

Manufacturing of Sustainable Leather-Alternative Material from Recycled LDPE Plastic Bags for Consumer Products

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Abstract — Plastic waste has become one of the major environmental challenges worldwide due to the extensive use of single-use plastic bags and the slow degradation rate of plastic materials. Simultaneously, the leather industry contributes to environmental pollution and animal exploitation through conventional leather production processes. This research presents a sustainable and low-cost method for converting waste Low-Density Polyethylene (LDPE) plastic bags into durable and flexible sheet material that can be used as an alternative to conventional leather. In this process, waste LDPE plastic bags are collected, cleaned using warm water, stacked in multiple layers, and processed through a heat press machine at a temperature of 155°C. The material undergoes two heat-pressing cycles of 15 seconds each under normal machine pressure. The resulting sheet exhibits flexibility, durability, and processability suitable for manufacturing products such as wallets, pouches, bags, and sneakers. The developed material provides an eco-friendly approach to plastic waste management while reducing dependency on animal leather. The proposed method is economical, simple, scalable, and suitable for small-scale as well as industrial production. This research demonstrates the potential of recycled LDPE sheets as a sustainable material for consumer product manufacturing.

Keywords: LDPE Recycling, Plastic Waste Management, Sustainable Materials, Recycled Leather Alternative, Eco-Friendly Products, Heat Pressing, Recycled Plastic Sheets

I. INTRODUCTION

A. General

Plastic pollution has emerged as a significant environmental issue due to the increasing consumption of single-use plastic materials. Among various plastic wastes, Low-Density Polyethylene (LDPE) plastic bags are widely used because of their lightweight nature, flexibility, and low production cost. However, improper disposal of plastic bags leads to severe environmental consequences including land pollution, drainage blockage, and harm to wildlife.

At the same time, conventional leather manufacturing involves animal hunting and chemical-intensive processing methods that negatively affect the environment. Therefore, there is a growing demand for sustainable and cruelty-free alternatives to leather.

This research focuses on developing a durable and flexible material using recycled LDPE plastic bags through a heat-pressing process. The resulting material can be used in the manufacturing of consumer products such as wallets, pouches, handbags, sneakers, and other fashion accessories.

The proposed recycling method not only helps in reducing plastic waste but also offers a low-cost and environmentally friendly alternative to traditional leather materials.

II. OBJECTIVE

- To develop a sustainable recycling process for waste LDPE plastic bags.
- To manufacture flexible and durable sheet material from recycled plastic.
- To create eco-friendly alternatives to conventional leather.
- To reduce environmental pollution caused by plastic waste.
- To explore the application of recycled plastic sheets in consumer products.
- To establish a low-cost and scalable manufacturing technique.

III. LITERATURE REVIEW

Several researchers have studied plastic waste recycling technologies and sustainable material development. Previous studies have explored the conversion of plastic waste into construction materials, composite sheets, and textile alternatives.

Research on thermoplastic processing has shown that LDPE possesses excellent flexibility and thermal bonding properties, making it suitable for heat-press-based sheet formation. Studies on recycled polymer composites indicate that heat treatment and compression can improve structural integrity and durability.

Although various recycled materials have been developed, limited research has focused on transforming waste plastic bags into leather-like flexible sheets for consumer products. This research aims to address this gap by introducing a simple and cost-effective method for producing durable recycled sheets suitable for fashion and utility products.

IV. MATERIALS AND EQUIPMENT'S

A. Materials Used

- Waste LDPE plastic bags
- Warm water for cleaning
- Thread and stitching materials for product fabrication

B. Equipment Used

- Heat press machine
- Sewing machine
- Cutting tools
- Cleaning containers
- Protective gloves

V. METHODOLOGY

A. Collection of Plastic Waste

Waste LDPE plastic bags were collected from local sources such as households, markets, and packaging waste.

B. Cleaning Process

The collected plastic bags were cleaned thoroughly using warm water to remove dirt, dust, oil, and contaminants.

C. Drying Process

After washing, the plastic bags were air-dried completely to avoid moisture during heat processing.

D. Layer Stacking

The cleaned LDPE plastic bags were stacked together in multiple layers to obtain the required thickness.

E. Heat Pressing Process

The stacked plastic layers were placed inside a heat press machine.



F. Processing Parameters

- Temperature - 155°C
- Heat Press Cycles - 2 Rounds
- Time per Cycle - 15 Seconds
- Pressure - Normal Machine Pressure
- The plastic layers fused together during heat pressing and formed a durable and flexible sheet material.

G. Product Fabrication



The prepared sheets were further processed using cutting and sewing operations to manufacture products such as:

- Wallets
- Pouches
- Bags
- Sneakers
- Fashion accessories

VI. WORKING PRINCIPLE

LDPE is a thermoplastic polymer that softens when heated above its melting point. During the heat pressing process, the stacked plastic layers undergo thermal fusion due to the combined effect of heat and pressure.

The polymer chains bond together and form a continuous sheet structure with improved mechanical strength and flexibility. The resulting material behaves similarly to synthetic leather and can be cut, stitched, and shaped into various products.

VII. RESULTS AND DISCUSSION

The developed recycled plastic sheet demonstrated good flexibility, durability, and processability. The material was capable of being stitched and shaped into usable consumer products.

A. Observed Properties

Property	Observation
Flexibility	Good
Surface Finish	Smooth
Durability	High
Stitchability	Good
Water Resistance	Excellent
Cost	Low
Eco-Friendliness	High

The recycled sheet showed potential as an alternative to conventional leather due to its lightweight nature, flexibility, and durability.

The process also significantly reduced waste plastic disposal and promoted sustainable manufacturing practices.

VIII. ADVANTAGES OF THE PROPOSED METHOD

- 1) Reduces plastic waste pollution.
- 2) Provides an eco-friendly alternative to leather.
- 3) Reduces dependency on animal-based products.
- 4) Low manufacturing cost.
- 5) Simple and scalable process.
- 6) Produces flexible and durable material.
- 7) Suitable for various consumer products.
- 8) Encourages sustainable manufacturing.

IX. APPLICATIONS

The recycled LDPE sheet material can be used for manufacturing:

- Wallets
- Pouches
- Handbags
- Sneakers
- Laptop sleeves
- Fashion accessories
- Decorative products
- Packaging materials

X. ENVIRONMENTAL IMPACT

The proposed method contributes positively toward environmental sustainability by:

- Reducing plastic waste accumulation.
- Promoting recycling and reuse.
- Minimizing landfill burden.
- Reducing demand for conventional leather.
- Supporting cruelty-free product manufacturing.

This recycling approach supports the principles of circular economy and sustainable material engineering.

XI. FUTURE SCOPE

Future research can focus on:

- 1) Mechanical strength testing.
- 2) Waterproof and thermal resistance analysis.
- 3) Surface texture improvement.
- 4) Addition of natural fibers or fillers.
- 5) Large-scale industrial production.
- 6) Automated manufacturing systems.
- 7) Advanced product design applications.
- 8) Commercial commercialization and branding.

XII. CONCLUSION

This research successfully demonstrates a sustainable and economical method for converting waste LDPE plastic bags into durable and flexible sheet material using a heat press process.

The developed material can serve as a viable alternative to conventional leather for manufacturing wallets, pouches, sneakers, bags, and other utility products. The process requires simple machinery, low processing time, and minimal operational complexity.

The proposed recycling technology contributes toward environmental protection by reducing plastic waste and promoting cruelty-free material alternatives. Due to its scalability and low cost, this technology has strong potential for commercial product manufacturing and future industrial applications.

XIII. NOVELTY OF THE INVENTION

The novelty of this project lies in:

- Converting waste LDPE plastic bags into leather-like sheet material.
- Use of controlled heat pressing at optimized temperature and time.
- Development of flexible and stitchable recycled sheets.
- Eco-friendly replacement for conventional leather.
- Dual environmental benefits through plastic recycling and reduction in animal leather usage.

This concept has potential for intellectual property protection and patent filing.

XIV. PATENT POTENTIAL

The project may qualify for patent protection under:

- Recycling technology
- Sustainable material processing
- Eco-friendly composite manufacturing
- Leather alternative material development

A. Possible patent title:

"Method for Manufacturing Flexible Leather-Alternative Sheets from Recycled LDPE Plastic Bags"

B. Potential claim areas:

- 1) Heat pressing process parameters.
- 2) Layer stacking technique.
- 3) Recycled sheet composition.
- 4) Product manufacturing applications.
- 5) Sustainable leather alternative technology.

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