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Chemical Resistance Properties

TriFLEX™

About This Paper

This white paper from Advanced Polymer Coatings discusses the chemical resistance performance attributes of our new product, TriFLEX™. The purpose of this document is to outline the challenges faced by exterior coatings in protecting assets from chemical exposures during processes such as loading, unloading, and secondary containment. It details how TriFLEX™ overcomes these challenges, offering superior protection for railcars, industrial equipment, and concrete surfaces.

The paper highlights the limitations of traditional epoxy and polyurethane coatings and explains the innovative resin technologies in TriFLEX™ that provide enhanced chemical resistance and UV stability. This document serves as a resource for technical professionals, asset managers, and decision-makers in industries relying on exterior coatings, offering insights into TriFLEX™'s measurable chemical resistance benefits.

The paper also provides standardized testing methods, including short-term and 72-hour splash and spill exposure, used to evaluate and compare coatings' performance. It presents data demonstrating TriFLEX™'s exceptional resistance to a wide range of chemicals, including oils, solvents, acids, and alkalis.

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Executive Summary

Exterior coatings play a crucial role in safeguarding substrates from a range of environmental and chemical factors. These coatings must be robust enough to withstand incidental chemical exposure, which can occur during various processes. For example, the exterior coating of a rail car might encounter the chemical it is transporting during loading and unloading operations. If the coating lacks adequate chemical resistance, it could suffer damage, leading to premature failure and potential corrosion of the railcar. Similarly, in secondary containment applications, concrete surfaces are coated to shield against incidental chemical splashes and spills during the loading and unloading of storage tanks. In extreme cases, these coatings must endure prolonged exposure to chemicals if the tank were to spill its contents.

Chemical Resistance of Traditional Coatings

Epoxies and polyurethanes are commonly used for such applications due to their superior chemical resistance and UV stability, respectively. However, each has its limitations:

- **Epoxies:** Known for their excellent chemical resistance, epoxies can protect substrates from chemical contact for up to 72 hours. However, they are prone to chalking and fading when exposed to UV radiation, which can diminish their chemical resistance over time.

- **Polyurethanes:** These coatings excel in UV resistance and do not chalk or fade like epoxies. However, they fall short in resisting a wide variety of chemicals, particularly organic solvents.

This creates a demand for external coatings that combine excellent UV stability with broad-spectrum chemical resistance.

Development of TriFLEX

TriFLEX™ was specifically engineered to address the shortcomings of traditional coatings. The formulation of TriFLEX™ focuses on achieving a balance between UV stability and chemical resistance:

- **Polyurethane Backbone:** The polyurethane used in TriFLEX™ was chosen for its resistance to degradation by acid hydrolysis. It includes a blend of polymers that provide superior resistance to a wide range of chemicals, including acids, alkalis, solvents, and oils.

- **Advanced Resin Technology:** The proprietary resin formulation imparts a high degree of hydrophobicity to the coating, enhancing its resistance to aqueous solutions and polar solvents—challenges that other polyurethane coatings struggle to meet. This advanced resin technology ensures that TriFLEX™ can withstand harsh chemical environments without compromising its structural integrity.

Testing Procedures

A series of rigorous tests were conducted to evaluate the chemical resistance of TriFLEX™:

- **Short-Term Exposure Test:** This test involves applying several chemical drops onto a coated surface and allowing it to sit for approximately 72 hours. After this period, any remaining chemical or residue is cleaned off, and the surface is inspected for signs of blistering, delamination, discoloration, or softening. This test mirrors real-world conditions, where complete chemical immersion is typically unnecessary, and many solvents would evaporate before the 72-hour mark.

Performance Results

TriFLEX™ demonstrated remarkable performance across a diverse array of chemicals:

- **Oils and Solvents:** TriFLEX™ showed excellent resistance to common commodities such as canola and vegetable oil and solvents like acetone, ethanol, and xylene. These substances are frequently encountered in railcar and industrial applications.

- **Acids and Alkalis:** TriFLEX™ exhibited superior resistance to acids, including acetic acid, fluorosilicic acid, and hydrochloric acid. Additionally, it performed well against alkalis, making it suitable for environments where alkaline cleaning agents are used.

- **Weathering Resistance:** In addition to its chemical resistance, TriFLEX™ maintained its color and gloss retention under UV exposure, demonstrating minimal chalking and fading.

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Real-World Applications

The unique properties of TriFLEX™ make it an outstanding choice for various exterior protection applications:

- **Rail Cars:** The high chemical resistance and UV stability of TriFLEX™ ensure that railcars can withstand the harsh environments they are exposed to during transportation, loading, and unloading processes. This extends the lifespan of the railcars and reduces maintenance costs.

- **Secondary Containment:** In secondary containment applications, TriFLEX™ provides reliable protection against chemical spills and splashes, ensuring that concrete surfaces remain intact and free from chemical damage.

- **Industrial Equipment:** TriFLEX™'s broad-spectrum chemical resistance and durability make it ideal for protecting industrial equipment exposed to harsh chemicals.

Conclusion

TriFLEX™ represents a significant advancement in exterior coating technology, combining the best attributes of epoxies and polyurethanes while addressing their respective shortcomings. Its superior durability, UV resistance, chemical resistance, and corrosion protection make it a versatile and reliable choice for protecting railcars and other industrial assets. By choosing TriFLEX™, industries can ensure long-lasting protection, reduce the risk of mechanical and chemical-related damage, and ultimately enhance the performance and longevity of their assets.

TriFLEX™