

ANNOTATION

dissertation work of Taldybaeva Aigul Sauletzhanovna: "Development of the power supply system for a mobile shearing station for sheep breeding", submitted for the degree of Doctor of PhD in the specialty: 6D081200 - Power supply for agriculture

1. Relevance of the research topic.

One of the most important products obtained in sheep farming is wool. The quality and quantity of wool obtained depends largely on how the machine shearing process is organized, as well as the technology and equipment used.

In farms for machine shearing of sheep, a whole range of installations are used, which, according to technological, operational, technical and economic indicators, are classified as stationary, portable and autonomous mobile shearing systems.

The most effective in relation to the current situation in sheep farming, where there is a predominance of farms with a relatively small number of sheep, are autonomous mobile shearing stations.

In this area, work was carried out at the Agroinzheneriya Scientific and Production Center on the design, manufacture, and production testing of a mobile shearing station (MSS). The MSS is equipped with advanced primary and auxiliary shearing equipment. Powering the MSS, ensuring favorable working conditions and providing hot water for hygienic and household needs is a technological necessity. Due to the conditions of modern sheep farming, the MSS is always located far from centralized power sources. Therefore, the key unresolved issue is ensuring the power supply of the MSS.

To improve the efficiency of the power supply system, it is necessary to reduce energy costs. One way to reduce costs is to choose a rational combination of energy resources consumed in the power supply system using renewable energy sources (RES).

When choosing a system, various options arise, among which the most common are autonomous diesel units, solar, wind, gas and biogas, heat pump units, and mini hydroelectric power plants. In this case, the power supply system must have a scientifically sound design and can have a rational composition and type of energy sources used.

Thus, the challenge lies in creating an effective scheme for the combined use of traditional and renewable energy sources to rationally combine the energy resources consumed in the power supply system of the MSS. A rational combination of energy resources consumed can be determined at the power supply system design stage and depends on the conditions for replacing traditional energy resources with a renewable source after the sources have been coordinated with each other and with the energy consumption regime.

Therefore, the development and research of a power supply system for a mobile shearing station is a pressing issue.

2. The purpose of the dissertation research is development and justification of optimal parameters of an autonomous power supply system for a mobile shearing station for transhumance sheep farming based on renewable energy sources.

3. Research objectives:

- conducting an analysis of modern autonomous power supply systems for remote agricultural facilities and determining the energy characteristics of consumers and renewable energy sources for a mobile shearing station;
- to substantiate the design, technological and structural schemes, create mathematical models, conducted computer simulations and determine the optimal parameters of the autonomous power supply system for a mobile shearing station;
- develop a methodology, carry out laboratory and industrial experimental studies of the power supply system to verify the validity of the simulation results;
- based on the results of production tests, determine the technical and economic indicators of the power supply system of the mobile shearing station.

4. Research methods: patent, analytical, statistical, engineering and computational studies, as well as experimental modeling methods on prototype equipment samples .

5. Main provisions to be defended:

1. Dependencies of solar radiation intensity in relation to the location of the mobile shearing station, guaranteed with a predetermined probability.
2. Characteristics of electric energy consumers of a mobile shearing station and its typical daily load schedule.
3. A methodology and computer program enabling the calculation of optimal parameters of photovoltaic installations and storage batteries.
4. Simulation model in MatLab/Simulink, allowing to evaluate the output characteristics and maximum power points of solar modules.
5. Results of modeling in the MatLab / Simulink environment and experimental studies of the operating modes of universal collector motors of shearing machines.
6. Results of experimental studies of charge-discharge characteristics of the energy storage system (batteries) as part of a photovoltaic installation.
7. Results of the technical and economic calculation of the power supply system of a mobile shearing station, allowing to estimate the capital and operating costs for power supply compared to the use of a liquid-fuel generator.

6. Description of the main results of the study.

Based on the data obtained during the study of the modes and levels of energy consumption of the MSS consumers, the energy characteristics of the consumers were determined, and daily graphs of the electrical load were constructed. For MSS electrical receivers with a rated power of up to 4.5–5 kW, it is advisable to use an

autonomous power supply system based on a solar photovoltaic installation (SPPI), capable of providing the required daily electricity generation. A calculation method was developed and the optimal parameters of the installation were determined. Transient processes of universal commutator motors used in the MSS were simulated in the MatLab/Simulink environment, and the possibility of stable operation of the autonomous power supply system was confirmed. The charge - discharge characteristics of batteries as part of the SPPI were also studied. The charge controller ensures stable operation of the batteries, and experimental data confirmed the reliability of the simulation results.

Developed modeling methods, computer calculation program and experimental tests are of professional interest to specialists working in this field, master's and doctoral students.

The results of the research confirm the possibility of effective use of an autonomous solar photovoltaic installation for power supply of the MSS in the conditions of transhumance sheep farming.

7. Justification of the novelty and importance of the results obtained:

- Based on the research results, a prototype of a mobile shearing station was manufactured and tested;
- recommendations have been developed for the implementation of an autonomous power supply system for a mobile shearing station in farms and small farms;
- a methodology for calculating and designing a power supply system for a mobile shearing station has been developed.

8. Compliance with scientific development directions or government programs.

The topic of the dissertation is directly related to the Concept of the transition of the Republic of Kazakhstan to the "Green Economy" and was carried out in accordance with the state programs of the Ministry of Higher Education and Science of the Republic of Kazakhstan, within the framework of grant projects of the Ministry of Higher Education and Science of the Republic of Kazakhstan on the priority "Power Engineering and Mechanical Engineering", project No. 0118PK01342, Inv. No. 0218PK01252 on the topic "Research and creation of technologies and machine systems for transhumance sheep breeding" for 2018-2020.

9. Description of the doctoral student's contribution to the preparation of each publication.

As part of a research team for a grant project from the Science Committee of the Ministry of Higher Education, the RK Academy of Sciences, the doctoral student participated in and independently investigated theoretical patterns and experimental relationships. She possessed the relevant background knowledge and experience.

She co-authored 11 scientific papers, including: 4 articles with the results of analysis and substantiation of the optimal parameters of the power supply system , technical and economic calculations, and operational tests, in scientific journals recommended by the Committee for Quality Assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; 3 articles with the results of system research in the materials of international scientific and practical conferences; 3 articles with the results of theoretical and experimental analysis in foreign publications included in the international database of scientific journals of the Scopus company. In collaboration with her, she prepared an application for an invention: patent for utility model of the Republic of Kazakhstan No. 4610 "Mobile shearing station for sheep" and patent No. 5295 "Complex for transportation and storage of wool" .

The requirement for an international peer-reviewed journal to have a Cite Score percentile of at least 35 in the Scopus database has been fully met.

During her studies, she completed an internship abroad (Minsk, Belarus). Her work was presented at scientific conferences and annual reports of the applicant. She presented papers on the topic of her dissertation at: International conferences: International Scientific and Practical Conference "Improving the Methodology of Cognition for the Development of Science", Russia, 2019;

XXIII International Scientific and Practical Conference of Young Scientists and Students "Scientific Youth in Agricultural Science: Achievements and Prospects" within the framework of the Year of Youth of the Republic of Kazakhstan. KazNAU, Almaty, Kazakhstan, 2019;

XI International Scientific and Technical Conference "Power Engineering, Infocommunication Technologies and Higher Education." NAO "Almaty University of Power Engineering and Telecommunications named after G. Daukeev", Almaty, Kazakhstan, 2020.

10. Volume and structure of the dissertation.

The work is presented on 105 pages of computer text, contains 56 figures , 20 tables, and 2 pages of appendices. The list of references includes 125 titles.