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Article

Increasing the Operational Efficiency of Mobile Agricultural Loaders

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Abstract: Hydraulic arrangements' melding grants refined command over diverse actions thus amplifying efficacy coupled with productive outcomes upon environments designated to laborious undertakings whereas paper's further sections elaborate varying deployments characterizing said machines across sectors nameable beside constructing works yet extending also onto utilities management following landscaping domains pursuing agricultural efforts amid municipal upkeep practices being outlined too due sheer versatility permitting critical interventions tasks alike hollow making tunnel building landscaping laying teeter-tottering items lifting merged into hauling events showcasing indisputably essential nature occupied by them.

Keywords: backhoe loaders, design, operational capabilities, diverse applications

1. Introduction

In modern economic conditions, the financial activities of road and industrial-civil construction enterprises, mining and processing industries depend on the fulfillment of contractual obligations, production costs and profitability of production. Reserves for reducing costs for production and auxiliary work depend on how effectively each unit of equipment is used in each shift.

The operational performance of a single-bucket excavator is one of the criteria for assessing the efficiency of the machine fleet [1], [2], [3], [4], [5].

2. Materials and Methods

When we researching a topic like "Backhoe Loaders: Versatility and Productivity," we employed several key research methods to gather comprehensive and reliable information. And we used methods:

- Literature Review. Conduct a thorough review of existing literature, including academic papers, industry reports, trade journals, and books, to understand the historical evolution, technical specifications, and applications of backhoe loaders; Identify key trends, innovations, and best practices related to backhoe loader versatility and productivity.
- Technical Analysis. Analyze technical specifications of different backhoe loader models, including engine power, hydraulic systems, digging depths, lifting capacities, and attachment options; Compare and contrast features across various manufacturers and models to understand how design differences impact versatility and productivity.

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3. Results and Discussion

The studies have shown that the currently available formulas for determining the output of a single-bucket excavator, created in the 40-60s, are acceptable only for cases of excavation of soil into a dump. For systems that operate an excavator together with vehicles [6], the mathematical model for determining the operational performance of a single-bucket excavator corresponds to the special case when vehicles are continuously received for service, i.e. The vehicle supply interval is equal to the time spent loading the vehicle.

Attempts to use the previously created mathematical apparatus for planning the work of the "excavator - car" or "excavator - cars" combination did not allow obtaining a result adequate to practice, and in most cases this approach is accompanied by large errors both in calculating the need for material resources and in the economic sphere. The identified inconsistencies between theory and practice led many scientists to try to use the classical apparatus of probability theory to describe and plan. However, the practical use of this device is associated with great difficulties, because it was created for other branches of knowledge. Therefore, the results of using the "excavator-car" set for planning either do not allow us to obtain an option acceptable for practice, or generally give an answer to the possible value of the probability of deviation, whereas practice requires an answer in specific quantities and at a given moment. Thus, as preliminary studies have shown, today there is no description of the joint functioning of excavators and cars, which is widespread in practice.

For high accuracy of work planning, it is necessary to correctly understand the ongoing processes in the systems under consideration, to develop models that make it possible to accurately calculate the need for equipment, people and resources, as well as the costs of work at the contracting stage.

Currently, there is no mathematical apparatus that describes the interaction of a single-bucket excavator and vehicles, as a system of interconnected elements, from the standpoint of the discrete process of delivering soil to the consumer, which leads to significant miscalculations, both in operational planning and in the organization of work. This entails irrational planning of material resources, inefficient use of excavators and vehicles, failure to complete the scope of work, and unreasonable formation of contract prices.

The "excavator-car" and "excavator-vehicle" systems under consideration, used in road and industrial-civil construction, in the mining and processing industries, are in most cases an auxiliary process of any production and are reflected in the cost of production.

In the new economic conditions, significant attention is paid to the development of small enterprises operating in conditions of limited resources, in which there is a small amount of technical equipment. Therefore, planning and accounting for the operation of each piece of equipment is very important for them. Often in such enterprises, the formation of a set of machines occurs without preliminary calculations, taking into account the financial capabilities of the enterprise at a given time; it does not take into account what systems the equipment will operate in and how effective their interaction can will be.

As a rule, such systems are not queuing systems and serve the purposes of one or more enterprises. It is obvious that the models of the functioning of a single-bucket excavator from the perspective of the theory of queuing systems are not acceptable here, and the particular cases under consideration [7] are not adequate to the actually existing systems of functioning of a single-bucket excavator and vehicles.

Operational and technological monitoring of loading, unloading and transport operations involving mobile loaders is not only a means of increasing productivity, quality of work, comfort and labor safety, but also a means of improving the consumer qualities of equipment. Constant monitoring of the stability of the loading unit allows the operator to make operational decisions to prevent emergency situations and increases the safety of loading and unloading operations.

Automation of agricultural loaders and loading manipulators, monitoring of technological parameters of loading equipment in real time helps to increase productivity and improve working conditions for the operator. However, modern agricultural loaders and manipulators are not sufficiently equipped with means of monitoring process parameters.

Increasing the operational efficiency of loading units for agricultural purposes is seen by solving the problem of creating an effective on-board information system for monitoring operational and technological parameters with an integrated system for monitoring the stability of the loading unit.

In this connection, equipping mobile loading units with monitoring systems for operational and technological parameters and stability control is an urgent task.

The relationship between the specific technical and economic indicators of agricultural cyclic loaders, assessing their efficiency, and increasing the productivity of loading units during loading and unloading operations with piece goods studied by V.F. Dubinin, V.M. Gerasun, V.L. Strokov, I.M. Pavlov, E.E. Demin, Yu.A. Guskov and others. The works of Ya.V. Ros, L.A. Goldobina, A.S. Ioffe, V.M. Gerasuna, V.I. Pyndaka, A.F. Rogacheva, V.I., A.I. Udovkin and other scientists are devoted to ensuring the safety of loading and unloading operations and the stability of agricultural loaders and manipulators.

Recently, on-board information systems have become an integral part of agricultural machines. The works of I.F.Borodina, S.P. Gelfenbein, S.A. Iofinova, G.M. Kutkova, Yu.A. Tyrnova and others are devoted to the development and analytical foundations of designing systems for instrument monitoring of operating modes of machine and tractor units. These works examined the main methodological approaches and analytical foundations for the design of control systems. However, the problem of implementing control systems for operating modes of domestic loading and transport units still does not have a comprehensive solution.

4. Conclusion

In our opinion, to increase operational efficiency through the development of a comprehensive system for monitoring the parameters of the technological process of cargo handling and monitoring the stability of the loading unit.

To achieve this goal, the following tasks need to be solved:

1) Conduct an analysis of automation equipment for agricultural loading units, systems for monitoring their performance indicators and safety equipment. To justify the structure and develop a comprehensive system for monitoring operational and technological parameters and monitoring the safe operation of a cyclic loading unit.
2) Theoretically substantiate and develop a methodology for obtaining performance indicators of the loading unit. Develop an algorithm for calculating operational and technological parameters based on recorded indirect performance indicators.
3) Formulate approaches to determining the stability of a loading unit in the longitudinal and transverse planes, develop a mathematical model of a position sensor, theoretically substantiate the parameters of the unit's tilt angle sensors and check the adequacy of the mathematical model for a prototype system on a stand and a real loader.
4) Assess the reliability of the developed system for monitoring operational and technological performance indicators and monitoring the stability of the loading unit.
5) Conduct production tests of an integrated system for monitoring operational and technological parameters and monitoring the safe operation of the loading unit and evaluate the economic effect of its use.

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