1. **Introduction**

Paints have been used for decorative purpose for many centuries. The cavemen were probably the first to use the paints to record their legacy. They used the paints as the means of communication and decoration. Paint making and paint application were meant to be an art rather than a science. But after industrial revolution the whole scenario has been changed which led scientists to emphasis more on better understanding of composition, constituents, application and testing of paints to meet the new requirements arose due to revolution. This in turn slowly transferred the art of paint-making into science which led to discoveries of new materials and new ways of application of paints, to meat the stringent requirements of protection coupled with decoration in certain instances under diverse service conditions.

Major constituents of paint generally are pigments, binders and solvents with smaller quantities of additives. A dispersion of the pigments in the binder constitutes the paint film, the properties of which depend on the nature of the binder to a large extent, but the nature and quantity of pigments also affect the properties of paint film.

Pigments generally give aesthetic appearance i.e. color and opacity to paint film and some pigments also provides protection to much or less extent, to cured film from UV radiation and penetration of liqids and this can be attributed to their chemical composition and structure of the pigment.

Binders in form of thermoset resins or thermoplast polymers are the polymeric materials which form a continuous and adherent film when applied over a substrate and so often termed as film formers. They also bind pigments in the film. The performance properties of a paint film which largely depend on the nature of bind up so more emphasis will be given on binder in these chapters.

Solvents are volatile compounds which leave the film by evaporation and so do not effect the performance properties of dye paint film They are in cooperative in paints to provides easy of processing during paint manufacturing and easy of application.
Additives are included in a paint system for much different reason. Though they are present in relatively small quantities, they can significantly influence properties of the liquid paint and/or the dried paint film. They are used either to overcome some defect or to provide certain properties and to improve overall performance of a coating system. To reach the high quality requirements of today, additive plays a major role in formulation and functioning of paint system. The produced thesis work is in context of modification of alkyd resin. Hence, more trace about the review on resin has been given.

1.1. **Resins (i.e. Binder) for Coating Industries.**

A wide range of binders are commercially available for coating industries nowadays but earlier chemists had to depend on natural products like natural resin or oils until the attempts were made to modify the natural resin to produce synthetic natural product and led to availability of synthetic polymers used in recent age. Very first synthetic plastic suitable for coating materials and which is still in use today was phenolic resin, developed by Leo Backeland in early 1900s. After that, there comes the new resin called alkyd in 1923 which is used till date. After the industrial revolution, extensive research in the field of polymer chemistry results in the availability of numbers of different resin suitable for surface coating industries.

Resin is continuous phase in a paint film and is largely responsible for the protective and general mechanical properties of the film. A large number of resins with different chemical composition, solubility, nature of film formation, application characteristic and performance properties of their films are available for surface coating industries. It is generally found that the performance properties of a coating system are best at higher molecular weight of resin but it will be difficult to process high molecular weight polymer during paint manufacturing or even at the time of paint application whereas low molecular weight polymer will facilitate ease of a coating system but at the loss of performance properties. To achieve the optimum balance between ease of processing and performance properties two distinct methods are used to arrive at final films.

In the first approach film formation take place solely due to evaporation of solvents form the film and no chemical reaction of any sort is involved in film formation. The resin used is of
sufficiently high molecular weight to provide better performance properties but the derived paint film remains sensitive to parent solvent/solvents. Such types of resins are known as non-convertible resins.

In the second method initially a low molecular weight precursor or a pre-polymer is used to provide ease of processing and ease of application which is then converted to a high molecular weight polymer to provide better performance properties through chemical reaction known as curing. Curing reaction involves use of either simple chemicals called curing agents or another resin with some special functional groups. Such resins are referred as convertible resins.

1.2. **Phenolic Resins**

The formation of resinous materials by the reaction of phenol and formaldehyde has been known for many years. Phenolic resin finds application in protective coatings. The reaction of phenol and formaldehyde alone is slow but in presence of acid or alkali catalysts they react rapidly and produce different products: Novalacs and Resoles.

Novolacs are produced when molar ratio of formaldehyde to phenol is less than one and acid catalyst is used. Since they are insoluble in oils and hydrocarbon solvents, they are not used in surface coating industries but widely used in plastic industries as a thermoplastic material. Resoles are produced when the molar ratio of formaldehyde to phenol is greater than one and alkali catalyst like sodium hydroxide or lime is used. Resoles are thermo-setting and soluble in oils so they are used widely in varnish making but if they are further heated, they react to produced insoluble and infusible products and results in little application in surface coating industries.

It is found that resoles react with rosin to give products which could be esterifies with polyhydric alcohols and the resulting resins are soluble in oils and these resins are known as rosin modified phenolics which find extensive application in decorative undercoats, primers, marine paints and in certain types of printings.

1.3. **Polyester Resins**
The product obtained from the condensation polymerization of a polyhydric alcohol and polyfunctional acid is known as polyester resin and widely used in surface coating industries. The most commonly used polyfunctional acids are maleic anhydride, phthalic anhydride, adipic acid, sebacic acid etc. whereas ethylene glycol, propylene glycol, diethylene glycols are used as polyhydric alcohols. Depending upon the raw material used, polyester can be either saturated polyester or unsaturated polyester. Both find extensive use in surface coatings [1]. Unsaturated polyesters are cured by many different ways but the basic reaction of curing is free radical initiated addition reaction. Free radical initiation can be achieved either at elevated temperature by use of an electron beam or UV beam or certain metal ions as a catalyst by decomposition of peroxides. Unsaturated polyesters are generally dissolved in reactive solvent such as styrene to produce final resin and then curing is carried out. Saturated polyesters are such formulated so that they produce high hydroxyl contents as they are mainly used in production of polyurethanes. They also react with some amino resins.

1.4. **Amino Resins**

These [2] are derived by reaction between formaldehyde and either urea or melamine-formaldehyde resins respectively. They are not used on their own as a Coating material as they give very brittle films but widely used in combination with alkyd resins mainly and also with other resins in co-cure systems.

Amino resins used in surface in surface coating industries are generally modified with butanol. The modification of amino resins with butanol provides solubility in normal coating solvents and better compatibility with other resins in co-cure systems. Melamine formaldehyde so better property than urea formaldehyde in term of colour retention-extirer-durability. Amino alkyd systems are widely used in stoving finishes of all types. Amino resins are also used with many other resins like saturated polyester, epoxide, acrylics etc.