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DESIGN AND DEVELOPMENT OF MANUAL TEXTILE CHEMICAL MIXING AND PROCESSING MACHINE

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ABSTRACT
In today's Textile product processing, customers are demanding lower prices, the best quality product and service. An effective cost reduction and higher productivity with short processing time is the main objective for textile manufacturer to be a strong competitor by having high market share with profitability and to compete successfully in the world market by keeping benefits of stoke holders including customers.
Nowadays the interest in producing Textile and Textile related products are increasing. The availability of raw material in nature combined with the ease of Textile wet processing was an attractive aspect, which makes it an essential income for the growth of a given country. In Ethiopia there is large number of small scale woven and knitted fabric producers. During wet processing and chemical finishing, they used a stick to mix chemicals on a small mixing barrel. Mixing chemical using stick by hand will not give uniformly mixed chemical solution, it causes shade variation on treated material and it is time consuming.
Nowadays there is different automatic Textile wet processing and chemical finishing machines, but they are expensive. Author Designed and developed manual Textile chemical mixing and processing machine. The machine can be driven by using hand. The machine has a barrel with mixer. The mixer can be fixed and removed easily during Textile chemical processing.

KEYWORDS: wet processing, finishing, Textile, chemical mixer, small scale enterprise.

INTRODUCTION
It is known that Textile industry is one of the oldest sectors which consist of difficult production processes [1]. The sector has a mixed structure due to its huge number of sub-sectors [2]. Textile sector is playing the most important role in the social and economic growth of different countries and nowadays more than 150 countries are supplying Textiles [3]. Textile Processing is main sub-sector in the Textile industry. It converts a virtually un-brand product to an attractive consumer product.
Finishing is the final manufacturing step in the production of fabrics. As an integral part of wet processing, Finishing is the process where the final fabric characteristics are developed [4]. Finishing material can be either chemicals that change the fabric's visual or physical properties or changes in texture or surface characteristics brought about by physically manipulating the fabric with mechanical devices [5-6]. In chemical finishing, water is used for chemical mixing.
In chemical finishing, water is used to mix chemicals. Heat is used to boil water and to activate the chemicals. Mechanical finishing is considered a dry process even though moisture and chemicals are often needed to effectively process the fabric. The textile industry includes a variety of operations ranging from the producing of artificial fibers and fabric manufacturing to retail sales. The wet-processing operations, namely preparation, dyeing and finishing of textile products which are used to give the desired uniqueness to the yarn or fabric, require the use of a number of chemical baths. [7-9]. In wet processing, it is commonly known that the steps encompassing preparation are:
Sizing: In the manufacturing of woven fabrics, warp yarns are sized with a protective coating to enhance weaving efficiency.
De sizing: It is the process of removing warp size applied during sizing process.
Scouring: It is a process of removing different natural dirt, waxes and grease from the fabric.
Bleaching: It is a process of removing color substances in order to whiten the fabric.
Mercerizing: It is a process of treatment of cellulosic fabric by NaOH in order to improve fabric lustre,

water absorbance, dye yield and fibre strength.

Carbonizing: It is a process of acid treatment of wool in order to remove unwanted vegetable matter from the wool.

Different machines can be used for wet processing and chemical finishing of fabric [10]. The final goal of any preparation process is to make fabric that is clean and rid of all impurities that interfere with dyeing and finishing. In mechanical wet processing and chemical finishing machines, the preparation steps can be carried out as either batch or continuous processes. In batch processing, machines are used where the entire load of fabric is immersed in the total amount of liquid needed for that process [11-12].

In Ethiopia, Textile product manufacturing is one of a key sector that identified by the government since 2010. In the country there are many domestic small scale fabric producers. In Textile chemical finishing, they use different manual Textile chemical finishing process. During wet processing and chemical finishing, they used a stick to mix chemicals on a small mixing barrel. Mixing chemical using stick by hand will not give uniformly mixed chemical solution, it causes shade variation on treated material and it is time consuming.

Different automatic chemical mixing and processing machines are available in the market. These machines can mix chemicals uniformly and bring a good result during fabric treatment but they are expensive [13-16]. The present work aims at fabricating manual Textile chemical mixing and processing machine that can be operated easily by hand that can improve the quality of fabrics produced by local fabric producers in the area.

METHODOLOGY

MATERIALS

Barrel, Hollow Structural Sections of circular (CHS) pipe, Rectangular (RHS), Sheet metal, Tubular steel, Bearing, Bevel Gear, Water faucet, Gate valve were used in fabrication work.

METHODS

Data are gathered through observation, Interview and referring books. The main aim of designing and fabricating manual Textile chemical mixing and processing machine which process up to 20 Liter chemical solution has a boiling unit under the machine which used to boil chemical solution. The mixing unit can be fixed during chemical mixing and removed easily during Textile treatment. The machine can be operated by hand and used for local small scale Textile producers.

DESIGN OF MANUAL CHEMICAL AND WET PROCESSING MACHINE

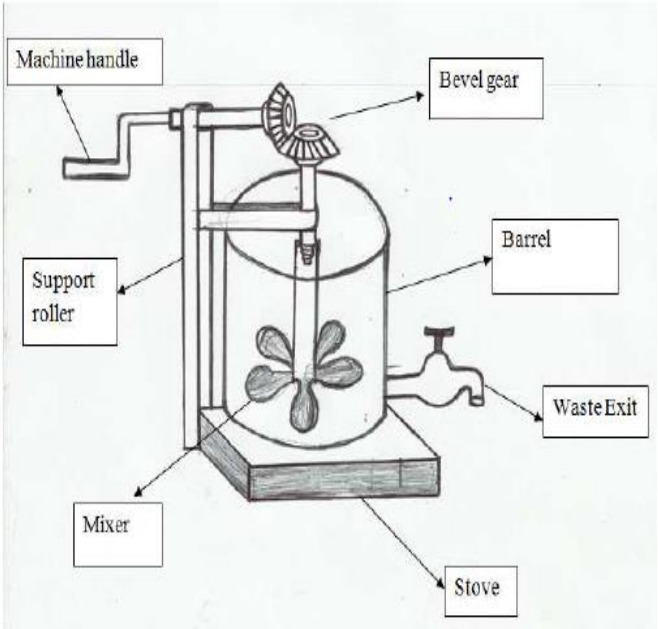

Figure 1. Manual Textile chemical mixing and processing machine (Design by Author)

As indicated in Figure 1, during chemical preparation, the mixer part can be fixed in the machine and the mixer part removed easily after chemical solution is prepared for further processing.

MANUAL TEXTILE CHEMICAL MIXING AND PROCESSING MACHINE

Manual chemical mixer has a barrel which used to hold chemical solution and have a mixer for the purpose of mixing. At the bottom of barrel there is a stove used to boil the solution during Textile treatment. The machine has a bevel gear which connected to machine handle and mixer part. The bevel gear helps to convert horizontal handle rotation to vertical mixer rotation. The mixer part can be rotated by rotating machine handle by hand. Chemical mixer part can be engaged with main shaft during mixing process and disengaged easily during Textile material treatment. The machine has a waste water exit used to remove waste water after treatment.

RESULT AND DISCUSSION

Fabricated Manual Textile Chemical processing machine can be used to process up to 20 Liter of solution. The machine can be operated by hand. The cost to fabricate this machine is very less compared to Automatic Electrical Textile Chemical processing machine. To fabricate this machine it costs around 200$.

Table 1: Machine Description

S/N	Description	Description
1	Type of machine	Manual Textile Chemical processing machine
2	Barrel solution mixing size	Up to 20 Liter
3	Working condition	Manual
4	Required Number of operator	Single
5	Maintenance system used	Oiling and cleaning
6	Width of machine	60 cm
7	Height of machine	1.2 meter

FABRICATED MANUAL TEXTILE CHEMICAL PROCESSING MACHINE

Figure 2. Fabricated Manual Textile chemical mixing and processing machine

As indicated in Figure 2, fabricated manual Textile Chemical processing machine can mix chemical solution by rotating machine handle by hand. The machine can mix the solution uniformly. After chemical solution preparation, the machine mixer can be removed and textile material can be impregnated into the solution for further processing.

Figure 3. Engaging and removing chemical mixer part (Photo shoot by Author).

As indicated in Figure 3, the mixer part has a bolt and can be engaged to the main shaft. The main shaft has a hollow teeth used for fixing of Mixer part. When Machine handle rotates, the mixing part can mix chemical solution.

CONCLUSION

The textile industries are main part of manufacturing production, employment and trade in many developing countries. Textile chemical processing involves different physical and chemical procedures in order to produce different products. Textile dyeing, printing and finishing are the most basic Textile manufacturing process.

The ever emerging need of sustainable Textile coloration, Printing and Finishing technologies has created great pressure on researchers and various stakeholders in Textile industry to build up highly competitive, resource efficient, technologically highly developed and sustainable methods to meet current industrial necessities. Basic knowledge and technical understanding of present developments is essential for all stakeholders in Textile industry to grow and remain competitive in worldwide market. Currently in Ethiopia there are many small scale enterprises participated in Manufacturing and processing Textile products. This sector created a big job opportunity for youths. Most of the enterprises are using traditional method of Textile Manufacturing and Processing. In order to enhance their income, different research works are required in order to develop advanced Textile production method, processing method and machines. The fabricated manual Textile chemical mixing and processing machine will have a positive impact for local Textile producers. The Author is planning to fabricate more machines for the community who participated in the sector.

Data availability: All data used for the current study available online.
Competing interests: The author declare that there is no competing interest.

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