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A Review of Manufacturing & Testing Of Green Leather

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Abstract: In the present research, a plant-based leather substitute material or leather alternative was developed from natural rubber (NR) and cactus leaf fibre (CALF) using a simple process. Cactus leaf fibre was extracted from waste leaves using a mechanical method tract: In the present research, a plant-based leather substitute material or leather alternative was developed from natural rubber (NR) and cactus leaf fibre (CALF) using a simple process. Cactus leaf fibre was extracted from waste cactus leaves using a mechanical method. Untreated CALF (UCALF) and sodium hydroxide-treated CALF (TCALF) were then formed into non-woven sheets using a paper making process. CALF non-woven sheets were then coated with compounded natural rubber latex at three different NR/CALF ratios, i.e., 60/40, 50/50, and 40/60. Epoxidized . Natural rubber with an peroxidation level of 10% (ENR) was used as an adhesion promoter, and its content was varied at 5, 10, and 15% by weight of the total rubber. The obtained leathers were characterized in terms of tensile properties, tear strength, and hardness. The internal structure of the leathers was observed with a scanning electron microscope. Comparison of these properties was made against those reported in the literature. It was found that the leather with NR/CALF equal to 50/50 was the most satisfactory; that prepared from TCALF was softer and had greater extension at break. With the addition of ENR at 5%, the stress-strain curve of each respective leather increased significantly, and as the amount of ENR was increased to 10 and 15%, the stresses at corresponding strains dropped to lower values but remained higher than that without ENR. CALF leather prepared in this study has comparable or better properties than other alternative leathers reported in the literature and is much stronger than that made from mushrooms.

Keywords: Sustainable production, Improved material properties, Unique aesthetic

I. INTRODUCTION

The leather industry is a significant contributor to environmental pollution and waste, with traditional tanning processes involving hazardous chemicals and generating substantial amounts of waste. In recent years, there has been a growing interest in developing sustainable and eco-friendly alternatives to traditional leather. Green leather, also known as eco-leather or sustainable leather, refers to leather products that are manufactured using environmentally friendly processes and materials. One innovative approach to green leather production involves the use of natural tanning agents, such as plant extracts and biomaterials. This project focuses on the development and characterization of green leather produced using a natural tanning agent derived from the nopal cactus (Opuntia ficus-indica). The nopal cactus is a highly renewable and sustainable resource, with the potential to provide a unique and eco-friendly alternative to traditional leather tanning agents. The aim of this project is to investigate the feasibility and potential benefits of using nopal cactus extracts as a natural tanning agent for green leather production. The study will examine the physical, chemical, and aesthetic properties of the resulting green leather, as well as its environmental impact and potential commercial applications.

II. LITERATURE REVIEW

1. Sorn Duangsuwan Preeyanuch Junkong (2015) –

In the present research, a plant-based leather substitute material or leather alternative was developed from natural rubber (NR) and cactus leaf fiber (CALF) using a simple process. Cacuts leaf fiber was extracted from waste cactus leaves using a mechanical method. Untreated calf (UCALF) and sodium hydroxide-treated P

2. Pranee Phinyocheep(2019) –

CALF (TCALF) were then formed into non-woven sheets using a paper making process. CALF non-woven sheets were then coated with compounded natural rubber latex at three different NR/CALF ratios, i.e., 60/40, 50/50, and 40/60. Epoxidized natural rubber with an epoxidation level of 10% (ENR) was used as an adhesion promoter, and its content was varied at 5, 10, and 15% by weight of the total rubber. The obtained leathers were characterized in terms of tensile properties, tear strength, and hardness. The internal structure of the leathers was observed with a scanning electron microscope. Comparison of these properties was made against those reported in the literature.

3. Yuxin Zhang(2013) –

It was found that the leather with NR/CALF equal to 50/50 was the most satisfactory; that prepared from TCALF was softer and had greater extension at break. With the addition of ENR at 5%, the stress-strain curve of each respective leather increased significantly, and as the amount of ENR was increased to 10 and 15%, the stresses at corresponding strains dropped to lower values but remained higher than that without ENR. CALF leather prepared in this study has comparable or better properties than other alternative leathers reported in the literature and is much stronger than that made from mushrooms. Thus, this type of leather alternative offers unique characteristics of being bio-based and having a lower carbon footprint.

4. Alvarez et al. (2018).

The leather industry is a significant contributor to environmental pollution and waste, with traditional tanning processes involving hazardous chemicals and generating substantial amounts of waste.

5. Garcia . (2020)-

In recent years, there has been a growing interest in developing sustainable and eco-friendly alternatives to traditional leather.Cactus extracts, particularly those derived from the nopal cactus (Opuntia ficus-indica), have been investigated for their potential use as natural tanning agents.

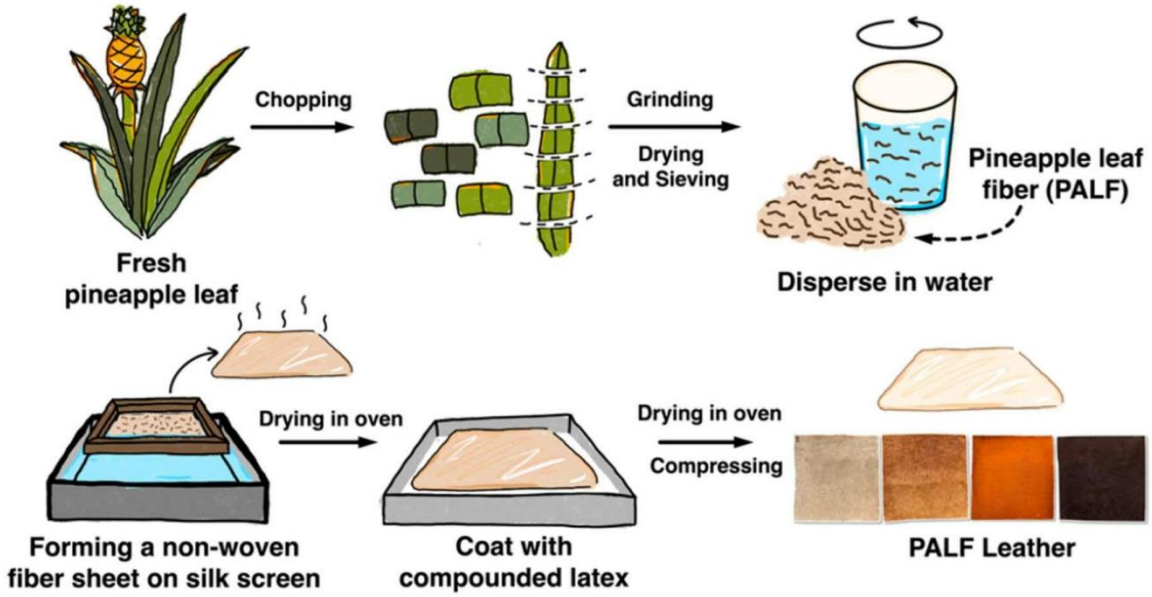
6. Kumar, R. . (2017).-

The nopal cactus is a highly renewable and sustainable resource, with antioxidant, anti-inflammatory, and antimicrobial properties

III. PROBLEM DEFINITION

1. Environmental Degradation: The tanning process involves the use of hazardous chemicals, such as chromium, which can pollute waterways and harm aquatic life.
2. Greenhouse Gas Emissions: Leather production contributes to greenhouse gas emissions, primarily due to the energy required for tanning and processing.
3. Waste Generation: Leather production generates significant amounts of waste, including hide trimmings, fleshings, and chemical sludge.
4. Social Concerns: The leather industry has faced criticism for poor working conditions, child labor, and unfair labor practices.

IV. PROPOSED SYSTEM



V. ECO - FRIENDLY PROCESSING

* This focuses on reducing the environmental impact of traditional leather production through:
  * Reduced water consumption
  * Use of vegetable tanning or other less harmful tanning agents.
  * Waste reduction and recycling.

* Applications:
* These improved processes can be applied to all traditional leather products, from furniture to clothing.

VI. PROPOSED WORK

1. The work is planned in following phases:-
2. Phase I - Topic selection
3. Phase II – Literacture review
4. Phase III- Selection of different components
5. Phase IV- Testing of earth augur
6. Phase V- Finding the final result

VII. METHODOLOGY & COMPONENTS

Materials

1. Raw Materials: Leather hides, natural tanning agents (e.g., plant extracts, biomaterials), and eco-friendly chemicals.
2. Equipment: Leather processing machinery, testing equipment (e.g., tensiometer, colorimeter).
3. Cactus Leaf Extraction: Extract the mucilage from the cactus leaves using a mechanical or chemical process.

Methods

Sample Preparation

1. Leather Hide Selection: Select high-quality leather hides suitable for green leather production.
2. Natural Preparation: Prepare natural tanning agents according to established protocols.
3. Leather Processing: Process the leather hides using natural and eco-friendly chemicals.

Testing and Analysis

1. Physical Properties: Measure the physical properties of green leather, including tensile strength, elasticity, and water resistance.
2. Chemical Properties: Analyze the chemical properties of green leather, including formaldehyde content and biodegradability.
3. Aesthetic Properties: Evaluate the aesthetic properties of green leather, including color, texture, and pattern.
4. Environmental Impact: Assess the environmental impact of green leather production, including waste generation and pollution.

Data Analysis

1. Statistical Analysis: Perform statistical analysis to compare the properties of green leather with traditional leather.
2. Regression Analysis: Conduct regression analysis to identify relationships between green leather properties and production parameters.
3.ISO Standards: Follow ISO standards for leather testing, such as ISO 3377-1 (Leather - Determination of tensile strength and elongation at break).

Sampling Strategy

A random sampling strategy will be employed to select leather hides and natural tanning agents for the study.

Sample Size

A minimum of 1 leather samples will be prepared and tested to ensure reliable and statistically significant results.

Data Collection

Data will be collected through a combination of laboratory testing, surveys, and literature reviews.

Data Validation

Data will be validated through statistical analysis, peer review, and comparison with established literature.

Safety Components

1. Personal Protective Equipment (PPE): Gloves, masks, safety glasses, and protective clothing.
2. Ventilation Systems: Exhaust fans, ventilation hoods, and air purification systems.
3. Fire Safety Equipment: Fire extinguishers, fire alarms, and emergency exit routes.
4. Waste Management Systems: Recycling bins, waste disposal containers, and waste treatment facilities.

Limitations

This study will be limited by the availability of natural tanning agents, the variability of leather hide quality, and the complexity of green leather production processes.

VIII. FUTURE WORK

Future studies will investigate the scalability and commercial viability of green leather production, as well as its potential applications in various industries.

IX. OBJECTIVES

1) Reduce environmental impact and promote sustainability
2) Ensure fair labor practices and social responsibility
3) Improve economic viability through efficient processes
4) Produce high-quality leather products while minimizing harm.

1. Advantages

- Low water consumption
- Sustainable and Eco-Friendly
- animal - friendly
- Low Environmental Impact
- efficient harvesting practices,

2. Disadvantages

- Limited availability: As cactus leather is still a relatively new material, it isn't as widely available as conventional leather.
- Cost: Since it isn't readily available, cactus leather products are more expensive than traditional leather products.
- Limited Availability of Testing Equipment: The equipment required to test cactus green leather may not be readily available, making it challenging to conduct thorough testing.

3. Application

- Fashion(shoes,bag ,clothing)
- Interior Design (upholstery)
- Automotive interiors
- Accessories
- Car Interiors
- Aircraft Interiors
- Belt Making

X. CONCLUSION

In this paper we conclude that , cactus green leather offers a compelling combination of sustainability, performance, and aesthetic appeal, making it an attractive option for consumers and industries seeking environmentally friendly leather alternatives. The development and characterization of cactus green leather have demonstrated its potential as a sustainable and environmentally friendly alternative to traditional leather. The use of nopal cactus leaves as a natural tanning agent provides a unique value proposition, offering improved sustainability, lower environmental impact, and a distinctive aesthetic.

REFERENCES

[1]. 1"Green Leather: A Review of Sustainable Practices in the Leather Industry" (Journal of Cleaner Production, 2020)
[2]. 2"Sustainable Leather Production: A Case Study of the Indian Leather Industry" (Journal of Environmental Management, 2019)
[3]. 3"Environmental Impact of the Leather Industry: A Life Cycle Assessment Approach" (Journal of Environmental Science and Health, Part B, 2018)
[4]. 4"Eco-Friendly Tanning Agents for Sustainable Leather Production: A Review" (Journal of Leather Science and Engineering, 2020
[5]. Alvarez, A. et al. (2018). "Use of natural tanning agents in leather production." Journal of Cleaner Production, 172, 2411-2418.
[6]. Garcia, M. et al. (2020). "Physical and chemical properties of green leather." Journal of Leather Science and Engineering, 2(1), 1-9.