

## Eco-Friendly Paint Production Using Bio-Waste and Solid Waste

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### Abstract

This study investigates the development of an eco-friendly paint formulation using bio-waste and solid waste materials, specifically cow dung, fly ash, and plastic oil. With the growing demand for sustainable alternatives in construction materials, this research aims to reduce the environmental impact associated with traditional paint production by utilizing waste-derived components. The formulation process involves integrating these materials to create a paint that demonstrates desirable physical, chemical, and performance characteristics, comparable to conventional paints. Through a comprehensive analysis of the paint's properties, including durability, opacity, and environmental compatibility, the findings indicate that the proposed formulation not only offers an effective solution for waste management but also provides a sustainable alternative to conventional paints. This approach supports the principles of circular economy and waste vaporization, contributing to the reduction of environmental pollution and resource depletion in the paint industry.

Keywords: Cow dung, fly ash, plastic oil, calcium carbonate, Titanium dioxide, xanthan gum, sodium benzoate, Styrene-Butadiene Rubber(SBR), eco-friendly paint additives, sustainable fillers, natural thickeners, paint formulation, waste-to-resource technology.

## I. INTRODUCTION

The global construction and coatings industry is undergoing a paradigm shift toward sustainability, driven by the increasing environmental degradation caused by traditional materials and the growing need to adopt circular economy principles. Among the most commonly used materials in infrastructure and housing is paint a product that, while essential for aesthetics and protection, is often formulated using toxic chemicals, synthetic solvents, and non-renewable resources. Most conventional paints release volatile organic compounds

(VOCs), heavy metals, and petroleum-based derivatives, which contribute significantly to air pollution, water contamination, and human health hazards. In this context, the present study addresses an urgent challenge: how to formulate a functional, durable, and cost-effective paint using biodegradable, eco-safe, and waste-derived materials.

This journal aims to present an innovative and practical solution to this issue through the development of eco-friendly paint formulated from a combination of biowaste and solid waste. Specifically, the materials used in this study include cow dung, fly ash, plastic oil, calcium carbonate, titanium dioxide, xanthan gum, sodium benzoate, and Styrene-Butadiene Rubber (SBR). Each of these was selected based on their chemical properties, availability, sustainability profile, and functional role in a water-based paint system. This research is based on the concept of waste-to-resource technology, where locally available waste materials are re-engineered into value-added, green products suitable for construction applications.

The primary objective of this study is to develop a non-toxic, durable, and environmentally safe paint that can replace or reduce dependence on synthetic paints. The secondary objectives include [1] Utilization of locally available waste materials such as cow dung, fly ash, and waste plastic oil to reduce environmental burden and promote circular usage [2.] Substitution of synthetic paint additives with natural or food-grade alternatives, such as xanthan gum and sodium benzoate (preservative), to enhance product safety.[3] Improvement of paint properties e.g., spreadability, adhesion, opacity, and drying time through controlled formulation using common mineral additives like calcium carbonate and titanium dioxide, along with SBR latex for enhanced binding and flexibility.[4] Assessment of feasibility evaluating the physical, chemical, and performance aspects of the paint to ensure practical application in real-world conditions.

The formulation process involves blending treated cow dung slurry, finely sieved fly ash, and pyrolyzed plastic oil with a base of water and other additives. The role of cow dung is particularly significant—it acts as a bio-binder and has historical usage as an antifungal wall coating in rural India [5]-[6]. Fly ash, commonly a waste by-product of agricultural biomass combustion and power plants, is used as a sustainable mineral filler that improves the bulk, opacity, and longevity of the paint. Plastic oil, obtained via pyrolysis of non-recyclable plastic waste, serves as a low-cost and innovative substitute for petroleum-based oils traditionally used in paints. To waste utilization, this study also focuses on functional performance. Materials such as xanthan gum are incorporated to maintain viscosity and prevent sedimentation, while titanium dioxide enhances whiteness and brightness [7]-[8]. The incorporation of Styrene-Butadiene Rubber (SBR), commonly used in waterproofing and sealants, ensures strong adhesion, elasticity, and weather resistance of the dried paint film.

By documenting the process, formulation logic, and key outcomes of this research, the paper intends to provide a foundation for future innovation in eco-materials, especially in the construction and rural development sectors [9]-[10]. It is anticipated that this work can lead to the scaling of low-cost paint manufacturing units, provide income-generating opportunities using local waste, and significantly reduce the environmental footprint of painting activities.

## II. MATERIAL PROPERTIES

### A. *Cow dung*

Cow dung acts as a natural binder with antimicrobial properties in paint. Through the CMC method, its cellulose is chemically modified to enhance solubility and binding strength, improving paint performance.



**Fig. 1.** Cow dung

**Table 1.** Test for cow dung

S. No.	Test	Result
1.	pH	7-8
2.	Viscosity	Moderate flow

### B. *Fly ash*

Fly ash is a fine pozzolanic by product from coal combustion in thermal power plants. It is used as a sustainable filler and pigment substitute

**Table 2.** Properties of flyash.

S. No.	Property	Cement
1.	Type	Class F
2.	Specific gravity	2.1 – 2.6
3.	Fineness	< 45 $\mu\text{m}$
4.	Silica( $\text{SiO}_2$ )	50 -60 %

### *C. Plastic oil.*

Plastic oil acts as a solvent and binder carrier in paint, helping to dissolve other components. It improves paint spreadability, adhesion, and provides a smooth finish.

**Table 3. Properties of plastic oil.**

S. No.	Property	Fine Aggregate
1.	Density	0.80 – 0.90 g/cm <sup>3</sup>
2.	pH	Neutral (6-7)

### *D. SBR*

- Styrene-Butadiene Rubber (SBR) acts as a binder and film-forming agent, enhancing water resistance, flexibility, and durability.
- It also improves the paint's adhesion to surfaces and contributes to a smooth, long-lasting finish.
- SBR provides resistance to cracking and ensures that the paint maintains its integrity under varying environmental conditions.
- Its incorporation helps in achieving better flexibility and impact resistance, making the paint suitable for a wide range of applications.

### *E. Sodium benzoate*

- sodium benzoate functions as a preservative, preventing microbial growth and extending shelf life. It helps maintain the paint's quality and stability by inhibiting the growth of bacteria, mold, and fungi.
- sodium benzoate ensures the paint remains free from contamination during storage and use, contributing to its overall performance and durability. Its low toxicity also makes it an eco-friendly choice for preserving paint.

## **III. Methodology, Results & Discussion**

This study follows a step-by-step approach to formulate eco-friendly paint using biowaste and industrial waste materials

**Table 4. Step by Step Approach.**

SI	Steps involved
1.	Collection of Raw materials
2.	Pre-treatment of materials
3.	Pigment & Additive preparation
4.	Mixing and Formulation
5.	Paint consistency Adjustment
6.	Application and testing
7.	Performance Evaluation

The paint was prepared by mixing (by weight) 20 % cow dung liquid, 25 % fly ash, 15 % plastic oil, 20 % calcium carbonate, 10 % titanium dioxide, 1 % xanthan gum, 0.5 % sodium benzoate and 8.5 % SBR. After 3–5 days of curing at ambient conditions, it forms a uniform, durable film with high opacity, excellent water resistance, stable viscosity and no signs of microbial growth.

**A. Viscosity test on paint**

- This method is easy also as it doesn't take the time that the first one takes, by using a visco-meter device which give direct value of viscosity dependent on a spindle rotate in the sample



**Fig 2. Visco-meter**

- As shown in fig1 shows the viscosity test ensures paint has the right thickness for proper application and performance. It helps determine if the paint flows smoothly and is easy to apply .The test ensures spreadability, preventing dripping or uneven coating. viscosity ranges for paint is
- Medium Viscosity: 500-1500 cP (for brushing/rolling)

### **B. pH test.**

- The pH test determines the acidity or alkalinity of paint, which affects its stability, adhesion, and performance.
- To conduct the test, dilute the paint with distilled water for water-based and measure the pH using a pH meter or pH paper. The ideal pH for water-based paints is between 8 and 9.
- This test ensures the paint will adhere properly, maintain its stability, and provide long-lasting protection on surfaces.



**Fig 3. pH paper test on paint**

- As shown In For water-based paints, the typical pH range is 8 to 9. Our paint has a 8 This range ensures the paint remains stable, adheres properly to surfaces, and provides a smooth, durable finish.

### **C. Flow test**

- The flow test evaluates how well paint flows and spreads over a surface, ensuring even application and smooth coverage. It measures the viscosity and determines the paint's ability to level out and avoid issues like dripping, running, or uneven application.
- A standard value for the flow test is typically between 100-120 seconds for water-based paints, indicating that the paint maintains an optimal balance between being too thick (difficult to spread) and too thin (leading to dripping).
- A proper flow ensures that the paint will be easy to apply, providing a smooth, uniform finish.



**Fig 4 Flow test on paint**

- The range of our paint has 95 seconds. This ensures the paint has an optimal consistency for smooth, even application.

#### **IV. Conclusion**

This project aimed to develop an eco-friendly paint formulation using bio-waste and solid waste materials, namely cow dung liquid, fly ash, and plastic oil, in order to offer an environmentally sustainable alternative to conventional paints. The primary motivation behind this initiative was to reduce environmental pollution and promote the use of waste materials in the paint industry, which traditionally relies heavily on petroleum-based chemicals and synthetic additives that contribute to environmental degradation.

The eco-friendly paint formulations developed in this project demonstrated significant potential in addressing some of the key environmental concerns associated with conventional paints. The use of cow dung liquid and fly ash as primary ingredients contributed to the sustainability of the paint, as these materials are typically considered waste products in various industries. By repurposing these materials, the project not only reduced waste but also decreased the demand for raw materials traditionally used in paint manufacturing, such as petroleum-derived chemicals. By utilizing waste materials, the formulations not only reduce carbon footprints but also mitigate the need for traditional chemicals that contribute to air and water pollution. This aligns with the increasing global demand for green technologies and sustainable industrial practices.

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