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AUTOMATION OF VIBRODIAGNOSTICS OF WHEAT GRAIN PROCESSING EQUIPMENT

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Abstract. *The article provides comprehensive information about methods and devices for detecting excess vibration in machine mechanisms used in production processes. Due to the continuous movement of the transmissions of the electrical parts of production and processing equipment, there is loosening of the fasteners and wear of the mechanism, which in turn causes excessive vibration. The article covers the issues of general diagnostics of the operation mode and control parameters of the excessive vibration detection mechanisms using modern measuring devices and controllers, as well as creation of control features.*

Keywords: *equipment and machinery, wear, diagnostics, breakdowns, technical monitoring, reliability, sensor, controller.*

Introduction

Grain and grain processing plants go through several stages to make any product ready. After the processing of the grain, until the product is ready, grinding, cutting, sorting, heating, cooling and similar technological process steps are performed, and these tasks are performed by devices and mechanisms. In turn, any equipment is exposed to various influences during operation and causes malfunctions, so the efficiency of machines and mechanisms is determined by the perfection of their maintenance and repair systems. Although the current maintenance system generally ensures that machines are kept in good condition, it cannot be perfect enough. This leads to sudden breakdowns that stop technological processes, increased costs of restoration and repair, accidents that cause great economic and environmental damage, and a number of other negative events. Therefore, it is necessary to first create a multi-level hierarchy of control algorithms for the equipment used in grain processing enterprises and their diagnostics, then to study the structural organization of production, the technological process, and create a mathematical model of the control object under uncertainty.

The above-mentioned issues and problems require a systematic approach, because such complex processes have not yet been fully explored, and their solution is one of the urgent issues.

Research method

Technical diagnostics mainly uses very limited data, it is usually carried out during operation and does not involve disassembling the machine. Vibrodiagnostic systems are carried out on the basis of probabilistic and deterministic methods and mathematical modeling.

Research results

The ongoing research is focused on vibrodiagnostics of wheat grain processing equipment and their automation and control in grain processing enterprises. In the course of the research, various terms were encountered, and it was necessary to choose them correctly and use them in our research. In this context, we defined some terms. Among them: technical diagnostics is a field

of knowledge that covers the methods and means of determining the technical condition of objects. Technical diagnostics is considered to be the determination of the technical condition of objects, and technical diagnostic tasks include assessing the technical condition of industrial facilities, machines, mechanisms, equipment and structures, as well as monitoring the technical condition of the object.

Evaluation of the technical condition of the equipment: this is also the most important link, it is the evaluation of the limiting condition and robustness criteria of the equipment for certain modes and operating conditions. The performance of the equipment is determined on the basis of strength calculations according to the actual condition of the external elements, taking into account the existing damage and changes in the physical and mechanical properties of the metal, since individual local damages can accumulate stresses and reduce the strength and durability of the metal.

The causes of equipment damage can be various factors, for example, erosive friction of the working environment of the walls, corrosion, metal fatigue, temperature drop, changes in the physical and chemical properties of the metal, etc. The impact of each of these factors has its own patterns and therefore requires a comprehensive analysis of their impact on the resource. The exhaustion of operational resources of the equipment of grain storage and processing enterprises creates emergency situations with serious consequences.

Now we will analyze the expression of the mathematical model of vibrodiagnostics of wheat grain processing equipment. As a controlled object, it is considered as a complex complex consisting of a set of certain technological devices (equipment) for the primary processing of oilseeds, in particular, wheat grain, warehouses of various types of raw materials and final products, intermediate storage of semi-finished products. As input parameters of the control object, a set of modifications of raw materials are oil seeds of different types of collection and varieties. The output of the control facility is different end products – and different types of waste, etc. An intermediate product is a modification of grains and grains. In the considered process with discrete-continuous technological processes, the main material is the flow of raw materials, intermediate and final products of grain processing.

However, the main functions listed above include:

- assessment of the technical condition of the grain grinding device;
- identifying and determining the location and localization of faults;
- forecasting the residual resource of the grain crushing plant.

The presentation of technical diagnostic tasks can be considered as the following expression [1]:

$$X = \{X_1, X_2, X_3, X_i \dots, X_n\} \rightarrow A = \{A_1, A_2, A_3, A_i \dots, A_m\}.$$

Here, $X = \{X_1, X_2, X_3 \dots Xi, \dots, Xn\}$ *is* a set of parameters that determine the condition of the technological object of grain grinding, and $A=\{A_1, A_2, A_3 \dots, Ai, \dots, A_m\}$ is the set of its possible states. Each value of the vector of object parameters X^k possible A^j must be matched with one of the cases.

vibro diagnostics is to divide the possible technical condition of the equipment into two subgroups: corrected and uncorrected. The next task is diagnostics, which consists in determining the nature of one or a group of defects corresponding to the state of vibration of the aggregate. One of the tasks of vibration diagnostics is to identify the defect at an early stage and predict its development over time. Based on the obtained results, the optimal operation mode of the device is

determined in the failure conditions and in the technology of eliminating the defect and restoring the operation of the device. The more reliable and accurate the diagnosis, the lower the costs associated with the restoration of the device [2].

Vibration can be characterized by several parameters

1. Vibrodisplacement and it is denoted by s(t) mm
2. The vibration speed is determined by v mm/s
3. Vibration acceleration is determined by a
4. Migration of vibration over time

$$v=ds(t)/d(t) \quad (1)$$

$$a=d2s(t)/dt^{2} \quad (2)$$

$$r=d3s(t)/dt^{3} \quad (3)$$

In addition, there are types of vibration aimed at mechanisms and devices, these types allow to determine and diagnose the condition of devices during technical inspection [3].

1. Periodic vibration .

Theoretically, vibration is a process of vibration, which is the repetition of a certain period of time (T)

$$x(t)= x(t+iT), \quad (4)$$

$$i=...-2,-1,0,+1.+2$$

T-oscillation period

F. died inversely proportional to the period of T ebration vibration frequency is also available

$$F=1/T \quad (4)$$

Taking into account these parameters, we can process information about the vibration state of any machine mechanisms. These, in turn, serve as key values for obtaining process diagnostics.

2. Harmonic vibration .

In technological processes, if the vibration of mechanisms is with only one frequency, it is called harmonic, if it is more than that, it is called *half-harmonic* . In addition, there are several factors that increase the vibration of the device, such as mechanical imbalance, curvature of the rotating shafts, increased voltage in the rotors, failure of the couplings, inaccuracy in the couplings, unevenness of the device base and many errors cause excessive vibrations.

Information sequence

one of the main organs of grain grinding devices is the electrical part. Usually, the operating power of the electric motor of the grinders is 10-15 kW. The number of revolutions in the motors of this power is 3000 rev/min. In order to know the condition of the motor, we install special sensors on it. Figure 1. The analog signals received through this are received in the controller and a graph is formed in (IMI).

Monitoring of grain crushing equipment and their operations, as well as the condition of individual functional elements of their devices, for example, insulation of high-voltage cables, is carried out using partial discharge detectors. They can be in a mobile version for regular inspections in "hand" mode as HVPD Longshot, and in a stationary position for continuous monitoring, for example, HVPD Kronos.

Also, it will be connected with the automation of grain processing and technological process equipment and strengthening of their processing modes, speed control of mechanisms, increase of

dynamic loads on machine parts. Given the ever-increasing demands on equipment accuracy and reliability, a completely different automation and management system approach to equipment maintenance and repair is required to maintain performance. In such conditions, automated control and diagnostic systems become more important, because they monitor not only the quality of the product and the progress of the technological process, but also the condition of the equipment, which allows to predict its condition [5].

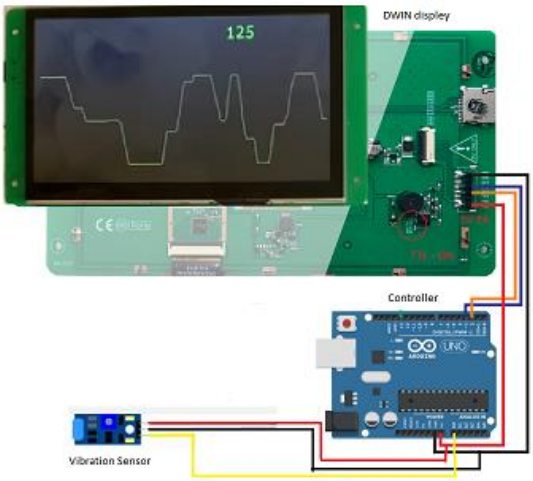

Figure 1 schematic diagram of the vibration diagnostics device

Summary

It is possible to quickly and easily determine the condition of machines used in technological processes. This data processing makes it possible to service and operate several parallel machines without interrupting the work process.

It is suitable for solving problems of automation of the technical diagnostic process using mathematical modeling, which includes models that are a means of testing real electrical devices. It is a simulation model of electrical circuits and electronic elements, algorithms and programs for personal computers, allows calculation of various options and is an effective tool for analyzing and predicting events. The use of the device diagnostics modeling method is associated with the complexity of the mathematical description of the elements and the operation of the system as a whole, as well as the need to process a large amount of data. The development of special software for modeling electrical circuits and increasing the computing power of a computer can overcome these shortcomings.

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