experiments, we took photos of contaminated zones, which were formed near the model. After each experiment the coal dust, which had fallen on the surface of the table, was weighted.

Results. The experiments, which were performed, simulate four different cases.

Case 1 (basic case). At the first step of our work, we studied the process of formation of contaminated zone near the model of poorly loaded wagon with coal. Sketch of the wagon (cross section) is shown in Fig. 3.

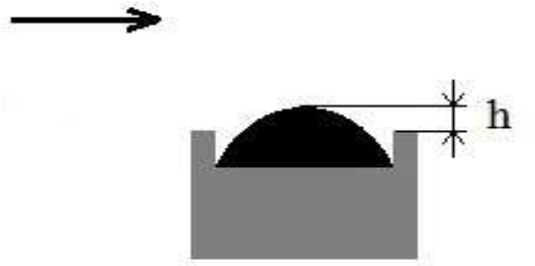
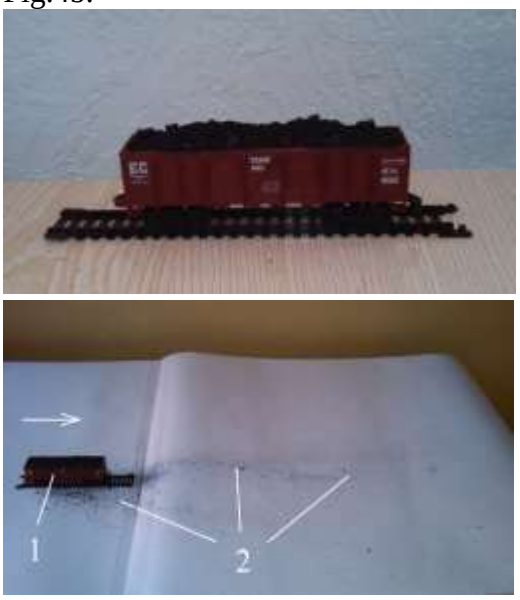


Fig. 3. Sketch of poorly loaded wagon (cross section)

Model of this wagon is shown in Fig. 4a. The results of the experiment are shown in Fig.4b.



a)

b)

Fig. 4. a) Model of poorly loaded wagon; b) Contaminated zone near poorly loaded wagon: 1 – model of the wagon; 2 –contaminated zone

As we can see from Fig. 4b, the contaminated zone near the wagon is large. It covers not only the railway track but also the nearby territory. The black color of this zone indicates on intensive coal deposition, which means the high intensity of coal dust emission from the model. The length of this zone is about six lengths of the wagon. The width of the contaminated zone is about three - four lengths of the wagon.

Case 2. At the next step, we studied the process of coal dust emission from the model,

which had additional vertical boards that are higher the real boards of the wagon (Fig.5).

As we can see from Fig. 6b, the intensity of contaminated zone is less than in case 1 but its dimensions are still large. The form of the contaminated zone is like the form of contaminated zone in basic case 1.

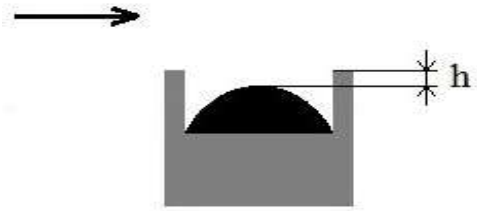


Fig. 5. Sketch of wagon with additional vertical boards

Model of this wagon is shown in Fig. 6a and results of the experiment are shown in Fig. 6 b.

a)

b)

Fig. 6. a) Model of wagon with additional vertical boards: 1 – vertical boards; b) Contaminated zone near wagon with additional vertical boards: 1 – wagon; 2 – contamination zone

Case 3. At the next step, we studied the process of coal dust emission from the model with additional vertical boards, which we called "wings". Sketch of these boards is shown in Fig.7. These boards partly covered top of the wagon.

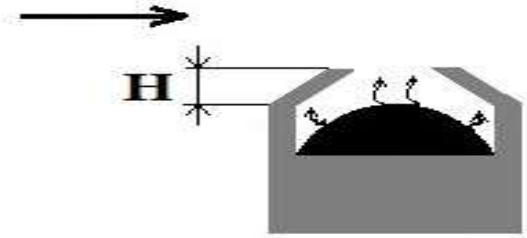
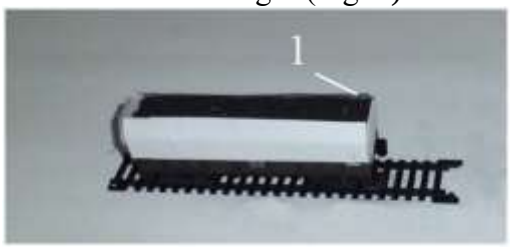


Fig. 7. Sketch of wagon with additional vertical boards "wings" (cross section)

Model of this wagon is shown in Fig. 8a and results of the experiment are shown in Fig. 8b.

As we can see from Fig. 8b, the contaminated zone is much less than in basic case 1. This zone is short.

Case 4. At the next step, we studied the process of coal dust emission from the model with additional vertical boards, which we called "internal wings" (Fig. 9).



a)

b)

Fig. 8. a) Model of wagon with additional vertical boards "wings": 1 – "wings"; b) Contaminated zone near wagon with additional vertical boards "wings": 1 – contamination zone

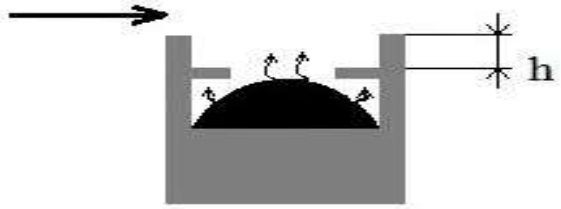
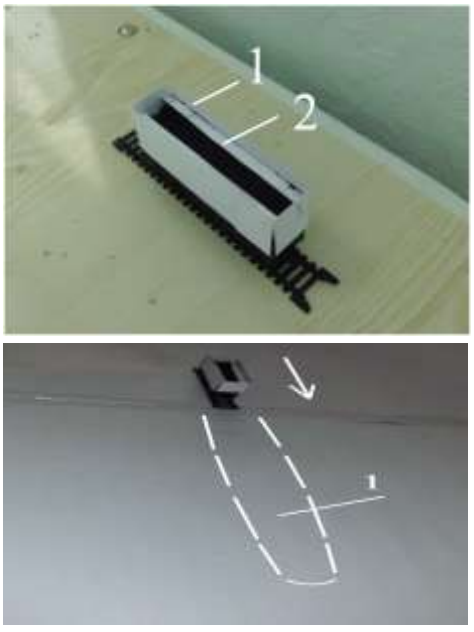


Fig. 9. Sketch of wagon with additional vertical boards "internal wings"

Model of this wagon is shown in Fig. 10a and results of the experiment are shown in Fig. 10b.



a)

b)

Fig. 10. a) Model of wagon with additional vertical boards "internal wings": 1 – vertical board; 2 –"internal wing"; b) Contaminated zone near wagon with additional boards "internal wings": 1 – contaminated zone

As we can see from Fig.10b, the contaminated zone is much less than in basic case 1. This zone is short and narrow.

In Table 1, we present some results about the coal dust mass, which has fallen on the surface for every type of the additional boards.

It is clear that the results shown in Table 1 are the "pilot" ones but they help to develop some strategy to reduce coal dust emission form wagons with low cost. Varying dimensions of additional boards it is possible to reduce environment pollution near railways during coal transportation.

Table 1 - Coal dust mass, which has fallen on the surface

Type of the additional boards	No additional boards, poorly loaded wagon (case 1)	Vertical boards (case 2)	Boards "wings" (case 3)	Boards "internal wings" (case 4)
Mass of collected dust	117 mg	97 mg	76 mg	68 mg

Conclusions. Application of additional vertical boards, which were considered above, allows reducing environment pollution near the railways due to minimization of coal dust emission. Implementation of additional vertical boards is not expensive and installation of the boards does not take much time**.** Further investigations of this work will be directed to the development of CFD models to study the process of environmental pollution numerically**.**

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