Sustainable Corrosion Protection Using Recycled Plastic-Resin Coatings for Marine Applications

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Abstract - This project investigates the use of recycled plastic mixed with resin as a protective coating for steel against corrosion in marine environments. The study involved collecting plastic waste from the sea, grinding it into a fine powder, and mixing it with resin to form a composite coating. A total of 20 steel pieces were used in the study, where 10 pieces were coated and 10 remained uncoated. The coated and uncoated steel pieces were tested under real marine conditions and laboratory-controlled conditions using sea water. After every 15 days, samples were inspected for signs of corrosion and degradation. The results revealed the potential of using plastic waste for protective coatings in marine applications, with promising outcomes for reducing corrosion on coated steel surfaces. This project investigated the feasibility of utilizing recycled sea plastic as a reinforcement material in resin-based protective coatings for marine applications. Plastic waste collected from coastal areas was processed into powder and incorporated into a resin matrix, which was then applied to steel substrates. The performance of this navel coating was evaluated through real-sea exposure and laboratory seawater immersion tests, comparing coated and uncoated steel samples. Results demonstrated that the recycled plastic-resin coating significantly enhanced the corrosion resistance of steel in marine environments, offering a sustainable solution for both plastic waste management and marine infrastructure protection.

Key Words: Coating, Corrosion, Recycle Plastic, Marine Applications, Protection, Sustainable

1.INTRODUCTION

Plastic pollution, particularly in the oceans, is one of the most pressing Environmental challenges today. Millions of tons of plastic waste are dumped into the oceans annually, contributing to environmental degradation. At the Same time, the corrosion of steel and other metals in marine environments Poses a significant challenge to infrastructure, from ship hulls to offshore oil Rigs. This project aims to combine these two problems by using Recycled plastic, ground into a powder and mixed with resin, to create Protective coatings for steel used in marine applications. By repurposing Oceanic plastic waste, the project proposes an eco-friendly solution to both Plastic pollution and metal corrosion. Marine plastic pollution poses a severe environmental threat, while corrosion of steel structures in marine environments incurs substantial Economic costs. This project aimed to address both issues by developing a Protective coating using recycled sea plastic. The hypothesis was that incorporating processed sea plastic into a resin Matrix would create a durable and effective coating, improving the corrosion Resistance of steel in marine conditions. The objective was to evaluate the performance of this coating through Controlled experiments in both real-sea and laboratory settings.

Marine corrosion significantly impacts the longevity and durability of steel structures exposed to seawater. Traditional protective coatings are often expensive, non-environmentally friendly, or not sufficiently effective. This study evaluates the effectiveness of a new composite coating made from recycled plastic and resin, comparing the corrosion resistance of coated and uncoated steel samples exposed to real sea conditions and controlled lab conditions. The marine environment presents a significant challenge for steel structures due to its highly corrosive nature. Traditional protective coatings often rely on non-renewable resources and may contain harmful chemicals. Furthermore, the escalating problem of marine plastic pollution poses a serious environmental threat. Therefore, there is a pressing need for sustainable and effective protective coatings that address both corrosion and plastic waste management. The ongoing degradation of marine structures, such as steel components, from corrosion due to exposure to saltwater poses a persistent challenge. Developing protective coatings utilizing recycled materials could present a sustainable solution.

Background and Rationale

Plastic pollution, particularly in the oceans, is one of the most pressing environmental challenges today. Millions of tons of plastic waste are dumped into the oceans annually, contributing to environmental degradation. At the same time, the corrosion of steel and other metals in marine environments poses a significant challenge to infrastructure, from ship hulls to offshore oil rigs. This project aims to combine these two problems by using recycled plastic, ground into a powder and mixed with resin, to create protective coatings for steel used in marine applications. By repurposing oceanic plastic waste, the project proposes an eco-friendly solution to both plastic pollution and metal corrosion. Marine plastic pollution poses a severe environmental threat, while corrosion of steel structures in marine environments incurs substantial economic costs. This project aimed to address both issues by developing a protective coating using recycled sea plastic. The hypothesis was that incorporating processed sea plastic into a resin matrix would create a durable and effective coating, improving the corrosion resistance of steel in marine conditions. The objective was to evaluate the performance of this coating through controlled experiments in both real-sea and laboratory settings.

Problem Statement

Marine corrosion significantly impacts the longevity and durability of steel structures exposed to seawater. Traditional protective coatings are often expensive, non-environmentally friendly, or not sufficiently effective. This study evaluates the effectiveness of a new composite coating made from recycled plastic and resin, comparing the corrosion resistance of coated and uncoated steel samples exposed to real sea conditions and controlled lab conditions. The marine environment presents a significant challenge for steel structures due to its highly corrosive nature. Traditional protective coatings often rely on non-renewable resources and may contain harmful chemicals. Furthermore, the escalating problem of marine plastic pollution poses a serious environmental threat. Therefore, there is a pressing need for sustainable and effective protective coatings that address both corrosion and plastic waste management. The ongoing degradation of marine structures, such as steel components, from corrosion due to exposure to saltwater poses a persistent challenge. Developing protective coatings utilizing recycled materials could present a sustainable solution.

Objectives

To develop a plastic-resin composite as a protective coating for steel against marine corrosion.

To compare the performance of coated and uncoated steel pieces exposed to real sea conditions and controlled lab conditions. To assess the degradation of the coating over a period of time and its ability to resist corrosion in both environments. To create a protective coating from recycled ocean plastic mixed with resin. To assess the efficacy of the coating in marine environments. To evaluate the corrosion resistance of the developed coating in real-sea and laboratory conditions. To compare the performance of coated and uncoated steel samples. To assess the feasibility of utilizing recycled marine plastic for sustainable marine applications.

Marine Pollution:

Biodegradable Materials: Developing materials that break down naturally in the marine environment, reducing the long-term impact of pollutants like plastics or coatings.

Pollution-absorbing Surfaces: Creating materials that can absorb or neutralize marine pollutants like oil or chemical spills, helping to mitigate environmental damage. Circular Economy Approaches: Designing products or structures that can be recycled or reused, reducing waste entering the ocean.

Structural Durability:

Corrosion-resistant Materials: Marine environments can accelerate the wear and tear on materials due to saltwater exposure. Innovations in corrosion-resistant coatings or materials could drastically increase the lifespan of structures.

2. Materials and Methodology

Materials Used

The materials used in this study were selected based on their availability, durability, and relevance to marine applications.

Recycled Plastic:

Collected from the sea to promote environmental sustainability and reduce plastic pollution. Cleaned thoroughly to remove salts. biological contaminants, and debris. Dried and ground into a fine powder to facilitate uniform mixing with resin.

Fig 1: Recycled sea plastic

Resin:

A high-performance marine-grade resin was chosen for its superior adhesion, durability, and resistance to seawater corrosion.

The resin served as a binding agent, ensuring the recycled plastic adhered properly to the steel surface.

Steel Pieces:
A total of 20 steel specimens were prepared, with identical dimensions to ensure consistency in testing.

The steel pieces were divided into two groups:

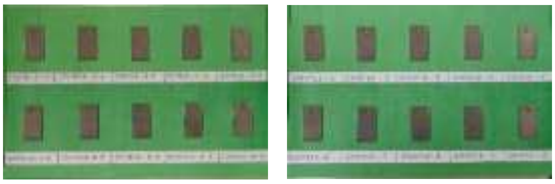


Fig 2: Coated & uncoated Samples

Coated Group: 10 steel samples coated with the plastic-resin mixture.

Uncoated Group: 10 steel samples left untreated for comparative analysis. The steel samples were cleaned with acetone and dried before coating application to remove contaminants that could interfere with adhesion.

Coating Preparation

The recycled plastic-resin coating was prepared using the following steps:

Plastic Grinding:

The collected plastic waste was shredded and ground into a fine powder using a mechanical grinder. The particle size was controlled to ensure uniform distribution within the resin.

Fig 3: plastic powder

Resin Mixing:

The powdered plastic was mixed with the marine-grade resin in a 1:1 ratio by weight. The mixture was stirred continuously to create a homogeneous, viscous coating solution.

Application Process:

The coating was applied to the steel pieces using a hand layup technique, ensuring even coverage. Multiple layers were applied, allowing each layer to dry before adding the next to enhance durability.

The coated samples were cured at room temperature or in a controlled environment to achieve optimal adhesion and mechanical strength.

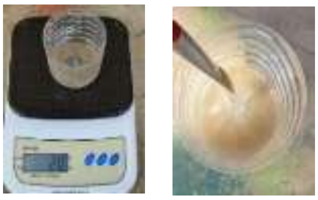


Fig 4: Resin mixing

Experimental Design

The study followed a controlled experimental design to evaluate the protective performance of the coating in marine conditions.

Sample Distribution:

Coated Group (10 samples): Received the plastic-resin coating.

Uncoated Group (10 samples): Served as a control to assess the impact of corrosion in unprotected steel.

Exposure Conditions:

Marine Submersion: Five coated and five uncoated samples were submerged in a real marine environment to simulate actual conditions.

Controlled Seawater Testing: The remaining five coated and five uncoated samples were placed in sealed glass jars filled with seawater to maintain controlled conditions.

Testing Procedures

The coated and uncoated steel samples were subjected to a 15-day interval inspection to assess the effectiveness of the coating in preventing corrosion.

Submersion Process:

The samples exposed to real marine conditions were attached to a submerged test rack to ensure uniform exposure to seawater. The sealed glass jar samples were placed in a temperature-controlled lab environment to mimic real seawater exposure without external disturbances.

Environmental Monitoring:

Water temperature, salinity, and pH levels were recorded periodically. Any visible changes in the samples were noted throughout the testing period.

Inspection and Assessment Criteria

The coated and uncoated steel samples were retrieved every 15 days to visually assess the corrosion resistance and coating integrity.

Visual Corrosion Assessment:

Presence of rust, discoloration, or pitting on the steel surface.

Comparison of rust development between coated and uncoated samples.

Coating Integrity Evaluation:

Inspection for cracks, peeling, or degradation of the coating. Adherence of the coating to the steel surface.

Comparative Analysis:

Differences in corrosion rates and structural integrity between the coated and uncoated samples. Documentation through photographs and microscopic analysis.

3. Experimental Setup

The experimental setup was designed to systematically evaluate the protective performance of a recycled plastic-resin coating on steel surfaces exposed to marine environments. The process involved plastic collection, preparation, coating application, and exposure to environmental conditions to assess corrosion resistance and coating durability.

Collection of Plastic

Plastic waste was sourced directly from marine environments, such as beaches, harbors, and coastal areas, ensuring that it had been exposed to natural weathering factors like:

Prolonged UV radiation from sunlight. Saltwater immersion, leading to chemical degradation. Mechanical wear from wave action and abrasive materials like sand.

Collecting weathered plastic was crucial, as it closely resembled real-world marine pollution and provided insight into its potential reusability in protective coatings.

Fig 5: plastic collection

The collected plastic mainly consisted of polyethylene (PE), polypropylene (PP), and polystyrene (PS), which are commonly found in marine litter.

Grinding Process

The collected plastic waste underwent a cleaning process to remove contaminants:

It was rinsed with freshwater to remove surface debris and salt deposits.

Fig 6: plastic powder

It was then soaked in a mild detergent solution to break down oils and organic residues. The dried plastic was mechanically ground into a fine powder using an industrial grinder to achieve uniform particle size distribution. The grinding process ensured that the plastic particles were small enough (micron level) to evenly disperse within the resin. Large particles were sieved out to maintain a consistent coating texture and adhesion properties. The ground plastic powder was mixed with high-performance marine-grade resin in a 1:1 weight ratio to form a composite coating material.

Mixing ratio:

Stirring and Homogenization:

Fig 7: Mixing ratio

The mixture was stirred using a mechanical agitator at controlled speed to ensure uniform dispersion of plastic particles in the resin.

To improve bonding, chemical additives (such as adhesion promoters or dispersants) were added where necessary.

Application on Steel Pieces:

PLASTIC POWDER:	2 GRAMS	10%
EPOXY RESIN:	12 GRAMS	60%
HARDENER:	6 GRAMS	30%
TOTAL LAYERS:	3 LAYER (1 layer consists of 0.1 mm thickness)	

The coating mixture was applied to steel samples using a spray method, ensuring an even and consistent layer. The spray pressure and nozzle diameter were carefully controlled to achieve a uniform thickness across all coated samples. Multiple coating layers were applied, with a brief drying period between layers to enhance durability.

Curing Process:

The coated steel samples were cured for 24 hours under controlled conditions (room temperature and controlled humidity).

The steel pieces are cured about 12 hours after every coating until three coatings are completed.

Fig 8: coating process (3 layers)

Environmental Exposure

To evaluate the coating's protective performance, two different test environments were selected:

Open Sea Exposure

Fig 9: sea exposure

Five coated and five uncoated steel samples were submerged in a real marine environment to simulate actual operating conditions. The sea samples were attached to a submerged test rack at a fixed depth, ensuring uniform exposure to seawater and marine organisms. Environmental conditions were monitored, including: Salinity levels (measured using a refractometer). Water temperature fluctuations recorded using a temperature logger. pH variations to assess seawater acidity impact. Marine biofouling accumulation (e.g., algae, barnacles).

Controlled Laboratory Exposure

Five coated and five uncoated steel samples were placed in sealed glass jars filled with seawater to create a controlled testing environment.

These samples were stored in a temperature-controlled chamber to simulate marine conditions without external environmental influences.

The sealed jars allowed for:

Fig 10: lab exposure

Precise control over corrosion conditions (no wave action or external contamination

Comparative analysis between open-sea-exposed and laboratory-exposed samples.

Exposure Duration and Inspection

Samples were retrieved every 15 days to assess changes in corrosion resistance and coating integrity.

A combination of visual inspection, weight loss measurements, and adhesion tests was performed on the samples.

4. Results

The results of the study provide insight into the effectiveness of the recycled plastic-resin coating in protecting steel from marine corrosion. Observations were recorded at regular intervals, comparing the coated and uncoated steel samples in both real-sea and laboratory-controlled conditions.

Data Collection Overview

Data was collected systematically after each 15-day interval to monitor changes in corrosion resistance and coating integrity.

The evaluation criteria included:

Visual inspections for rust formation, peeling, and coating degradation. Photographic documentation to track progressive corrosion changes. Quantitative assessments, including the measurement of rust-affected surface areas. Weight loss analysis (if applicable) to quantify the material degradation over time. Differences between open-sea exposure and laboratory-controlled conditions were also analyzed to understand the coating's performance in varied environments.

Day 15 Observations

Coated Pieces:

Minimal signs of corrosion were observed. Slight surface wear was noted, but no rust penetration was detected. The coating remained intact and adhered well to the steel surface

Uncoated Pieces:

Early signs of corrosion appeared, particularly around edges and exposed areas. Small patches of rust were visible, indicating the onset of oxidation. The samples in the open sea environment showed faster corrosion than those in laboratory conditions.

Fig 11: Sea exposure **Fig 12: lab exposure**

Day 30 Observations

Coated Pieces:

The coating started showing minor degradation, especially in high-friction areas. The steel surface underneath remained largely unaffected, demonstrating that the coating was still preventing significant rust formation.

Uncoated Pieces:

Extensive rust patches developed across the entire surface. The corrosion was more pronounced in marine-submerged samples, likely due to continuous seawater exposure and biological activity.

Fig 13: Sea exposure **Fig 14: lab exposure**

Day 45 Observations

Coated Pieces:

The coating remained functional but exhibited visible signs of wear in high-impact areas affected by wave action. Minor peeling was observed at sharp edges, suggesting areas of mechanical stress were more vulnerable. No deep rust penetration was found under the coating.

Fig 15: Sea exposure **Fig 16: lab exposure**

Uncoated Pieces:

Severe corrosion covered the majority of the steel surface.

The structural degradation was more evident in open-sea samples, where constant exposure to water, oxygen, and biological factors accelerated the rusting process. In the laboratory-controlled samples, the corrosion was somewhat less aggressive but still widespread.

Day 60 Observations

Coated Pieces:

The coating continued to provide protection, though peeling and surface degradation became more noticeable. Certain areas, especially along edges and impact zones, experienced coating detachment, exposing the steel to direct seawater contact. Despite this, rust formation remained significantly lower than in uncoated samples.

Uncoated Pieces:

The steel pieces were heavily corroded, with deep pitting observed in areas submerged in seawater.

In the open-sea samples, biological growth (such as algae and barnacles) further accelerated degradation.

The laboratory samples, while also corroded, showed slightly

lower rust formation, confirming that environmental conditions influenced corrosion severity

Fig 17: Sea exposure **Fig 18: lab exposure**

Comparison between Real-Sea and Laboratory Results

Coated Samples: Performed better in both environments compared to uncoated samples. Real-sea samples showed more biological growth and surface wear due to constant wave impact and biofouling. Laboratory samples experienced less degradation, as they were not exposed to external stress factors like wave action, oxygen fluctuations, and microorganisms.

Uncoated Samples:

Severely corroded in real-sea conditions, with extensive pitting and material loss. Laboratory samples corroded more slowly, but rust formation was still substantial.

Key Findings:

The recycled plastic-resin coating delayed corrosion significantly compared to uncoated steel. The coating provided effective protection for up to 60 days, though degradation became evident over time.

Real-sea conditions accelerated coating wear due to biological growth, wave impact, and continuous saltwater exposure.

Controlled lab tests demonstrated that, in the absence of mechanical and biological stressors, the coating lasted longer before showing signs of deterioration.

Weight Measurement in the Study

Weight measurement plays a crucial role in assessing the **efficacy of the recycled plastic-resin coating.** It helps determine **material degradation, corrosion resistance.**

Initial Weight Measurement

Before applying the coating, the weight of each steel sample has weight of 6.5 grams. The coated samples should be weighed again after the coating is 6.90 grams.

Weight Change During Exposure in Sea

Corrosion Rate Formula (mm/year):

$CR = K \times \Delta W / ATD$

CR = Corrosion rate (mm/year)

K = Constant (87.6 for steel)

ΔW = Weight loss (g)

A = Surface area (cm^2)

T = Time (hours)

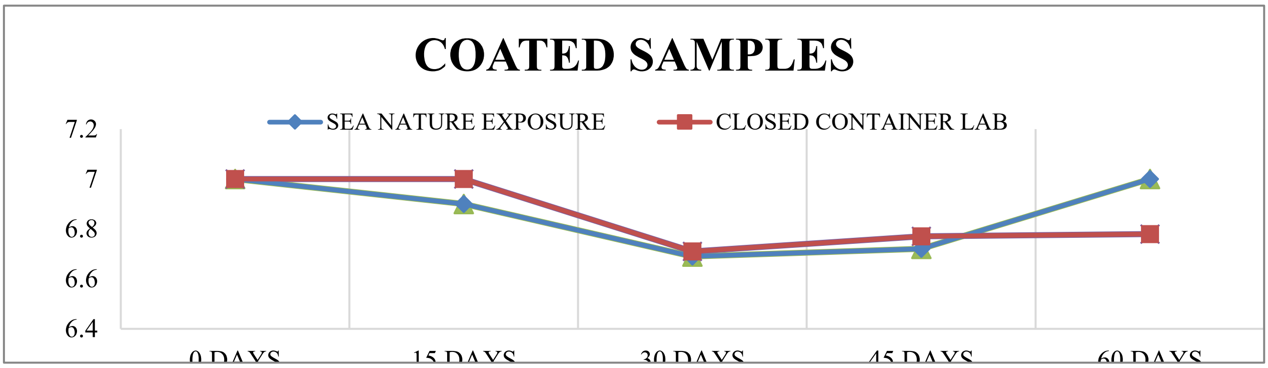
D = Density of steel (g/cm^3)

This formula helps quantify the effectiveness of the coating in preventing corrosion compared to uncoated steel.

WEIGHTS OF COATED SAMPLES

	SEA NATURE EXPOSURE			CLOSED CONTAINER LAB		
DAYS	INITAL WEIGHT	FINAL WEIGHT	WEIGHT LOSS	INITIAL WEIGHT	FINAL WEIGHT	WEIGHT LOSS
15 DAYS	6.9 gm	6.9 gm	0	7.00 gm	7.00 gm	0
30 DAYS	6.9 gm	6.69 gm	0.21 gm	6.9 gm	6.71 gm	0.18 gm
45 DAYS	7.00 gm	6.72 gm	0.27 gm	7.00 gm	6.77 gm	0.23 gm
60 DAYS	7.00 gm	7.00 gm	0	6.9 gm	6.78 gm	0.12 gm

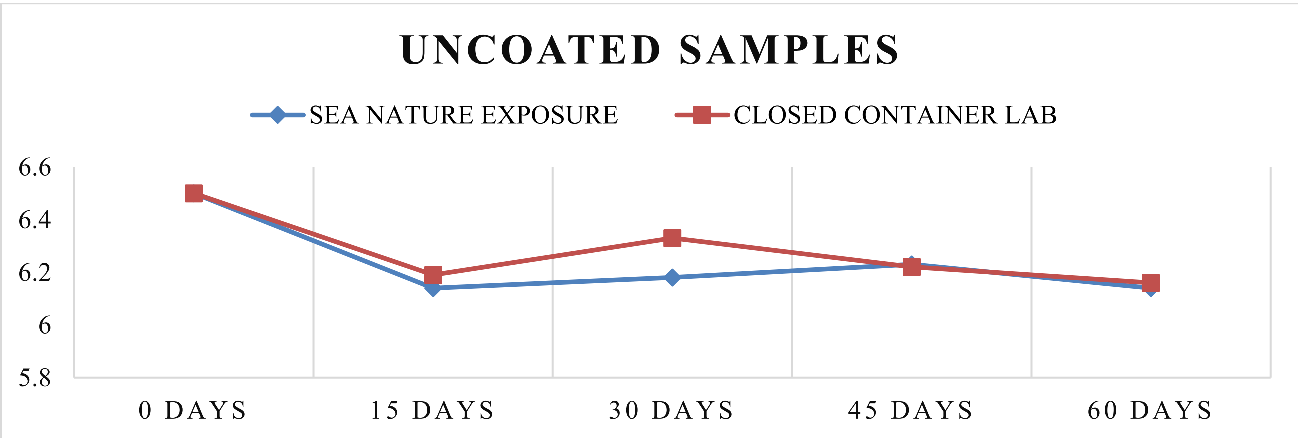
GRAPH 1



WEIGHT OF UNCOATED SAMPLES

	SEA NATURE EXPOSURE			CLOSED CONTAINER LAB		
DAYS	INITAL WEIGHT	FINAL WEIGHT	WEIGHT LOSS	INITIAL WEIGHT	FINAL WEIGHT	WEIGHT LOSS
15 DAYS	6.5 gm	6.14 gm	0.36 gm	6.5 gm	6.19 gm	0.31 gm
30 DAYS	6.5 gm	6.18 gm	0.32 gm	6.5 gm	6.33 gm	0.17 gm
45 DAYS	6.5 gm	6.23 gm	0.27 gm	6.5 gm	6.22 gm	0.28 gm
60 DDAYS	6.5 gm	6.14 gm	0.36 gm	6.5 gm	6.16 gm	0.34 gm

GRAPH 2



5. Discussion

The results of this study provide valuable insights into the feasibility of using recycled plastic-resin coatings as a corrosion-resistant solution for marine applications. The discussion evaluates the performance, longevity, and environmental impact of the coating while comparing it to existing commercial alternatives.

Analysis of Coating Performance

The experimental findings indicate that the plastic-resin coating effectively delayed corrosion, reinforcing its potential for protecting marine structures. The coating's high adhesion strength and uniform coverage contributed to its ability to prevent direct exposure of the steel to seawater, thereby reducing oxidation.

Initial Performance: The coating showed strong adhesion and minimal degradation within the first 30 days, indicating its short-term reliability in marine conditions.

Mid-Term Performance: By Day 45, minor degradation, such as peeling at stress points, became apparent, particularly in samples exposed to wave action and high salinity.

Long-Term Performance: By Day 60, noticeable coating wear and peeling were observed, but corrosion was still significantly lower compared to uncoated samples.

These observations confirm that recycled plastic coatings are an effective barrier against early-stage marine corrosion but may require reinforcement for long-term applications.

Corrosion Resistance

A key objective of this study was to evaluate how well the recycled plastic-resin coating resisted corrosion in real-sea and controlled laboratory conditions.

Real-Sea Exposure:

Future research could explore hybrid coatings—combining recycled plastics with the coated samples exhibited better resistance than uncoated steel, but the harsh marine conditions (waves, biofouling, salt deposition, and temperature variations) gradually weakened the coating over time.

The edges and impact-prone areas were the first to degrade, suggesting that additional reinforcement may be required at stress points.

Laboratory-Controlled Exposure:

The controlled environment slowed the corrosion process, indicating that external environmental factors (oxygen fluctuations, microbial activity, and mechanical stress) contribute significantly to corrosion rates.

The coated samples lasted longer in laboratory conditions, confirming that mechanical and biological interactions in real-sea environments accelerate coating wear.

Key Takeaways:

The coating significantly reduced the corrosion rate compared to uncoated steel, demonstrating protective potential.

Enhancements in formulation, such as thicker applications or additional protective layers, could further improve corrosion resistance.

Comparison with Other Coating Technologies

Traditional Coating Methods vs. Recycled Plastic Coatings

Key Observations:

Commercial coatings provide longer durability, but they often contain hazardous substances.

The recycled plastic-based coating is a promising eco-friendly alternative, especially if improvements are made in adhesion, wear resistance, and long-term stability. and laboratory-controlled conditions. The key findings include:

traditional protective materials for enhanced durability and sustainability.

6. Conclusion

This study investigated the feasibility of using recycled plastic-based coatings for protecting steel surfaces in marine environments. The findings indicate that such coatings offer significant corrosion resistance, promoting an eco-friendly and sustainable alternative to conventional petrochemical-based coatings. The research highlights both successes and limitations, paving the way for further advancements and industrial applications.

Weight measurement is a critical metric in evaluating coating effectiveness and corrosion resistance.

Regular weight tracking helps quantify material loss, coating degradation, and long-term protection.

If coated samples retain more weight than uncoated ones, it confirms the effectiveness of the recycled plastic-resin coating.

Summary of Findings

The study successfully formulated and applied a recycled plastic-resin coating to steel pieces and evaluated its corrosion resistance over a 60-day period under both real-sea exposure

Corrosion Resistance: The coated samples exhibited significantly lower corrosion rates compared to uncoated steel, confirming that the coating effectively delayed oxidation and surface degradation.

Comparative Performance: While the coating showed strong adhesion and protective properties in early testing phases, gradual degradation was observed over time, particularly in real-sea conditions where mechanical wear and biological growth accelerated deterioration.

Environmental Impact: The use of marine plastic waste as a raw material demonstrated a dual benefit—reducing plastic pollution while providing an alternative protective solution for steel surfaces.

Laboratory vs. Real-Sea Exposure:

The coating lasted longer in controlled laboratory conditions, suggesting that wave action, biological activity, and fluctuating environmental factors accelerate coating wear in real-sea settings.

The findings reaffirm the need for coatings with enhanced mechanical resilience to withstand harsh marine environments over extended periods

Scalability and Potential Applications: The success of this experiment opens opportunities for scaling up production and expanding applications to various industries such as shipbuilding, offshore structures, coastal infrastructure, and other industrial sectors exposed to corrosive environments.

Challenges Identified:

Long-Term Durability: While effective in the short to medium term, further enhancements in the formulation are needed to extend service life in extreme marine environments.

Coating Degradation: The coating showed peeling at stress points, indicating that stronger adhesion promoters and reinforcement materials could improve longevity.

Testing Beyond 60 Days: Since long-term corrosion protection is crucial for industrial applications, extended testing periods are needed to assess performance over several months or years.

Recommendations for Future Research

To enhance the performance and applicability of recycled plastic coatings, future research should focus on the following key areas: Advanced Formulations for Improved Performance Investigate different plastic-resin ratios to optimize adhesion, flexibility, and wear resistance. Explore additives such as graphene, silica nanoparticles, or UV stabilizers to enhance mechanical strength, weather resistance, and longevity. Consider multi-layered coatings to provide added protection against abrasion, salinity, and impact stress.

Infrastructure Protection: Bridges, pipelines, and concrete reinforcements exposed to harsh weather.

Automotive Industry: Underbody coatings for vehicles exposed to road salts and moisture.

Aerospace & Aviation: Protective layers for metal components in humid or saline environments.

Oil & Gas Sector: Corrosion prevention for offshore drilling platforms, storage tanks, and industrial equipment.

Environmental & Sustainability Considerations

Explore biodegradable polymer alternatives that balance longevity with environmental safety. Assess life-cycle impacts and carbon footprint reductions compared to traditional coating materials. Investigate potential government incentives or policies promoting recycled materials in industrial applications.

Final Thoughts

This study demonstrated that recycled ocean plastic can be repurposed into protective coatings that reduce corrosion, minimize environmental waste, and offer a sustainable alternative to traditional coatings. However, further research and material improvements are necessary before large-scale industrial adoption. If optimized successfully, recycled plastic coatings could revolutionize multiple industries, creating a greener, more cost-effective solution for corrosion protection while addressing the global plastic pollution crisis.

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