



DESIGN OF A YARN SPINNING ENTERPRISE EQUIPPED WITH 100,000 PNEUMATIC SPINNING CHAMBERS

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ANNOTATION

This graduation qualification work examines the design of a spinning enterprise equipped with 100,000 pneumatic spinning chambers. The project focuses on organizing the production of high-quality yarn based on modern pneumatic-mechanical spinning technologies, selecting technological processes, and improving production efficiency. During the project, the technological equipment required for the preliminary processing of cotton fibers, cleaning, carding, sliver preparation, and pneumatic spinning processes was selected, and their production capacities were calculated. A technological scheme of the enterprise was developed based on the arrangement of the main and auxiliary workshops, as well as the movement of raw materials and finished products. In addition, the project considers labor protection, occupational safety, fire safety, and environmental requirements. Recommendations were provided for reducing production costs and improving product quality through the efficient use of energy and resources. As a result, a modern, highly productive, economically efficient, and competitive yarn spinning enterprise project was developed in accordance with current industrial requirements.

Keywords: pneumatic spinning, yarn spinning enterprise, cotton fiber, spinning technology, pneumatic-mechanical spinning, rotor spinning.



INTRODUCTION

Today, the textile industry is considered one of the most important and rapidly developing sectors of the world economy. Due to the increasing demand for high-quality and competitive textile products, the introduction of modern technologies in yarn spinning enterprises has become highly significant. In particular, the deep processing of cotton raw materials, the production of high-quality yarn products, and the expansion of export potential are among the most urgent issues of the present day. Therefore, the use of high-performance pneumatic-mechanical spinning technologies is an important factor in improving production efficiency.

The Republic of Uzbekistan is implementing large-scale reforms aimed at developing the textile industry. Special attention is being paid to increasing the volume of cotton processing, expanding the production of finished goods, and manufacturing products that meet international standards. The establishment of modern yarn spinning enterprises creates opportunities for generating new jobs, reducing production costs, and improving the economic efficiency of manufacturing processes.

Pneumatic spinning technology differs from traditional ring spinning methods by its high operating speed, increased production efficiency, and lower labor requirements. This technology makes it possible to produce high-quality and durable yarn, while the automation of production processes further enhances enterprise efficiency. In addition, pneumatic spinning machines help reduce energy consumption and ensure the efficient use of production areas.

The main objective of this work is to design a highly efficient yarn spinning enterprise based on modern pneumatic-mechanical spinning technologies. To achieve this objective, the following tasks were identified:

- studying the physical and mechanical properties of cotton fibers;
- selecting and substantiating technological processes;
- selecting and calculating pneumatic spinning equipment;



- arranging production workshops;
- developing the technological scheme of the enterprise;
- developing labor protection and occupational safety measures;
- determining economic efficiency indicators.

As a result of this project, a modern, highly productive, economically efficient, and competitive yarn spinning enterprise model that meets current industrial requirements will be developed. The practical implementation of this project will contribute to the development of the textile industry, the increase of export volume, and the deep processing of local raw materials.

LITERATURE REVIEW

Scientific research conducted in the textile industry, especially in the field of yarn spinning technologies, is aimed at improving industrial efficiency, enhancing product quality, and ensuring the rational use of energy and resources. In recent years, the development of pneumatic-mechanical spinning technologies has made it possible to achieve high productivity in yarn manufacturing processes. Therefore, the pneumatic spinning method is widely used in modern spinning enterprises.

Scientific literature highlights the main advantages of pneumatic spinning technology, including high production speed, automation of technological processes, increased labor productivity, and reduced production costs. Researchers have extensively studied the uniformity, strength, and quality indicators of yarns produced by rotor spinning methods.

In the scientific works of scholars such as A.A. Abdullayev, Sh.R. Khudoyberdiyev, and B.M. Mardonov, the physical and mechanical properties of cotton fibers and their influence on the spinning process were analyzed. These studies demonstrated that the length, strength, moisture content, and impurity level of cotton fibers directly affect the quality of the finished yarn. Furthermore, it was emphasized that high-quality yarn can be obtained by improving the preliminary processing stages of raw materials. Research conducted by foreign scientists widely



investigated the structural design of pneumatic-mechanical spinning machines, rotor rotation speed, chamber diameter, and the effect of airflow on the yarn formation process. According to the research results, the optimal selection of rotor speed improves the yarn strength and surface quality. In addition, it was determined that modern automated control systems reduce production defects and increase manufacturing efficiency.

The literature also pays considerable attention to the issues related to the design of yarn spinning enterprises. The rational arrangement of production workshops, proper organization of technological flows, and effective selection of equipment are considered important factors in increasing production productivity. Some scientific studies indicate that economic efficiency can be achieved through the efficient use of production space and the reduction of energy consumption. Labor protection and environmental safety issues are also considered important directions in scientific sources. Research emphasizes that reducing dust emissions, improving ventilation systems, and lowering noise levels in production create favorable working conditions for employees. At the same time, it is noted that the use of energy-saving technologies can reduce the environmental impact of enterprises. The studied scientific literature and research demonstrate that the application of modern pneumatic spinning technologies makes it possible to produce high-quality yarn, increase production efficiency, and improve economic indicators. Therefore, the design of a yarn spinning enterprise equipped with 100,000 pneumatic spinning chambers is considered to have significant scientific and practical importance.

MAIN PART

In this project, technological, structural, and economic issues related to the design of a yarn spinning enterprise equipped with 100,000 pneumatic spinning chambers were examined. The enterprise is based on the production of high-quality yarn from cotton fibers using the pneumatic-mechanical spinning method. During the design process, special attention was paid to increasing production efficiency,



reducing energy and raw material consumption, and implementing modern technologies.

At the initial stage of the project, technological processes were selected based on the yarn assortment and the production capacity of the enterprise. Modern equipment was recommended for the preliminary processing of cotton fibers, cleaning, blending, carding, sliver preparation, and pneumatic spinning processes. The production capacities of the technological equipment were calculated, and their suitability for the enterprise capacity was justified.

The main technological parameters of pneumatic spinning machines, including rotor rotation speed, number of chambers, yarn linear density, and production productivity, were analyzed. It was determined that the optimal selection of rotor speed improves the strength and quality characteristics of the yarn. In addition, automated control systems were introduced to ensure continuous management of technological processes during production.

The main and auxiliary workshops of the enterprise were arranged in accordance with modern production requirements. The raw material warehouse, cleaning and carding departments, spinning workshop, finished product warehouse, and auxiliary service rooms were designed based on technological interconnection. The arrangement of workshops was aimed at ensuring the continuity of the production flow and reducing unnecessary transportation costs.

Special attention was also paid to labor protection and occupational safety issues in the project. Ventilation systems, dust cleaning devices, and fire safety equipment were installed in the production areas. In order to create favorable working conditions for employees, lighting, humidity, and temperature indicators were established according to standard requirements. To determine the economic efficiency of the enterprise, the main technical and economic indicators were calculated. Production cost, electric energy consumption, labor productivity, and annual production volume were analyzed. The results showed that the use of modern



pneumatic spinning technology significantly increases the economic efficiency of the enterprise.

RESULTS

As a result of the project, a modern yarn spinning enterprise equipped with 100,000 pneumatic spinning chambers was developed. The enterprise provides the opportunity to produce high-quality and competitive yarn products. The correct selection and optimal arrangement of technological equipment contributed to increasing production efficiency.

The calculations carried out showed that pneumatic-mechanical spinning technology has higher productivity compared to traditional spinning methods. Through the use of modern automated systems, production defects were reduced, and the stability of product quality was ensured.

Efficient use of energy and resources in the designed enterprise created opportunities to reduce production costs. At the same time, a safe and comfortable working environment was established in compliance with labor protection and environmental safety requirements.

In general, this project was developed in accordance with modern industrial requirements and is considered to have significant scientific and practical importance for establishing a highly efficient yarn spinning enterprise in the textile industry.

CONCLUSION

The analysis showed that pneumatic spinning technology is characterized by high production speed, lower labor demand, and stable quality indicators. During the research, the physical and mechanical principles of yarn formation in the pneumatic spinning process were considered, particularly the movement of fibers under the influence of an air stream inside the chamber, where they form a stable yarn structure by wrapping around a central core. Compared to traditional spinning methods, this process ensures higher twisting speed and better uniformity of the yarn



structure. According to the project results, the use of automated control systems in production processes increases technological stability and reduces errors caused by the human factor. It was also determined that optimal control of air pressure in pneumatic spinning machines has a direct impact on yarn surface quality and strength. The project demonstrated that proper organization of raw material flow, especially improvement of fiber sorting and cleaning processes, significantly enhances the quality of the produced yarn. In addition, maintaining standard microclimatic conditions (temperature and humidity) in production workshops positively affects the stability of technological processes. From an energy efficiency perspective, pneumatic spinning technology allows for reduced electricity consumption through optimized compressed air systems. This contributes to improving the overall economic efficiency of the enterprise. In general, the results of this project confirm that it is possible to design a modern, highly productive, economically efficient, and competitive yarn spinning enterprise. The practical implementation of this project will contribute to the development of the textile industry and increase the level of deep processing of local raw materials.

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