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Features of Railway Security Design

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Abstract: *The article addresses the issues of reducing the negative impact and proposes practical measures for the design of the system to protect the railroads from sand. The absence of a logically interconnected protection system was revealed. There is an urgent need to develop theoretical and practical foundations, the practical application of which is the methodology for its design, based on constructive solutions and their organizational and technological schemes for protecting railroads from drifting sand. The research methods are the axiomatic rules for designing measures to protect railroads from quick sands.*

Keywords: *railroads, axiomatic rules for protection against drifting sand, protection from sand.*

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Introduction

The study of the negative impact on the railway tracks requires the systematization of measures taken to reduce the impact of exogenous processes.

An ecological approach, such as protecting railroads and highways from drifting sands, is closely related to the creation of shelters of trees that hold the surface of drifting sand immobile and trap sand from outside [1]. This is due to the need to increase the roughness of the sand surface so that the sand remains stable, which leads to a decrease in wind speed. It is known that when the wind speed is less than 4 m/s, grains of sand remain motionless. For the movement of sand particles, a wind speed of 5.3 m/s is required at the height of the flyer, in this case, the wind speed on the sand surface corresponds to 4.1 m/s [2].

The movement of sand from one place to another is called deflation, and its negative impact on railways and other natural and technical systems is manifested in the removal of sand from the surface and its accumulation in the upper layers of the road structure. Consequently, the first step in reducing the negative impact on natural and technical systems is to stabilize the drifting sands. In this case, preference is given to the biological method, which is the most environmentally friendly method from an aesthetic point of view. However, in a sandy desert, this method is not very efficient; it requires a lot of time and money [3].

From an engineering point of view, a 10-20% result accepted in agro-amelioration is not satisfactory. Therefore, where it is necessary, the biological method is used in combination with engineering measures to achieve a quick result. There are two methods: artificial (mechanical) barriers and physicochemical methods. In order to preserve both of these methods, desert plants are planted and looked after. Currently, there are many methods. The article analyzes the methodology for designing barriers.

2. Methods

The research method is the axiomatic rules for designing measures to protect railroads from drifting sands.

3. Materials

In short, the main goal of compacting drifting sands in areas of reclaimed sandy deserts is to protect transporttracks, farming and other facilities from sand cover [2,4]. This includes the following activities: inspection of the railway tracks and road superstructure; strengthening the sands with plants; implementation of technical measures to improve the results: the creation of mechanical protection and covering the sandy surface with binding materials; creation, maintenance and protection of vegetation in the roadsides leading to the territory of the building [3-5].

Computational schemes and formulas are inextricably linked with axiomatic assumptions about the nature of the protection aimed at trapping moved sand.

Axiomatic rules for designing measures to protect railroads against drifting sands. The method for protecting railroads from sand is based on the following

axiomatic rules:

Rule 1. The barrier condenses the flow of sandy wind and makes it get up speed. The flow speedis at its maximum value above the barrier. The flow speed behind the barrier decreases sharply, and the fact that it is below the critical value (the critical speed is the wind speed that moves the sand particles) causes the sand particles to fall out of the flow and coagulate [2,9].

Rule 2. A long aerodynamic shadow of length (6H) is formed behind the barrier (the flow speed is below the critical limit). The height of the collected sand forms a triangular prism equal to the height of the barrier (H) [2,6].

Rule 3. The amount of work done by the wind is proportional to its third level and is represented by the volume of sand moved ($Q=f(v^3)$).

Rule 4. The volume of sand brought to the rail and accumulated in its elements is proportional to the fall of the sand wind flow to the road (angle of attack): at an angle of 90^0 it reaches its maximum, and at an angle less than or equal to 30^0, it reaches its minimum or is zero. In this case, the accumulation of sand particles in the structure from the sand wind flow can be represented by the coefficient of the angle of attack k_α= 0-1 [1, 2, 6, 12].

Rule 5.The drop in sand wind flow relative to the road is taken into account, and the volume of sand (Q_i) brought to the railroad needs to be adjusted accordingly and the same volume of sand should be retained.

Rule 6. Due to the fact that the main method of protecting the railroad from the movement of sand is the biological (vegetation) method, temporary support barriers are designed for a period of at least one year, i.e. Forone growing season. Therefore, the sand retention capacity of the protective barriers must be capable of retaining the volume of sand transported per year, i.e. the total capacity of the barriers must be at least equal to its magnitude.

Rule7. Taking into account that the wind blows in all directions during the day, the direction of transfer should be considered as the annual resultant in one direction of transfer of sand relief elements (dunes, dune systems, etc.) The amount of its work should be determined for each point.

This is determined by the product of its average statistical resultant by the work of the wind and the rule of summing the vectors of the resulting value along the resulting direction [9,12].

Rule 8. When organizing activities to protect the railroad from transported sand, the limited resources are taken into account as well as the fact that the wind resulting parameter relative to the road visually fills the upper structure of the road with sand.

For such an estimation, the following classification is used [4]:

Category	Condition of the roofing device on the sand cover
I	The space between the rails is covered with sand; more than half the height of the sleeper and rails is also sunk in sand.
II	In the space between the rails, the bottom of the rails is covered with sand; the middle part of the sleepers is slightly covered with sand.
III	The space between the rails is lightly covered with sand; no sand is visible in the space between the sleepers.

Rule 9. The scarcity of resources and the need to conserve them lead to the establishment of priorities in the protection and cleaning of various sections of the railroad from sandblasting based on a scale of priorities obtained as a result of requests from experts, managers and line engineers directly involved in sandblasting cleaning [4]:

Priority	Description of the upper elements of the road
1	Main roads on curved road sections
2	Arrow guides on the main road
3	Main roads in straight sections
4	Arrow guides on other sections of the road
5	Small artificial structures
6	Other station roads besides the main road

Rule 10. When designing theprotectionfrom sand backfilling, which will be moved during the operation of the railway, based on rules 1-8, the following aspects are introduced into the plan sequentially: from the properties of sand compaction of the first level to the curved sections of the main road and thus until the resource is exhausted.

Rule 11. The organized characteristics of the containment shell formed during the reinforcement of sand surface are estimated using the characteristics of the binder: plastic strength (P_m) and criterion values of thickness (h) [4,10].

Rule 12. In the process of stabilizing the blown sand surface with the binder material, the propagation of the action ofthe anti-deflation shell beyond its boundary by another 3 meters is taken into account. Therefore, when processing the surface of sand with a binder, a constructive and technological line scheme is used [8, 9,10].

4. Conclusion

1. The graph-analytical models of constructive solutions and the organizational and technological schemes of protection barriers from sand drifts were developed.
2. By analyzing and summarizing the previously performed practical work and research, the drift of railroads by drifting sand can be identified as a manifestation of a hazardous lowland geological exogenous process. Reducing the negative impact of this process is an important measure to ensure the safety of the railroads.

3. Identification of the constituent elements of barriers of known geometric shapes and the introduction of the transition coefficient made it possible to simplify as much as possible the design of the railroads protection by barriers from sand drifts.

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