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Innovative Steamer for Plasticizing Rattan

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ABSTRACT

Rattan is an outstanding non timber forest product used for many applications in art and construction. One of the many characteristics of this outstanding forest product is its ability to be bent, curved or bowed into forms. Bending of these materials by the traditional craftsmen requires the use of blow torch, which lives burnt marks that affect the rattan and the resultant market value of its products. A high temperature steaming facility for plasticizing of local rattan varieties in Ghana was designed and constructed. Materials used include locally manufactured heat retention bricks, locally compounded refractory mortar and gas burners rated at 158 kilojoules. This innovative steamer is an answer to the blow torch method of rattan bending used by traditional craftsmen, production units and a number of institutions that work with rattans in Ghana. The fire box constituent of the steamer which ensured utmost heat preservation is specially built to keep the temperature of the steamer elevated for successful plasticizing of rattan, resulting in easy bending of rattans around jigs.

Keywords: *Rattan, heat retention, steaming, kiln mortar, density, craftsmen, temperature.*

1. INTRODUCTION

In social, economic and ecological terms, rattan is one of the most important non-timber forest products in Ghana that has its traditional processing technology forming a part of the sum total of achievements of the people. Rattan is extensively used in numerous forms of construction and also in integration with other materials like bamboo for construction of furniture for homes and hotels, and file racks for the office. Rattan has the physical property that allows it to be bent and fabrication into useful products like gymnastic rings, rocking chairs and countless constructions that involves bending. The bending of rattan requires that the part to be bent must be softened to allow bending. Most institutions and local craftsmen use the blow torch to heat up the area of the rattan to be bent to soften it to aid bending of the rattan. The blow torch has been used for several years and its still being used in several parts of the world including Ghana. An important point of concern to the authors is the burnt marks that come as a result of softening or plasticizing of rattan using the blow torch. The burnt marks are created as a result of contact of the naked flames of the blow torch with the rattan. Studies made revealed that conventional steamers for plasticizing rattan are available, unfortunately local craftsmen and some institution cannot afford to buy them. Where there are some kinds of steamers for plasticizing rattan, these are environmentally unfriendly because of the use of wood fuel, they pose health hazards to their users and most of their energy input is lost into the atmosphere. Gnanaharan and Mosteiro (1997) said steam bending of cane has many advantages over blow torch bending. The major advantages they said, are that the bent cane does not have burn marks or localized reduction of strength. Amin and Grewal (1989) described a steam generator developed for the rattan industry in Malasia with the capacity for 30 poles each 3m in length. Unfortunately most artisans cannot afford so still use the blow torch for rattan bending.

The necessary steps involved in rattan steam bending according to the International Network for Bamboo and Rattan Transfer of Technology Model,(TTM) includes plasticizing or softening rattan poles to be bent by steaming them in an enclosed chamber at a temperature of 100°C, and removing the poles from the steaming chamber one at a time and immediately bending each one manually or by mechanical means. Information from (TTM), explained that hand bending is commonly done with bending forms or jigs. Bending jigs can be made of wood or metal fashioned to the preferred form of bend. The jigs ensure unswerving curvature in the bends. In personal communication Albit Agawal (2013) said on a jig steadfastly set to a bench, lock one end of the pole while bending and slowly force the pole against the jig to follow its outline. Slightly over bend the pole to give allowance for springback. Lock the pole in the jig by placing restraining attachments or stoppers on the ends to prevent the rattan from springing back. Albit Agawal (2013) further explained that the bent rattan must be left to cool, and seton the jigs for a time frame of about 20 to 24 hours depending on diameter of rattan. He said diameters below 3.5 cm sets between 18 to 20 hours.

In this paper an attempt has been made to develop a steamer for plasticizing rattan for easy bending, which is environmentally responsive, operates with little or no health hazards, well-organized in the use of energy and fueled by liquefied petroleum gas.

2. MATERIALS AND METHODS

The method adopted to manufacture the gas fired steamer is fundamental and consists of five core components: the steaming tank, firebox, liquefied petroleum gas, a 50mm x 50 mm galvanized metal mesh racks and the pyrometer. This system is user friendly.

The Steaming Tank

A double wall rectangular tank and fitting lid, fabricated from 3mm thick aluminum plate that measured 125 cm in length, 55cm in width 30cm in depth. Sandwiching the double wall of the steaming tank is sawdust pulverized through 120 mesh size sieve. The sawdust serves as insulation material improving heat retention in the steaming tank. The double wall rectangular tank accommodates 40 pieces of rattan approximately 3cm in diameter and 100cm in length. In the steaming tank is a 50mm x50 mm galvanized metal mesh rack on which rattans to be softened are placed. This galvanized metal mesh rack is designed to fit the tank and it is raised 4cm above water level. The lid is fixed air tight with a 3mm diameter tube vapor escape outlet to regulate the internal pressure in the tub.

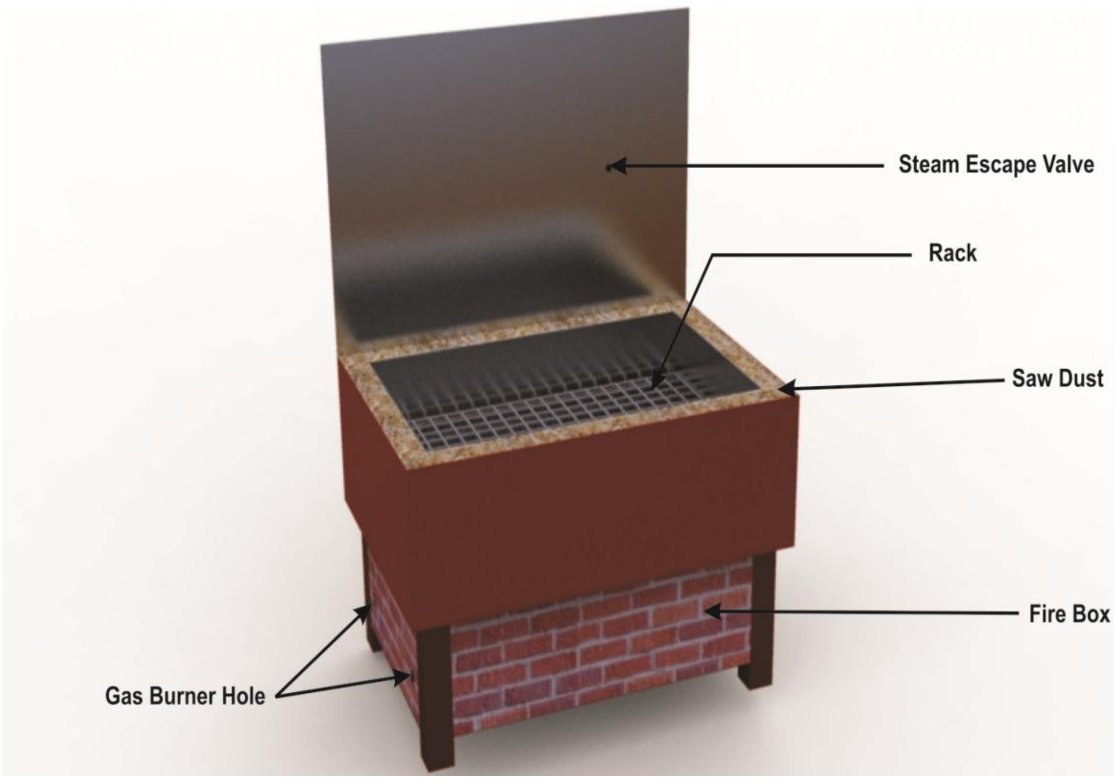

Fig 1 A. **Rhino representation of the gas fired steamer tub.**

The Firebox

The second component is the firebox, a fabricated 50mm angle iron frame that also measured 120cm in length, with 50cm in width, and 30cm in depth and 10cm above the ground supports the aluminum tub. This component is a construction of a high temperature insulating material for maximum energy utilization. Steiner et al (2012) said that low density bricks with high insulation properties can be composed from local earthenware clay from Mfensi in the Ashanti region of Ghana and sawdust, as suitable material for the accommodation of heat for kilns and similar projects where heat preservation is essential. According to Steiner et al (2012), a number of experiments conducted determined the most favorable quantity of clay, the main material and sawdust necessary to mix well with water and sodium silicate to mould the low-density bricks. The sodium silicate Rhodes (1968) explained served as deflocculant for reduction in water, obvious thickness and the drying time. The 5 cm x 7.5 cm x 15 cm molded bricks were air dried and fired to 1100 degrees Celsius. This temperature was essential for the appropriate tensile and compressive strengths of the bricks as well as the total burning of the sawdust to create the multitude of air cells necessary for the preservation of heat in the fire box for supply during the steaming process.

Table 1 shows the results of moisture absorption test made on the burnt porous low-density bricks.

Table 1- Moisture Absorption Test showing the Properties of the 5 cm x 7.5 cm x 15 Low-Density Bricks

True porosity, %	42.0
Density in g/cm3	0.949
Crushing strength in kg/sq cm.	60.3
Maximum service temp. in Celsius	1100
Average mass of each brick in grams.	500
Size of brick. In cm	5.0 x 7.5 x 15.0

The mortar for laying the bricks was composed from available raw materials based on earlier successful studies on mortar preparations by Steiner *et al.*, 2010. Table 2 shows the component materials and their requisite mass for the compounding of the mortar used for this project. First, the low-density bricks efficiently secured with the compounded mortar lined the base tray of the firebox frame.

Table 2

COMPOSITION OF LOCAL MORTAR	
Available local plastic clay	30 kg
Flint or builders sand	15 kg
Sodium silicate	10 ml

Next was the construction of the four walls of the firebox and the creation of burner and exhaust holes in the walls. After constructing the fire box, the interior of the firebox was painted with deflocculated slip and allowed to set three days as recommended by Steiner *et al.,* 2010. This sheltered the walls from thermal pressure. Last but not least, ceramic fiber was used to line up the edge of the firebox in regulate and to avert heat loss when the steamer is mounted on the firebox during the firing and steaming process.

Fig 1B. The steamer

Operation

The steaming tank of the facility was one third-filled with water, about 4cm below the galvanised mesh rack and fired to a temperature of 100 degrees Celsius.. Samples of straightened *Laccosperma opacum* and *Laccosperma secundiflora* rattan species were gently lowered onto the galvanized metal mesh rack (fig 2)over the boiling water in the steamer.

Fig 2 Samples of rattan on galvanized metal mesh rack

The steaming tank was covered and firing continued for 30 minutes with the gas burner firing at about 158 kilojoules. After 30 minutes the steamer was uncovered and the first rattan piece was drawn out and coiled around the metal jig which was firmly secured The ends of the rattan pole were lucked together with a tie to prevent uncoiling or springing back (fig 3).. The bent rattan was left to set as recommended by Amin and Grewal (1989).

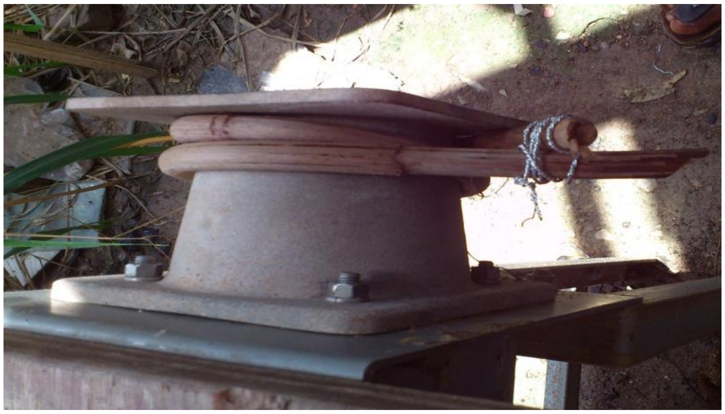

Fig. 3. Rattans coiled around the jigs

3. RESULTS AND DISCUSSIONS

Samples of *Laccosperma opacum* and *Laccosperma secundiflora* rattan species steamed for 30 minutes in the steaming tank were immediately coiled around jigs constructed to create bends. Very little effort was required in coiling the rattans around the jigs immediately the rattans were taken out of the steamer. It was obvious that the softening of the rattan was temporary. Rattans which were taken out the tank and were not immediately bent lost their property of plasticity after a considerably short time and much effort was required for the coiling and bending.

Fig 4 Test result of steam bending

The rattans that were coiled around the metal jigs retained the coiled form after 24 hours of setting time. The study has satisfactorily confirmed that when Laccosperma opacum and Laccosperma secundiflora rattan species are steamed, the plasticity of the rattans is temporary improved. It be came obvious that the most efficient bending method for rattan involves plasticizing the rattan for a suitable period in a steaming chamber prior to bending to the required shape with the aid of appropriate bending jigs as shown in Fig. 4,
This facility has also addressed problems associated with health hazards in using facilities of thjis kind that run on charcoal and wood fuel . The firebox has also improved the steaming methods adopted by local craftsmen, industry and institutions that use fuel wood in the open

4. CONCLUSION

The steaming facility for the rattan comprises the steaming tub, the galvanized metal rack and the firebox. After the first steaming cycle, the time taken for the subsequent rattans to be brought to state of plasticity was between 30 and 35 minutes. The firebox was able to house the heat produced by gas burner rated at 158 kilojoules and very little heat was lost. The ceramic fiber, which lined the edge of the firebox, barred loss of heat amid the firebox and the steaming tub. These have confirmed the suitability and the quality of local materials processed for construction of the firebox. Effective steaming of rattan for bending will helps to avoid burnt marks and weakening of rattan if bent using the blow torch especially in areas where strength and beauty of the rattan is necessary. This can result in enormous social and economical benefits, which would facilitate employment potential in Ghana.

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