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Open-air leather dryer: An innovative equipment for indigenous leather industry in Ghana

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Abstract

The research is focused on the deficiencies affecting the open-air drying method used Ghanaian indigenous tanners, where quite a number of pelts are hung on drying lines or spread on the ground for air or sun drying but are susceptible to the gathering of dust which cause irreparable stains on the leathers. The weight of the soaked pelt or leather also do not make hanging effective and tanners do not find it easy removing them forth and back during rainy seasons. Based on the identified drying deficiencies confronting indigenous tanners, the researchers sought to use the qualitative research method in pursuance of which the observational, studio based research and descriptive research designs were used, to design and produce an open-air leather drying equipment in wooden. design and produce a blue print drying equipment that can easily be reproduced by local craftsmen. The finished equipment enabled leather to be stretched on both sides of flat wooden boards or plywood that are fixed into specially designed slots that support ventilation, the arrangement of the leathers on the slotted boards does not give room for dust or dirt to settle on them and are thus protected from stains. Besides, it is also easy to lift the device and its content from one place to another in the event of unfriendly weather conditions. The drying equipment will serve as a blue print for the local tanning industry, and it will not require any extraordinary skills to manufacture it, the use of wood as the core material also makes it easy for reproduction by average woodworker or carpenter.

Keywords: Open-air dryer; leather; tanning; moisture; equipment

Introduction

The indigenous leather industry has been in existence in Ghana for so many years before the colonial era. Initially the people processed leather as a past-time activity after animals were slaughtered for their meat and their pelt (raw hides or skins) processed through curing and tanning into leathers, cured pelts were traditionally used as drum heads or as mats for seating or worshipping purposes. Cured pelts were sometime taken through vegetable based chemical processes known as tanning, and the finished product of these are tanned leathers, which were used to produce some basic domestic items, and the key ones were bags and footwear. The increasing demand for leather products brought about the formulation of indigenous leather industry since people chose to practice it as a specialized vocation Sharpouse (1995)^[13].

Leathernet (2015)^[2] has indicated that, together with wood, leather constituted the foundation of greater part of ancient technology, and the National Economic & Social Council of Kenya (2010)^[1], have also stated that, the leather industry is one of the major agricultural subsectors that can contribute to achieve economic advancement. World bank report (2015)^[3] state's that, the development of the leather sector offers an opportunity for industrialization and diversification of exports, and these would hopefully enhance Kenya's strive to become an industrialized, middle-income country by 2030. The universal role of the leather industry is also attested to by Gudro, *et al.* (2014)^[9], as they state that the leather production industry is one of the earliest oldest technological ventures in the world, which these days assumes a great part in the monetary system globally. Looking through the historic era, we can state that leather is a material capable of providing sustainability, on the grounds that while individuals eat meat, they will have this raw material accessible.

Unfortunately, in Ghana the leather industry has not received the needed recognition despite the availability of sufficient animal husbandry to promote the industry. The provision of improved technology that could easily be accessed or secured by local tanners would be a booster for the industry.

In countries where leather tanning receives governmental recognition as potential source of income, opportunity most often exist for obtaining some of the required equipment. Haghi & Rondot (2004) ^[7] have stated that, Leather Tanning has turned into a vital industrial development globally, like other technologically driven process businesses. Be that as it may, a portion of the unit operations required in this industry, particularly the drying procedure, are still grounded on practicality and tradition, with very little reliance on scientific principles.

The people who are often attracted to the tanning vocation and are currently operating tanning in most developing countries have no or very low educational background, this affects their thoughts of securing and even operating modern equipment. Haghi & Rondot (2004) ^[7] have stated that, in spite of the fact that drying of pelt or leather is an old and well recognised procedure, it is to a great extent controlled by the reliable guidelines. This is not due to the absence of comprehension of the fundamental physical principles required as because of the absence of information on the rates of different exchange components and how they interrelate. Sarkar (2005) ^[12] has it the kind of information required for the use of contemporary control methods to the drying procedure of pelt and leather is still generally obscure, especially among traditional tanners.

In order for the Ghanaian indigenous leather industry to surge forward without waiting for highly expensive imported machinery, and yet be considered equally as prominent force in the leather industry as found with some developing countries such as Kenya, Ethiopia and Nigeria, it would require the production of innovative equipment based on easily adaptable design concept that can be produced with locally available materials. Such approach would hopefully make it possible for small scale leather industries located in small and big towns improve in the production of leather and leather goods.

Nick (2010) ^[6], have stated that there are important processes that help to determine how tanning activity will occur. Among these processes is how pelt or leather is dried. The processes in preparation of leather leave a lot of moisture which need to be removed or dehydrated at appropriate temperatures rates. Drying according to the online Dictionary (2016) ^[4], is the common word that reveal the lack or deficiency of water or other liquid or absence of moisture. Greensmith, (1998) ^[4] has defined drying as evaporation process involving the removal of solvent or water from a liquid, semi-solid or solid state. Nick (2010) ^[6], reveals that there are four different types of drying and these are air drying, vacuum drying, pasting and toggling. the most common ones used by indigenous tanners are Sun and Natural air drying, Sun drying is bothered along the lines of

hot air drying, in this instance, air heating is serve as the driving agent for accelerating drying. Natural air drying on the other hand, consists of a situation where materials are dried with the force of dry air. The geographic conditions in Ghana make it possible for leather to be dried under friendly and reliable temperatures that allow pelts and leathers to be dried at regular rate, however, the extent of drying depend largely on the end usage of the leather. In sun drying excessive heat from the sun is avoided to prevent force drying that could result in excessive shrinkage which can affect the quality of the finished leather. The choice of dryer type depends on the characteristics which make it suitable or unsuitable for identified purpose or specific application (Mujumdar 2015) ^[5]. The rate of drying invariably determines the final texture, consistency and flexibility of the leather product.

Drying Techniques used by Indigenous Craftsmen

Amongst the challenges facing Ghanaian indigenous tanners is the mechanism used for drying leather, tanners often dry leathers on the ground and on drying lines most often under the scourging sun, unfortunately these methods do not support the achievement of quality leathers, these methods slow down production and leathers dried on the ground sometime gather dust and are susceptible to stains as a result of the foreign matters that drop on them. The leathers are dried with the grain side facing upwards and in a sunny condition, excessive temperatures caused by the direct heat of the sun result in hardened leathers which will require extra strenuous measures to soften them. This unpleasant situation necessitates the development of alternative technology that can be used to improve the processes needed for determining the final texture, flexibility and consistency in the production of quality leathers. Lui, *et al.* (2011) ^[8], confirms the importance of finding alternative drying technology for indigenous tanners by stating that One of the significant mechanical processes in the leather manufacturing process is the vaporization of excess water from leather. Lemam (2003) ^[10] has emphasized that leather attains its final flexibility, consistency and texture in the drying operations. Besides, lack of adequate spaces also hinders the work of tanners resulting sometime in the congestion at the drying areas. The production of drying equipment that can be manufactured by woodworkers or carpenters without having to acquire higher technical skills will make it possible for accessibility by indigenous tanners.

Sample view of mechanism for drying pelts and leathers as used by indigenous tanners. This technique in plates 1 and 2 are particularly done during the curing stage of processing pelts in the open air when they are held down with wood or bamboo pegs or long nails as in plate.



Plate 1: Drying pelt on the ground



Plate 2: Drying Pelts on drying lines



Plate 3: Drying leathers on the ground

This technique is specially used when freshly skinned pelts are meant to be used early.

Unavailability of specially designed stretchers causes students to stretch their pelts and leathers on any available surface as in Plates 4, 5, and 6.



Plate 4: Stretching on an old plywood



Plate 5: Stretching on a workshop table

Materials and Methods

Designing Process of Open-Dryer

The design indicates a leather dryer that has all of its sides uncovered to allow air to pass through naturally for gradual drying of pelt or leather. Specially designed stretcher boards

on which leathers are supposed to be stretched are to be slotted into the dryer.

The design has equally spaced out slots on opposite sides through which the stretcher-boards are to be slotted (figure 1 and 2).

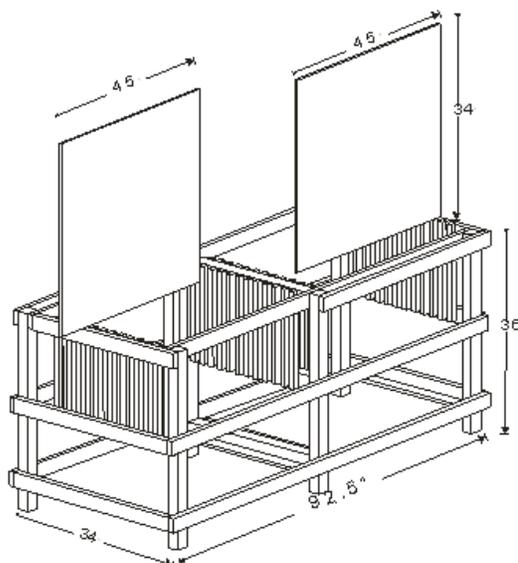


Fig 1: Slots for stretcher boards
Pictorial representation of the Open leather dryer in rhinoceros.

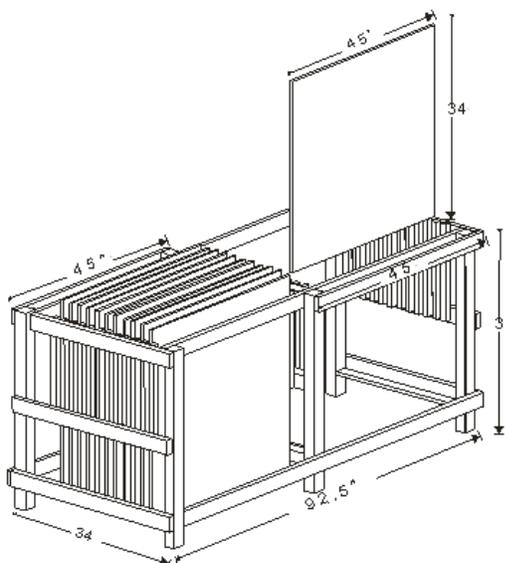


Fig 2: Stretcher boards slotted in the dryer.



Fig 3: Side view



Fig 4: Three-quarter view

Constructing the Open-Leather Dryer

The designer sought for the assistance of two technicians (furniture maker and electrician). Two different sets of equipment were considered for drying pelts, leathers and fur. These were the electric powered dryer and the open-air dryer. The following materials, tools and equipment were used in producing the open-air dryer in wood according to the selected design. The following materials and tools were employed: Red-wood Sanding sealer, Sandpapers, Acrylic paint, ½ inch Plywood, Hammer, Pincers, Square, Plane, Saw, Nail, Tape measure, Sanding machines, Planning machine, Combined sawing surfacing and mortise.

Working Process

Step 1, Treatment of wood; Wood is treated with a chemical known as “desban” to protect it against the attack of woodborers, and afterwards left to dry.

Step 2, Preparation of boards. The boards were planed with mechanical planing machine. This was done to give it a smooth, even surface texture, equal thickness and straight edges, plate 72 and 73.

Subsequently, the boards are given equal dimensions and sawn into the various widths using the combined sawing surfacing and mortise device.

Step 3, Cutting boards into required dimensions; various lengths and dimensions were cut using the saw. Afterwards the plane is used to give smooth surfaces and straight edge to all cut boards.

Step 4, Assembling the slot bars that would guard the stretcher boards

(a) Frames for the two ends were first to be formed, each had three bars and these were at the top, middle and bottom ends, (Plate 6)

(b) The pieces of wood that were sawn for creating slots for the stretchers were fixed on the end frames, linking the top bars to the middle bars on each frame at equal opposite positions, (Plate7)

Step 6. The four main bars joining the ends were fixed and nailed in grooves that have been made in the two opposite frames to give it a firm support to form the upright post

Step 7. The full length of the frame is divided into two chambers, (Plate 8) one chamber for smaller stretchers and the other for bigger ones.

Step 8. Two short bars are nailed at the base of the opposite widths below the slots for the stretchers to rest on when they are slotted.

Step 9. Two pockets are made at the opposite sides along the lengths of the frame to serve as rooms for keeping stretching pins. (Plate7).



Plate 6: Finished stretcher guard

Step 10. The work was subjected to massive sandpapering, three abrasive sheets of different grades (grades 60, 80 and 120) were used to sandpaper the work. The first and the second sandpapering are preceded by the application of sanding sealer. The sanding sealer seals all the pores of the wood for better finish fixing.



Plate 7: Trough for stretching pins



Plate 8: The painted finishing

The work was finished by painting it with acrylic paint to protect the wood from excessive exposure to the heat of the sun and rain. Plate 79.

Cutting of the stretcher boards

Step 11 A two quarter plywood is selected for use as stretcher boards. Each plywood is then cut into three equal sizes with

the exception of those that are meant for stretching extremely bigger leathers (plate 9). Holes are drilled through the boards as vents. They are then slotted into the various chambers. Step 12. The stretcher frame is given a tan finish to beautify and protect it.



Plate 9: Stretcher board



Plate 10: Stretcher guard with boards

Test of equipment

- The following test were done in the warm season and under the sun
 Experiment 1. Six sheets of fleshly-skinned pelts that had been soaked and removed from the brine were stretched in the dryer and kept in the open- air. It took eight (8) hours to dry. This experiment was repeated indoor and it took 12 hours to dry.
- The following test were done in the wet season
 Experiment 2. Six sheets of fleshly-skinned pelts were fixed in the dryer and kept indoors. These took twelve (12) hours to dry. Another set of six leathers were fixed in the dryer and it took 24 hours to dry adequately.

- Test on secondary treated leather (indoor)
 Experiment 3. Six indigenous tanned leathers and six tanned goat fur that were under-going secondary treatment were stretched and dried in the dryer. The drying period was three hours for the leather and four for the goat fur.
- The following test were done in-doors in a warm season
 Experiment 4. Six indigenous tanned leathers that were under-going secondary treatment were stretched and dried in the dryer at outdoor, for three hours. Similarly, six tanned furs from goats were also stretched in the dryer and kept-indoor. These took eight hours to dry.



Plate 11: Worker using the drying boards



Plate 12: Drying leather on the dryer

Results and Discussion

The equipment was tested at different instances, that is outdoor under the sun and indoor with pelts and leathers, it is established that leathers dried in the dryer at both instances, dried gradually and became smooth and supple. This is unlike the situation where leathers dried directly under the sun with the grain side facing upwards, thus allowing foreign particles and bird feces to drop on them to cause stains. The dryer is mobile and could be carried to any point. This will therefore make it possible for students and other leatherworkers to dry their materials at all times, particularly during rainy seasons. The test on the dryer demonstrates the effectiveness of the equipment for drying pelt, leather and fur; and that leather will maintain some degree of softness when allowed to dry gradually. The equipment had the capacity to contain adequate number of leathers since both sides of flat boards could be fixed or tacked on with leathers. The spaces between each board as indicated by the separate slots allow free flow of air over the stretched leathers, as a result uniformity of dryness is achieved on each leather, the positioning of the dryer against the direction of the wind contribute to the acceleration of dryness. The timing for drying of the leathers however depended on the humidity at any given period however, shorter period of about 24 hours to dry during wet seasons and 8 to 12 hours during dry seasons, Besides, the equipment again saves space because students and craftsmen do not need large spaces for drying. The research established that, the differences in the drying rate is the flow of air which was rampant in the open space than indoor.

One major problem which Procter (1922) ^[11] emphasized as a worrying situation faced by indigenous tanners is open air drying which results in discolouration resulting from dirt and environmental impact. This problem has been avoided in the equipment produced through the suspension of the stretcher boards from the floor. The half foot space left between the ground and the base of the stretcher boards prevents direct contact of the leather from the dust.

Conclusion

The research has indicated that the qualities of leathers that were dried on flat boards with grain side up under the sun were low, they became boney and stiff and often stained after drying, as compared to those dried in the dryer that were

protected and came under some form of control against excessive heat and unwanted stains. The research demonstrates the possibility of making available locally, simple equipment that can be used by indigenous tanners to improve upon the quality of finished products and also increase production. The open-air leather dryer thus provide opportunity for tanners to acquire an improved drying device for enhanced productivity.

Recommendation

Since the production of the drying equipment has been localized through the materials and techniques employed, it is recommended that carpenters are empowered through workshops and practical training to develop the capacity to produce such dryers for tanners to buy to support their tannery activities.

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