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Review on study of wear resistance of Nano composite to Polyester powder coating

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***Abstract**: Growth in Nano composite coatings technology is moving towards implementing Nano composite coatings in many sectors of the industry due to their excellent abilities. Nano composite coatings offer numerous advantages, including surface hardness, adhesive strength, long-term and/or high-temperature corrosion resistance, the enhancement of tribological properties, etc. In addition, Nano composite coatings can be applied in thinner and smoother thickness, which allows flexibility in equipment design, improved efficiency, lower fuel economy, lower carbon footprints, and lower maintenance and operating costs. Nano composite coatings are utilized efficiently to reduce the effect of a corrosive environment. A Nano coating is a coating that either has constituents in the Nano scale, or is composed of layers that are less than 100 nm. The fine sizes of nanomaterial and the high density of their ground boundaries enable good adhesion and an excellent physical coverage of the coated surface. Yet, such fine properties might form active sites for corrosion attack. This paper reviews the corrosion behavior of Nano composite coatings on the surface of metallic substrates. It summarizes the factors affecting the corrosion of these substrates, as well as the conditions where such coatings provided required protection*

***Keywords:** Nano composite, polyester coating, wear resistance*

1. INTRODUCTION

Powder coating includes depositing a finely ground pitch (powder) on a substrate and heating the coat in the oven. During the curing process, the powder melts and makes a uniform, consistent coating. Powder coatings give incredible erosion, effect, and scratch resistance, and gloss. Manufacturers utilize powder coating measures in a wide range of uses as they cheap in labor, materials, and energy are adaptable and present cost, and in light of the fact that powder coats are durable.

Initially the coating was applied by flame spraying on the metallic surface to protect from weathering and scratch. And after the evolving of the process, most powder-coating applications required dipping a hot part into a powder bed which is fluidized. But this method caused in uneven thickness of film. Electrostatic spray equipment provided a way to coat cold substrate which helped in forming of uniform, thinner coating resulting in saving of raw material.

Powder-coating method is used in most production related field for forming protective finishes. Powder can be formed to provide protective surface, and endurance characteristics, and to obtain higher hardness, chemical

resistance, and gloss persisting surface. With the help of automation the powder coating can be applied on hot and cold substrate where the environment is of corrosive and have high pressure.

Automobile industries uses powder coating, for example, to shield under-hood parts from high temperature environment and pressure. The surface finish provided by powder coating is also good and improves the quality of the wheel, mirror frame, oil filter, and coil spring. Automakers are using powder coatings not only as primers for topcoats, but improved durability. Some appliance manufacturers change the energy consuming procedure of applying a porcelain surface on washing machine tops with specially framed scratch-resistant powder coatings. Appliance parts, such as range dryer drums, housings, and microwave oven inside and frame, are now powder coated.

1.1 Working Principle of Powder coating

The spray gun through which the powder is sprayed creates an electrostatic charge on powder particles as they flow through the spray gun and on to the surface. The deposition of powder on the substrate can be controlled by the guns control it allows to change gun position velocity of deposition and the shape or pattern. Powder spray guns are operated manually and programmed i.e. fixed post, charging of the powder by internal or external source, creating a charges space in front of the spray gun by internal or external power source these have their advantages and disadvantages in coating

1.2 Applications, Advantages and Limitations

Application

Polyester powder coats are cheaper, have longer durability and required less maintenance and in chemically hostile and wearing environments. They can be applied as thin film for decorative purpose and thick film for protective purpose. Typical applications are internal insulators for automobile alternators, distribution piping in gas and oil fields, and rebar for highway and bridge decks, as well as the following

1. Automobile springs
2. Bathroom fixtures
3. Dryer drums
4. Fertilizer spreaders
5. Fire extinguishers,
6. Furnaces,
7. Hospital equipment
8. Instrument cases
9. Microwave ovens

10. Mixers and blenders
11. Office furniture
12. Power tools
13. Room air conditioners

Advantages

1. chemical resistance
2. Low-gloss qualities
3. Smooth coatings
4. Good corrosion resistance
5. Tremendous adhesion to the substrate
6. Tremendous electrical properties

Disadvantage

1. Chalks when exposed to ultraviolet light and
2. Poor gloss retention Poor gloss retention

Table 1: *Properties of common thermosetting powder coatings*

Sr.no	Property	Epoxy	Hybrid	Polyester Urethane	Polyester TGIC	Acrylic
1	Application thickness mil (mm)	1–20 (0.025–0.508)	1–10 (0.025–0.254)	1–3.5 (0.025–0.089)	1–10 (0.025–0.254)	1–3 (0.025–0.076)
2	Cure cycle ° F (° C)	450 (232) 10 min	450 (232) 10 min	400 (204) 10 min	400 (204) 10 min	400 (204) 10 min
3	Metal temperature ° F (° C)	350 (177) 25 min	250 (121) 25 min	320 (160) 25 min	300 (149) 25 min	350 (177) 25 min
4	Pencil hardness	HB–7H	H–2H	HB–3H	HB–6H	2H–3H
5	Direct impact resistance lbf/in. (Nm)	60–160 (6.8–18.1)	80–160 (9.0–18.1)	60–160 (6.8–18.1)	60–160 (6.8–18.1)	20–140 (2.3–15.8)

6	Adhesion	Excellent	Excellent	Excellent	Excellent	Excellent
7	Chemical Resistance	Excellent	Good/Very good	Good/Very good	Good/Very good	Good
8	Mandrel bend	Excellent	Excellent	Excellent	Excellent	Poor
9	Salt spray resistance (hr)	1,000	1,000	1,000	1,000	1,000
8	Application ease	Very good	Excellent	Very good	Excellent	Good
9	Corrosion resistance	Excellent	Very good	Good	Very good	Very good

2. LITERATURE SURVEY

Table 2: *Literature survey*

Title, Name & Year	Input Parameter and Powder type	Response Parameter	Composite material	substrate	Remark
Optimization of wear parameters on Ni–Al2O3 nanocomposite coating by electrodeposition process C. Raghavendra SN Applied Sciences-2019	Load, Hertzian pressure, sliding speed and sliding distance Ni Powder	Wear rate	Ni–Al2O3	mild steel	The presence of Al2O3 nanoparticles has increased wear resistance compared to Ni coating. normal load applied on the pin has foremost influence on the specific wear rate which is followed by its interaction effect with sliding distance and sliding speed and specific wear rate is less at lower load
Effect on wear resistance of nanoparticles addition to a powder	Current , Gas flow rate, Electrode	Wear	Silica nanoparticles	Al 7075	The addition of nanoparticles to the textured polyester has changed the morphological structure of the final coating,

polyester coating through ball milling Marı´a Ferna J. Coat. Technol. Res-2018	gap,Welding speed polyester powder				and voids tend to appear when the amount of reinforcements added and Additions of silica nanoparticles to the selected powder polyester reduce the mass loss of The organic coating in the abrasive wear test.
Hindering the decrease in wear resistance of UV-exposed epoxy powder coatings by adding nano-SiO2 through ball milling M. Fern´andez Elsevier-2019	Frequency, load and temperature Epoxy powder	Wear and hardness	Nanosilica SiO_2	Stainless steel	It has been possible to hinder the decrease in wear resistance of functionalized coatings after UV exposure.
Effect of Al2O3 reinforcement nanoparticles on the tribological behaviour and mechanical properties of Al6061 alloy Huda A. Al-Salihi AIMS -2020	Speed, Load and reinforcement	COF and Wear	Al2O3	AA6061 alloy	The mechanical properties (tensile and hardness) of the nanocomposite were increased with increasing the amount of Al2O3 nanoparticles into the Al6061 matrix since the wear rate of the nanocomposites was significantly less compared to the matrix material.
Manufacturing and Characterization of Coatings from Polyamide Powders	Load, temperature Polyamide	hardness	Nanosilica	Mild steel	The addition of SiO2 nanoparticles to powder polyamide promotes the hardening and stiffening of the

Functionalized with Nanosilica Maria Fernández MDPI-2020	powder				coatings manufactured, while slightly reducing their crystallinity. After composite increases its hardness and sti_ness, showing the lowest loss of crystallinity. This material presents the best wear behavior after irradiation

3. CONCLUSIONS

1. Increasing demand of the tribological properties of many mechanical systems, new designs and improvements of surface modifications and manufacturing technologies. Nanoparticles exhibiting many unique mechanical properties have become one of the most attractive choices for meeting these needs in the past couple of years. The foregoing parts review basic physics and recent important results of nanoparticles from the perspectives of their mechanical properties and interfacial interactions, as well as related applications. Available fundamental research data regarding the mechanical properties of nanoparticles provide valuable guidance for their effective implementation in surface engineering, micro/Nano manufacturing and nanofabrication etc. Many of these applications with nanoparticles have already made impressive progress in practice and exhibited significant advantages in many fields
2. Various researches have been done on polyester composite coating. But there is very few research on polyester resin powder coating and the effect of Nano fillers added to Them the polyester powder coating has an advantage over other epoxy based coating because of easy to deposit and no initial processing of powder is required before applying on substrate. The use of Taguchi optimization to improve the wear resistance is not enough in the literature.
3. The use of nanoparticles for the wear resistance has been mentioned in may but the required optimum quantity of nanoparticles and the various parameters which will required to obtain the optimum value of the nanoparticles content is not studied. So to optimize the wear resistance and the hardness of the coating nanoparticle is used in different quantity.
4. In the literature survey it was found that the optimization can be done in process and in the coating material content. The material is reinforced with various Nano fillers and the wear is checked on pin on disk or liner reciprocating wear machine. The parameters to be considered during testing were %. Wt.

reinforcement, Load, Distance/Frequency, time are the main factors which determine the wear rate. Hence the optimization is done with taking the above parameters and keeping time constant.

5. From the literature it is also clear that many researchers have studied the effect of different parameters like load, sliding velocity, sliding distance, temperature, counter face hardness and weight percentage of reinforcement and found out that this parameter have significant influence on wear rate.

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