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Short Communication

Preparation of value added composite sheet from solid waste leather - A prototype design

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Leather sector in Ethiopia is blessed with huge livestock resource which serves as source of raw material (hides and skin), cheap and highly disciplined workforce, cheap cost of doing business, significant international comparative advantages, investment incentives, and custom duty exemption. This industry remains a supplier of low value added, semi- processed hides and skin to the international market. leather sheet of wonderful strength (9.84±0.16 MPa) and very reasonable elongation at break (31.40%) having amenable use was prepared and the production of this value added products from waste material is a reasonable task of the time that scholars should do as it can serve as means of income besides its advantage to reduce environmental pollution specially in countries like Ethiopia which, have untapped solid waste leather resource.

Key words: Solid waste, leather fiber, latex, Ethiopia.

INTRODUCTION

The leather industry of Ethiopia obtains its raw material from local supplies of hides and skins that in turn rely on the huge livestock population which is estimated at about 90 million heads of cattle, sheep and goats (MOARD, 2007). The country's share of livestock holdings is 2.4, 3.1, 11.15, 23 and 35.5% when compared with the total livestock population of the world developing countries, such as Africa, COMESA member countries and East Africa, respectively (FAO, 2001). This potential of livestock resource could be the basis for the development of a vibrant leather and leather products industry (John, 2007). With availability of plentiful raw materials, cheap and highly disciplined workforce, cheap cost of doing business, Ethiopia's leather sector, including the footwear

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industry and tannery, enjoy significant international comparative advantages (ETI, 2010). According to the report by ECBP (2009), due to its importance and potential such as market access, great investment incentives, and custom duty exemption besides resource base and cheap workforce, the Government has defined the leather industry as a priority sector in the Industrial Development Strategy of the country aimed at obtaining a rapid sustainable growth for the whole leather value chain. The contribution of Leather and leather products in Ethiopia is about 18% of the total export earnings (EPA, 2002). But when we consider the potential of the sector neither its contribution to export earning nor to employment do match. This is because the leather industry has basically remained supplier of low value added, semi-processed hides and skin to the international market (ECBP, 2009).

Currently, there are 30 tanneries in the country and all leather industries put together use 2.3 million pieces of hides and 44.3 million pieces of skins annually, as an input for processing at full capacity operations (LIDI and UNDP, 2010). Besides these, 16 medium and large scale footwear manufacturers, 15 garments and goods factories, 3 gloves factories and 368 micro and small scale enterprises producing leather products (ELIDI, 2013). The study by Zulfikar (2012) at ELICO (Ethiopian Leather Industry Corporation) indicated that from the processing of 7,251 ton of cattle hide and sheep skins annually, the tannery generates a total of 4,048.96 ton of solid waste from beam house, tanning, re-tanning and finishing processes, equivalent to 55.8% of the raw hide and skin processed. This shows that Ethiopia is one of the most promising leather producing countries in Africa and it is indicative from this single work that it generates significant amount of solid waste leather which is sent to the landfill. Environmental pollution becomes an alarming issue of the time in most parts of the world including Ethiopia. Leather industries in general give less attention to solid waste management and it is common to see heaps of illegally dumped wastes around rivers, tannery compounds and other open spaces. Burning of solid waste is also a common occurrence in many areas. There is no sorting of the solid wastes based on their properties and mixed solid wastes are disposed in open dumping sites Mulat (2016). Teklay et al. (2017) also confirmed that presently, the leftovers from leather product industries are discarded as waste in Ethiopia. Though the resource (solid waste leather) is huge and its effect to the environment is critical, no significant work is done in Ethiopia to convert it into wealth. Therefore utilizing this waste as raw material to prepare value added product could be a novel idea as it can generate income besides serving as means of minimizing environmental pollution and thereby securing environmental sustainability.

The objective of the present work therefore is to prepare composite sheet from finished leather waste using natural rubber latex as a binder with different chemicals and evaluate its physical property.

MATERIALS AND METHODS

Finished leather scraps were collected from ELICO (Ethiopian Leather Industry Corporation) and used as source of leather fiber for composite sheet making. Natural rubber latex, ethylene glycol, H_2SO_4 acid and initiator/accelerator chemicals were purchased from Sastha PLC Chennai India and used as adhesive mixes.

Preparation of leather fiber (LF)

Finished leather scraps were cut into small pieces of about 10 cm using Swing ARM Clicker (Porielli S.20, VIGEVANO-ITALIA and those pieces were converted into leather fiber (LF) with the help of pulverizing machine (SDL868, USA).

Preparation of recycled leather (RCL) sheet

130 g of fiberized LF was soaked in water for 24 h and minced in the mincing machine (La Minerva C/E 680N) at least two times using 2 mm blade. 65, 98, 130, 195 and 260 ml natural rubber latex, 10 ml of ethylene glycol, 4% $Al_2(SO_4)_3$ and initiator/accelerator chemicals were added and mixed thoroughly in the eco plus grinder mixer for homogenous mixture. Using 1M H_2SO_4, pH was adjusted to 4.5 - 4, the prepared slurry was poured into the vacuum tub of 30 cm × 30 cm and all the water was drained using the vacuum pump. The wet sheet was again pressed using hydraulic press (polyhydron 4DL10SGS-10) at a pressure of 1,500 psi for 10 s. The pressed sheet was made to dry in open air for 2 - 3 days and plated after dried using hydraulic press at a pressure of 2,000 psi at 80°C for 10 s.

RESULTS AND DISCUSSION

A leather sheet having a wonderful strength and elongation that could be used for different consumer applications was prepared as shown in Figure 2. As presented in Figure 1A, the optimum tensile strength for the recycled leather sheet is at the third sample (130 ml) of natural rubber latex (9.84 or 9.84±0.16 MPa) which the testing is done as per the SATRA TM2:1995 test method. The result of this test is much higher than the result obtained by Senthil et al. (2014) (3.41 ± 0.18 MPa) at the same leather fiber (LF): latex ratio (natural rubber latex), and with very reasonable elongation (31.40%) (Figure 1B), which is comparatively much higher than the result of Senthil et al. (2014) (3.06 ± 0.12%). The reason for this higher value in tensile strength and elongation at break could be the use of initiators/accelerators in this study that might have enhanced the chemical reaction and efficiency of the binder. The elongation at break in this study has optimum value of 38.26% at the fourth sample (195 ml) natural rubber latex (NRL).

As seen in Figure 2, the flow diagram shows the composite sheet prepared from waste leather scrap indicating that the product can be used for different

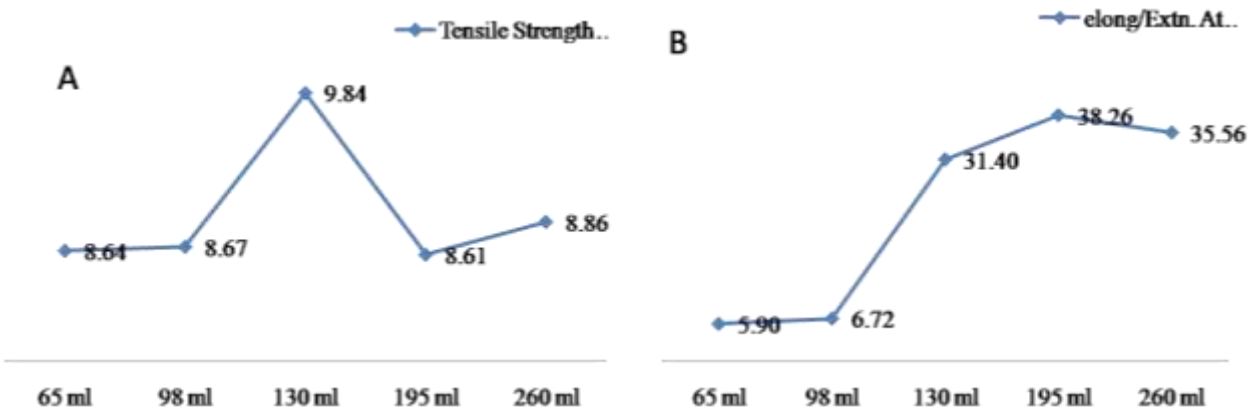

Figure 1. (A) Average tensile strength and (B) the elongation at break point.

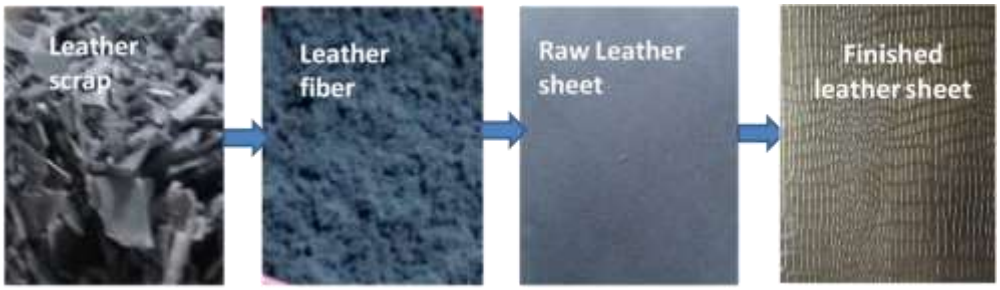

Figure 2. Leather sheet from leather scraps and plant fibers.

purposes of consumer applications such as inner decoration, wall coverage, mouse pad etc.

Conclusion

The study revealed that the solid leather waste can be used as raw material to produce value added consumer products such as insole, chappal uppers, purse, small hand bags, mouse pads and other interior decorations. These are products that are not only agreeable for consumer application, but also minimize environmental pollution and thereby secure environmental sustainability.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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