Leather Sanding and Burnishing Machine for Small Scale Indigenous Leather Industry

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Abstract: The purpose of this research is towards the production of dual purpose leather sanding and burnishing machine for small scale industries to help alleviate the health implications associated with the indigenous technique of burnishing and also to make available to leather tanners and other leatherworkers an equipment useful for sanding off excess film of flesh left after tanning. In pursuance of this, the researchers used the qualitative research method whereby the observational, descriptive, and practised based approach were used in the production of the designed equipment. The successful production of the equipment and subsequent test run for sanding and burnishing, affirm the fact that inward retrospection towards the use of science, technology and innovative measures in comparative areas of advantage would lead to achieving competitive advantage in the global market and for national gain.

Keywords: Sanding, Burnishing, Leather, Tanning, Technology

1. Introduction

Globally, leather work has contributed immensely, in the life of man from the prehistoric period to this present ages. During the prehistoric era, man depended on the skins of animals basically for food (meat) and to protect himself (body) against the harsh weather conditions. As the years passed, man was able to transform the skins into a material that could become less susceptible to decay and shrinkage called leather. The processing of rawhide and skin general termed as pelt, into leather is known as tanning, the pelts are treated with chemical agents known as tannins these are derived from vegetable or mineral sources. The tanning process covert the putrescent pelt into long lasting, durable and versatile natural material that can be used for various purposes (National Centre for Technology Management (NACE- TEM 2008).

The versatility of the leather has made it necessary for various individuals and corporate bodies to venture in transforming and redefining the various processes in getting the material well processed for utilitarian purposes. The major efforts at developing technologies to harness the utility value of leather have been concentrated in the advanced countries as compared to the developing one’s despite the fact that leather abound in many of developing countries. According to the UN Millennium Project (2005), the increasing technological advancement globally, has not seen developing countries involvement in the creation and production of technological knowledge to take advantage of their areas of comparative strength. The way forward for developing countries as opined by Siyanbola, et al (2012), is that, it makes sense that poor third world economies might be better situated in the activities of worldwide competition if, instead of solely concentrating on catching-up with the developed world, they look inwards to de-ploy science, Technology and innovation (STI) in particular territories where they have near point of preference. These comparative advantage could then be utilized to accomplish competitive advantage.

Considering the challenges faced by the Ghanaian indigenous leatherworkers the researchers sought to identify local technological means by which some of these challenges could be overcome to create opportunities that would bring about local economic transformation and even for global competitiveness. Siyanbola et al (2012) have stated that, such situation would happen when technologies are enhanced and standardised through the application of science and technology. With concentration on small and medium-sized production ventures, businesses could be established around these industries which would cultivate national creativity, evolve avenues for employment and produce wealth.

Sanding as defined by The Free Dictionary (2016) is the act or process of polishing or smoothing a surface with sandpaper. There are a lots of sanding machines at the local market however, these are mostly designed for sanding wood and therefore inappropriate for use on leather. Kirkpatrick, ed. (1983), also indicate that sanding or glasspaper are generic names used for a type of coated abrasive that consists of sheets of paper or cloth with abrasive material glued to one face. However, the sandpaper as used in woodwork is the same as...
required for sanding leather, different grains are used to achieve the required surface textures. Wikipedia (2016), explains that, there are many ranges of sandpaper, with differences in the paper or backing, the material used for the grit, the grit size, and the bond.

One of the major factors in leather processing is finishing, however, the finishing processes come in different forms and processes, they include trimming, colouring, fat-lacquering, sanding, burnishing and stretching to achieve softness (ISTT. 2014). Two of the major areas in finishing which affect the quality of leather after tanning are sanding and burnishing. The research is geared towards finding simple and easy to assess technological means to support Ghanaian indigenous tanners in two of the finishing processes in tanning and leather product manufacture; these are Sanding and Burnishing. Baker (2011), explains that finishing involves mechanical means to smooth and shape leather, this operation is thus not limited to tanning process alone but at the post tanning period of processing leather items.

Burnishing in leatherwork is a major operation that take place in the tanning process and post tanning process in the tanning process broadsheets of leathers are burnished to give it a finish shine. It been described as a Cold Working process which produces a fine surface finish by the planetary rotation of hardened rollers over a surface as a result a shiny surface of material is achieved, it toughens the surface and protect it against wear and corrosion. Wikipedia (2016), defines burnishing as, the plastic deformation of a surface because of sliding contact with another article or object. Outwardly, burnishing slurs the texture of an uneven surface and makes it shinier. burnishing may happen on any sliding surface if the contact pressure locally surpasses the yield strength of the material”. Advanced leather industries use heavy-duty roller machines for burnishing large sheets of leathers. The operations of indigenous tanners do not involve such activity.

Ghana as a developing country has advantage in the processing and production of leather items, however, the technology used by local tanners have not seen any major improvement, therefore the gains that could have been obtained in the industry is forth coming. Boahin (2008), has indicated that despite the fact that locally produced leather works attract a number of people, particularly tourist who visit the country, yet the technologies used in the industry have remained the same thus indicating that quality indigenous tanned leather have not seen improvement to further enhance their value. Boahin (2008), is of the view that, in the indigenous Ghanaian leather industry, the finishing techniques used has remained the same; partially dried dyed leather is hooked on a stick and held upward with the lower edge resting on a block or a hard surface, then with pressure on the leather by using the side of one foot as in Plat 1, it is pulled upwards repeatedly till it becomes soft and glossy a process known as burnishing which form part of the post tanning operations or activities.

Boahin, Asubonteng and Adu-Gyamfi (2013) have indicated that indigenous leather tanners are not able to remove all the flesh from hide and skin during tanning thus little films of flesh are left on flesh side of finished leathers. Sanding and Burnishing as post tanning finishing processes are required by both small scale cottage tanneries and heavy duty industries, however, the differences in their operations are with the technology used, whilst the big time tanneries use motorized means to perform sanding and burnishing, the small scale Ghanaian indigenous tanneries use physical energy for the same activity as in Plat 1.

Despite the fact that the indigenous approach of using physical energy for burnishing leather have helped leather workers over the years, the approach has its resulting complications; among these are the stress and strains involved, the laborious nature of the process, the health implications such as physical deformities they experience after years of work as evidenced in plate 2, and uneven (undesirable) marks and scratches created on the surface of the leathers, thereby distorting or impeding the accomplishment of the required quality.
Even though the local tanners and leather artisans desire to adopt some more advanced mechanisms to make quality products, however, known machines for sanding and burnishing are far from their reach, they are foreign and cannot afford them.

On the event of post tanning sanding, Ghanaian indigenous tanners do not consider its application, and research have proven that lack of post tanning sanding is one of the major causes of offensive odour that discourage many patrons of locally m leather products. Boahin et al. (2013), reveal that flesh particles left after tanning are among the causes of fungal attack on indigenous tanned leathers and production of offensive odour whenever the leather come into contact with moisture. This condition affects the patronage of locally tanned leathers and finished products.

The availability of a sanding and burnishing equipment would boost the local leather industry practically these two finishing processes make use of friction and pressure, the consistent application of these on leather would enable even sanding on the flesh side and gives the leather its shiny and glossy finish on the grain side. Currently, the manual operation of using human energy where friction and pressure result in inconsistent even surface value is and leather tha have remnant of flesh. Considering the challenges confronting the small scale leather industries in Ghana the researchers sought to design and produce a dual purpose machine with local raw material for leather sanding and burnishing to meet the needs of small scale industries.

2. MATERIALS AND METHODS

The researchers used the qualitative research method where the descriptive and the practiced based Research approaches were applied for observation, narrative description of the sanding and burnishing methods used by indigenous leatherworkers and the processes used to develop an innovative equipment that will help in reducing the hardship workers go through in sanding and burnishing leather.

**Designing Process**

The needs and specification of the tanners were taken into consideration during the design process. These include the following; Cost, Sustainability of the machine, Size of machine in respect to the size of their work shop, Power source which is electrical, Thickness of the leather, Efficiency, Safety and Speed. The researchers developed different sketches out of which figure 1 below was selected.

**Figure 1.** selected sketch for the project.

The design was rendered in three dimension through the use of rhinoceros’ software as in the figures following figures (8,9,10,11).
Identified component for the machine with various measurement. Figure 2 a, b, c

<table>
<thead>
<tr>
<th>Component</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polypenco and Abour</td>
<td>55cm, 31cm, 19cm</td>
</tr>
<tr>
<td>Motor stand</td>
<td>16cm, 19cm, 50cm</td>
</tr>
<tr>
<td>Over-Arm</td>
<td>43.25cm, 43.18cm</td>
</tr>
</tbody>
</table>

**Fig. 2(a)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame</td>
<td>77.47cm, 49.26cm, 92.71cm</td>
</tr>
<tr>
<td>Supporting bracket</td>
<td>15cm, 43.18cm</td>
</tr>
</tbody>
</table>

**Fig. 2(b)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wooden board</td>
<td>77.47cm, 48.26cm</td>
</tr>
<tr>
<td>Pulley</td>
<td></td>
</tr>
<tr>
<td>Electric Switch</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 2(c)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td></td>
</tr>
<tr>
<td>Power screw</td>
<td></td>
</tr>
<tr>
<td>Rubber wheel</td>
<td></td>
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</tbody>
</table>
Fig. 3. Assembled parts of the machine
Rhino rendition of the selected sketch in different views as in figure 4 below.

![Fig. 4 Rhino rendition of design](image_url)

Tools Employed in the Construction of the Machine

- Drill bits: it is fixed into the machine for the creation of holes. Adjustable spanner: used for closing and opening of bolts and nuts. Veneer callipers: used for measuring the inner and outer diameter of objects. Bench vice: used for holding objects firm during cutting. Scribing block: used for making centric holes in the pulleys. Cutting disc: fixed into the cutting machine for cutting metals. Grinding stone: fixed into the cutting machine for grinding metals surfaces to smoothen them. Screw driver: for driving screws into holes. Hack saw: cutting metals. Try-square, Spanner. Tape measure

Equipment:

- Lathing machine, Drilling machine, Hand drill, Slotting machine, Shaping machine

Materials used for the construction of the machine

- Mild steel (Metal), Motor engine, Polypenco, Bearings, Bolts and Nuts, Rails, Electrodes, Pulley, Belt, Power screw

Constructional Process: Building of the frame involved the following:

- Marking and cutting of four mild steel of length 93cm which served as the stand for the frame.
- The top and base of the frame were also marked and cut-out with the help of a cutting machine.
- The various parts of the frame were assembled and temporary welded (tacking) together to form the frame of the burnishing machine.
- Rough edges after the welding were grinded with the grinding machine to give it a smooth surface.

Plate 4. Welding and grinding of the frame

Construction of the overarm and double bracelets

- For the double bracelet, two mild steel of length 43cm were cut and another of length 5cm were also cut. The small mild steel was placed in-between the two mild steel and with the help of a clamp, they were held firmly together and welded.
• The double bracelet was welded to the frame and a hole was drilled in the overarm in order to accommodate the arbor.

**Construction of the motor stand**

• Three pieces of mild steel with length 15cm were marked and cut with the saw for the motor stand.
• Sharp edges were chamfered by grinding to prevent injuries.
• They were then welded together to form the stand which was in turn welded to the base of the over-arm.

**Assembling of the arbor and polypenco**

• With the help of a saw, the foam covering the arbor was removed.
• The arbor was lathed with the lathing machine. The lathing was done to reduce the diameter of the arbor in order to correspond with the diameter of the bearings.
• The drilling machine was used to drill hole in the polypenco and it was lathed.

**Assembling of the arbor, polypenco, and the over-arm**

• The arbor was inserted into the polypenco and the bearings were fixed at the ends of the arbor as one unit, this was next inserted into the hole in the over-arm and with the use of bolts and nuts it was fixed on the over-arm.

**Assembling of the parts**

The various constructed parts of the machine were assembled. The motor was fixed to its stand on the over-arm. The over-arm together with the motor were placed in between the supporting brackets. In order to prevent the over-arm from falling, it was supported with a small metal plate which was screwed to the supporting brackets. Wheels were welded to the base of the frame for easy movement.

Two pulleys were fixed. One at the far end of the arbor and the other at the end of the motor. Belt was used to connect the pulleys together. The power screw was fixed beside the over-arm which allows the arbor to move up and down.

**Fixing of starter to ensure electricity connection**

The starter was attached to the machine, connected to the motor and to a 3 yards three face power cable. However, before the placement of the starter, a metal was welded to the frame which served as the support for the switch. Holes were drilled into the metal for screwing.

**Finishing of the machine**

With the help of the grinding machine, final grinding was done to smoothen all rough edges. The various part of the machine was dismantled after it was tested. The frame, supporting brackets, the power screw and the bearing were painted green and the over arm and the motor were also painted ash. The wooden board was put on the surface of the frame and with the help of the drilling machine, holes were drilled at various parts of the surface. It was then screwed on the frame with bolts and nuts.
3. Discussion of Results

Test 1

After testing the burnishing machine, it was realized that the burnishing was effective on the red leather. The glossy and shiny effect was achieved on the leather. However, Researchers found out that, during the burnishing process the polypenco was melting as a result of the friction and heat created in the process.

Plate 37: Red leather after burnishing with the polypenco

Test 2

The melting of the polypenco resulted in the replacement with lathed wood (teak wood). The wood was used in burnishing the coffee-coloured leather which brought about a shiny and glossy effect on the surface of the leather. It was further tested on the cream leather, red leather and they were all successful.

Plate 18: Burnished coffee-coloured leather using the wooden (teak wood) roller.

Test 3

Upon the realisation that the polypenco could not be use effectively for burnishing it was covered with sandpaper of grade eighty (80) and tested it on indigenous vegetable tanned leather; the result was successful as in plate 19 below.

Plate 19: The test on flesh side of leather after sanding

This paper has revealed that the development of the indigenous leather industry can best be achieved when efforts are made towards finding appropriate local technologies that are easily accessible to support the industry this confirm Siyanbola et al (2012), statement that people in developing economies should look inward to de-ploy science, technology and innovation in practical areas where they are strong and thus have comparative advantage.

The test on sanding demonstrated effective removal of films of flesh from the grain side of the leather, also even surface texture was achieved, this, therefore make it possible for both sides of leather to be used whenever necessary. The performance of the machine on sanding would make it possible for Ghanaian indigenous tanners to incorporate sanding activity to their work an activity which...
they have overlooked over the years; an activity which the Ghanaian indigenous leather tanners over look, and therefore always having the problem of offensive odour and fungal attack as revealed by Boahin et al (2013).

The results from the burnishing work on the indigenous tanned leathers were successful, thus the glossy effect which took very laborious and time consuming efforts of indigenous tanners to achieve was done in a limited and without much energy supping effort of the leather worker. Burnishing active cannot be done away with, since tanned leathers come crumpled after going through the vigorous tanning processes. To achieve effective burnishing without having to wait for very expensive imported machines, the successful use of locally available materials to produce an alternative will be very useful for the industry in Kenya (NESC, 2010).

4. Conclusions

The production of a single equipment that serves important dual finishing activities of sanding and burnishing through the use of local technology is a positive step in helping to overcome the hindrances affecting the competitive value of indigenous Ghanaian tanned leathers and finished products. The research thus satisfies such policies of some developing countries that are geared towards self-reliance in industrialisation, which Ghana is not exempted. Researchers believe that if conscious efforts are made towards finding solutions to challenges facing local craftsmen in the three major areas of design concepts in its entirety, material accessibility and technical innovation for processing in manufacture, a lot could be achieved with the available limited resources to enhance productivity.

5. References


