

Review Article

Study of Various Epoxy-Based Surface Coating Techniques for Anticorrosion Properties

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Polyepoxides are a kind of chemical polymerization that is widely employed in several industrial purposes. Due to their macromolecular structure, polyepoxides offer superior superficial treatment and antierosion activity compared to basic organic corrosion inhibitors. During metal-inhibitor interactions, the polyepoxides outlying glacial efficient clusters operate as adsorption centers. Numerous polyepoxides have been employed as anticorrosive coating materials in both pure and cured forms, most notably for ferrite in acidic and NaOH solutions. The majority of polyepoxides operate as inhibitors of interface and mixed-type corrosion. Numerous computer models have been done to illustrate the anticorrosive properties of polyepoxides on metallic shells and their adsorption behavior. However, because the majority of polyepoxides have low solubility, they are best used as anticorrosive coating materials. Numerous polyepoxides-based coatings have been created and effectively applied on ferrite and aluminum in salt-water solution according to a review of the literature. Natural and synthetic additives can be used to further enhance the anticorrosive properties of polyepoxides coatings. This review article compiles published findings on the anticorrosive properties of pure and cured polyepoxides for a variety of metals and alloys in a variety of electrolytes.

1. Introduction

A variety of industrial finishes, from pipeline protection to warehouse floor sealing, employ epoxy to preserve surfaces, reinforcing materials, and prevent corrosion and decay. As a result, epoxy is one of the most extensively used industrial finishes, with applications ranging from pipeline protection to warehouse floor sealing. Epoxy coatings are still more substantial than some other surface polymeric matrices at first, but their potential that provides long-lasting corrosion

protection, adhesion, and adaptability to a wide variety of substrates ultimately makes them more cost-effective than other options [1–5]. Less frequently, coating materials may be reapplied when materials are properly prepared for coating application. The various epoxy resin and nanoparticles used in the different polymer matrix composite materials and resulted from reasonable improvements in various aspects [6–9]. Corrosive species cannot permeate or diffuse through the micropores in ER coatings because of the addition of additives. All published reports on the

anticorrosive effects of ERs on various metals and alloys in various electrolytes are compiled in this review article.

2. Types of Epoxy Surface Coatings

It is possible to make coatings, adhesives, and thermoplastic elastomers with epoxy-based polymers. Surface coatings made from these materials have excellent mechanical qualities, electrical conductivity, cohesion, and chemical and thermal resistance. Bisphenol A, bisphenol F, and phenolic novolac are the most prevalent epoxy resins. It is common to utilize epoxy resin hardeners or coreactors such as polyamide and amidoamine with epoxy resin coreactors. These hardeners are also known as coreactors and are used with epoxy resins. A resin and coreactant combination's suitability for a given application will be determined by the demands placed on it. It is possible to employ polyamide as a coreactant with phenolic novolac resin to provide an extremely chemical and corrosion-resistant finish [10–13]. Figure 1 shows the various epoxy floor coatings used for household and industrial applications.

2.1. Considerations for an Epoxy Coating on a Surface. Epoxy coatings necessitate certain climatic conditions and surface preparation to apply well. It is possible that, before you can put an epoxy coating on steel, you will have to remove a thin corrosion layer that is already formed there. Chemicals and blasting products are two ways to clean surfaces.

Once you have cleaned and prepared a surface, it is exposed to contamination from the outside. Flash rust can build in as little as 30 minutes while handling using steel, for instance. Longevity in the field decreases with delay in applying an epoxy surface coating. Consequently, producers provide detailed directions on how quickly the first coating should be applied and the optimal surrounding conditions. Figure 2 shows the chemical formulas, chain link of epoxy polymer, and its reaction (source: Wikipedia).

Cleaning and preparing the surface, as well as being exposed to the ambient environments during preparing, applying, and curing, are all critical to the performance of an epoxy protective coating. Professionals use temporary climate control systems to provide the ideal ambient conditions for each phase of the epoxy surface coating process when a meticulous atmosphere, such as a factory, is not available. Polygon's unique provisional environment control technologies are perfect for shipyards, power plants, and building sites since they provide you with complete control over the ambient temperatures. Find out about the advantages of polygon's temperature-controlling surface coatings on epoxy substrates and how they can help keep your project within budget while also keeping it on schedule.

2.1.1. Epoxy Coating in Corrosion Resistance. Epoxy coatings are known for their remarkable mechanical qualities, such as toughness and endurance, as well as resistance to abrasion, impact, and chemicals. Adhesives are an excellent surface

treatment material for parts in harsh industrial environments because of these characteristics.

Epoxy floor sealants, for instance, are often used to improve the performance of concrete floors in manufacturing units, factories, logistic centers, and other areas with fairly heavy foot traffic. Epoxy coatings are a preferred protection layer in the automobile sector due to their resilience to chemicals such as those present in oils, cleansers, and bleach.

To protect pipeline assets against corrosion, fusion adhered epoxy-based technology is widely employed in the oil and gas and water/wastewater industries.

2.1.2. Uses of Surface Treatment with Epoxy. In addition to being strong adhesives and long-lasting paint, epoxy coatings can be utilized as floor and metal coatings, as well as a variety of other things. Epoxide resin and polyamine hardener are used to induce an electrochemical reaction that forms epoxy coatings. Curing occurs when these two substances are mixed. A few moments to so many hrs are required in the process, which converts the wet epoxy layer into an incredibly tough and long-lasting solid.

Epoxy and epoxy coating compounds have an assortment of uses due to their ability to provide a durable, robust, and chemically resistant substance. Epoxy coatings are employed in several electrical, locomotive, and naval applications, as well as in industrial production plants and composite materials like carbon fiber and fiberglass. For a wide range of applications, epoxy ingredients and epoxy layer compounds can be employed as strong adhesives.

2.1.3. Polyurethane Epoxy Coatings and Paint. The use of epoxy resins as paints or varnishes is a common application for epoxy coatings. It is common to apply epoxy coatings on types of metal because they dry quickly, are robust, and give protection from the elements. Conventional high-temperature powders are time-consuming and difficult to apply; epoxies are both quick and easy. Epoxy coatings are commonly used for the following purposes.

3. Acrylic and Acrylic-Based Epoxy Coating Materials

Using epoxy-based acrylic resin or paints is one of the most common applications for epoxy coatings. It is common to apply epoxy coatings on alloys and additional materials because they are quick to cure, resistant to scratch, and protective when applied properly. Because epoxy coatings are rapid and simple to apply, they may be used for a wide range of applications, as opposed to typical heat-cured powder coatings. Some of the most common applications for epoxy coatings are as follows [11–16].

3.1. Applications for White Goods Coatings. Epoxy coatings are frequently used as powder coatings on washers and dryers, as well as other "houseware" because they are long-lasting and simple to apply.

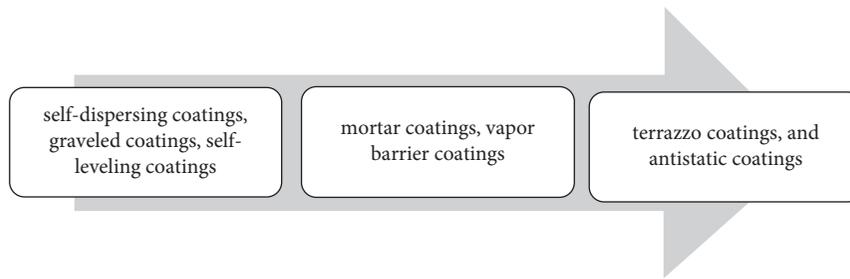


FIGURE 1: Types of epoxy floor coatings.

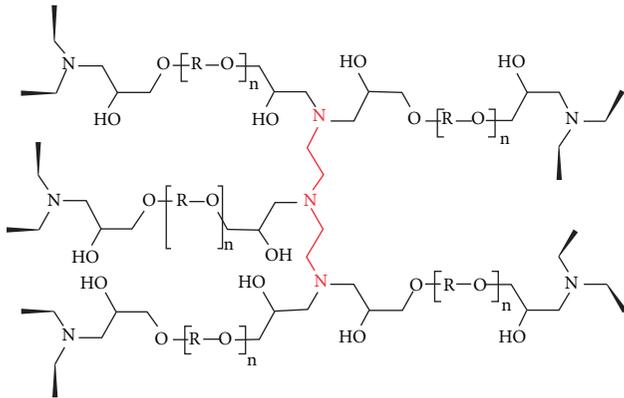


FIGURE 2: Chemical formulas and chain polymer chain diagrams of epoxy.

3.2. Applications in the Industrial and Automotive Industries. An adhesive (epoxy resin) will function as a primer for vehicles and boats, preventing corrosion and ensuring that paints adhere to their surfaces.

3.3. Steel Anticorrosion Coatings. Another application is the protection of corrosion in pipe materials as well as fittings in the oil-gas transportation lines, similarly in water transfer pipelines and concrete transporting lines.

3.4. The Application of a Coating on Metal Containers and Cans. The application of an epoxy coating on metal cans and containers is a frequent technique to avoid corrosion, particularly when acidic foods like tomatoes are packaged in them.

3.5. Applications for Flooring. Residential and manufacturing facilities could indeed benefit from resin coatings, such as epoxy flooring coatings.

4. Epoxy Coating Systems in Flooring Implementations

Epoxy coatings produce a long-lasting, resilient flooring solution when utilized in flooring applications. Epoxy floor coatings are utilized in manufacturing facilities, commercial and retail establishments, industrial facilities, warehousing, healthcare, exhibitions, garages, aviation hangars, and other commercial and industrial applications. Epoxies and surface

paints give a beautiful, high-gloss surface that comes in a wide range of colors and designs. Marble floors carpeting, chip flooring, and multicolored aggregate flooring are some of the decorative possibilities available when utilizing an epoxy varnish on floors. Epoxy floor coatings are a chemically resilient and easy-to-maintain flooring solution that may be put directly to new or improved concrete floors [14–16].

Modern Ecological Services provides epoxy surface paint application services using long-lasting epoxy coating chemicals. Please contact our epoxy floor application business if you would like to learn more about how our epoxy coatings can provide a lasting and attractive flooring environment for your light industrial building. We can provide a solution and make your flooring more practical and appealing by using our long-lasting epoxy coatings, which come in a range of colors and styles.

5. Coating of Carbon Nanotube on Carbon Fiber Surface and Interfacial Properties

By using a one-step dipping approach, a multiscale carbon fiber/carbon nanotubes reinforcement was created, with a silane coupling agent such as KH560, oxy-propyl trimethoxy silane, and 3-glycidyl ether acting as a bridge between CF and CNTs. The individual fiber tensile behavior of improved carbon fibers all increased considerably as a result of the CNTs being evenly coated onto the CF surface. In addition, the interfacial bonding and shear behavior of the carbon/carbon nanofibers reinforced epoxy composite, as measured by SEM, revealed excellent interface adhesion. The interfacial characteristics of the coupling agent silane and carbon nanotubes were also shown to be enhanced synergistically. Furthermore, the linking consequence of carbon NTs has proposed an adhesive bonding system for carbon fiber/carbon NTs multiple-scale strengthening polymer composite. This inimitable reinforcing process might serve as a model for improving CF surface characteristics and interfacial qualities.

In conclusion, a generous amount of carbon and carbon nanofibers multiresolution fortification was created using a one-step dipping technique with bridge agent as silane; it is proved to be an effective way for composite interphase augmentation. This technique is simple to use, saves time, and does not harm the mechanical properties of single CFs. The shear strength in interfacial bonding of carbon fiber-X-CNTs/EP-KH560 rose by 86.81 percent from 83.86

44.89 MPa. Interfacial bonding surface microscopy of the fractured sample also indicates strong bonding of matrix material. Furthermore, findings show that KH560 mass fraction is a major element in CNT absorption on CF surfaces and that, following CF modification, the thickness of the composite interface layer would considerably rise. CNTs' bridging action has been considered as a crucial component in improving the interface properties for multiscale reinforcement composites regarding the interphase strengthening procedure. This fast preparation technique of carbon fiber-X-KH 560-carbon NTs might give details about the investigational and hypothetical direction to future multiscale CF reinforcement in industrial applications due to its ease of use, high efficiency, and mechanical property preservation [17].

5.1. Risk Evaluation of Coating Surface Abrasion Resistance in Drilled Conditions Using AHP. Adopting an analytical hierarchy process (AHP), this study aimed at developing a methodology for evaluating laboratory-tested or field-tested epoxy coatings for internal drilling based on 5 failure mechanisms that were frequently visible and measurable; the model was then validated using an electrochemical impedance spectroscopy test (EIS). Consequently, the FBE coating's corrosion-resistance levels were established, and three kinds of business wet epoxy coatings were examined and specified on the premise of the fully examined results. They found that the electrochemical impedance of the assessed or revealed epoxy coating correlated with their fully analyzed values. Finally, the model was used to test the interior epoxy coatings of the 3 drill pipes for corrosion protection under real-world settings after being subjected to a variety of drilling service meters. Tests conducted in a lab replicating drilling conditions proved that the complete assessment model was a sound one for determining the corrosion conferring resistance overall performance of a revealed epoxy coating clearly and comprehensively. In comparison, no flaws were found on the FBE coating's surface, indicating that it was more erosion-resilient than the melted composite layer in the penetrating environment, as evidenced by the presence of holes and fractures [18].

5.2. Bonding Agent Improves Epoxy Resin Covering Adhesion. An innovative epoxy resin adhesive agent is proposed in this study, which strengthens the adhesion properties of coatings. Rehabilitation and reuse of public cement-based buildings, particularly concrete floors, are two of the most common applications for these types of systems. We have shown in this study the outcome of a sequence of tests on epoxy polymer resin adhesives, whereby the matrix of the adhesive substance, which is comprised of epoxy resin, has been changed by the inclusion of coconut fibers to improve its performance. Testing was carried out on the cementitious material and mortar samples substrates to ascertain their resistance to pull-off. The findings indicate that the addition of 0.5 percent to 1.0 percent natural fibers to the coupling agent matrix led to the improvement of the pull-off strength of the coating layer. The use of a greater volume

proportion of fibers, on the other hand, resulted in a more frequent occurrence of crack propagation failure seen between polymer matrix and the substrate; it was discovered. As a result, the epoxy resin covering's pull-off strength is lowered, which is likely due to the huge amount of presence in fiber bunches in the epoxy polymer resin matrix, as demonstrated by pull-off strength measurements. Finally, to verify the macroscopic findings, the specimens were subjected to SEM; this was utilized to inspect the coating's interaction with the substrate. It was possible to accurately forecast the behavior of pull-off strength by numerical simulations that used plasticity of simplified concrete degradation. As a result of this research, a linear behavior of the substrate was constructed to portray the softening behavior of the substrate when loaded [19]. A novel form of nanocomposite epoxy coatings with ecological sustainability and durable erosion resistance was disclosed. The polymer epoxy resin modified PVC concentrate coated applied as priming and strong PVC epoxy coatings to protect steel against erosion in maritime environments. TEM and SEM validated the coated morphology, and the influences of congealing and multilayer drying were compared. As an outcome, the material showed the best adhesion and salt erosion spray protection when the primer's epoxy concentration was 50%. Polyethylene terephthalate (PET) coatings differ from epoxy and vinyl chloride (PVC) coatings, the epoxy-PVC coating had outstanding protection against corrosion due to the composite primer's adherence and the topcoat's barrier and high durability [20].

5.3. Green Epoxy Self-Healed under UV Light. Several studies have been carried out in other countries to develop polymer coverings that defend metal polymers against corrosion. This includes biobased epoxy coatings that self-heal. A dual container self-healing coating system employing biobased epoxy resin, nanotubes, and silica nanoparticles was developed. They were sealed with a biobased polymer matrix by vacuumed injection, and the nanomaterials were mixed using a UV activator. They were then formulated with a natural organic epoxy binder to make self-healing composites. When the epoxy coating is scratched, the nanotube ruptures, releasing the epoxy resin with a biobased component that fills the scrape and reacts through the UV originator immobilized on the silica nanoparticles to cure an epoxy coating. The abrasion on the biobased epoxy coating heals completely in the face of sunshine at 40% entrapped HNTs. Furthermore, the polymers had better UV protection, heat resistance, and transparency. As a result, the biobased reinforced composites are a feasible metal covering [21].

6. Epoxy-Polyamide Coating Cathodic Debonding Behavior

Here, we looked at how epoxy polymeric amide cathodic disbonding is affected by factors such as coating thickness and applied voltage as well as salt content, temperature, and pH in the solution. Following an investigation into how

coating thickness and immersion duration affect cathodic disbonding, it was discovered that moisture, oxidant, and salt potassium ions all enter via the coating's hollow. The applied voltage had a negative relation with the coating's cathodic disbonding region, the researchers found. Rise in saturated salt solute concentration from 3.5 to 5 percent raised coating disbonding level, whereas concentrations from 7 to 9 percent lowered coating disbonding level. Temperature and pressure increases in sodium chloride solution increased the counter electrode disbonding frequency of epoxy resins as well [22]. The use of waterborne protective coatings has lately gotten a lot of attention, but their practical uses are severely constrained due to their weak shielding capabilities and low mechanical endurance. Fly ash, metal oxides, and nonlinear and noncarbon nanotubes were stacked with the assistance of a silane coupling reagent to create a concrete-like three-dimensional networking filler that improves aqueous epoxy coating's anticorrosion and wear resistance. Due to chemical alteration, the filler's surface has a high concentration of epoxy and amino organizations, allowing for more crosslinking events between the filler and the resin as well as between the resin and another resin inside the coating. The water-based layer has high anticorrosion and fatigue strength because of the "imitation" cement reactor's stable form and the silane-modified laminate material's increased contact durability. Using the Taber abrasion test, the imitation cement coating loses just 0.0098 g of mass each cycle, and after 14 days of immersion in a 3.5 percent NaCl solution, its $|Z|$ 0.01 Hz value stabilized at roughly $1 \times 10^7 \text{ cm}^2$, which is two vastly greater than pure epoxy. As a consequence, the results demonstrate that the imitation concrete's matching of the three filler types and interfacial biocontrol agents of the filler surface may increase the compatibility of the functional filler with water-based epoxy resin. Using industrial waste fly ash as a filler promotes resource recycling, making the coating more cost-effective and having more technical use. There is a good chance that this research will shed light on how to better design internal fillers in water-based coatings so that they have better anticorrosion and wear resistance [23].

6.1. Hydration Cemented Mixture and Adhesive Coating Interfacial Tension Testing. The goal of this research is to find out how strong the bond between epoxy and cement paste is at various points in the hydration process. Researchers also looked at the aspects that affect the interfacial adhesive strength magnitude. Using macromechanical studies such as slant shear and pull-off adhesion tests, the interface insertion process between the concrete mixture and epoxy coating was assessed after a few days' worth of hydration. Depending on when the epoxy coating was applied, the hydration process took 2, 7, 14, 21, or 28 days to complete. The water-cement ratio, curing period, and coating thickness were all parameters that may have an impact. Macromolecular experiments on cement paste and epoxy coating demonstrate that the mean interfacial bond strength is the same regardless of when the coating is applied. However, even though higher surface heat and adhesion effort should lead

to greater epoxy coating interfacial strength on the second day, the observed value of epoxy coating interfacial strength did not support this hypothesis. Despite increased surface energy and adhesion effort, epoxy-coated interfacial strength is equivalent to that of 28th-day coating on day two, possibly because more surface water was present earlier in the day. The extra water has a counterbalancing influence on the physical interactions and mechanical interlocking that would otherwise be present. Parametric analysis revealed that the parameters examined in this study had a significant impact, especially when applied early in the hydration process.

The concrete polymer coating has several uses in the construction industry, especially as a barrier against the infiltration of water or chemically hostile substances. Glazing finish, tinted surface, etc. are examples of aesthetic applications for polymer coatings. The total effectiveness of the coating system depends heavily on the adherence of the concrete to the polymeric coating in all of these applications. A polymeric coating can blister, rip, peel, or otherwise fail due to insufficient adhesion between the polymeric covering and the cementitious substrate [24].

6.2. The Effect of Filler Particles on the Tribological and Tensile Qualities of Epoxy Repair Coatings. Adding fillers for modification increases the coating's sagging resistance while also improving its mechanical qualities during the restoration process of concrete buildings with epoxy coatings. This necessitates careful consideration of the materials used. The influence of fillers on the rheological parameters (friction coefficient, toughness) and tensile strength of protective coatings was studied using a combination design approach using 3 synthetic additives (plaster, kaolin, and silica). The ideal epoxy coating mix was eventually discovered using multiple regression techniques. Increased cement content had a detrimental impact on the thixotropy of the epoxy coating, but it had a positive effect on its tensile strength. Bentonite, on the other hand, improved the coating's thixotropy while degrading its tensile strength. The shear-thinning index may be increased by 1.85 times with a 1% increase in bentonite concentration. Finally, multiple optimizations were used to determine the epoxy repair coating percentage range needed to fulfill the project's engineering requirements [25].

6.3. Epoxy Clay Nanocomposites: Surface Characteristics. The hardness, roughness, morphology, and topography of an epoxy clay nanocomposite covering were all measured. With a full factorial design involving three input elements (nanoclay loading, ultrasonic amplitude, and duration), one output response (hardness), and optimization of hardness as well as evaluation of input components and their interactions on polymer clay nanocomposite coating hardness, a full factorial approach was used. There were three levels for each of the variables, resulting in a total of 27 experiments. Nanocomposites loading and sonication duration have a far greater impact than sonication amplitude, which was previously thought to be relevant. In contrast to the other two

parameters, nanoclay loading has a negative impact on hardness. When nanoclay loading is 1 wt. percent, sonication period is 20 minutes, and sonic amplitude is 100 percent, the maximum strength is reached. The geometry and texture of the coating were examined with a micrograph (SEM) and an atomic force microscope (AFM). SEM and AFM photos help explain why the experiment's lowest hardness and maximum hardness were different. The distribution of nanoclay with a lower cluster size was shown to be improved with a nanocomposite loading of 1 wt percent. While increasing the amount of nanoclay improves properties such as clustered size and surface roughness, it detracts from coating hardness due to its lessened hardness impact [26].

6.4. Treatment of Mild Steel's Ecofriendly Surface with a Neodymium-Based Nanofilm. The surface of mild steel was chemically treated with a ferromagnetic material oxide nanofilm to significantly minimize cathodic residual stresses rate and improve the adhesion and corrosion resistance of fusion-bonded epoxy (FBE). The Nd film was found to cover the steel surface evenly and enhance the surface properties, roughness, and work of adherence. The results indicated that the application of an Nd layer significantly improved the intercellular metal/FBE adhesive (dry/wet), lowered the rate of cathodic delamination, and boosted the FBE coating protective function. Additionally, theoretical simulations demonstrated that coating molecules adsorb more strongly on neodymium oxide than on iron oxides [27]. This research looked at the corrosion protection capabilities of an epoxy ester coating in combination with a copper acetaldehyde focus almost exclusively L. leaf extract hybrid organic/inorganic pigment. In the presence of hybridization pigment extract, electron microscopy (FESEM spectroscopy) (EIS) showed that mild steel erosion was greatly suppressed. The results showed that the corrosion prevention efficacy rose considerably and reached a maximum value of 94% with an increase in immersion duration up to 24 h. The deposition of inhibitive coatings on the mild steel surface was confirmed by scanning electron microscope (SEM), X-ray photoemission spectrometry (XPS), and energy dispersive spectrometry (EDS). The results demonstrated that the epoxy ester coating's barrier and active inhibition capabilities were both improved when the hybrid pigment was present. When hybrid pigment was added to the epoxy ester coating, the lower frequencies resistance value grew. This proves the importance of pigment for coating barrier action augmentation. The hybrid pigment's ability to actively impede charge transfer was demonstrated by the epoxy ester coating's increased charge transfer resistance after being scratched artificially [28].

7. The Effect of Surface Shape on Epoxy Coating Barrier Characteristics in Various Corrosion Environments

Through the use of soft lithography and a variety of abrasive materials as templates, we created hydrophilic epoxy sealants with project surfaces. The hydrophilic nature of these

substrates first rose and subsequently declined as the surface finish improved. Using P2000 abrasion sandpaper as a template, the highest wettability of 136° was attained. To further understand the significance of surface topography on coating resistance qualities during wet-dry sequential absorption and salt-spray exposure, researchers employed electrochemical impedance spectroscopy (EIS). Wet-dry cycle immersion created hydrophobicity in the surface microstructures and thus produced greater barrier qualities than a flat coating would have. The coating made using P2000 rough paper offered best coating to the composites. However, in salt-spray testing, these microfabricated repellent coatings degraded more rapidly due to the immediate precipitation of salt electrolytes nanoparticles on the interrelated and the greater coating surface area. The coating made from P6000 emery papers deteriorated the fastest when exposed to salt spray [29].

8. Ceramic Particulate Thermal Interface Surface Coating Systems for GFRC

They investigated the heat transfer barrier performance of five commonly used glass fiber reinforced epoxy composite materials that have been coated with widely viable ceramic nanoparticles and microparticulates (GRE). In the first approach, advanced ceramics were distributed in a modified epoxy binder and applied to a GRE surface using a K-bar coater; in the second, extra ceramic materials were started spraying on top of the first sealant although the polymer was temporarily healed to permit the outer layer to be entirely covered with inorganic nanoparticles, deciding to leave no resin exposed. Both approaches were successful. Cone calorimetric characteristics at incidence heat transfer coefficients of 35 and 50 kW/m² were used to analyze the energy barrier effectiveness of these coats, as was a thermal resistance recorded by thermocouples inserted on the uncovered and rear surfaces even during conical tests. The coatings' morphology and water absorption, peeling, impact, and flexural stress durability were also investigated. The results indicated that the outer surface of all treated samples was homogenous and that the coating and substrate had good adherence. The mechanical characteristics of GRE composites were unaffected, and the mechanical and physical properties of GRE polymers remained stable even after being heated [30].

9. Conclusion

Polyepoxides are a class of powerful oxidizing prepolymers or polymeric materials that include epoxide groups. Their molecular architectures feature hydroxy (-OH) and glutamic (-NH₂) active groups that allow them to readily adsorbed on metal substrates and perform as excellent corrosion-resistant compounds whether deployed as kept making or antifouling in solution. They are soluble in polar electrolytes because they consisted of a mixture of basic organic molecules and polymers. This means they cover more surface area and give greater corrosion protection than basic organic corrosion inhibitors.

Peripheral functional groups improve solubility in polar fluids. Several ERs were employed as corrosion-resistant coating materials for graphite steel corrosion in 1 (1M HCl) and sodium hypochlorite (3.5% and 3.5%) solutions. ERs' anticorrosive actions in aqueous phases have been studied experimentally and computationally. Interaction and mixed-type anticorrosion components were found in most ERs electrochemically studied. SEM, EDS, AFM, XRD, and XPS indicated that ERs protect surfaces well. Many computer studies have shown the anticorrosive and adsorption activity of ERs on metal particles. Adsorption sites for donor-acceptor relationships in which ERs flatly bind on metal substrates have been observed. Additives, both organic and inorganic, enhanced ER anticorrosive effects. So, these additions should be examined for other ERs as well. However, because most ERs are water-insoluble, they are better used as coating materials than as antagonists in aqueous systems. A literature review revealed various ER-based coatings for carbon steel and aluminum in brine solutions. ER-based coatings outperform organic coatings in terms of corrosion resistance. Organic and inorganic additions can improve the anticorrosive properties of ER coatings. Additives such as these prevent corrosive elements from penetrating or diffusing within ER coating structures. The use of exogenous chemicals in liquid and coated phases requires more research. To screen anticorrosive formulations before expensive wet trials, computational strategies (DFT, MDS, and MDS) should be studied.

Data Availability

The data used to support the findings of this study are included within the article.

Disclosure

The publication of this research work is only for the academic purpose of Addis Ababa Science and Technology University, Ethiopia.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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