Review on Automation of Soap Cleaning Process Using Aspects of Lean Manufacturing to Improve Productivity in the Soap Manufacturing Industry

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Abstract

The soap manufacturing industry is one of the most significant contributors to the FMCG sector. A critical stage in this industry is the **soap cleaning and polishing process**, which ensures removal of surface residues and improves product aesthetics before final packaging. Traditionally, this stage is carried out manually. While effective, the manual method is *replaced by low-cost automation.* This paper reviews existing studies on the automation of the soap cleaning process when guided by lean manufacturing principles. The purpose of this review is to study how lean principles and automation together can improve the soap cleaning operation. The paper attempts to understand limitations of the existing manual method, explore lean tools applicable to this stage, examine different automated solutions available, and highlight the barriers and research opportunities connected with implementation. The purpose of this review is to study how lean principles and automation together can improve the soap cleaning operation. The paper attempts to understand limitations of the existing manual method, explore lean tools applicable to this stage, examine different automated solutions available, and highlight the barriers and research opportunities connected with implementation.

Keywords: Lean manufacturing, automation, soap cleaning, productivity improvement, waste reduction

1. Introduction

Soap is an essential consumer commodity produced through a sequence of operations such as saponification, mixing, extrusion, cutting, stamping, cleaning, drying, and packaging. Once the soap cakes are stamped to the required shape, they frequently exhibit flashes, unwanted edges, small burrs. These issues affect the final appearance of the product and must be removed before packing. In many manufacturing plants, cleaning is still carried out manually using microfiber cloth and isopropyl alcohol. Although this technique is simple, it depends heavily on operator skill and concentration. Output quality varies from person to person, the process is slow, and workers experience continuous repetitive strain. Fatigue, reduced productivity and inconsistent finishing are common consequences.

At the same time, Large-scale soap manufacturers use expensive automated polishing machines to overcome these issues. However, small and medium enterprises (SMEs), which constitute a large part of the soap industry, cannot afford such costly equipment. As a result, many SMEs still rely on manual cleaning and polishing operations, which limits productivity and efficiency. This situation has created a growing interest in lean manufacturing and low cost automation. Lean manufacturing focuses on identifying and eliminating non-value-adding activities, while automation allows

repeatable, precise, and consistent execution of tasks. When these two approaches are integrated, the soap cleaning stage can be transformed from a labour-intensive operation into a cost effective, controlled and efficient process.

2. Review of Related Work

J. Bhamu and K. S. [01] Sangwan (2014) carried out a systematic literature review of lean manufacturing studies across various industries, with particular emphasis on the Indian manufacturing context. Their study highlighted that lean manufacturing practices significantly enhance productivity, quality, delivery performance, and cost efficiency in manufacturing organizations. The review also revealed that most existing studies confirm the positive impact of lean tools and principles on operational performance. However, the authors identified important research gaps, including the lack of lean implementation frameworks specifically tailored for Indian small and medium enterprises (SMEs) and limited long-term empirical validation of lean benefits. Additionally, the study pointed out insufficient research integrating lean manufacturing with automation and advanced manufacturing technologies, indicating a need for future studies in this direction.

Gupta and Jain [02] carried out a case study on productivity improvement in a soap production line. Their work highlighted that manual cleaning and trimming operations after stamping were major bottlenecks, causing delays and quality variations. They introduced semi-automated trimming tools which improved consistency and reduced operator effort. However, their research did not integrate lean manufacturing concepts with full automation of the cleaning process, indicating scope for further enhancement through lean-based automated solutions.

Kumar and Das [03] used simulation techniques to study the impact of introducing an automated cleaning station into a soap processing line. Their simulation predicted improved throughput and reduced production time when automation was implemented at the cleaning stage. However, their work was limited to software simulation and lacked experimental validation in real industrial environments. Additionally, lean tools such as 5S, SMED or VSM were not combined with automation in their study.

3. Classification of Existing Systems

Existing systems used in soap cleaning and finishing operations can broadly be classified into manual, semi-automatic, and fully automatic systems. Manual systems rely entirely on human operators using hand tools such as scrapers or blades to remove fins and surface defects, which leads to high variability, fatigue, and low productivity. Semi-automatic systems incorporate basic mechanisms such as motor-driven brushes, trimming attachments on stamping machines, or pneumatic actuators, where machines assist the operator but still require continuous supervision and handling. Fully automatic systems integrate conveyors, sensors, actuators, and sometimes vision-based inspection to perform cleaning, orientation, and transfer operations without direct human intervention. While fully automated systems offer superior consistency and throughput, they are less common in small and medium-scale soap industries due to higher initial cost and lack of lean-based process optimization, highlighting the need for lean-guided automation in future developments. Comparative Analysis of Existing Systems

4. Comparative Analysis of Existing Systems

Author(s)	Year	Method / Approach	Key Findings	Identified Gap
J. Bhamu & K. S. Sangwan	2014	Systematic literature review of lean manufacturing studies across industries, with focus on Indian manufacturing context	Lean manufacturing improves productivity, quality, delivery performance, and cost efficiency.	Lack of lean implementation frameworks tailored for Indian SMEs and limited long-term empirical validation. Insufficient studies integrating lean manufacturing with automation and advanced manufacturing technologies.
Gupta & Sharma	2017	Case study on soap production line improvement	Identified bottlenecks in manual soap cleaning; suggested semi-automated trimming tools improved consistency	No systematic integration of lean principles with full automation for cleaning
Kumar & Das	2025	Simulation of soap processing line with automation	Simulation predicted improved throughput with automated cleaning station	Needs real-world validation and lean integration analysis

5. Research Gap Identified

Based on the above literature review, the following research gap is identified:

There is a lack of integrated study that designs, develops, and evaluates an **automated soap cleaning system guided by lean manufacturing principles**. The need exists to minimize manual involvement, eliminate waste, improve productivity, minimising cost and ensure consistent finishing quality in soap manufacturing industries.

6. Future Scope

The review of existing soap cleaning methods indicates substantial scope for improvement through enhanced mechanical automation and process optimization. Future research may focus on improving the mechanical design of cleaning mechanisms to achieve better uniformity, dimensional accuracy, and higher production rates while reducing handling losses. Energy-efficient system design is another key area of development, including optimized motor selection, efficient power transmission, and the use of lightweight and low-friction components to minimize energy consumption. Additionally, the development of modular and scalable automation systems can support adoption by small- and medium-scale soap manufacturing units, allowing gradual implementation with reduced capital investment. Such systems can be customized based on production requirements and plant layout constraints. Overall, these future developments support

lean manufacturing principles by minimizing non-value-added activities, reducing waste, improving process consistency, and enhancing overall productivity in soap manufacturing operations.

7. Conclusion

The review indicates that automation of the soap cleaning process, when guided by lean manufacturing principles, can significantly enhance productivity, quality, safety and helps to eliminate waste, while automation minimizes manual effort and variability. The combined approach of lean methodology and automation represents an effective pathway for modernizing soap manufacturing and meeting rising market expectations.

8. References

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