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Valorization of Tannery Solid Waste by Blending with Natural

Fibers for Production of Technical Textiles

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Abstract

The leather industry generates a large amount of solid waste. Safe disposal of these solid wastes is imperative, and several waste management strategies such as anaerobic digestion, landfilling, and thermal incineration are widely employed. These waste management strategies bring environmental pollution and involve extensive workforce engagement. Recent research has begun to explore alternative pathways for valorizing leather waste, such as incorporation into composites, polymer matrices, and adsorbents. This work aims to utilize post-tanned leather waste by blending it with natural fibers and fabricating technical textiles.

Natural fibers chosen can be any cellulosic fibers derived from plant sources. The fabric formed by blending leather waste and natural fibers can be woven, knitted, or nonwoven. These fabrics carry the synergistic properties of both leather and natural fibers. Blended leather/natural fiber fabric can be used for different applications. The developed fabric can be applied to different industrial products, construction components, and geotextiles. Polymer coatings enhance the properties of fabric based on the end application. Here, composite polymer coating is done by mixing different biopolymers on blended fabric to enhance its properties. Different ratios of composite polymer are given, and the effective ratio blend is taken for further on-field studies. Thus, this work produces an eco-friendly fabric that is a sustainable waste management strategy and can also be used for real-life applications.

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Key words: Technical textile, Leather solid waste, polymer coatings.

## 1. Introduction

Leather industries, with increasing economic development they are prone to environmental pollution. There is recent concern on utilizing eco friendly enzymes and adopting to different sustainable measures. United Nations Industrial Development Organization states that leather products are consumed by more than one-fourth of the world’s population. Leather industry generates a large amount of solid waste as only a small portion of raw materials (20–25%) is converted to finished leather, while the remaining 75–80% is released into the environment as trash. Among these buffing dust is released in post tanning process, it is a proteinous solid waste as it is generated during finishing process presence of Cr, a tanning agent, serves as a threat to pollution1.

In consequence, safe disposal of these solid wastes are imperative, and several waste management strategies such as anaerobic digestion, landfilling, and thermal incineration are widely employed. About 30-40% solid waste produced from the leather industry are buffing dust and chrome shaving dust2. Current techniques to manage these waste includes landfills and incineration. Yet involving these practices brings in environmental pollution extensive workforce engagement provoking unhygienic situations, and high temperature can convert trivalent chromium (nontoxic) into hexavalent chromium (toxic)3. As a result, environmentally sustainable and commercially feasible waste management techniques are emergent to mitigate this problem.

Leather solid wastes like buffing dust, shaving dust can be employed for fabrication of a novel textile material like nonwoven. Textile industry is a potent industry for different sustainable approach4. Current scenario needs unconventional raw materials for textile processing due to the increased prices of commercially available fabrics5. There is increasing demands for different blended fabrics like cottonpolyester6, cotton-nylon7, and polyester-viscose8.

The objective of this study is to prepare technical textile from post tanned leather waste like buffing dust, shaving dust and to blend with cellulosic fibers extracted from plant sources such as bamboo, sisal, snake plant

and use conventional fibers as extra additional support for the fabric. Retting method was employed for the plant fiber extraction. Characterization like FT-IR, FESEM, physical properties of the fibers and the fabric was assessed in this work.

## 2. Methodology

### 2.1 Extraction of cellulosic fibers from plants:

The cellulosic fibers of plant leaves were extracted through the water retting process. The plant leaves were washed and soaked in water for a few days. The water was changed accordingly when the color of the water changed. The fibers were separated, washed thoroughly, and stored.

### 2.2 Fabrication process:

Figure 1: FTIR analysis of extracted cellulosic fibers

The extracted cellulosic fibers were taken in equal proportion of cotton and the post-tanned leather waste collected from the leather industry, Chennai, and blended during the carding process, a preliminary step for spinning, where the mass of fibers clumps are converted to individual fibers. The carded web of fibers was further taken for either spinning or the needle punching technique for the development of woven/ nonwoven fabric.

### 2.3 Polymer Coating:

Polymers like xanthan gum / chitosan were coated to improve the fabric’s property and analyzed for further applications.

## 3. Results & Discussion

### 3.1 Fiber Characterization:

The tensile strength of the fiber was calculated as 2.09±0.59 N. The structure of the cellulosic fibers was viewed under FESEM. Functional groups were analyzed using FTIR. Degradation study of the fiber was also carried out where the fibers initially gained and gradually reduced but there is no significant loss of weight over the weeks.

Thus, the cellulosic fibers extracted have a good tensile strength when compared to conventional fibers like cotton and also have stability so further it was taken for fabrication.

Figure 2: FESEM images of the fibers

### 3.2 Fabrication:

Post tanned leather waste was mixed with cellulosic fibers and cotton during carding step. All three components taken in equal quantity was blended during this step and carded web was taken for needle punching. In needle punched needles are stroked from top and bottom to interlock the fiber for nonwoven fabric formation.

The formed nonwoven fabric was assessed for tensile strength and air permeability and morphology was checked using FESEM. The tensile strength of the developed nonwoven fabric is comparatively higher than the conventional nonwoven fabric developed by the same procedure.

### 3.3 Polymer coating:

Xanthan gum and chitosan was alternatively coated over the nonwoven fabric for the bringing in properties for geotextile applications.

## 4. Conclusion

This study has developed a fabric utilizing post tanned leather waste, cellulosic fibers and cotton. All three components were taken in equal proportion for fabric development. This work emphasizes managing leather

solid waste in large quantities which greatly helps to manage solid waste in industries and also reduces the associated consequences caused during disposal of waste. The fabric can be which has potent applications in geotextiles/insulating properties, etc., as it has synergistic property of leather and cellulosic fibers.

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