Hungarian University of Agriculture and Life Sciences

Szent István Campus

Institute of Technology

MSc. Engineering Management

Enhancing Energy Efficiency in Production Lines Through Advanced Process Monitoring and Control System

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Gödöllő

2024

Abstract

This thesis research examines the possibilities to improve energy efficiency in production lines by creating and developing a Process Monitoring and Control System (PMCS). The principal aim of the project is to develop the schedule of production's processes, according to which it will be possible to perform all the operations at the time of the lowest prices for energy with the help of a complex monitoring and control system that can optimize energy consumption immediately.

The literature review evaluates current practices and technological advances in energy efficiency within the manufacturing sector. reviewing hierarchical nature of energy consumption, from individual machines through to the factory level, and underscores the potential for transformations made possible through the integration of systems for real-time monitoring and control. The paper has laid a very strong foundation toward the need to adopt highly advanced systems, which are able to change dynamically in the reflection of demand for energy and changes in operational conditions for maximum efficiency.

The study is performed based on a structured methodology with the central emphasis on the development, and effectiveness of the PMCS in real industrial settings. The development of the Process Monitoring System Infrastructure and the Optimization Workflow are key addressed points in this. An in-depth explanation of these two components shows how the PMCS harvests, processes, and uses data in making energy use in manufacturing activities efficient. This approach has emphasized the capability of the system to analyze real-time data and the strategic application of optimization algorithms with the aim of improving overall energy management.

The thesis's results introduced a holistic design and effective implementation of a PMCS that is configured to perform the continuous monitoring of energy usage along a production line. The system is engineered to process and analyze this data in order for it to make well-informed decisions in its energy usage and production scheduling. In doing so, the system can be integrated into the present infrastructural setup for production, which adds to its features, adaptability, and functions, and hence, a sharp reduction in energy consumed and operating costs. Analysis of economic feasibility is in strong support of the financial feasibility of the system through analyses like Net Present Value (NPV) and Return on Investment (ROI), thus enabling it to produce more sustainable manufacturing operations.

Overall, the integration of PMCS resulted in an evident improvement in reducing energy consumption among the manufacturing production lines. Given the innovative design of the system and its application of real-time data, more industries worldwide should integrate it. The promising outcomes from the above case and already integrated systems indicate that PMCS would be integral in enhancing sustainability and cost-effectiveness in global manufacturing.