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HIGH TEMPATURE PROTECTIVE COATING

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Abstract—The market for High temperature protective coatings is rapidly growing as these paints provide higher protection to walls, prevent corrosion and rust formations, resist high temperatures and offer protection from irreparable damages. Growth in this market is mainly driven by increasing demand in Western countries, which is supported by rising consumer incomes and availability of state-of-the-art footings are usually applied as multi-layered systems that are composed of primer and topcoat. However, in some cases – for example automotive coating systems, this may vary from four to six layers. Each coating layer is applied to perform certain specific functions, though its activities are influenced by the other layers in the system. The interactions among different layers and the interfacial phenomenon play an important role in the overall performance of the multi-coat systems. Different properties of coatings are typically associated with specific parts of a coating system. Coatings may be applied as liquids, gases or solids. A coating is a covering that is applied to the surface of an object, usually referred to as the substrate. Process of coating involves application of thin film of functional material to a substratecilities in all sectors. With increasing competition, major companies are launching quality products.

Keywords— solvent losses, coating, Pleasant appearance, light intensity, low-cost.

I. INTRODUCTION

The development of jet aero-engines and rapid advancements in aeronautical, aerospace, automobile and advanced power generation industries created demands for high temperature structural materials. In modern aero-engines, base alloys (substrate) have been designed primarily for light weight and high temperature strength and these advanced materials may not provide optimal corrosion or oxidation resistance. In such cases, the only option is to rely on effective surface coatings to prevent or minimize sulphidation and corrosion problems. A novel coating of high performance polymeric material is a need of today. These polymeric materials have superior mechanical, thermal and anticorrosive characteristics ideally suitable for adverse environmental conditions. High temperature protective coatings are specially manufactured to withstand extremely high temperatures for longer durations. These paints do not degrade quickly compared to their normal counterparts and are resistant to high temperature, heat and thermal variations. Heat-resistant paints have various industrial applications, including pipes, petrochemical tanks, silencers, boilers, chimney stacks, and furnaces and their piping structure. These paints are different from fire-retarded coatings, which are usually used to protect metal surfaces. These coatings are not designed to extinguish fire. The coating only reduces the chances of fire. High temperature protective coating are in-tumescent and swells up and increases in volume when subjected to high temperatures, the swell up coating produces a shielding substance which discourages the heat conduction and this leads to control the fire.

1.1 PURPOSES OF A COATING

- Protection of metal structures from the environment by acting as a barrier between the substrate and the aggressive environment, such as the marine and industrial environments.
- Control of solvent losses.

- Reduction in friction (coating reduces friction between two contacting surfaces).
- Pleasant appearance; certain types of coatings provide a pleasant appearance and produce attractive surroundings.
- Change in light intensity; by selection of appropriate coatings the light intensity in rooms and buildings can be varied as desired.
- Modification of chemical, mechanical, thermal, electronic and optical properties of materials.
- Application of thin coatings on low-cost substrates results in increased efficiency and cost savings.

1.2 MARKET TRENDS OF PAINT AND COATING INDUSTRY

The market for High temperature protective coatings is rapidly growing as these paints provide higher protection to walls, prevent corrosion and rust formations, resist high temperatures and offer protection from irreparable damages. Growth in this market is mainly driven by increasing demand in Western countries, which is supported by rising consumer incomes and availability of state-of-the-art facilities in all sectors. With increasing competition, major companies are launching quality products.

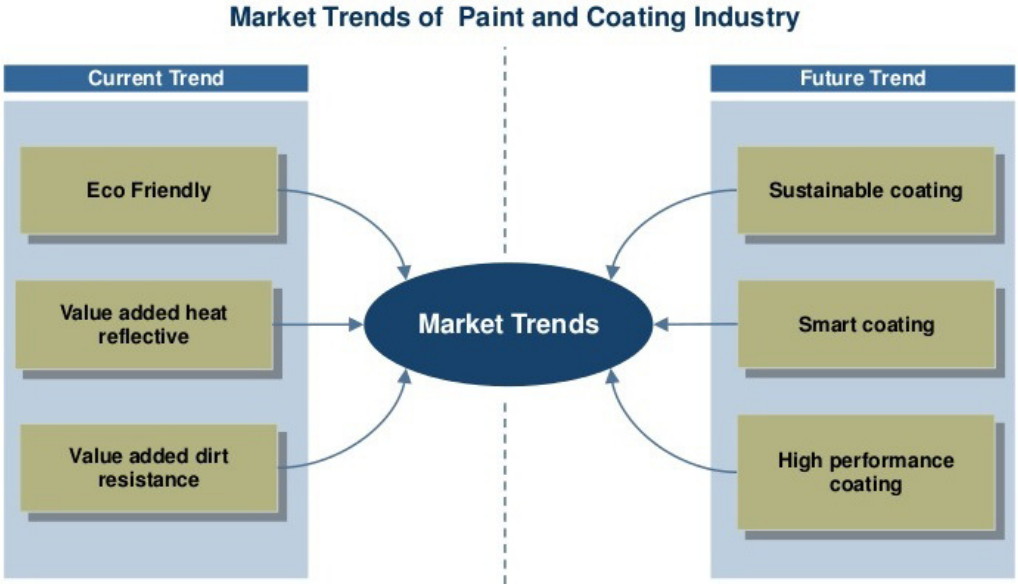

Fig (1) Market Trends of Paints and Coating Industry

II. OBJECTIVES OF STUDY

1. To develop the blend of Epoxy - Silicone resin.
2. To characterised the physical and chemical properties of paint.
3. To analyse the High temperature protective coating property with different pigments and solvent.
4. To study the % loss of heat after applying paint of different coat thickness.

III. PAINT

Pint is any liquid, liquefiable or mastic composition which after application to a substrate in a thin layer is converted to opaque solid film. It is more than just the colour though; it is a material that is applied as a liquid and dries by a variety of chemical processes to a solid. Paints (or surface coatings

as they are termed technically) are generally recognized as materials applied to substrates such as metals, plastics and many composite assemblies. They generally have a dual role which is to protect and to decorate, the latter including an ability to disguise. The protective role is that of shielding the substrate from such environmental agents as ultraviolet radiation, moisture and oxygen.

Paints consist of three principal components, namely binder, pigment and solvent. The first two are the permanent constituents, with the binder providing the adhesion and cohesion, keeping the pigment within the coating and ensuring that the paint remains attached to the substrate. Pigments provide colour and opacity. Solvents are present to aid manufacture and application, but are lost from the coating during application and the subsequent period of curing, the loss often aided by the application of heat. Varnishes are non-pigmented coatings.

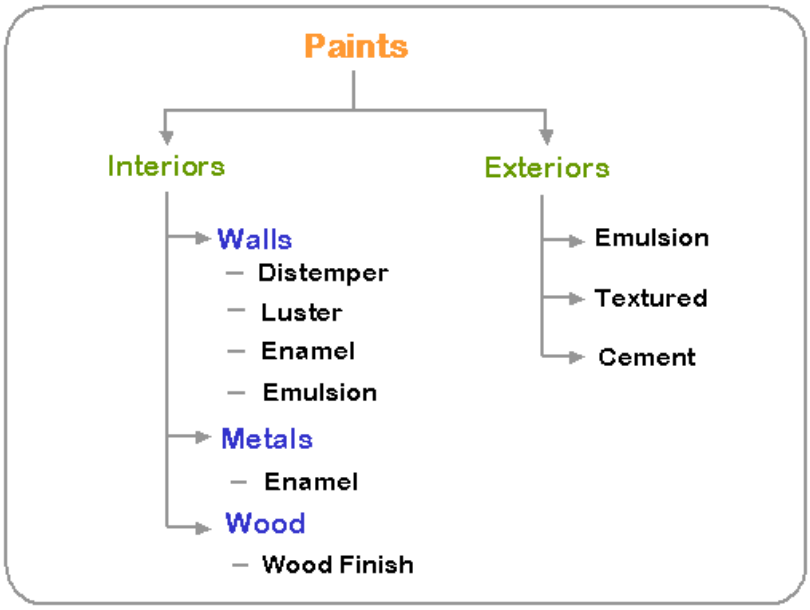

FIG (1): TYPES OF PAINTS

3.1 FUNCTION OF PAINTS

1. Decorative paint - Paint can be used as a coating to decorate a surface or substrate. It has a wide variety of colour, texture, finishes and gross level.
2. Protective paint - Paint can be designed to protect the surface or substrate against ultra-violet rays, humidity, chemicals, corrosion, algae, abrasion etc.
3. To retard corrosion of metal – Paint can be used to protect from corrosion
4. To add functionality and to modify light reflection or heat radiation of surface.
5. Special Purposes - Paint can also be formulated for specific uses such as luminous paint that glow in the dark for emergency signage, anti-condensation paint to provide an insulating layer to minimise condensation, fire retardant paint to enhance the fire resistance of combustible surfaces such as soft board or hardboard.

All paints are basically similar in composition in that they contain a suspension of finely ground solids (pigments) in a liquid medium (vehicle) consisting of a polymeric or resinous material (binder) and a volatile solvent. During the drying of paint, the binder forms the continuous film with the necessary attributes of adhesion, flexibility, toughness and durability to the substrate (the surface being coated). Paints also contain additives, which are added in

small quantities to modify some property of the pigments and binder constituents. Paints are composed of three basic components. These are (1) Pigments (2) Binders
(3) Solvents .

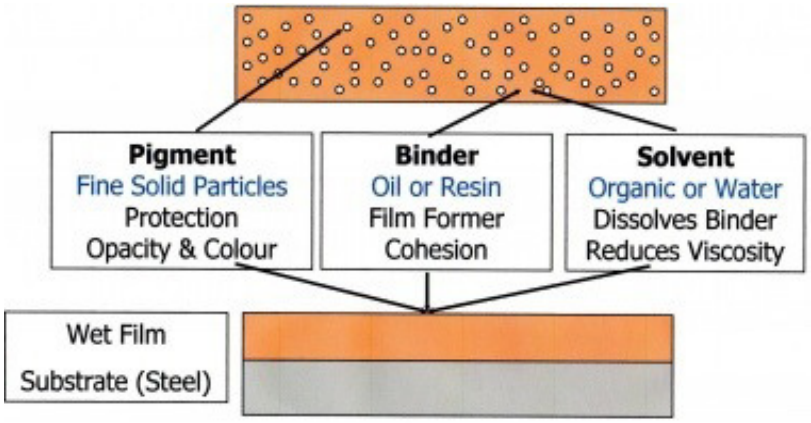

FIG (2) CONSTITUENTS OF PAINTS

3.2 FAILURE OF PAINT

A tremendous amount of financial loss is incurred every year as a result of premature failures of paints and coatings. The cost to repair such failures far outweighs the initial cost of painting, since excessive rigging may be needed to access the failing areas. Coating failures can occur for dozens of reasons, although they are typically a result of poor application, a defective coating, or an inadequate specification. A determination of the fundamental causes behind coating failures is critical.

The majority of paint and coating-related failures can be attributed to six primary causes. These causes are as follows.

1 Improper surface preparation – the substrate surface is not adequately prepared for the coating that is to be applied. This may include cleaning, chemical pre-treatment or surface roughening.
2 Improper coating selection – either the paint or coating selected is not suitable for the intended service environment, or it is not compatible with the substrate surface.
3 Improper application – this can be a problem with either shop-applied or field applied coatings, and occurs when the required specifications or parameters for the application are not met.
4 Improper drying, curing and over coating times – again, this problem relates to a lack of conformance to the required specifications or parameters.
5 Lack of protection against water and aqueous systems – this is a particularly serious problem with aqueous systems containing corrosive compounds such as chlorides.

IV. PIGMENTS

1. Paints contain pigments of different colours mixed with a liquid which carries the pigment (the medium).
2. In water colours, the finely ground pigment is suspended in water; when the water evaporates it leaves behind the pigment on the page.
3. In spray paints, the medium is a volatile organic substance that quickly evaporates.
4. It takes a long time for oil paints to dry. The oil does not evaporate, but hardens and reacts with air to form a flexible film; the oil protects the pigment and helps bind it to the surface being covered

.

4.1TYPES OF PIGMENTS

Organic Pigment- The natural pigment may be contaminated by some impurity, such as silica, which is uneconomical to remove; the synthetic products are pure. The naturally occurring organic pigments are mainly of historical interest and are no longer used. lakes, tonner are examples of organic pigments

Inorganic Pigment – Many inorganic pigments are found in nature as minerals. The light stability, degree of opacity and chemical resistance of natural inorganic pigment is normally very high. Frequently, inorganic pigments are chemically prepared from inorganic raw materials. The synthetic inorganic pigments are apparently the same chemically as the naturally occurring pigments, but often quite different in properties. Some examples of inorganic Pigment are carbon black, red iron oxide.

Metallic Pigment- Metallic pigments are used on the surfaces for lustre and brilliance finishes which are normally not produced by conventional pigments. For many applications, a metallic effect is highly desirable and can be achieved by adding aluminium, zinc, bronze, stainless steel or pearlescent pigments. Some examples of metallic pigment arealuminum paste, zinc oxide.

V. MATERIALS AND METHODOLOGY

The main constituents of paints are Resin, Pigments, Solvents and Additives. The raw materials for the preparation and analysis of coating are

1) **Resins**
   a) Epoxy Resin
   b) Silicone Resin
   c) Polyamide Resin as Hardener

TABLE 1- PHYSICAL AND CHEMICAL PROPERTIES OF RESINS.

Epoxy Resin	Silicone Resin	Hardener
Atul Limited Clear viscous liquid	Dow Corning Liquid	ATUL LIMITED Clear liquid
Lapox® L - 12	Xiameter(R) Rsn-0808 Resin	Lapox® K-6
Density1.1 – 1.2g/cm3	Specific Gravity @ 25°C: 1.006	Density 25ºC 0.95 – 1.1 g/cm3
Viscosity9000 – 12000mPa.s	Viscosity at 25°C -80 to 200 mPa.s	Viscosity 20ºC 5 – 10 mPa.s
Epoxy Equivalent Wt 180 – 190 gm/Eq 5.25-5.40		Amine value :280-320

2. Pigments

   a) Titanium Dioxide
   b) Carbon Black
   c) Aluminium Paste

TABLE 2- PHYSICAL AND CHEMICAL PROPERTIES OF PIGMENTS

Titanium Dioxide	Carbon Black	Aluminum Paste
Vijay Paints	Abbey Chemicals	Metal powder company ltd
White Solid.	Powder, dust- Black	Semi-Solid/Silvery White
Melting Point: 1855°C	Melting Point (°C) >3000	Melting Temperature -660°C
Boiling Point: 2750°C	Boiling Point (°C) >3000	Boiling Temperature 2467°C
Specific Gravity: 4.26	Density 1.7-1.9g/cm3	Density 1.4-1.6 gm/cm³

VI. REQUIREMENT FOR PREPARATION OF PAINT

- Beaker/Container
- High Speed Mechanical Stirrer
- Weighing Balance
- Measuring Cylinder
- Porcelain iron balls
- Weighing Balance

6.1 PROCEDURE

- A 50ml epoxy resin prepare by using a1:1:1 Mixture of xylene, Acetone and methyl iso butyl ketone solvent in the ratio 10:1
- The above resin and the solvents are added to round bottom flask (Beaker) and to dissolve the resin. Stir it for 10 min
- A 50 ml silicone resin prepare by dissolving with xylene solvent in ratio 10:1
- A Blending process is used in the manufacturing of paint, the mixture of Epoxy resin and Silicone resin are blend together with the solvents like xylene, acetone, methyl isobutyl ketone Add this silicone resin into epoxy resin , stir it continuously for 10-15 mins.
- Disperse the pigment such as Titanium oxide, red iron oxide and Aluminium paste pigments 10% and 15% of solution into epoxy-silicone resin using ball mill with the help of porcelain iron balls.
- Disperse the epoxy silicon resin continuously stir it for 10 min with the help of glass ball
- A 25ml of polyamide hardener is added to the mixture of epoxy-silicone resin.
- This is two packs and so the resin and hardener are mixed at the time of application.
- Prepare paint sample with different formulations with different solvents and pigments and analyse the different samples.
- Apply paint by using brush on mild steel test panel. This painted panel are allowed to cure at ambient temperature and analysed properties of paint at different thickness.

VII. TESTING OF PAINT

- Density Measurement :
- Viscosity:
- Pot life

- Drying Time
- Curing Time
- Surface to Touch Time
- Complete Dry time

CONCLUSION

1. The "hybrid" chemistry achieved by combining an aliphatic epoxy with a silicone resin allows the formation of a silicone-epoxy resin that performs better than an organic or inorganic polymer alone. This allows for a durable binder for the protective coatings industry.
2. The development of this paint reduces the cost.
3. The Paint can be used for the corrosion protection and decorative purpose.

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