# ABSTRACT

of the doctoral thesis in 6D071300 – "Transport,
transport equipment and technologies" by

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## DEVELOPMENT AND JUSTIFICATION OF THE PARAMETERS OF A SEMI-TRACKED PROPULSION TRACTION VEHICLE

**Relevance of the thesis topic.** Transportation works account for a significant portion of the total volume of agricultural work in modern conditions. The transport process combines a complex of operations for loading, transporting and unloading various cargoes.

Agriculture transportation is classified into household, on-farm, and off-farm transportation depending on the points of departure and destination.

A significant amount of transportation work falls on on-farm transportation, which includes the delivery of goods within the farm. When servicing sowing and harvesting units, part of on-farm transportation is the process of technological maintenance of automotive and tractor vehicles. On-farm transportation in agriculture is the main one, as they account for up to 60% of the total volume of transportation work.

High soil moisture conditions require the use of running systems with increased cross-country ability to transport spring field work. The use of tracked propulsion systems only is hampered by the fact that they damage the road surface and are thus unsuitable for driving on public roads. In this regard, it is recommended to use various devices during spring fieldwork to enhance the traction properties of wheeled vehicles. This makes it possible to use a wheel mover for transport work in normal soil conditions, and to use these devices in severe soil conditions. The most relevant is the use of a semi-tracked propulsion system.

The use of a semi-tracked propulsion system allows not only to increase the traction properties of traction vehicles, but also to increase their annual load.

Therefore, the research devoted to the development of a semi-tracked propulsion traction vehicle and the determination of its main parameters are relevant.

**Purpose of the dissertation work.** Improving the efficiency of operation of a traction transport vehicle by developing the design of a semi-tracked propulsion system and substantiating its main parameters.

**Scientific novelty of the results obtained:**

- the semi-tracked propulsion system that has rubber-reinforced tracks has been invented;
- a mathematical model of the interaction of a rubber track with a support base is proposed, taking into account the stiffness of rubber-reinforced tracks under tension;
- mathematical dependences have been obtained to determine the resistance to movement and the tangential thrust force of a traction transport vehicle on a half-track with rubber-reinforced tracks, taking into account the deformability of the tracks and the physical as well as mechanical properties of the soil;
- dependences are obtained for calculating the transverse and longitudinal stability of a traction transport machine with a semi-tracked propulsion;

- experimental studies of the influence of the layout scheme of a traction transport vehicle on its traction qualities have been carried out.

**The novelty of the technical solutions of the research** is confirmed by the patent for the utility model of the Republic of Kazakhstan No. 5185 "Semi-tracked propulsion" dated 05/06/2021, issued by the National Institute of Intellectual Property of the Ministry of Justice of the Republic of Kazakhstan.

**Main provisions submitted for defense:**

- the design of the semi-tracked propulsion of a traction transport vehicle, which allows to increase its traction properties, expand functionality and increase annual load;

- a mathematical model of the interaction of a rubber track with a support base, taking into account the stiffness of rubber-reinforced tracks under tension;

- theoretical dependencies for determining the resistance to movement, tangential traction force and indicators of static stability of a traction transport machine with a semi-tracked propulsion;

- the results of an experimental study of the influence of the layout scheme of a traction transport vehicle on its traction qualities.

**The practical value and implementation of the results of the work.**

The use of a semi-tracked propulsion system in a traction transport vehicle will increase its traction properties, expand its functionality and increase its annual load. The use of a rubber-reinforced track allows the machine to perform transport work on asphalt and concrete surfaces without destroying them.

By obtaining theoretical and experimental dependences, the cost of time can be reduced by 2-3 times as well as the and material resources in the design, manufacture, improvement and operation of a semi-tracked propulsion system with rubber-reinforced tracks.

The results of the study were introduced into the educational process of the Toraighyrov University and the Ekibastuz Engineering and Technical Institute named after academician K. Satpayev, and are also used by the Association "Association of Legal Entities of machine builders of Pavlodar region".

**Publications and testing of work.** The results of the dissertation work were published in five articles, including:

1) one article in a journal included in the Scopus database (38th percentile):

- Abishev Kairatolla, Assylova Karlygash, Kassenov Assylbek, Baltabekova Almagul. DETERMINATION OF THE VALUE OF TANGENTIAL FORCE FOR THE HALF-TRACK TRACTION VEHICLE WITH RUBBER TRACKS // Journal of Applied Engineering Science. – 2023. – Vol. 21, Iss. 2. – P. 411-417. – Article number 1085. DOI: https://doi.org/10.5937/jaes0-39677.

2) three publications in journals from the list of publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan for the publication of the main results of scientific activity:

- Abishev K. K., Kassenov A. Zh., Assylova K. B. On the issue of choosing the design of a semi-tracked propulsion traction vehicle // Scientific journal "Mechanics and Technologies". – 2020, – №1(67). – pp. 31-38.

- Abishev K. K., Suleimenov A. D., Assylova K. B. The influence of the normal stiffness of the caterpillar on the pressure distribution along the length of the rubber

track mover // Scientific journal "Science and Technology of Kazakhstan". – 2023, – No.2. – PP. 103-112. DOI: https://doi.org/10.48081/AFWF6462 .

- Abishev K. K., Assylova K. B. Determination of longitudinal stability of a semi-tracked traction and transport machine // Scientific journal "Science and Technology of Kazakhstan". – 2023, – No. 3. – pp. 233-241. DOI: https://doi.org/10.48081/JRMW8460.

A patent for a utility model of the Republic of Kazakhstan has been obtained:

- Semi-tracked propulsion: utility model patent No.5185 Republic of Kazakhstan: MPK B62D 55/04 / A. Zh. Kassenov, K. K. Abishev, R. B. Mukanov, K. B. Assylova, B. K. Kayrolla. – №2020/0433.2; application 05.20; publ. 05/06/2021, Byul. No. 38.

The main provisions and results of the work have been tested and reported at domestic and foreign scientific and practical conferences:

- Abishev K. K., Kassenov A. Zh., Assylova K. B., Gumarov G. S. Study of the Interaction of a Transport Vehicle with an Open Road // ICTE in transportation and logistics 2019. Lecture Notes in Intelligent Transportation and Infrastructure, Springer, Cham. – 2020. – Vol. Part F1382. – pp. 154-163.

Abishev K. K., Assylova K. B., Akulbekov T. O., Kayrolla B. K. On the issue of determining the normal stiffness of a rubber caterpillar // Proceedings of the international scientific and practical conference "Improving the quality of education, modern innovations in science and production", Ekibastuz: KuzSTU branch in Prokopyevsk, 2020. – pp. 485-487.

- Abishev K. K., Kassenov A. Zh., Assylova K. B. Design Justification of Half-Track Propulsor of Traction and Transport Vehicle // Lecture Notes in Mechanical Engineering. – 2022. – P. 434-440. – 7th International Conference on Industrial Engineering, ICIE 2021.

**Structure and scope of the dissertation.** The dissertation work consists of an introduction, content, the main part of 5 sections, conclusion and appendices. The content of the work is presented on 94 pages, includes 34 figures, 3 tables, a list of used sources from 105 titles and 4 appendices.