

Manufacturing Processes In The Footwear Industry: A Study Of Mechanized Cement Lasting Process

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Abstract:

In the footwear manufacturing system, the upper parts of the shoe and bottom parts of the shoes are attached with the help of adhesive or stitched with the help of thread. In the earlier time shoes were made from bark, twine and other natural man made materials. 5000 year ago leather has come as natural material to produce the footwear. Which is comes in the form of leather hide. Handmade shoes are very unique to wear because they conform to the anatomy of the foot. Firstly, we take the structure line of man's foot to measure the foot structure, according to which we make the shoe last, while the customer chooses the size, material and design of the shoe. After the measurement process shoe were made by hand.

The manual operations for the upper parts led to a large variability in processing times, resulting in higher work-in-process inventory. Nowadays the efficient mechanized system is available, which is more powerful to produce the goods at given time period, the efficiency of the equipment and machinery is very high. In the mechanized cement lasting process the upper part of the shoes stuck with the outsole with the help of adhesive by machinery, in which construction the different types of shoe making machineries are involved.

The purpose of this paper is to review the areas where the current footwear manufacturing system can significantly affect the way of footwear sector is practiced, and also we will discuss the implementation.

Keywords: Expert system, manufacturing system, Advance Technology, Opportunity, Material, Process.

1. Introduction:

In the vast and ever-changing world of footwear, the manufacturing process plays a pivotal role in determining the quality and durability of the final product. A well-executed manufacturing process not only ensures that each pair of shoes meets the highest standards but also guarantees customer satisfaction. On the other hand, a flawed or haphazard process can lead to product defects, delays in

production, and ultimately, customer dissatisfaction. Therefore, understanding and implementing an effective footwear manufacturing process is vital for success in this industry.

Innovation has always been a driving force in the footwear industry, pushing boundaries and revolutionizing manufacturing processes. Technological advancements have brought about automated machinery capable of intricate tasks like cutting patterns or stitching with unparalleled accuracy and speed. As a result, productivity has skyrocketed, allowing manufacturers to produce more shoes without compromising on quality.

The importance of a well-executed footwear manufacturing process cannot be overstated. From design to assembly line management, every step is crucial for creating high-quality shoes that meet customer expectations. By embracing innovation and sustainable practices while maintaining rigorous quality control measures, manufacturers can navigate this ever-evolving industry successfully.

The process of making shoes by hand takes a lot of time, in this process, a person can hardly make 4 to 5 pairs of shoes in a day, due to which the production process cannot achieve its target, Therefore, nowadays automatic cement lasting plant has been introducing, which are very efficient and the make around 500 pair in 8 hours by one shoe making line, which have around 10 machine along with 10-12 work force. In this process upper stretch over the last and fix it with the help of adhesive, Cement lasting process is very effective.

The Indian Footwear Industry holds a prominent place in the Indian economy. This sector is known for its consistency in high export earnings and it is among the top ten foreign exchange earners for the Country.

The export of footwear, leather and leather products from India was to the tune of US \$ 5.26 billion during 2022-23. The industry is bestowed with an affluence of raw materials as India is endowed with 20% of world cattle & buffalo and 11% of world goat & sheep population. Added to this are the strengths of skilled manpower, innovative technology, increasing industry compliance to international environmental standards, and the dedicated support of the allied industries. The leather industry is an employment intensive sector, providing job to about 4.42 million people, mostly from the weaker sections of the society. Women employment is predominant in leather products sector with about 40% share.

The major production centers for footwear states in India are Tamil Nadu, West Bengal, Uttar Pradesh, Maharashtra, Karnataka, Hyderabad, Delhi, Madhya Pradesh, Kerala, Rajasthan and Jammu & Kashmir.

2. Literature Review:

Footwear manufacturing system play an important role in the development of the country economy. Some review of literature is given here:

Mayank Dev Singh (2012) pointed out that the improvement of work process was executed by eliminating and combining of work process, which reduces production time, number of process and space utilization.

Kavitha & Jayalakshmi, (2014) They said that that customers in India are willing to pay a higher price for footwear products that are of better quality.

Chahine Ghimouz, Jean Pierre Kenné & Lucas A. Hof (2023) In this study has successfully demonstrated the development of a comprehensive approach for footwear manufacturing focused on design for disassembly using AM techniques, enabling the realization of a fully 3D printed footwear product for the first time. By taking advantage of the benefits of AM as fabrication method, including new design possibilities and glue less assembly by snap fit systems, the proposed approach reduces the number of parts used for footwear production and improves the re-manufacturability and recyclability of (high-heeled) shoes.

Based on the literature review, it can be concluded that Quality, technology, automation pricing, variety are important factors that influence customer perception of footwear products.

3. Objective:

The objective of manufacturing process is:

- a. To maintain the quality of product and achieve production within time
- b. To maintain the efficiency and cost of the product.

4. Research Methodology:

The data have been compiled from the different source which are given below:

- a) Published documents and reports
- b) The World Wide Web
- c) Practical demonstration in work lab

5. Mechanized shoe cement lasting process:

In the footwear manufacturing, the assembly line stands as the beating heart of the entire process. It is here that the various components of a shoe seamlessly come together, creating a final product that is not just aesthetically pleasing, but also sturdy and comfortable. In this paper, we will delve into the intricacies of the assembly line, exploring each step involved in assembling different components and highlighting its importance in maintaining consistent quality and meeting production deadlines.

The assembly line process begins with the upper part of a shoe. This encompasses everything from stitching together leather or fabric panels to attaching eyelets for laces. Skilled craftsmen meticulously work their magic, ensuring that each stitch is precise and strong. Attention to detail at this stage is crucial as any flaws can lead to discomfort or premature wear and tear.

Once the upper part has been crafted with care, it moves on to sole attachment. This step involves joining together the outsole (the bottom layer) with either a midsole for added cushioning or directly attaching it to the upper part. Adhesives are carefully applied in precise amounts to ensure a secure bond that can withstand daily wear.

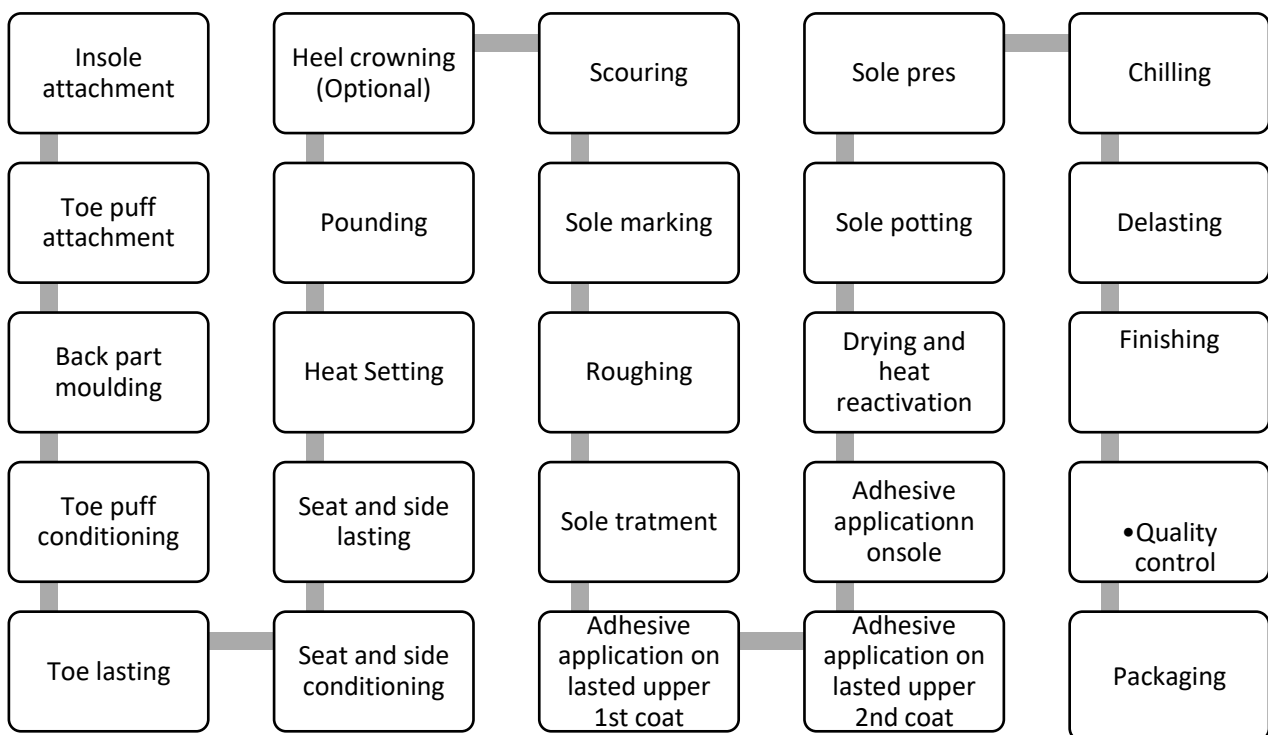
Stitching details add not only functional strength but also an aesthetic touch to footwear products. Whether it's decorative stitching along seams or reinforcing critical areas like toe caps or heel counters, skilled artisans bring their expertise to ensure durability without compromising style.

As each component comes together like pieces of a puzzle on the assembly line, efficient management

becomes paramount. Supervisors oversee operations, ensuring smooth coordination between different teams involved in various stages of production. Communication flows seamlessly from one workstation to another as workers collaborate towards a common goal - delivering high-quality shoes on time.

Efficiency plays a vital role in maintaining consistent product quality while meeting production deadlines. An organized workflow ensures that no steps are overlooked or rushed through hastily. Each worker knows their role and performs it with precision and expertise, eliminating the risk of errors or delays.

Cement lasting is a method of attaching the outsole and midsole to the upper body using an adhesive. Cemented shoes can be found in all price ranges for most types of shoes and are one of the most common construction methods used due to the wide range of shoe types that can be produced with cementing construction. The specialty of the construction is that the upper part is joined to the lower part by cement, without the need for any stitching or other physical bond. Due to this it is also known as stuck on construction.



Sequence of operation Cement lasting construction

5.1 Upper preparation

Upper preparation process includes the toe puff attachment, back part molding, lining pasting lacing and upper bottom edge rounding. In mechanized lasting process. Upper preparation process can be done before lasting.

5.1.1. Toe puff attachment:

In this process, non-woven heat activated toe puff is used. In this process toe puff attaching machine is used. The condition of machine is generally pneumatic and electrical. Around 100-130-degree Celsius temperature is required to attach the toe puff with the upper. Generally, temperature is depending on the

upper material. The toe-puff must be placed 5 mm inside from edge of the lasting margin. The toe-puff must be properly attached all around with the upper.

5.1.2 Back part moulding:

This machine suitable for back part molding of men and women high-quality leather shoes, boots, canvas shoes and sports shoes. Suitable for any counter material, best for thermoplastic, silicon resistance outer mould, hot mold can reach 200 degree Celsius and cold mold can down to -20 degree Celsius and temperature can be adjusted for different materials. Cold mould can be equipped with optional wiper.

5.1.3 Lining pasting & Edge rounding:

After completion of toe puff and counter stiffener attachment process, Lining may be pasted by adhesive. After that shoe upper shall be ready for lasting. Edge rounding is required to control the replacing of toe and counter and stiffener.

5.2 Insole attaching process:

In mechanised lasting process, insole stapling process generally carried out by insole stapling gun/machine. It is very fast process. It can produce 500-700 pair in 8 hour shift by one machine. The preformed staple is used in this machine, The length of the preformed staple around 13-15 mm.

5.3 Making Process:

In mechanized lasting process, making process includes toe puff conditioning, Toe lasting, Seat and side conditioning, Seat and side lasting and heat setting.

5.3.1 Toe puff conditioning process:

A last with Insole attached, together with its respective upper, is placed in the conditioning unit to soften the toe puff sufficiently to get the shape of the last when pulled over. In addition, steam may directed onto the upper assists in the prevention of finish or grain cracks which might occur in the toe area.

5.3.2. Toe lasting Process:

The hot-melt adhesive used for this operation is thermoplastic Polyester, which is supplied on reels in rod form or in granules. The rod is fed to the applicator through heated tubes so that it is in a molten state when applied to the insole. The granules are melted in a heated pot and fed by tube to the applicator.

5.3.3. Seat and side conditioning:

Steam is directly applied onto the upper assists in the prevention of grain cracks which might occur in the seat area.

5.3.4. Seat and side lasting process

The hot-melt adhesive used for this operation is thermoplastic Polyamide, which is supplied on reels in rod form. The rod is fed to the nozzles through heated tubes so that it is in a molten state when applied to the insole. The granules are melted in a heated pot and fed by tube to the nozzles.

5.3.5 Heat setting process:

Heat setting has provided a significant reduction in production time and the number of lasts required in the production process, as footwear can be removed in a fraction of the time compared to production without heat setting.

5.4 Bottoming process:

5.4.1 Pounding Process:

Improvements in lasting techniques have introduced this operation in most factories where it has been substituted by toe and heel scouring.

5.4.2 Sole marking process

Sole marking with help of marking machine is faster and more accurate. For sole marking the lasted upper is placed on the sole and is placed on this machine. Then with help of white pencil the upper is marked on the edge of the sole.

5.4.3 Scouring and roughing Process:

Scouring Process:

Its purpose is to remove any surplus material after the lasting process. It also flattens the bottom by eliminating any pleats or creases so that the roughing operation can be carried out correctly. .

Roughing Process:

Although bottom roughing is not always applicable to some of the synthetic upper materials, it is essential on leather uppers.

Its purpose is to provide a surface to which the sole bonding adhesive will adhere correctly, so that it will not separate from the upper material.

5.4.4 Dryer & Heat reactivation Process:

The purpose of forced cement drying is to reduce the use of factory floor space whilst carrying out efficient drying under controlled conditions. It also speeds up the process resulting in quicker last turn around, reduced throughput times and a reduction of the number of lasts needed to achieve output targets.

5.4.5 Sole press:

The purpose of sole pressing is to attach the sole permanently with the lasted upper.

The machines most commonly used for this operation have two separate operating stations, one for each foot of a pair of shoes. These operate independently of each other. The time dwell is set either to a minimum of ten seconds or to the working speed of the operator if it is greater than 10 seconds. During this time dwell, the operator has sufficient time to prepare the next shoe for processing.

5.4.6 Chilling process:

In mostly factories the shoe is removed from the sole press and placed immediately into a chilling unit. This assists to consolidate the heat setting that has previously taken place.

5.4.7 De-lasting Process:

The purpose of this operation is to remove the lasts from the lasted shoes

Where eyelets have been laced prior to lasting the string should be cut to prevent distortion of the eyelets, or cutting of the upper material if there are no eyelets. This is normally done by the last slipping operator as part of the slipping operation.

6. Quality Control Measures in Footwear Manufacturing

As the demand for high-quality footwear continues to rise, manufacturers must implement stringent quality control measures throughout the manufacturing process. These measures are crucial for ensuring product consistency and customer satisfaction. In this chapter, we will explore the various methods used in quality control and how they contribute to the overall success of footwear manufacturing.

Quality control measures are indispensable in footwear manufacturing. By implementing stringent inspections at every stage of production, manufacturers can ensure that every pair of shoes meets or exceeds customer expectations. From inspecting raw materials to evaluating finished products, these measures contribute to the overall success and reputation of footwear brands.

7.0 Time study

7.1 Time study of manual process:

Manual process is time taken process, the most of the operation done by manually. The detail of time along with operation is given below:

S.No	Process	Sub process	Time
1.	Upper preparation	Toe puff attachment	40 second
		Back part moulding	40 second
		Lining pasting	15 Second
2	Insole attachment	Insole attachment by nail	12 second
3	Making process	Drafting	05 Minute
		Toe lasting	10 Minute
		Seat & Side lasting	10 Minute
		Heat setting	Leave for 24 hour at room temperature
4	Bottoming process	Sole marking	15 second
		Roughing and scouring	30 second
		Adhesive application 1 st coat	30 second
		Adhesive application 2 nd coat	30 second
		Sole treatment	30 second
		Adhesive application on sole	30 second
		Reactivation	08 second
		Sole press	12 second
			29.86 Minute excluded the heat setting process

In manual lasting system, a big bottle neck occurred after lasting process, because you have to left the shoe with the last for 24 hour. The whole process is stopped. It means for bottoming process you have to wait for next day.

7.1 Time study of mechanized process:

This system is very fast, almost all mechanized machinery is used, The dwell time of the machinery is very less. The detail of time along with operation is given below:

S.No	Process	Sub process	Time
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1.	Upper preparation	Toe puff attachment	12 second
		Back part moulding	18 second
		Lining pasting & rounding	30 Second
2	Insole attachment	Insole attachment	08 second
3	Making process	Toe puff conditioning	12 second
		Toe lasting	10 second
		Seat and side conditioning	12 second
		Seat & Side lasting	10 Second
		Heat setting	90 second
4	Bottoming process	Sole marking	08 second
		Roughing and scouring	15 second
		Adhesive application 1 st coat	30 second
		Adhesive application 2 nd coat	30 second
		Sole treatment	30 second
		Adhesive application on sole	30 second
		Reactivation	08 second
		Sole press	12 second
			6.08 minute

Based on the time analysis in work lab it has been found that the manual work takes long time in compared to mechanized work. Manual processes involve human effort and rely on personal skills, while automated processes use technology and machines to complete tasks more efficiently.

8. Conclusion:

The Lasting Operation is one among the most important processes of footwear manufacturing operation. With comparison of manual lasting system, the mechanized lasting system is very fast and it produced good quality of footwear. Hence we can say that the mechanized lasting system is the requirement of the footwear industry. There is a general feeling among the footwear industrialist that future growth and development in footwear sector would depend on the automation. It serves as a testament to the collaboration between man and machine, blending traditional craftsmanship with technological advancements. From stitching together intricate patterns to attaching soles with unwavering precision, every step on this journey ensures that each pair of shoes meets the highest standards.

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