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To Study the Various Methodologies Involved in Powder Coating Technology

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Abstract:- Many ingredients in powder coating technology plays an important role. So, the study of the testing is a very essential stage in paint industries. The paint is used in large number of day-to-day products such as coolers, freezers, washers, microwaves, architectural products, lawn and as garden tools in fact they are also used in anti- corrosion valves like drill pipes, valves and fixtures and used many things. Out of all the above-mentioned techniques, extruder and grinding mill are the most important steps in paint industries and plants. And moreover, analysis of various pigments is also important as it is a very crucial constituent of paints that imparts colors to paints. The thermoplastic resin in these powders e.g. polyethylene used very much. Pigment is used to give color there are two types pigments used in paint industries organic and inorganic pigments. Epoxy powder used to cover pipelines, posts and columns just as to cover steel rebars utilized in high burden - bearing substantial design. Hardener is one in every of the foremost necessary ingredients of powder formula the hardener is chargeable for the solidification of the powder and dictates. Polyester is that the most typically used powders and supply unbelievable incentive for money. The two most typically used forms of polyester powder TGIC and non-TGIC.

Powder covering could be a top-notch end found on large number of items you are free contact with day by day. Powder covering ensures the harshest, hardest apparatus moreover on the grounds that the home things you depend on day by day. Comparatively these polymers provide an additional durability better than any other liquid paints and still has the capacity of providing a beautiful finish. Powder coated products provides an additional proof which results in reduction in coating quality and also has adverse effects on the moisture content, chemicals ultraviolet absorption strength and there is an alternate climatic condition. There is an additional advantage that it reduces the chances of scratches, chipping, abrasions, corrosions, fading and alternative wear problems.

Keywords:- *Powder Coating, Thermosetting Coating, Epoxy Powder, Acrylic Powder, Polyester Powder, Hardener, Resin, Additives, Color and Extender, Extruder, Grinding Mill, TGIC-Triglycidyl Isocyanurate.*

I. INTRODUCTION

Two principal technologies used as rear bone of coating industry are- liquid coating technology (i.e. wet coating method) and powder coating technology (i.e., dry coating method) and has been applied on an industrial scale. Out of these two techniques, the powder coating technology is the most common one and at each phase of the gathering interaction the standard ought to be observed is in light of the fact that once the covering material has been created it cannot be changed in any huge way [1]. Therefore, the proper monitoring of the formulation methodologies and the manufacturing conditions are essential criteria. Powder coating could be a dry finishing method accustomed apply a dry covering material. A perfect covering material is prepared from finely ground particles of gum and shade for shading, moreover more specific and exciting properties like gloss or hardness can be incorporated. A thermoplastic coating have the specialty is that it doesn't react with chemical throughout drying process. Rather the coating is fused to the substrate victim station heat. Thermosetting coatings are sometimes offered in powder type.[1] The coating particulates of the metals surface is initial heated to the specified temperature.

II. LITERATURE REVIEW

Extruder- In this stage, the dosing arrangement carried out in extruder is very essential as it is essential in deciding the quality of the blend. The extruder barrel is kept at a foreordained temperature which ranges between 70 and 120 °C.[1] The barrel temperature is to be maintained so that the resin is just liquefied and its contents are mixed well using the screws present in the barrel. All the individual ingredients are dispersed and wetted by the resin which ultimately produces a homogenous composite. The feeding rate of the dosing equipment and the extruder and their speed are balanced in such a way so as to ensure that all the screws are kept loaded with in the extruder barrel. [2]

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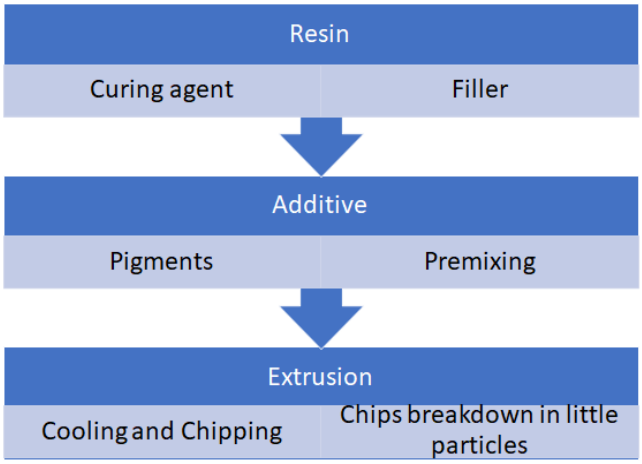

Fig -1. Process of powder coating.

Grinding Mill- In this the chips are first ground to a specified practical size inside the grinding machine. The chips afterwards are fed inside the grinding wheel which is attached with chrome pins that breaks down to increase the surface area to convert the chips into the powder. The powder is then introducing through in classifier into a collection cyclone system.[2]

Fig-2. Process of grinding mill.

Infrared oven- In this progression there is use of warmth energy to create an item through electromagnetic waves. Infrared waves are very essential as they cause quick heating. There are broadly three types of emitters used in these ovens that is short, medium and radio wavelength. [2,3] However, high temperature ends up in quicker warming rates and a lower productivity which results in higher loss through convection heat.

Reduction of raw material weighing, premixing and size-

In powder technology, the raw materials typically consist of curing agents, resin, pigments additive and extenders like flow degassing aids. [2] Each unique component in this stage must be weighed with maximum number of accuracy (which is approximately the closest ten thousand of a gram).[2] All the materials are reweighed and gradually placed in a mixture container which is consistent with the formulation calculations. The instrumentality consisting of all materials is hooked with the blending drive and whole of the cure materials are mixed completely by the uncommonly planned premixer cutting edge for a predetermined amount of it to achieve the maximum output of all the raw materials which can be reduced in size to increase the efficiency of the melt mixing during the process. After mixing, the quality control is the basic stage in which a last example of the premix is checked for its virtue and bit by bit handled through extensive lab extruder and grinder.[3] The subsequent powder is then applied onto a test board, and it is relieved inside the stove and afterward at long last exposed to different tests for their physical and substance properties, for example,

1-Color, surface flow rate and glossiness
2-Mechanical execution including restoring
3-Gel time

OBJECTIVE-

The objective of the study are as follows:

a. To learn and analyze the various aspects of powder coating technology.
b. To learn about the factors involved in powder coating technology.
c. To analyze the output and ridding for extruder and grinder mill.
d. (d) To analyze the reduction of raw materials weighing, premixing and size.
e. To determine the properties of thermosetting ornamental powder, resin, curing agent, additives and pigments and extender.
f. To determine the Epoxy powder, acrylic powder and polyester powder in detail.

III. METHOD AND METHODOLOGY

(a-) Properties of thermosetting fancy powder coatings fundamentally dependent on the plan- The crude materials that is required for the creation of powder coverings and also these are the natural compounds used for restoring specialists, colors, extenders and additives.[4] The optimization and selection of the individual parts and their structures can be affected by the following factors:

1- The specific film properties required for proper phenolic polymers are hardness, adaptability and the corrosion resistance capacity.
2- Application method.
3- The main applicability of having exceptional hardening conditions is in the applications such as kind of kitchen machine, restoring time and temperature optimization.
4- Manufacturing conditions and methodology.

(b) Resin- The proper selection of a good quality resin mixture is very necessary as these are the deciding factors which helps in sorting of good powder coating materials with fundamental film properties like melting point, flow and levelling.[5] Generally, the low molecular mass compounds are preferred which possesses a good softening properties between 60^0C and 110^0C. Low melting point resins have the tendency to be able to be convertible to cakes which can be easily stored and can be utilized for storage purposes.

Depending on the coating flow these can be associated in extreme flow degrees on hardening whereas in case of coating flow edges an occasional degree of sharp edge coverage is obtained. Most common resins are epoxies, polyurethan, polyester and acrylics [5].

(c-) Curing agent (also named as hardener): Curing agents also known as hardener is mostly employed to inculcate the amount of cross-linking in the resin at a given

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temperature. And the cross-linking degree can also be confirmed by the amount of gloss level, degree of surface area and additionally different aspects along with structure and texture effects. Usually, crosslinkers area unit used are amines, anhydrides and blocked isocyanates.[6] And the catalyst's area unit accustomed is used to accelerate the action speed.

(d-) Colors and extenders: Pigments ought to be inactive, quick to lightweight and warmth safe. Like most coatings they are acclimated produce a fancy outcome. [7]

1-Titanium oxide makes white, pastel and lightweight colors.
2-Carbon makes dark and grays.
3-Phthalocyanine is used to make blue and green pigments.
4-Bronze makes metallic impacts**.**

Organic pigments need to be handled carefully as some of them have the capacity as they can react throughout and can cause solidification [7]**.** This can result in loss of brilliance and tidiness and under such conditions different pigmentation should be utilized.

(e-) Additives: Once there is proper selection of resin amount, hardener and pigments there should still be proper changes which are needed to tune the flow and film properties so that they are suitable for machine and natural activity conditions. i.e., thixotropic specialists to chop down the flow and ultraviolet radiation stabilizers.[8] Alternative elements of added substances are:
: Increase / decline power fascination
: Increase / decline surface levelling.
: Production of improving effects.
: Reduction in stoving temperature demand.
: Dynamical conduction.
: Enhancement of surface hardness.

(f-) Epoxy powder: - Epoxy powder is being developed nowadays to obtain high quality gloss and sleek coatings which have wonderful adhesion, flexibility and hardness properties along with good improved solvent and chemical resistance.[8] The most deficiencies is their poor tolerance limits to heat and the fact that they are lightweight and their high tendency to turn into yellow-colored substances at elevated temperatures and exposure to subtle day lightweight.[9]

(g-) Acrylic powder- In recent times, the acrylic powders are widely being used for surface coatings. Their main need is the color retention power and more exposure towards heat and alkali resistance. [10]

(h-) Polyester powder- Polyester powders properties and performances can be categorized between epoxy and acrylic powders. The unique feature of these powders is that they have wonderful durability and a high resistance towards yellowing under ultra–violet radiations.[11] Most of these coatings used nowadays in buildings are supported with linear polyesters which are cross linked with TGIC. Today modern polyester powders are TGIC freed**.**[12]

Properties of thermosets powder coats			
Property	**Epoxy**	**Acrylic**	**Polyester**
Weatherability	Poor	Excellent	Excellent
Chemical Resistance	Excellent	Very good	Very good
Heat resistance	Very good	Good	Good
Flexibility	Excellent-Very good	Good-fair	Very good
Adhesion	Excellent	Good-fair	Excellent

IV. RESULTS AND DISCUSSION

Acrylic resin (yet not acrylic emulsion, that is that the possibility of acrylic paint) is additionally a thermoplastic, that proposes it's one in each of a lot of plastics which might be warmed and controlled more than once, though polyester matter and epoxy unit thermoset plastics, that utilization heat or an impetus to harden into a strong mass that will not determination. Acrylic is blended from acrylic compound, a dry powder, an alkyl bunch methacrylate matter, a thin fluid, and normally partner natural peroxide hardener of some kind.[13] If things of any size unit of estimation thought about, partner autoclave or press is significant for lessening air-bubbles and balancing within stresses made by the intensely response. The mud is cytotoxic, just like that the matter and its fumes. and furthermore, the natural peroxides unit of estimation prominently hurtful, assortment of them being hazardous et al causing moment visual turmoil on the off chance that they get in one's eyes**.**[13]

Polyester compound, a sweet clear fluid, is blended in with a little yet factor of a hearty impetus, that makes the set mass heat up which increases its flexible stuff, being helpful for covering, projecting, and develop composites, typically related to fiberglass material. [13,14]

Epoxy pitch works similarly, doesn't smell as undesirable, anyway it—and the hardener that produces it set—is an activator, which implies essentially merely that you just basically will get a frightful overly sensitive response once lasting openness. Some hardeners don't give off an impression of being just about as unfortunate as others all through this respect.[15] Epoxy will not set water-clear like acrylic, and doesn't avoid light (UV) debasement extra, however works higher with cutting edge materials, as Kevlar and carbon. [16]

Practically any dry shade (with a few exemptions—test beginning on a little scale) will be acclimated shading these saps, extra as shifted inactive fillers that set up add tone; there are unique polyester colors out there. it'll be made misty or straightforward—acrylic is used for projecting "Plexiglas" sheets, among very surprising clear things. Be truly cautious once exploitation any of these materials: these sq. gauges commonly pondered mechanical as opposed to workmanship gives, and you are required to comprehend the gratitude to shield yourself from their unsafe impacts.[16] If you don't have the correct offices for overseeing them, trust abuse more secure fluctuated frameworks.[17]

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V. CONCLUSION

Epoxy is additional proof against wearing, cracking and peeling and corrosion or harm from chemical or environmental degradation, polyester additional fragile and helpful for temporary fixes, or low stress use.[18] Epoxy is usually costlier than rosin, because of its strength and formulation needs comparatively, polyester powders supply strong adhesion properties and glorious gloss retention once exposed to ultraviolet illumination rays. they need robust weathering characteristics, however lower chemical resistance; they're usually used on fencing and outside ornamental furnishings. Most acrylic powder coatings used nowadays square measure spoken as "GMA Acrylics" as a result of the incorporation of GMA (glycidyl methacrylate) compound within the chemical compound backbone. GMA Acrylics square measure virtually universally used as clear coats.[19] Epoxies are the most well-known thermoset pitches utilized in modern powder covering, and they have a wide scope of plan alternatives. Various kinds of epoxy can be created into utilitarian thick film or more enriching slender film, while their crosslinking properties are like those of epoxy glues and paints. Most epoxy-based materials are created to be thermally steady at room temperature [20]. Acrylic powder coatings are helpful for their significant degree of outside strength and relative simplicity of utilization. Acrylics require relieving temperatures near those of hydroxyl polyesters, and they consolidate great surface style with adaptability and effect obstruction. They additionally display incredible antacid obstruction, making them appropriate for use on apparatuses, like broilers and clothes washers. Acrylic powder coatings can be successfully applied through electrostatic splashing and have flexible slim film qualities.[21] Nonetheless, acrylics are more receptive to substrate credits than most other powder coatings, making them inconsistent with certain synthetic mixtures. Beside their utilization in machines, acrylic powder coatings can likewise be found on aluminium expulsions, auto trim segments, and work vehicles.

VI. FUTURE DEVLOPMENTS

Powder coating technology is obtaining common day by day with its vital blessings and easy properties. Powder coating is cheaper and surroundings friendly as compared to ancient liquid painting technique. though powder coatings have some disadvantages however these unwanted shortcomings are going to be eliminated or reduced by the advance of equipment's and formulation method [23]. As associate degree example we will discuss regarding rosin systems, this new technology permits powder coatings to be cured at solely 120°C, that is significantly low temperature in term of natural process. This coldness natural method natural action action activity process is often called IR natural process. In modern world IR natural process has widen up the marketplace for heating sensitive substrates like plastic and wood. This success indicates the good way forward for powder coating trends.[23] With increasing advancement mostly in the application fields, there is a shift of powder coatings towards the following not many focuses. Micro-fine Powder coatings have amazing stream capacity because of miniature fine powder that makes a decent development condition. The shaping temperatures of the films made of thermoplastic and thermosetting powder coatings were found to be about 180˚C - 200˚C, and additionally the framing temperatures reaches up to 350˚C [24]. Energy utilization is huge, so energy saving is crisis. So as per the recent research works, nations are more focused and are working towards development of growing low temperature or room temperature reparable powder coatings. Functional advancement of new assortments the covering has a particular capacity in the wake of adding the relating alteration substances, for example, antibacterial, antiperspirant. [25] New innovation and new hardware advancement continuum VAMP US Ferro created strategy is a technique for assembling the progressive powder covering. Paint showering robot has become a reality to pass on proceeded with powder coating.

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