International Journal of Energy Optimization and Engineering
Volume 10 • Issue 1 • January-March 2021

Evaluation of Damages Due to Failures of Electric Motors in Technological Equipment of Enterprises

Anton Nekrasov, Federal State Budgetary Scientific Institution "Federal Scientific Agroengineering Center VIM", Russia
https://orcid.org/0000-0001-5816-8939

Valeriy Kharchenko, Federal State Budgetary Scientific Institution "Federal Scientific Agroengineering Center VIM", Russia
https://orcid.org/0000-0003-3725-2976

Alexey Nekrasov, Federal State Budgetary Scientific Institution "Federal Scientific Agroengineering Center VIM", Russia
https://orcid.org/0000-0001-6141-984X

ABSTRACT

The subject of the study is electric equipment system of milk farms at agricultural enterprises. The purpose of this work was the enhancement of operational reliability of electric equipment designed for technological process at milk farms based on the use of results of calculations made for the value of expected economic damage caused by failures of electric motors, and owing to the advancement of technical maintenance system. Effectiveness of the work is defined by evaluation of damage and, therefore, reducing the idle time period for technological equipment involved in various processes, at milk farms, as well as increasing lifetime of electric equipment, at agricultural enterprises. Application of the results of these studies may increase the operational reliability of electric equipment and ensure economical savings owing to the reduction of idle time of technological equipment, at milk farms, making it possible to reduce assets for operation and maintenance purposes by 10% to 15% and to decrease electric power consumption as a result of effective use of electrified machinery.

KEYWORDS

Electric Equipment, Failure of Electric Motor, Technical Maintenance, Technological and Technical Damage

INTRODUCTION

In Russia, a national concept has been developed in the field of energy supply in agriculture for the period until 2020. This concept includes substantial enhancement of power supply reliability, for rural customers, and growth of the effectiveness of use of electric equipment and electrified machinery, at agricultural enterprises.

The importance and timeliness of the research subject and project development are determined by the task of reliability improvement of electric equipment designed for rural application. The same applies to increasing the effectiveness of electrified machinery use in agricultural production. Technical and commercial analysis of electric drive failures in technological equipment is vital for the sake of substantiating the application of innovative strategy for technical maintenance and repair of electric equipment.

DOI: 10.4018/IJEOE.2021010101

In our work, we used materials on the economic evaluation of technological processes (Vasant, Zelinka & Weber, 2019, Kharchenko & Vasant 2020, Kharchenko & Vasant, 2018, Thomas, Karagoz, Ahamed & Vasant 2020, Kharchenko & Vasant 2020). However the existing methods involve complicated calculations and, therefore, are hardly applicable in agricultural production. (A. I. Nekrasov, Yu. S. Borisov, 1995, A. S. Guzachev, V. A. Trushkin. 2017).

The scientific novelty of the carried out research and development includes the obtained calculation data and results of analysis of information for estimating damage due to the failures of electric drive of technological equipment, in animal farming. The effectiveness of the research work is defined by the improvement of equipment reliability, increasing its life span and reducing both failure rate and consumption of labor and material resources for maintaining operability of electro-technical and energy equipment.

An important task is to improve, specify and supplement the existing system of maintenance and repair of electrified equipment for agricultural enterprises and to increase the output of agricultural products by improving the operational reliability of electric equipment, in technological processes.

Materials

In order to improve the effectiveness of agricultural production, principally new approaches to the issues of energy provision for technological processes are needed. These include priority areas and production technologies on the basis of electric energy use, in conditions of reliable power supply for customers and high operational availability and safety of electric equipment and power installations (Yu. F.Lachuga, D. S. Strebkov, A. I. Nekrasov 2009; "System of scheduled-preventive repair" 1987, N. N. Syrykh, N. E. Kabdin 2007; Vinogradov et al., 2018; Vinogradov et al., 2019).

The system of machines and technologies for comprehensive mechanization and automation of agricultural production for the period until the year 2020 approved for Russia, comprises developing the milk farming mainly by building new large specialized farms and complexes for 100, 200 and 400 cows, as well as by reconstruction and modernization of existing milk farms of optimal capacity including small farms for 10, 25 and 50 cows. Power consumption for performing the processes of milking and milk transportation is 0.56 kWh/year while that for cooling and storage amounts to 0.4 kWh/year. At the same time, the aggregate installed power of electric drive of machinery and equipment for these technological processes is 8 kW ("Machinery system for complex", 2012).

In 2018, the gross milk yield at agricultural economies of all categories, in Russia, was 30.6 mln. ton which is 1.5% higher compared to the year 2017. For the same period, the growth of gross milk yield in large production enterprises was 3.6% attaining 16.2 mln. ton. This growth was achieved as a result of the increase of milk cattle productivity that was as high as 6,094 kg per cow, in 2018. It is 3.8% higher compared to the previous year. According to the report by RF Ministry of Agriculture dated 07.02.2019, the price of milk is about 25 rub/kg or USB 0.38 $. (Prices for agricultural production 2019).

At the present day, the use of highly effective up-to-date electrified machinery and advanced methods of its maintenance is essential in order to perform technological processes and mechanized operations that could prevent and exclude possible damage to agricultural production due to failures of electric motors and other electric equipment. Adhering to the requirements of the scheduled preventive-maintenance repair system for electric equipment in agriculture and with the use of innovative methods of technical maintenance of rural electric installations makes it possible to reduce substantially the fault rate of electric equipment. Therefore, material and labor assets for operation of electric equipment and damage at agricultural enterprises are much lower due to failures of such equipment ("Calculation method for economic" 1995, A. I. Nekrasov, Yu. S. Borisov. 1995).