4. Coatings Composition and Characteristics

4.1 Most Protective Coatings are composed of three basic components as below:

1. PIGMENTS. The functions of pigment are:
   (a) Impart opacity
   (b) Impart decorative colour
   (c) Gives additional strength to the film
   (d) Increase chemical and atmospheric Exposure resistance
   (e) Contributes to regulation of viscosity

2. RESIN BINDERS OR VEHICLES. The functions of binder are:
   (a) Binds the pigment
   (b) Gives adhesion to the substrate
   (c) Promotes chemical and atmospheric resistance
   (d) Imparts flexibility to the film
   (e) Increases the abrasion resistance

3. SOLVENTS: The functions of solvent are:
   (a) To transport the pigment-binder combination to the substrate
   (b) To control viscosity
   (c) To control the flow of binder
   (d) To make the substrate wet.

While the pigment can characterise the properties of a coating, it is the generic resin type that primarily determines the performance and resistance characteristics of a coating. The solvent is determined by the resin type and plays little part in the long-term performance of the coating once it has played its part of depositing the coating uniformly and pin-hole free onto the substrate.

4.2 Coatings and Composition

Coatings of a given generic type display common properties, as detailed below:

4.2.1 Epoxies

Epoxies are available in three general types: oil modified, catalyzed, and high bake. The oil modified varieties are commonly referred to as epoxy esters. They display properties which are intermediate between those of high quality conventional enamel and truly chemical resistant protective coatings. Since such products contain a drying oil, they are not suitable for exposure to strong alkalis. They display a high chalking rate which is characteristic of all epoxy coatings, and their use on exterior steel is limited. Their natural area of application is interior surfaces of buildings exposed to fumes and mild alkaline cleaners. The catalyzed epoxies are offered in four common variations which differ in the catalyst employed. Amine cured epoxies display the best solvent and chemical resistance of coatings of this generic type. The polyamide cured epoxies have somewhat less general chemical resistance but are superior to the amine cured epoxies in water resistance, weather resistance, and the ability to adhere to difficult surfaces. Amine adduct cured materials are based on a pre-reaction of a portion of the catalyst with the epoxy resin. Such materials are less sensitive to climatic conditions than amine cured epoxies and are considered the equal of either amine or polyamide variations in all environments.

4.2.2 Inorganic Silicates

Inorganic zinc silicate coatings display the best weather and solvent resistance of any type of protective coating. These products contain no organic matter and are resistant to attack by virtually any solvent, including chlorinated solvents. The ultimate life expectancy of materials of this type in severe weathering service has not as yet been established. Since the film contains zinc, they are not suitable for strong acid nor for strong alkali environments. Successful application requires good surface preparation and a minimum of special spray equipment.
4.2.3 Polyurethanes

Polyurethane coatings are offered in a wide variety of formulations varying from varnishes for wood surfaces to multiple component materials for industrial service. Safety precautions for handling and use must be followed when two components are being polyurethanes applied. They have found widespread use where a high gloss, hard, weather resistant coating in a wide range of colours is required. Recoatable polyurethanes have expanded usage because of the ease of recoating aged coatings.

4.2.4 Coal Tar Epoxies

Coal tar epoxy coatings, as the name implies, are mixtures of coal tar pitch and low molecular weight epoxy resins. In the simplest terms, they are a combination of thermoplastic and thermosetting resins. Common formulations contain up to 35% of the epoxy resin. The resulting films are very resistant to acids and water. Further, they have good resistance to solvents of moderate strength. While they are never recommended for immersion in strong caustic, they do display good resistance to spills of mild caustic. Coatings of this type make excellent water tank linings and good coatings for equipment such as pipelines which will be buried in the soil. The principal disadvantage of coal tar epoxies is their colours, which is always black, their high chalking rate when exposed to sunlight, and the difficulty of repairing or topcoating. The films, with age, cross-link to such a point that refresher coats cannot be applied without mechanically roughening the film and coating failure usually occurs through embattlement of the film.

4.2.5 Chlorinated Rubber

Chlorinated rubber coatings are offered in a number of variations. The principal resin is manufactured by chlorinating synthetic rubber. They are almost always offered in high solids solutions and display easy application and recoating properties. They have good resistance to strong caustics and acids and are outstanding protective coatings.

4.2.6 Alkyds

Alkyd coatings are based on the resin formed from reacting a drying oil with phthalic anhydride. They exhibit good wetting and gloss characteristics but very poor resistance to water, ion penetration and alkalis and are not suitable for long life service in heavy duty, severe marine or chemical environments.