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**FACTORS FOR IMPROVING THE TECHNOLOGICAL RELIABILITY OF COTTON
PICKING MACHINES**

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Abstract: This article analyzes the ways to improve the technological reliability of cotton-picking machines, the main causes of their malfunctions, and the factors ensuring efficiency during operation. It also presents methods for ensuring uninterrupted machine performance through the implementation of modern technologies.

Introduction: Cotton growing is one of the leading sectors of agriculture in Uzbekistan. Increasing the level of mechanization in cotton production—particularly the efficient operation of cotton-picking machines—directly affects yield. The reliable performance of these machines depends on their technological condition and operational conditions.

Main part:

1. Factors affecting the reliability of cotton-picking machines:

The technological reliability of cotton-picking machines is determined by numerous factors. The most significant of these are analyzed below:

Design solutions: The machine should incorporate a modular structure with easily replaceable and repairable components. Any complexity in the construction prolongs maintenance time and increases the likelihood of malfunctions.

Material quality: The use of high-quality materials—such as heat- and wear-resistant steel, alloys, and plastics—in manufacturing enhances reliability. This is particularly important for components that are in motion and operate under load, where material quality plays a critical role.

Assembly and installation quality: Accuracy during factory assembly, including adherence to geometric specifications and tightness of joint connections, directly affects technical reliability. Even minor errors during assembly can cause malfunctions in the overall system of the machine.

Condition of hydraulic and electrical systems: Maintaining stable pressure in hydraulic systems and ensuring the safe and consistent performance of electrical components play a decisive role in the uninterrupted operation of cotton-picking machines.

Maintenance and operational culture: Adherence to the maintenance regulations recommended by the manufacturing company, compliance with lubrication schedules, and timely replacement of spare parts are all critical factors in ensuring machine reliability.

Climatic and field conditions: External factors such as uneven soil surfaces, dust, and moisture levels directly influence machine systems. Flexible designs that are resistant to climatic conditions contribute significantly to reliability.

Operator qualification: The operator's level of technical knowledge, attentiveness to the machine, and adherence to operational rules play a vital role in the longevity and efficient functioning of the cotton-picking machine.

2. Common issues during operation:

The long-term and effective performance of cotton-picking machines largely depends on operational conditions. The following issues often cause machine malfunctions and reduced productivity during the harvesting season:

Wear of working components: Picker drums, separators, and traction wheels operate under intensive loads. These components frequently experience surface wear, deformation, and brittleness in alloys. Such wear leads to a decline in harvesting quality.

Lubrication system problems: Insufficient lubrication in hydraulic and mechanical systems increases friction, causing moving parts to overheat and fail. This issue often arises due to failure to clean oil filters in a timely manner.

Failures in electrical systems: Malfunctions in sensors, control panels, and signaling systems disrupt the automated functions of the machine. Damage to electrical wiring or loose contacts can cause interruptions in automatic control operations.

Improper adjustment of picking mechanisms: To ensure high-quality cotton harvesting, the picking mechanisms (such as picking drums and separating elements) must be precisely adjusted. Inaccurate calibration can result in incomplete picking or an increased presence of impurities.

Impact of dust and contaminants: In field conditions, external elements such as dust, soil particles, and cotton fibers can infiltrate the machine's internal mechanisms, slowing down its operation. This particularly affects air filters and cooling systems, often causing serious damage.

Lack of monitoring and preventive maintenance: Many operators and service personnel inspect the machine only after a malfunction has occurred. Minor issues that go undetected in time can later develop into serious failures.

Shortage of spare parts: A lack of necessary spare parts delays repairs, leading to interruptions in the harvesting process. This is especially detrimental during peak harvesting periods, causing significant economic losses.

3. Ways to improve reliability

Enhancing the reliability of cotton-picking machines ensures their uninterrupted operation during the harvesting season and enables efficient performance with minimal failures. The following measures are among the most effective in this regard:

1. Implementation of preventive maintenance: Carrying out scheduled technical maintenance on a regular basis is one of the most important factors in ensuring machine reliability. Before each harvesting season, a full diagnostic inspection should be conducted, with the replacement of worn or damaged parts and thorough checks of lubricants and filter elements.

2. Integration of innovative technologies: The use of automated monitoring systems, remote control modules, and sensor-based diagnostic tools enables real-time tracking of the technical condition of cotton-picking machines. This allows for early detection of malfunctions and the prevention of breakdowns.

3. Structural improvements: Simplifying machine design, introducing modular structures, and utilizing quickly replaceable components facilitate easier maintenance. This increases operational reliability and reduces downtime during repairs.

4. Enhancement of Operator Qualification: A skilled operator can fully utilize the machine's capabilities, adhere to operational rules, and detect faults early. Therefore, consistent attention should be given to both practical training and theoretical knowledge improvement.

5. Development of manufacturer service networks: Establishing local service centers, spare parts warehouses, and rapid response technical support teams can significantly improve machine operability and maintenance efficiency.

6. Adaptation to operating conditions: Developing machine modifications tailored to local climate, terrain, and field conditions enhances machine durability. Flexible systems that can withstand factors such as humidity, dust, slopes, and field obstacles significantly contribute to overall reliability.

7. Reforms based on statistical analysis: Consistent analysis of malfunctions, downtime causes, machine operating hours, and service costs during each harvesting season allows for improvements in design, technical systems, and service procedures.

4. Application of modern technologies

In recent years, modern digital and automated technologies have been widely applied to increase the efficiency and reliability of cotton-picking machines. These technologies help monitor every stage of machine operation, enable early detection of faults during use, and simplify the maintenance process.

GPS and GNSS technologies: Global positioning systems enable cotton harvesters to follow optimal movement trajectories within the fields. This ensures precise harvesting without deviation, minimizes losses, and reduces fuel consumption.

IoT (Internet of Things) systems: Key components such as the engine, hydraulic systems, and drums are equipped with special sensors. These sensors transmit real-time data to a central control panel, allowing the operator to constantly monitor the machine's status and receive immediate alerts in case of malfunctions.

Smart diagnostic modules: Indicators such as engine pressure, temperature, and electrical system voltage are automatically analyzed. The machine performs self-diagnostics and issues warnings to the operator, thereby increasing operational safety.

Automatic adjustment and calibration systems: In certain modern cotton-picking machines, the height and rotation speed of pickers and drums are automatically adjusted according to the cotton density. These features reduce human-related errors and enhance picking quality.

Cloud-based information systems and telemetry: Machines used in large-scale farming operations are interconnected via a unified server. Information about each machine's activity,

route, and technical condition is remotely monitored. This simplifies management and strengthens oversight.

Green technologies: To ensure environmental safety, some advanced models are equipped with gas or electric engines. These machines are energy-efficient and environmentally friendly.

By implementing modern technologies in practice, the service life of cotton harvesters is extended, breakdowns are reduced, and the quality of harvesting and productivity are improved.

Conclusion

The enhancement of the technological reliability of cotton harvesting machines is not only dependent on their structural quality but also on continuous monitoring and servicing during the operational process. The application of modern technologies extends their operational lifespan and increases productivity.

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