

Title: Biodegradable Eco-Friendly Pen: An Innovative Sustainable Writing Solution

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Abstract

This invention proposes an innovative, fully biodegradable pen constructed using sustainable, non-toxic materials such as bamboo, cork, paper pulp, and plant-derived pigments. It eliminates the use of conventional plastics, metal tips, and chemical-based inks. Targeted particularly at regions like Kerala, where educational institutions produce high volumes of plastic pen waste, the pen provides a zero-waste alternative that supports India's broader sustainability and plastic ban missions. The eco-pen has potential for mass adoption in schools, offices, and public institutions, helping reduce microplastic accumulation in landfills and oceans.

1. Introduction

The global stationery market is heavily reliant on disposable plastic pens, which are inexpensive but environmentally harmful. In India alone, billions of plastic pens are discarded annually. Kerala, a state known for high literacy and school enrollment, reportedly discards over 35 million plastic pens every year, making it a major contributor to stationery waste. These pens typically end up in landfills or waterways due to their non-recyclable components. To address this, the proposed invention introduces a biodegradable pen that utilizes entirely compostable materials and natural ink.

2. Problem Statement

Existing Problem: Traditional pens are made with non-biodegradable plastic casings, synthetic ink reservoirs, and metal tips. Once discarded, they contribute to long-term environmental pollution and often remain undegraded for hundreds of years. Their recycling is costly and inefficient due to mixed-material construction.

Proposed Solution: A pen constructed entirely from biodegradable and compostable materials including plant-extracted ink, cork-based barrels, paper-based ink tubes, and fabric nibs, which fully decomposes after disposal.

3. Materials and Construction

Pen Body:

- Crafted using bamboo, cork, or compressed paper pulp for a lightweight, durable structure.
- Coated with beeswax or natural resin to improve water resistance.

Ink Cartridge:

- Made from tightly rolled biodegradable paper or cork.
- Refillable design allows multiple uses.

Nib:

- Made from dense, soft fabric (cotton/felt) acting as a capillary-based ink delivery system.

Ink Composition:

- Derived from boiled, filtered flower petals (e.g., hibiscus, marigold), leaves, or tree bark (e.g., walnut, neem).
- Mixed with natural binders such as gum arabic and vinegar for consistency.
- pH-balanced for safe skin contact.

4. Key Features

- F1: 100% plastic- and metal-free design
- F2: Ink from non-toxic, natural sources (zero VOCs)
- F3: Fully biodegradable in composting environments within 90 days
- F4: Fabric-based nib ensures smooth writing experience
- F5: Minimal carbon footprint from manufacturing to disposal
- F6: Compatible with all standard paper types
- F7: Affordable for mass distribution in schools and offices

5. Working Operation

The pen works using the capillary action mechanism between the ink and the compressed fabric nib. As the user applies pressure, ink from the natural cartridge flows smoothly onto paper surfaces. The biodegradable materials maintain shape and performance during normal use. Post usage, the pen can be disposed of in compost pits or garden soil where it decomposes naturally without leaving behind any microplastic or toxic residues.

6. Environmental Impact

The invention addresses environmental concerns on two levels:

1.

Preventive Waste Management: Reduces plastic waste at source by eliminating synthetic stationery from use.

2.

Circular Economy: Supports composting-based waste cycles and returns resources to soil.

In Kerala, where high pen usage and disposal rates have sparked concern among schools and green activists, this pen can replace millions of plastic pens per year. Integration with school and university procurement policies can create a large-scale shift.

7. Market Applicability

Primary Users:

- Students in eco-conscious institutions
- Environmentally responsible companies and government offices
- Artists and journaling enthusiasts seeking natural products

Commercial Value:

- Aligns with ESG goals and CSR procurement policies
- Excellent for branding as sustainable merchandise

Scalability:

- Manufacturing processes such as pulp molding and organic ink synthesis are low-cost and scalable for small and medium enterprises.
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8. Prior Art & Limitations

Closest Prior Art: Paper pens and biodegradable pens exist, but they often use plastic ink tubes and metal nibs.

Limitation of Prior Art:

- Incomplete biodegradability
- Industrial ink usage
- Unrefined aesthetic and usability

Proposed Innovation Overcomes:

- Full-component biodegradability
- No plastic/metal trace
- Plant-based safe ink with natural colors

Known Limitations:

- Ink may fade under UV exposure
 - Not suitable for archival writing or extreme humidity use
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9. References

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