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DESIGN AND FABRICATION OF PARAFIN WAX CUTTING MACHINE

Ashenafi Adugna

HOD, Department of Industrial Engineering, Institute of Technology, Dire Dawa University, Ethiopia

Abstract: **In industry at present uses the traditional method of cutting wax using long knife manually which involves more human effort, time taking process and the output of cutting process is not meeting the required level of size leading to long melting time, wax wastage, possibility of contaminated particle being added in the paraffin wax. All such factors affect the entire productivity of the company and quality of the product. In order to overcome such problems encountered in the industry, it is intended to design an innovative machine on considering engineering design approach seeking to produce fine output of paraffin wax by which the process can be improved in all the phases, eventually the productivity of the company is expected to be increased. This work aim that innovative design and fabrication of paraffin wax cutting machine is an attempt to solve problems encountered in kromoto industry in Dire Dawa, Ethiopia interns of simplifying the process of cutting paraffin wax. Solid woks simulation software can be used to model and simulate the machine that can be designed and fabricated.**

Keywords: **Wax machine, Design, paraffin wax cutting.**

I. INTRODUCTION

Now a day's studies show that natural degradation of plastic takes around 100 to 1000 years. This resulted in a substantial increase in plastic wastes dumped all over the world. Also these studies show that a major chunk of the global waste is composed of various kinds of plastic that can cause a negative impact on the environment. Plastic bottles, bags, and other such products can be seen floating in the rivers, lakes, and oceans. It can be said that such waste can be seen in almost all regions with human inhabitation. Similarly, our country is one of the victims of waste plastic products. To alleviate this problem the current technology has introduced benefits and methods of recycling waste plastics products. Fortunately, they are recycling and reprocessing of waste plastic products. Here after, collecting and gathering almost all type of waste plastic products will be one of our major tasks just to reuse and reduce our production cost and to make our contribution on the cleanness of our environment. We hope this will be astonishing news to the government, the general public as well as every individual who knows the environmental pollution caused by this non-biodegradable material.

KROMOTO Manufacturing PLC is conceived and established by two young visionary Dire Dawa dwellers under Ethiopian law to engage in the manufacturing of various types of Cosmetics and Plastic products. The firm is located in Dire Dawa Administrative region, Among these private investors, owners of Kromoto Manufacturing PLC have decided to join the manufacturing sector by investing in the cosmetic and plastic manufacturing business in order to put their own finger print up on the growth of the general economy of the country. Some of these uniquely designed products are, Avocate, Coconut, Tonic, Olive, and Lina Sachet. In addition to these, via its plastic manufacturing line, the company is producing plastic products with its injection molding machines and plastic film bags using film and bag making machines. Though our injection molding machineries are multipurpose heavy duty machines capable to produce various plastic products such as pre-form, Plastic Chairs, Cape for various types of plastic bottles, Plastic jars etc. they are busy now in producing plastic cups for our own cosmetic products.

II. LITERATURE REVIEW

Paraffin wax was first created in the 1850s when chemists first developed the means to efficiently separate and refine the waxy substances naturally occurring in petroleum. Paraffin represented a major advance in the candle making industry

because it burned more cleanly and reliably, and was cheaper to manufacture than any other candle fuel. Paraffin wax initially suffered from having a low melting point, however, a shortcoming later remedied by the addition of harderstearic acid. The production of paraffin wax enjoyed a boom in the early 20th century as a result of the growth of the meatpacking and oil industries, which created paraffin and stearic acid as by products. Paraffin wax is shown in fig.1, is a white or colourless soft solid derivable from petroleum coal or oil shale that consists of a mixture of hydrocarbon molecules containing between twenty and forty carbon atoms. It is solid at room temperature and begins to melt above approximately 37 °C (99 °F) [1] its boiling point is >370 °C (698 °F).[2] . Common applications for paraffin wax include lubrication, electrical insulation, and candles [3]. It is distinct from kerosene, another petroleum product that is sometimes called paraffin. Paraffin candles are odourless, and bluish-white in color. Paraffin wax was first created in the 1850s, and marked a major advancement in candle making technology, as it burned more cleanly and reliably than tallow candles, and was cheaper to produce. In chemistry, paraffin is used synonymously with alkane, indicating hydrocarbons with the general formula CnH_2n_{+2}. The name is derived from Latin parum ("barely") + affinis, meaning "lacking affinity" or "lacking reactivity", referring to paraffin's unreactive nature.

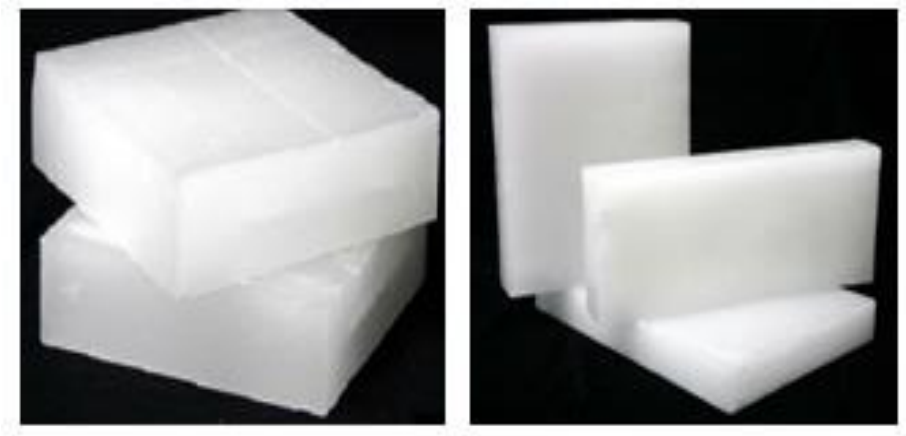

Fig.1 Solid Paraffin Wax

III. SIGNIFICANCE OF THE PROJECT

The company has been practicing traditional hand cutting process so as to reduce its size which involves in tedious human efforts, occurrence of accident, wastage of wax, non uniform size of wax, slow down melting process of wax, contaminated particles mixing with wax. These factors are being reflected in terms of defects in the finished product produced by company. The main significance of this project is to find the technical solution to the difficulties that the company experienced in cutting solid paraffin for the production of cosmetic and also provide specifically for the following advantages:

- The size of the wax to be cut is uniform and relatively smaller than the existing size.
- Reduced labour force, cutting time, enable timely feeding of wax to furnace lead to increase productivity of the company.
- Avoiding the possibilities of accident during hand cutting.

IV. METHODOLOGY

For the purpose of convenience and focusing on a specific part of the proposed project, we are using exploratory research method. Exploratory research might involve a literature search or not appropriate. The exploration of new phenomena in this way may help the researcher's need for better understanding, may test the feasibility of a more extensive study, or determine the best methods to be used in a subsequent study. For these reasons, exploratory research is broad in focus and rarely provides definite answers to specific research issues. The objective of exploratory research is to identify key issues and key variables. We use three data gathering techniques to understand current problem and system by interviewing, direct observation and document analysis. The documents which are analysed for the proposed project will be web sites, and many types of reports and pamphlet about paraffin wax cutting machine. After the qualitative data are gathered from those sources we will implement on paraffin wax cutting machine as a solution of the current manual cutting. The flow chart of the project as shown in fig.2.

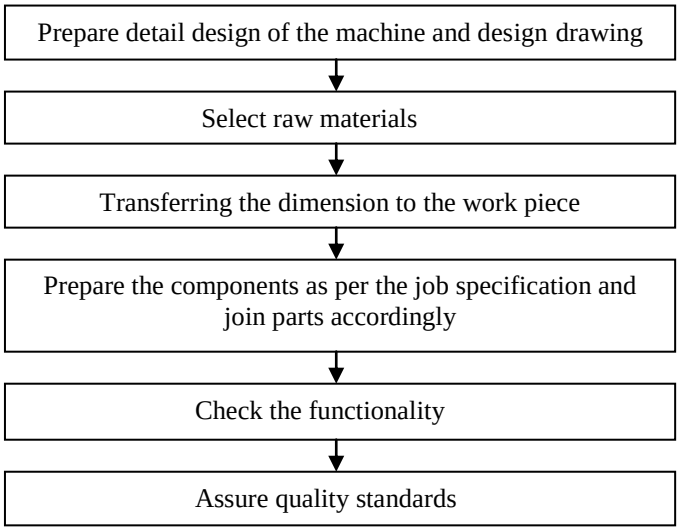

Fig.2. Methodology

V. WORKING OF WAX MACHINE

The project is made up of Low carbon steel of different metal structure. It has different components and operated manually as well as automatic, inbuilt with four subassemblies parts as shown in fig 3. This paraffin wax cutting machine has been designed specifically to be constructed in company workshops that have only a basic manufacturing capability, such as those that are to be found in small working area. Standard metric sizes of metal are specified in this project details. But other sizes can be substituted according to availability, providing some consideration is given to the strength and durability which the components require. The tools that are necessary to construct this machine are: welding equipment, drilling machine, lathe machine, and general tools such as files engineering square, hack saw, etc. The machine is a very useful addition to any manufacturing companies, enabling new and better ways of cutting solid wax. In many places, the facility to disintegrate can do away with the need for crashing will be much stronger and quicker to make. The feedstock for paraffin is slack wax, which is a mixture of oil and wax, a by product from the refining of lubricating oil. The first step in making paraffin wax is to remove the oil (de-oiling or de-waxing) from the slack wax. The oil is separated through crystallization. Most commonly, the slack wax is heated, mixed with one or more solvents such as a ketone and then cooled. As it is cooled, wax crystallizes out leaving oil in solution. This mixture is filtered into two streams: solid (wax plus some solvent) and liquid (oil and solvent). After the solvent is recovered by distillation, the resulting products are called "product wax" (or "press wax") and "foots oil". The lower the percentage of oil in the wax the more refined it is considered (semi-refined versus fully refined). The product wax may be further processed to remove colours and odors. The wax may finally be blended together to give certain desired properties such as melt point and penetration. Paraffin wax is sold in either liquid or solid form.

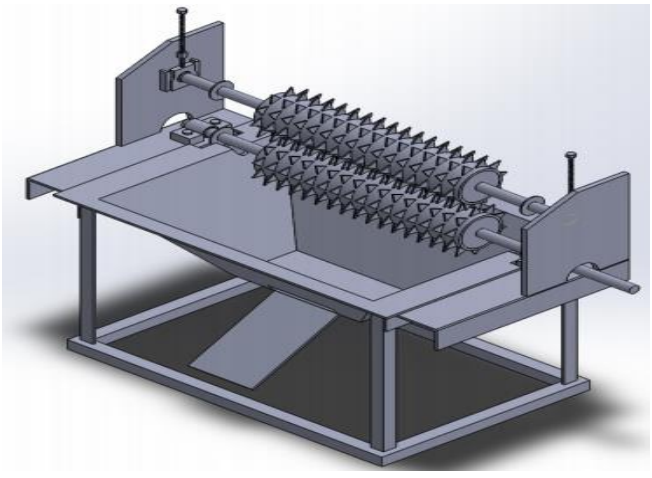

Fig.3 Wax cutting machine

VI. DESIGN

The engineering design process is the formulation of a plan to help an engineer to build a product with a specified performance goal. This process involves a number of steps, and parts of the process may need to be repeated many times before production of a final product can begin. It is a decision making process (often iterative) in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process the establishment of objectives and criteria, synthesis, analysis, construction, testing and evaluation are the basic. The engineering design process is a multi-step process including the research, conceptualization, feasibility assessment, establishing design requirements, preliminary design, and detailed design parts diagram as shown in fig 4 to 8.

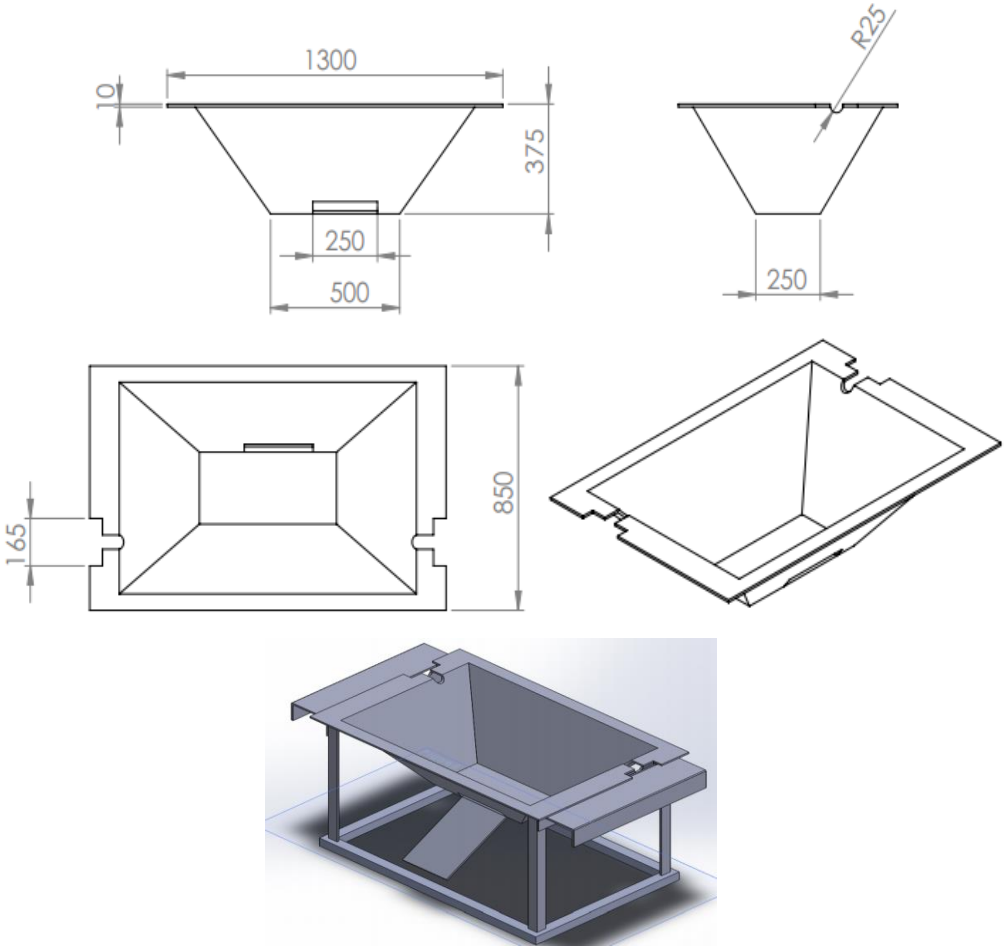

Fig. 4. Container box

TABLE I: Material

S.No	Item	Quantity	Unit Price	Total Price
1.	Shaft	2	2000	4000
2.	Bearings	4	300	1200
3.	Screw Plunger	4	500	2000
4.	Spring	4	200	800
5.	Sheet Metal (2m x 1.5 m x3 mm)	2	1000	2000
6.	Flat Bar (30 mm x 4 mm x 6 m)	1	500	500
7.	Steel Pipe (Square) 60 mm x 60 mm x 4	6 meter	750	750
8.	Anchor Bolt	4	125	500
9.	Bolts and Nuts (M 8x1.0x100 mm)	10	3	30
10.	Motor	1	3000	3000

11.	Pulley (Diameter 320 mm)	1	1000	1000
12.	Pulley (Diameter 50 mm)	1	500	500
13.	V- Belt (750 mm Length)	2	300	600
14.	Hinge and Handle – Standard	2	50	100
	Total		16980 INR	

A. Material Selection

To prepare any machine part, the type of material should be properly selected, considering design; safety .The selection of material for engineering application is given by the following factors:

1) Availability of materials

2) Suitability of the material for the required components.

3) Suitability of the material for the required components.

4) Cost of the materials.

The machine is basically made up of mild steel. The reasons for the selection are Mild steel is readily available in market .It is economical to use and is available in standard sizes. It has good mechanical properties i.e. it is easily machinable .It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure. It has high tensile strength. Low coefficient of thermal expansion.

B. Force Calculation

Force required cutting the wax

F= Max. Shear Strength x Area

= 30 x 1.5x 25 = 1125 N

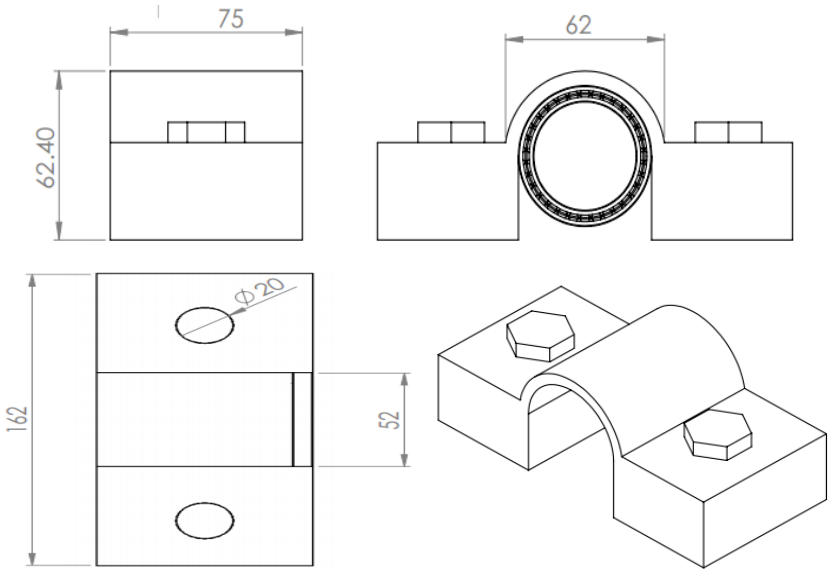

Fig.5. Coup assembly

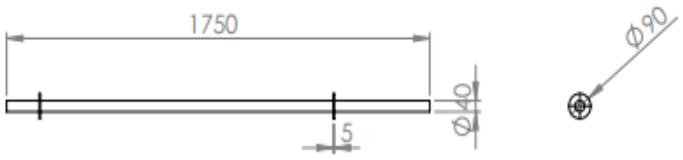

Fig.6. Driver Shaft

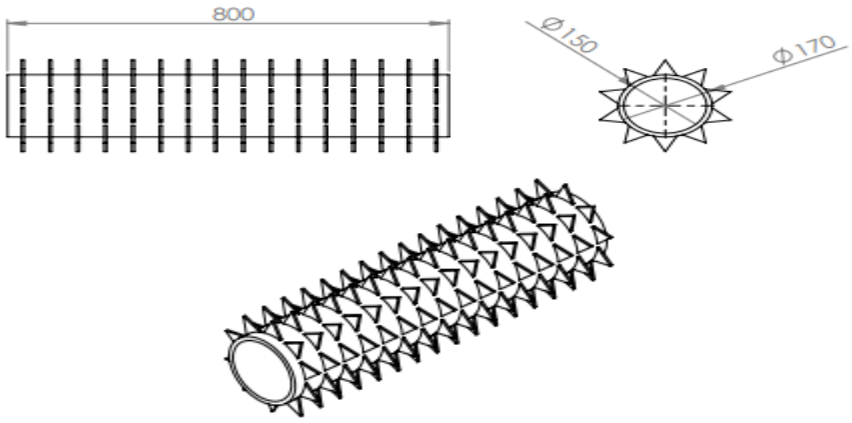

Fig.7. Roller with blade

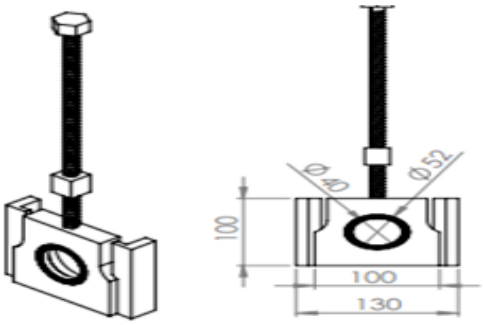

Fig.8. Shaft holder assembly

VII. CONCLUSION

In industrial applications, it is often useful to modify the crystal properties of the paraffin wax, typically by adding branching to the existing carbon backbone chain. The modification is usually done with additives, such as EVA copolymers, microcrystalline wax, or forms of polyethylene. The branched properties result in modified paraffin with a higher viscosity, smaller crystalline structure, and modified functional properties. Pure paraffin wax is rarely used for carving original models for casting metal and other materials in the lost wax process, as it is relatively brittle at room temperature and presents the risks of chipping and breakage when worked. Soft and pliable waxes, like beeswax, may be preferred for such sculpture, but "investment casting waxes," often paraffin-based, are expressly formulated for the purpose. In future the mechanism can be developed to use this wax machining fully automated.

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Biography:

Ashenafi Adugna, HOD, Dept. of Industrial Engineering , DDIT, Dire Dawa University, Dire Dawa, Ethiopia has academic experience of 8 years and research experience 5 years. He has obtained his Master Degree in Manufacturing Engineering. He has got wide exposure in the field of Industrial Engineering, Production, Project planning, Erecting, Commissioning Utility and Maintenance.