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Experimental Investigation on Epoxy Polyester Powder Coated Feed Roller in Small type Cone Winding Machine

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ABSTRACT

When the cone winding feed roller has corrosion and wear in a small type cone winding machine for frequent winding applications. It has an impact on the correct clamping of the cone. It is difficult to attach the cone in the feed roller. It has an impact on yarn winding. It has an impact on the yarn's consistent tension. The primary goal of this project is to enhance corrosion resistance and wear resistance. The most extensively utilized corrosion protection technology for materials in various environmental situations is protective coatings. Metals are isolated, resulting in a more lasting framework. The purpose of this study is to assess the corrosion resistance and surface morphology of epoxy–polyester powder coatings. Powder coatings' protective characteristics are investigated via salt spray chamber testing. This reveals that coating surface texture has a detrimental impact on coating thickness, resulting in a lack of barrier and adhesion qualities. In comparison to the polyester coating, the epoxy–polyester powder coating performed better. Epoxy-polyester coatings are used for a variety of purposes. They have the highest hardness and chemical and corrosion resistance of any powder on the market. The advantages of this sort of powder include its ease of usage and the variety of cure schedules available. It's a Thermoset, which means it won't melt when reheated. A high-temperature curing procedure follows the electrostatic powder coating application, resulting in a smooth-coated surface. The Feed Roller is composed of low carbon steel that has been chemically pre-treated with iron phosphating in a bath to achieve a Fe-phosphate coating. This experiment evaluated good protective characteristics in epoxy–polyester coatings for salt spray testing, and the results showed no signs of corrosion in the feed roller's surface area. The coatings were examined cross-sectionally and found to be entirely cured, with no cracks or pores, and satisfactory adherence to the substrate.

Keywords – CNC turning, Low carbon steel, epoxy polyester, Powder coating.

OBJECTIVES

- To improve the corrosion resistance
- To improve wear resistant

INTRODUCTION

Epoxy-polyester coatings are used for a variety of purposes. They have the highest hardness and chemical and corrosion resistance of any powder on the market. The advantages of this sort of powder include its ease of usage and the variety of cure schedules available. Epoxies stick to metals exceedingly effectively, and various pre-treatments of the metal, such as phosphate and sandblasting, improve adherence. Powder coating procedures use epoxy-polyester, which is non-toxic, non-volatile, and fully safe, whether sprayed or merely sitting in one place. It's a thermoset, which means it won't melt when reheated. It produces even, consistent, and repeatable coatings with less waste than traditional coatings. The electrostatic coating process begins with the powder being electrostatically charged. Charged particles repel each other when they depart the spray gun and disperse uniformly over the oppositely charged or grounded item. Because of the electrostatic attraction between the powder particles and the item, the powder adheres to the surface and forms an uniform covering. A high-temperature curing procedure follows the electrostatic powder coating application, resulting in a smooth-coated surface. A tribo-charging spray gun is used to charge the powder. The frictional charge of powder that is conveyed via a

certain substance, such as polytetrafluoroethylene (PTFE), metal, or other powder particles, is known as tribo-charging. At greater charges, the powder particles are more widely scattered and have a higher transfer efficiency. Tribo-charging produces a lower charge on powder particles. Powder coatings provide various advantages, including the absence of volatile organic content, a 68 percent reduction in coating material loss, a 40 percent to 84 percent reduction in dust production, high utilization rates, quick curing, minimum health hazards, and the removal of hazardous wastes.

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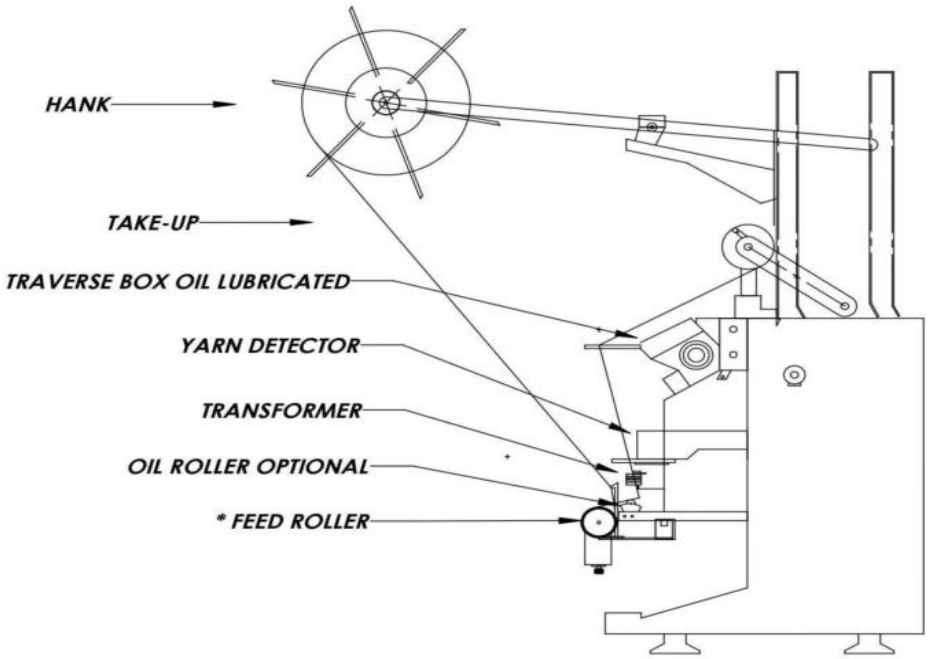
CONE WINDING MACHINE



Epoxy Polyester Powder Properties

Chemical Nature	Epoxy –polyester
Particle Size	Not exceeding 100 microns suitable for Electrostatic Spray
Coverage	10 to 12 M^2/kg - if film thickness of 50 to 60 microns is recommended
Shelf life	If store in cool and dry place, Min. 6 months from the date of manufacture.

Characteristics Of Epoxy Polyester Powder

Epoxy powder coatings are created for applications requiring great chemical and corrosion resistance and a high quality aesthetic, but where exterior durability is not important. The epoxy powder coatings are typically used in a wide range of applications including metal cabinets, sports and recreation equipment, hand and power tools, brass plumbing and hardware fixtures, tool boxes, wire goods, pipe coatings, rebar and automotive underbody/under hood parts.

Material Selection

Feed Roller is made up of Low carbon steel as the specified dimension. Low carbon steel is a type of steel that has small carbon content, typically in the range of 0.05% to 0.3%. Its reduced carbon content makes it more malleable and ductile than other steel types. Feed Roller was chemically pre-treated using iron phosphating in a bath and Fe-phosphate coating was obtained. Subsequently, the epoxy–polyester with different surface textures, were applied to the pre-treated samples using a electrostatic spray gun, with spraying. The powder-coated samples were then cured in an oven for about 20 min at 185–200^0 C.

EXPERIMENTAL PROCEDURE

The work piece was mounted using a hydraulic chuck in CNC turning centre. The machining parameters like feed, depth of cut, cutting speed, etc., were selected based on the manufacturer's recommendations.

CNC TURNING CENTRE

FINISHED WORK PIECE

METHODS OF PROCESSING STEPS OF POWDER COATING

- Degreasing
- Water Rinse
- Derusting
- Water Rinse
- Iron Phosphating
- Water Rinse
- Passivation
- Baking
- Inspection

Degreasing

Removal of oil and grease from the surface. This can be done by.

SOLVENT BASED DEGREASING: - Petroleum based solvents have excellent degreasing abilities but are not commonly used because they are highly inflammable.

ALKALINE DEGREASING POWDERS:- This is generally a blend of alkalies and surfactants.

DEGREASING

WATER RINSE

Water Rinse

After a metal surface receives a conversion coating, the surface is water rinsed to remove unreacted conversion coatin chemicals and a post-treatment is applied.

Derusting

Removal of rust and light scale from the surface. These are necessarily acidic chemicals unlike degreasing, which may be alkaline in nature. The chemical is generally a blend of mineral acids like phosphoric acid, sulfuric acid and hydrochloric acid with added inhibitors.

DERUSTING

WATER RINSE

Water Rinse

After a metal surface receives a conversion coating, the surface is water rinsed to remove unreacted conversion coating chemicals and a post-treatment is applied.

Iron Phosphating

Phosphating is a process that coats steel and iron components with a conversion coating. The technique involves soaking a component in a dilute solution, which transforms the metal's surface into a coating of minuscule Phosphate Crystals.

IRON PHOSPHATING

WATER RINSE

Water Rinse

After a metal surface receives a conversion coating, the surface is water rinsed to remove unreacted conversion coating chemicals and a post-treatment is applied.

Passivation

Passivation is a corrosion-prevention metal finishing technique. The chemical treatment leaves a protective oxide layer on the surface that is less prone to react chemically with air and cause corrosion.

PASSIVATION

Powder Coating

Epoxy Polyester powder coating is a form of coating that is sprayed onto a material with a spray gun as a free-flowing, dry powder that is electro statically charged. Coating metal in powder form and baking it to a fluid state to attach it to the product's surface creates a protective layer. Epoxy-polyester coatings are general-purpose coatings with limited sunshine exposure. This is the most commonly used powder coating. They have the highest hardness and chemical and corrosion resistance of any powder on the market

Powder Coating

BAKING

Powder coating ovens bake powder coated components by heating them up. They can be electric or gas fuelled, and they are most typically batching style ovens, in which one load of parts is loaded into the oven and heated at a time

BAKING

FINISHED COMPONENT

Salt Spray Testing

Salt spray testing is a technique for determining the corrosion resistance of coatings and materials used in product manufacturing. An accelerated corrosive assault is created during salt spray testing to better estimate how effectively the coating protects the metal. The most common application of

salt spray testing is to make fast comparisons between expected and actual corrosion resistance. In truth, there is only a shaky link between the coating's test duration and its actual predicted life. This is owing to the fact that corrosion is influenced by a variety of external circumstances, as it is not a straightforward process. As a result, the most effective use of salt spray testing is on samples to determine a pass-or-fail grade and compare it to expectations. This is usually done as part of a quality control procedure or to see how effective a certain production process is. Because it is quick, repeatable, and reasonably inexpensive, salt spray testing has long been the standardized corrosion test method. Salt spray tests are carried out in a sealed chamber. A spray nozzle is used to apply a salt-water solution to a sample. A corrosive experiment is simulated with this intense salt-water fog. The appearance of oxides is examined over a period of time, which is based on the corrosion resistance of a product. The longer it takes for the oxides to emerge, the more resistant the product is. For certain coatings, testing can take anything from 24 to 1,000 hours or more..

SALT SPRAY TESTING REPORT

CORROSION TEST REPORT FOR FEED ROLLER	
TYPE OF TEST	SALT SPRAY TEST
TYPE OF SALT / WATER	Nacl (LR Grade) / DM Water (Type - IV)
CHAMBER TEMPERATURE	35.0° ± 2.0°C
SALT SOLUTION (CONCENTRATION / SPECIFIC GRAVITY)	5% Nacl method / 1.02 – 1.04 g/cm^3
pH VALUE / COLLECTION DEVICE	6.5 to 7.2
AIR PRESSURE	0.7 to 1.4 bar
POSITION OF SPECIMEN	15° to 30° Angle
RATE OF COLLECTION OF SOLUTION	1 to 2 ml/hr
METHOD OF CLEANING	Tap water
METHOD OF HANDLING	Plastic tray
INTERVAL OF INSPECTION TIME	Once in 24 hours
REQUIREMENT OF TEST DURATION	24 hours
SAMPLE RECEIPT CONDITION	Good
TEMPERATURE & HUMIDITY	30 ± 5°C, < 75% RH

SALT SPRAY TESTING OBSERVATION

TIME	**OBSERVATION**
At 0 Hrs	Component placed in the chamber. Test started
At 24 hrs	No sign of corrosion observed in the outer surface area of sample

RESULTS AND DISCUSSION

The thickness of the applied epoxy polyester coating with rough surface roughness was determined by measuring the coating, with a minimum coating thickness of 0.04 mm. Greater thickness variations were not found in other samples. The average thickness of the coating was roughly 0.05 mm. The undercoated surface did not blister or rust throughout the accelerated corrosion tests in the salt spray and humidity chamber (30°C, 75% RH) for a duration of 24 hours. Only the hole through which the samples were suspended on a metal hook for grounding developed corrosion. The metal hook physically blocked access to the hole, preventing coating application. This is unquestionably a disadvantage of electrostatic powder coating because such areas must be fixed with a brush or spray. Corrosion around the margins of the samples was not taken into account. Following the corrosion test, samples were placed in a humidity room and tested in a salt spray chamber, where they performed well. The materials examined in the salt spray chamber had a thicker coating to protect them. During 24 hours of accelerated chamber testing, the chemical composition of the powder coating binder had no effect on the coating protective qualities. Tables show the results of powder coating dry-film thickness and corrosion testing in the salt spray chamber and humidity chamber after 24 hours, as well as subsequent adhesion tests.

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CONCLUSION

The experiments conducted in this study revealed that the powder coatings had excellent qualities but also had certain flaws. The epoxy–polyester coatings demonstrated excellent protective characteristics. The barrier mechanism is commonly used to achieve the protective efficacy of an organic coating, confirming the considerable influence of coating thickness on corrosion protection behavior. All of the coatings examined were totally cured, with no cracks or pores, and good adherence to the substrate, according to the cross-sectional examination. This experiment evaluated good protective characteristics in epoxy–polyester coatings for salt spray testing, and the results showed no signs of corrosion in the feed roller's surface area.

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