Inorganic Chemical Technology
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Lecture - 30
Varnishes, Lacquers and Industrial Coatings

Welcome to the MOOCs course Inorganic Chemical Technology, the title of today's lecture is Varnishes, Lacquers and Industrial Coatings. Before going into the details of today's lecture, what we will be doing? We will be having a kind of recapitulation of what we have discussed in last couple of lectures.

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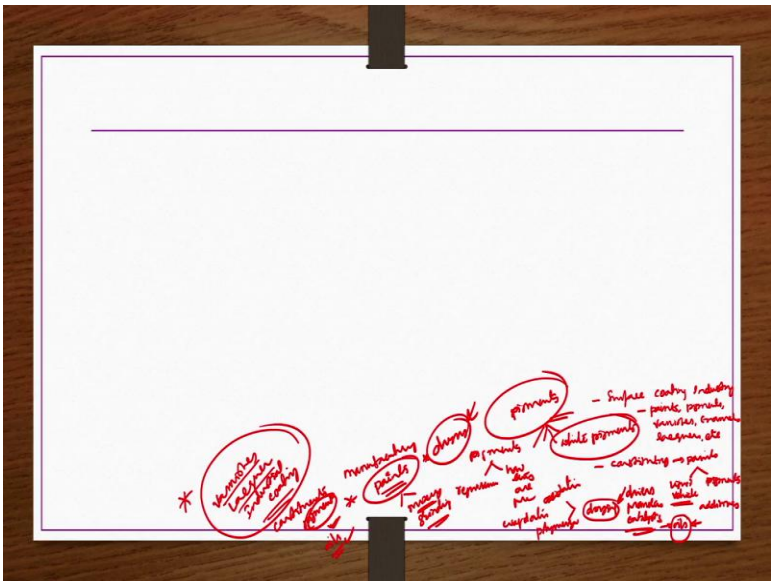

We started discussing about the surface coating industry products in which we have seen that there are many products like paints, pigments, varnishes, enamels, lacquer, etcetera. Then we have seen what are the constituents, what are their constituents, those things we have seen, especially you know when it is coming to the paints, we have seen that you know it constitutes primarily a liquid vehicle and then pigments right.

So, these liquid vehicles are maybe volatile, non-volatile, etcetera and then they can be sometimes resins also. Sometimes you know additives are also being added and then these to these liquid portions sometimes oils are also added which are nothing but film

forming agents or they help film forming, not only helping the film forming, but also it allow drying it.

So, then drying is another issue of these products; so, drying is nothing but you know making the surface whatever making the thin layer of the these products applied on a structure or something like that; so, then that has to be you know hardened. So, the hardening of that is are thin layer whatever applied is known as the drying. So, for this purpose you know some chemical changes occurs like oxidation or you know polymerization in addition to evaporation right, these kind of things you know occurs.

So, obviously, when we are calling is there is a drying is there. So, then dryers are promoters or catalyst which are these are the terms used for the drying substances. When you add some kind of foreign materials like promoters or catalyst the drying becomes an inputs. Likewise oils, what are the oils, what are their, you know what are their you know requirements, etcetera we have seen.

Then coming to the pigments, what are the requirements of pigments they should provide in a product and then how they are prepared etcetera these things we have seen. Then primarily in manufacturing process, manufacturing of a paints we have started. It we have taken as a kind of generalized one not specific to any kind of paint.

How to make paints? Then we have realized that its primarily mixing and then grinding are the operations or grinding and mixing are the primarily unit operations involved in the paints manufacturing. That is in other words in manufacturing of the paints or paint formulation, there are a no chemical operations, there are no unit processes are there.

There are no reactions are there only you know physical changes or mechanical changes something like grinding mixing etcetera are only being there of course. Before start making paints whatever the constituents are there you know of the paints let us say pigments. Pigments is one of the important constraints along with the vehicles like you know oils etcetera.

So, how these are prepared here in these cases in manufacturing of the pigments and oils there may be some kind of chemical processes. After applying the paints again you know drying of you know layer that has been applied is also you know there. So, which may be including you know chemical changes like oxidation, polymerization etcetera.

But as long as making the paints there is you know nothing, there is no chemical reaction or no chemical process is occurring only physical changes are occurring that is those things we have seen. Then we also discussed about the pigments right; so, these pigments you know how you know how many types are there those things we have seen depending on the colors etcetera, we have seen different types of pigments are there.

So, we cannot discuss manufacturing of each and every pigment. So, then we have taken discussion on white pigments and then what are the different types of white pigments available you know how to manufacture white pigments by lithopones. And then how to manufacture you know white pigments something like lithopones or titanium dioxide etcetera these kind of things we have seen right.

In this lecture we are going to discuss about the you know varnishes, lacquers and then industrial coatings etcetera, these things we are going to discuss right. Before going to the discussion today we may not be having any flow charts etcetera. Because we have already seen you know whether it is paints or you know lacquer, enamel etcetera. Whatever it is primarily mixing of a resinous material or a vehicle and then you know another constituents like oils etcetera.

So, that process may be quite similar from one to other only the applications and then constituents may be changing. So, that is the reason we will be having a few basics about these things only not about their manufacturing processes. Because, manufacturing processes; obviously, they will be different from one paint to other paint one varnish to other varnish, but in general they may be similar right.

So, that similar approach that we have already seen in the previous lecture through paint manufacturing ok. Similarly, we have also seen the pigment manufacturing through you know manufacture of a white pigments part ok. So, now let us start with varnishes, we have already seen that varnishes are nothing but unpigmented colloidal dispersions.

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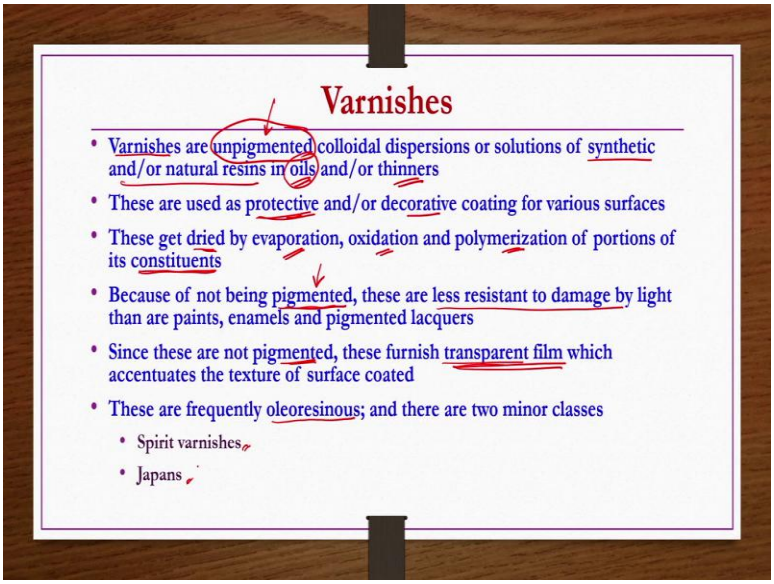

We have already seen that these varnishes are unpigmented there are no pigments in the varnishes that is the reason we have seen that they are clear. When we are talking about the few basics of individual surface coating industry products in the first lecture of this chapter, we have seen these are mostly clear.

And then they provide transparents you know layer whatever the film forms by applying varnishes on a structure usually you know they are transparent because they are unpigmented. Because, the pigments what they do they provide opaqueness and then surface covering ability.

And then they also provide you know resistance to resistance or they offer the resistance, against the destructives and destructive lights you know destroying the surface of you know structure on which they are applied; so, all these things are coming because of the pigments.

So, if there is no pigment in varnishes; so, you do not expect that you know resistance to destructive will rays would be you know good enough it will be there it may be lower ok. So, since it is not there; so, then the surface would not be opaque it will be you know transparent kind of surface you will be getting ok. Now, what are if they are unpigmented how they are prepared? They are prepared by the solutions of synthetic or natural resins in oils and or thinners right.

So, oils will provide some kind of you know surface forming ability or help surface forming ability or drying the layer that has been formed right. Thinners sometimes required in order to meet the required you know thinness to this or to the paint or the to the varnish or the product ok. So, now so since they are solutions of synthetic or natural resins and oils or thinners; so, they are also used for protective as well as the decorative purpose.

However, protection may not be as good as paint or enamel, lacquers etcetera provides. And then the layers that have been formed are film formed because of applying the varnishes on a given structure would get dried by different approaches like evaporation, oxidation and polymerization. And that also depends on the what are the constituents. If the resin that has been dispersed or you know made as a solution in oils if that resin is very thick or very viscous.

So, you know; obviously, drying may take time and then rather depending primarily on evaporation you have to concentration concentrate in oxidation and polymerization or even adding plasticizers if required. So, as mentioned already since these are not pigmented they are less resistant to damage by light than are paints, enamels and then pigmented lacquers. Because these pigments they provide resistance to destructive lights.

These pigments which are present in the paints or lacquers etcetera, they resist the destructive lights to reach the surface on which these you know these pigments or paints, these paints or lacquers etcetera are been applied. So, since here in varnishes they are not there; so, then these things should be less resistant to the damage by the light than are paints.

And also since they are not pigmented these furnish transparent film, because pigments are usually opaque and then they provides proper surface covering, proper surface covering ability they have. Pigments you know they are opaque and they have proper surface coating or surface covering ability.

Since, if it is not there; so, then whatever the product varnishes that is that will provide you transparent film ok. These are frequently oleoresinous and there are two minor types within this they are spirit varnishes and Japan's. Now, we see a few basic information about this spirit varnishes and Japan's as well.

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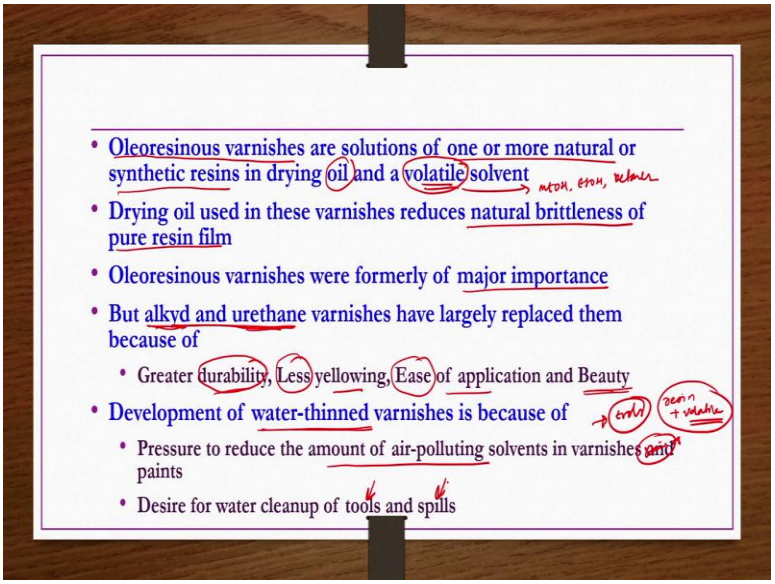

However, before going to the discussion about spirit varnishes and Japan's, we have a information about what are these oleoresinous varnishes. They are nothing but solutions of one or more natural or synthetic resins in drying oil and then volatile solvent. These volatile solvents are often methanol or ethanol or some kind of ketones or hydro carbons etcetera they are very volatile.

So, since they are very volatile you know while making these varnishes or manufacturing varnishes as well as when we applied them on a structure they cause a pollution, because they quickly evaporate because they are more volatile. So, there is a pollution issue associated with this varnishes as well right. So, then you may be thinking why not to go for non volatile solvent, if you take non volatile solvent then these resins may not be dissolved properly in the non volatile solvents that is that could be reason.

So, drying oils used in these varnishes produce natural brittleness of pure resin film, these oleoresinous varnishes were formerly of major importance. However because of certain issues nowadays alkyds and then urethanes have largely replaced oleoresinous varnishes, why?

Because of the durability and then yellowing ease of application and beauty. But when you use the varnishes made up of alkyd and urethane resins then you get a better durability, then yellowing problem would be less by applying or using this alkyd varnishes.

And then application, it is application is not just simply like you know brush applications are applying by brush or deep coating or spray coating, there are different types of other methods of applications are also there.

Considering all those things, ease of application is possible if you use alkyd and urethane varnishes rather than oleoresinous varnishes. Also when you apply alkyd and urethane varnishes on the surface the surface look more beautiful compared to the surfaces on which oleoresinous varnishes are applied.

So, because of these things nowadays we most of the varnishes are alkyd based varnishes. Later on development of water thinned varnishes has also taken place, because as I mentioned these varnishes are made in the you know natural or synthetic resins in volatile solvents right So, these volatile solvents are usually alcohols, ketones etcetera. So, while making or while mixing them and then preparing these varnishes lot of pollution causes are there, because these solvents are more volatile.

And then also you know sometimes you know when you apply any of the surface coating industry there is a there may be a kind of spill over. So, you suppose to clean it as easily as possible and as effectively as possible. For other you know tools that you are using for applying these products, let us say you know fluidized bed coating is there, electro beam coating is there and then deep coating is there and then you know brush coating is there.

So, the different types of application methods are there; so, then you may be using different tools right. So, those tools whenever you use you should able to clean them effectively and then able to reuse next time whenever you required it right. So, there should not be one time use and throw kind of thing that is the product should not be like that. So, because of these two reasons water thin varnishes have been developed, because if the product is water thin kind of thing you can easily clean the tools which are utilized for applying these products.

And then also you can remove the stains etcetera, if at all there is a you know spill over of the products etcetera is there. So, because of these two reasons the water thinned varnishes have also been developed that is pressure to reduce the amount of air polluting solvents in varnishes and paints and then desire for water clean-up of tools used for applying these products and then spill over's as well right.

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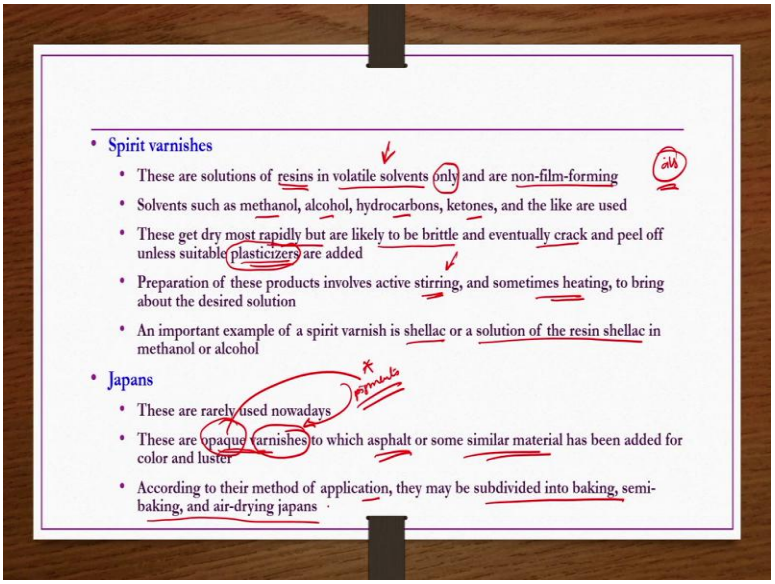

Now, we talk about the spirit varnishes, spirit varnishes they are again since they are varnishes; obviously, there will be solutions of resins in volatile solvents, in volatile solvents only and they are non-film forming. If they are non film forming, how the film formation is taking place when you apply these varnishes? That may be questions.

So, then there may be some kind of oils may be added; so, these oils will provide you know film formation required film formation. Solvents such as methanol, alcohol, hydrocarbons, ketones and the likes are used and then they may cause some kind of pollution as well, not only pollution since they are very volatile what happens they may quickly dry up. If they are quickly drying up what happens, there may be cracks formation possibility may be there.

Even sometimes you know peeling of the applied layer may from the surface may take place if the you know drying is very quick ok. These get dry more most rapidly, but are likely to be brittle and then eventually crack and peel off unless suitable plasticizers are added. So, in if you are applying spirit varnishes most often it is required that you may be adding plasticizers as well along with the oils.

Preparation of these products involve active stirring sometimes heating to bring about the desired solution. Whether it is varnishes, paints or lacquer enamels or whatever industrial coating products etcetera whatever you take most of them are you know involved in

proper stirring and then mixing ok. An important example of spirit varnishes is shellac or solution of the resin shellac in methanol or alcohol; alcohol means here, ethanol.

Next type of oleoresinous varnish is Japan's, these are rarely used nowadays. These are opaque varnishes if you are calling them varnishes then how come opaque is coming into the picture, because in the varnishes we are not using pigments and then whatever the opaque nature is there that is coming by pigment.

So, why how the opaqueness comes into the varnishes that because of adding some kind of asphalts or similar material being added to this Japan's to get the required color. According to their method of application they may be subdivide into baking, semi baking and air drying Japan's.

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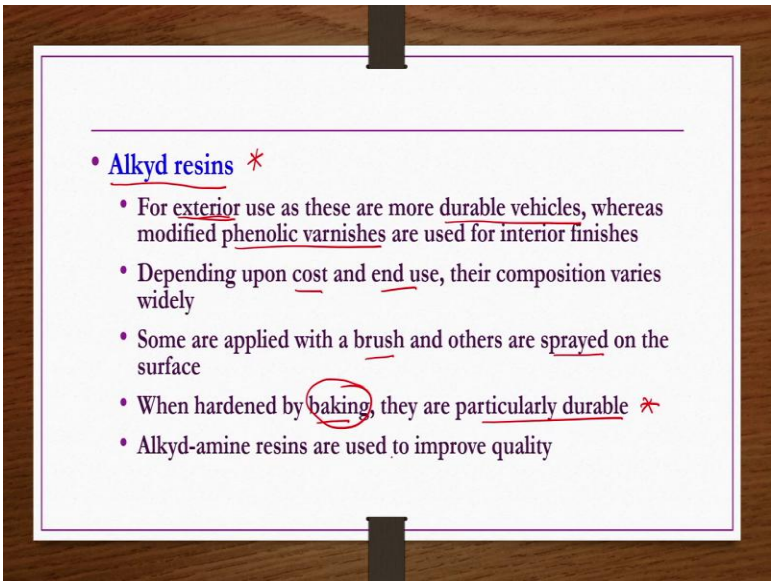

Now, we talk about alkyd resins, because we have seen this alkyd resins found to be better option to make resins rather than oleoresinous materials. Because of their durability one of the reason and then less alloying another reason and then ease of application and then beauty that they provide if they are present in the varnishes that is what we have seen.

So, then it is better to see what are these alkyd resins right why, what for they are made. Since they are you know the durability is better they used for exterior use right, because of their durable vehicles whereas, modified phenolic varnishes are used for interior

finishes. Phenolic varnishes or phenolic resins are other kind of you know things are there like for like phenol formaldehyde resins etcetera ok, we are going to see them as well.

Depending on the cost and then end use their composition varies widely. Some are applied with a brush others are sprayed on the surface that is either spray coating or brush application methods are used, if you are if you are having alkyd resins varnishes. And when this alkyd resins varnishes are dried or hardened then by baking they are particularly durable.

If you are doing the hardening or drying by baking method then the durability is better. Alkyd amine resins are used to improve the quality as well, these are the few details about the varnishes and then different types of resins you know that are used to make these varnishes. Because varnishes are nothing but the colloidal dispersion and the colloidal solution of a synthetic or natural resins in some kind of a volatile solvents along with the oils.

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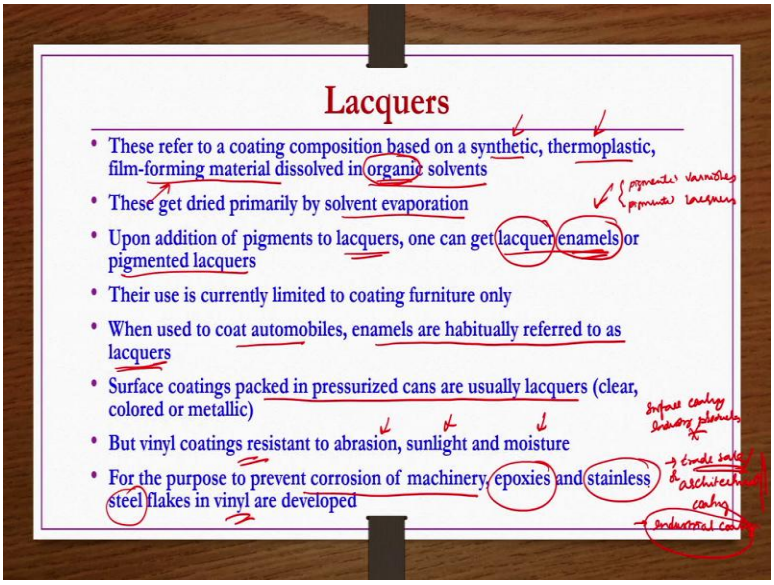

Now, we start discussing about the lacquers, what are the lacquers? They are nothing but you know synthetic, thermoplastic, film forming materials, dissolved in organic solvents. Similar like other products like paints and varnishes, but here what we have we can have either synthetic materials, we can have thermoplastic materials, we can have film

forming material as well and then, but dissolved in organic solvents only ok. Because, many of the thermoplastics and synthetic resins do not dissolve in other kind of solvents.

These get dried primarily by solvent evaporation ok sometimes there may be some oxidation also, but polymerization is almost absent in the drying of the lacquers. Upon addition of pigments to lacquers one can get lacquer enamels or pigmented lacquers.

Actually people confuse with the enamels and then lacquers are separately, you can take as a kind of you know probably if you have the pigments also added to the lacquers then whatever the products that you get you call them enamels. Or varnishes, if you have the varnishes if you have the pigmented varnishes then they are also called as enamels.

So, maybe we can say these pigmented varnishes or pigmented lacquers are nothing but the enamels ok. Their uses currently limited to coating furniture only primarily, when used to coat automobiles enamels are habitually referred to as lacquers as well. Surface coatings packed in pressurized cans are usually lacquers they can be clear, colored or metallic.

But vinyl coatings how better resistant to abrasion, sunlight and then moisture. For the purpose of prevent corrosion of machinery, epoxies and then stainless steel flakes in vinyl are developed ok. So, these epoxies and then stainless steel flakes are also used as industrial coatings or you know marine surface protection purpose also they are used in general we are going to discuss them anyway; so, that is what about some information about the lacquers.

So, now what we have seen now you know most of the architectural coatings are you know trade sale coating material or architectural coatings we have seen. Because, this whatever the surface coating industry products are there. they are two types that is what we have seen that is one is the trade sale or architectural coating; another one is the industrial coatings.

So, now till now we have seen trade sale coatings all those things paints, varnishes, lacquers etcetera all of them are you know comes under the trade sale coatings. Now, we start discussing about the industrial coatings, industrial coatings.

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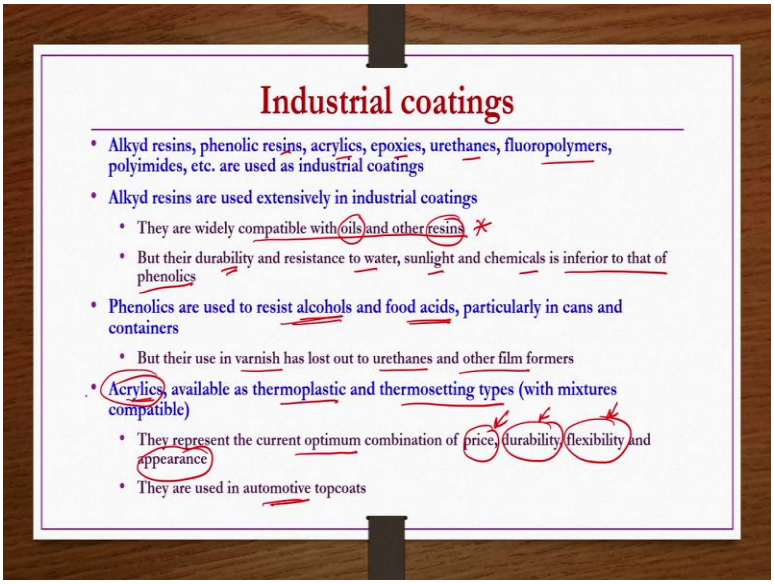

Now, we talk about the industrial coatings often alkyd resins, phenolic resins, acrylics epoxies, urethanes, fluoropolymers, polyimides etcetera are used in industrial coatings or may be directly used as industrial coatings. So, what we are going to see? We are going to see what are these alkyd resins, phenolic resins, what are their purposes if at all their merits demerits etcetera those things we are going to discuss now.

Alkyd resins are used extensively in industrial coatings, they are widely compatible with oils and other resins this is one of the reasons that you know even in varnishes also you know oleoresinous varnishes are being replaced by this alkyd resinous varnishes.

Because, they are compatible their compatibility durability is better not only as individual, but also when if you want to mix with other oils and then other resins you know their compatibility is very good that is one of the important thing that is alkyd resins are used in varnishes as well.

But their durability and resistance to water, sunlight, chemicals is inferior to that of phenolics ok. So, what are these phenolics? Phenolic resins like phenol formaldehyde, resins etcetera those things are also used sometimes for coating purpose. Phenolics are used to resist alcohols and in food acids particularly in cans and containers wherever these food items etcetera are you know stored in cans and containers. You need to do some kind of coating of those cans and containers etcetera.

So, for that purpose these phenolic resins or phenolic industrial coatings are used, they are good at resisting alcohols as well. But their use in varnish has lost out to urethanes and other film formers. Now, the acrylics, acrylics they are available as thermoplastics are well as well as the thermo setting types, there are some kind of mixtures of these two are also possible.

They represent the current optimum combination of price, durability, flexibility and appearance or the beauty. Considering all four factors that is you know appearance, flexibility, durability and price, presently this acrylic industrial coatings are better. Or they provide optimum combination of these four important factors in any of the industrial coating products or even trade cell coating products as well.

They are used in automotive top coats; most of the automotive top coats are done by this acrylic industrial coatings.

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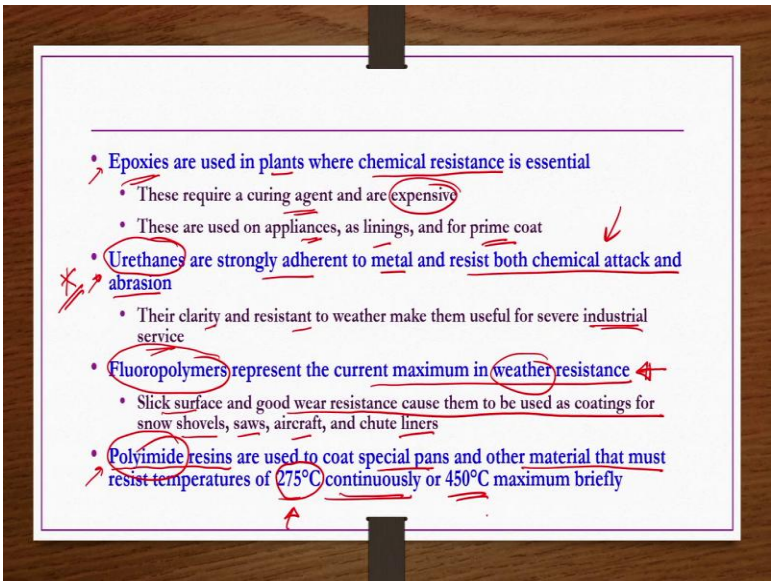

Then epoxies are used in plants where chemical resistance is essential. In any of the chemical plant if you take there is you know a possibility that each and every part of the plant including unit operations, unit processes, connecting pipes etcetera everything are exposed to one or other kind of chemical. So, then chemical resistant resistance is very much essential; so, in some of the plants you know epoxies are used to or used as the industrial coating.

So, that to have chemical resistance onto the products or in even in the plant. These require a curing agent, but these curing agents are expensive. These are used on appliances as linings or for prime coating as well. Whereas, the urethanes are strongly adherent to metal and resist both chemical attack and abrasion as well. Their clarity and resistant to weather make them useful for severe industrial services.

So, industrial services rather going for the epoxies, if you can go for a urethanes the options would be the better. Because, you know their resistance to the weather and then you know chemical attack abrasion resistance to the chemical attack as well as the abrasion is better right. Also you know they are you do not need any kind of you know curing agent which are expensive; so, then that way also urethanes are better.

Other types of resins are fluoropolymers, they represent the current maximum in weather resistance. If you are looking weather resistant only for the industrial product to have industrial coatings then you can go for the fluoropolymers. But in addition to the weather resistance, if you wanted to look at the chemical attack and then abrasion then it is better to give for the urethanes based industrial coatings.

Fluoropolymers you know they provide slick surface and then good wear resistance cause them to be used as coatings for snow shovels, saws, aircraft, chute liners etcetera ok. Other type of resins used in industrial coatings are polyimides, they are used to coat special pans and other material that must resist temperature of 275 degree centigrade continuously or 450 degree centigrade maximum briefly.

Most of the pans you know they are having polyimide resins or coating, because their temperature you know would not go more than 275 degree centigrade for application different types of applications.

Then, if you are exposing them to a temperature less than 275 degree centigrade continuously; so, then these are the better options. But; however, if you are going beyond that one only briefly you can go up to 450 degree centigrade not continuously. So, that was about a few basics about the different types of resins used in industrial coatings.

Now, we see the application methods of industrial coatings, as I mentioned not only brush coating or deep coating or spray coating, but there are many other methods are also available for applications of the surface coating industry products. So, some of them we

are going to see especially with respect to the industrial coatings. Some of them may be having some advantages, some disadvantages like that you know each one may be having some merits and demerits those things we are going to see only a few basics.

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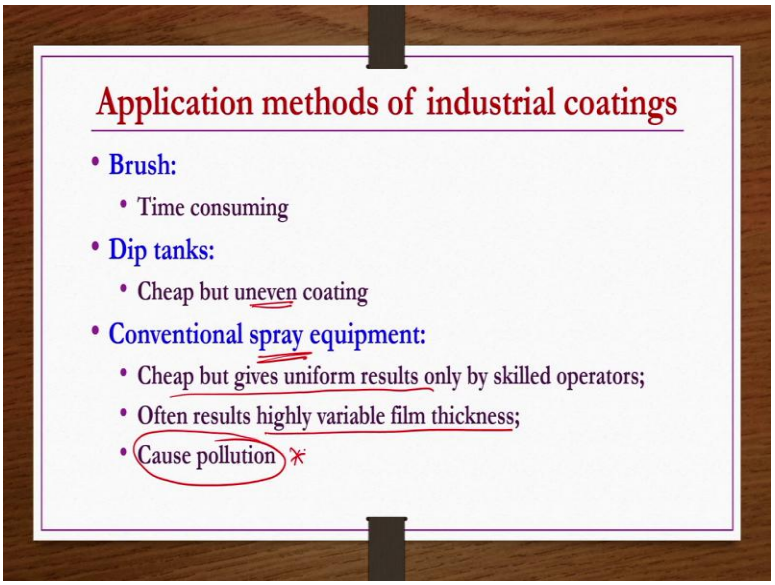

Brush applying its good, but it is very time consuming; whereas, the deep tanks it cheaper, but coating is uneven; whereas, the conventional spray equipment they are cheaper, but gives uniform results only by skilled operators. Often results highly variable film thickness, if you are not experienced enough to have a you know use the spray coating equipment. So, then you may have highly variable film thickness and then; obviously, cause pollution.

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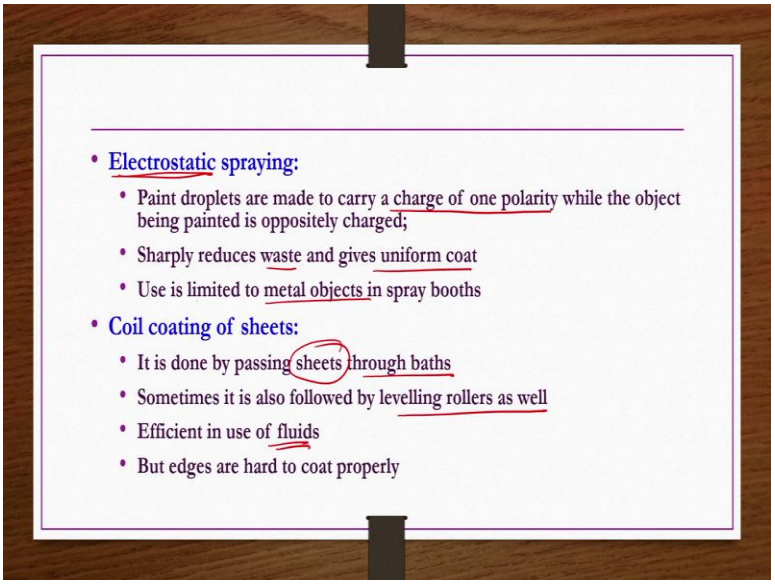

So, wherever you might have seen that whenever some surfaces are being coated using you know spray coaters; so, then surrounding area is very much polluted; so, they cause pollution.

Next one is the electrostatic spraying, when you talk about the electro static spraying; that means, you know the surface on which you are doing the coating; so, the surface and then coating must be having opposite charges ok. So, paint droplets are made to carry a charge of one polarity while the object being painted is oppositely charged.

They sharply reduces the waste and gives uniform coat and then it its use is limited to metal objects in spray booths only. The next method is coil coating of sheets, coil coating of sheets in the sense whatever the surface that you wanted to coat they are passed through you know some kind of you know coils kind of things ok.

It is done by passing through baths, sometimes it is also followed by levelling rollers as well for the sheets on which you are doing the coating. It is efficient in use of fluids there is no loss kind of thing, but the problem is that whenever you have this passing sheets through baths kind of thing you know edges may not be properly coated that may be an issue; so, but edges are hard to coat properly.

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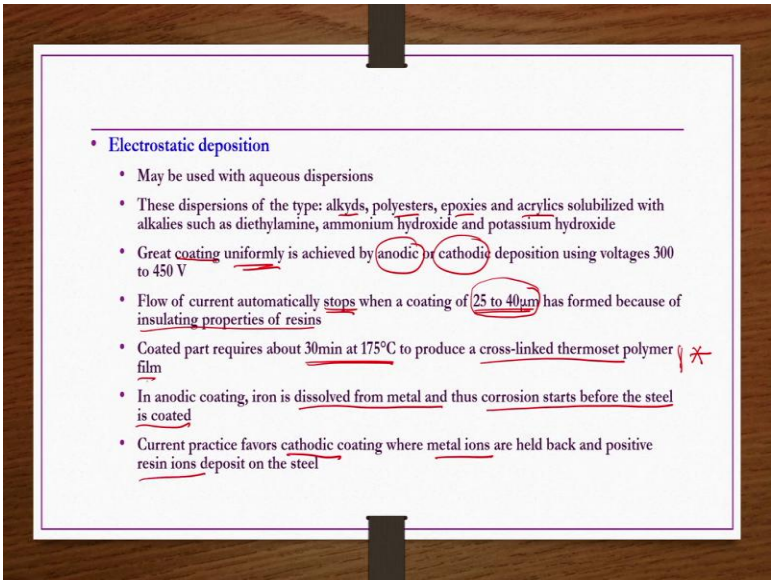

Next method of application is electrostatic deposition; so, maybe used with aqueous dispersions; these dispersions of the types are alkyds, polyesters, epoxies, acrylics etcetera ok. So, but they are solubilized with alkalis something like ammonium hydroxide, potassium hydroxide. However you get great coating uniformity by anodic or cathodic deposition using voltages between 300 to 450 volts.

Good thing about this one, the current would stop or the voltage passes with stop if you have the coating of 25 to 40 microns thickness that is the reason you get great coating uniformity. Because, once the thickness of the coating becomes 25 to 40 microns, automatically you know current would stop.

Why this current would stop automatically when this surface become of you know the coating whatever applied becomes 25 to 40 microns size? Because after that one you know primarily it is the resin that is you know being exposed for the deposition and then that is having insulating properties not the surface on which we are applying ok.

Coated part requires 30 minutes at 175 degree centigrades to produce a cross link to thermoset polymer film this is the problem, but; however, these kind of things are applied for the specific purposes only. In anodic coating iron is dissolved from metal and thus corrosion starts before the steel is coated, because of that reason current practices favors cathodic coating where metal ions are held back and positive resin ions deposit on the steel.

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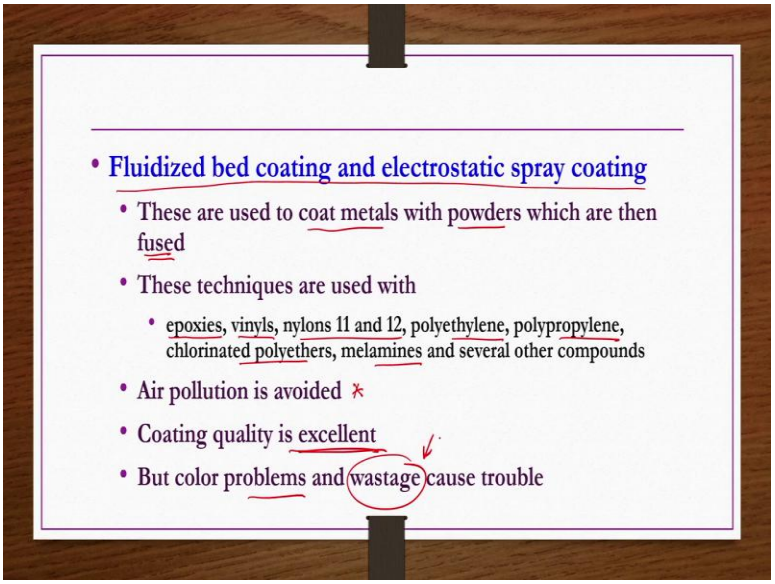

Next method is fluidized bed coating and electrostatic spray coating; so, here in these processes you know coating is very better, but there is a lot of wastage also there. These are used to coat metals with powders after coating they are fused ok. These techniques are used with a different types of coating materials or resins like epoxies, vinyls, nylons, polyethylenes, polypropylenes, chlorinated polyethers, melamines and several other compounds.

Air pollution is avoided because they are taking place inside the fluidized bed or inside the electrostatic spray coating. However, coating quality is excellent, but color problems and waste cause or wastage cause troubles; so, that wastage is very high in these kind of applications.

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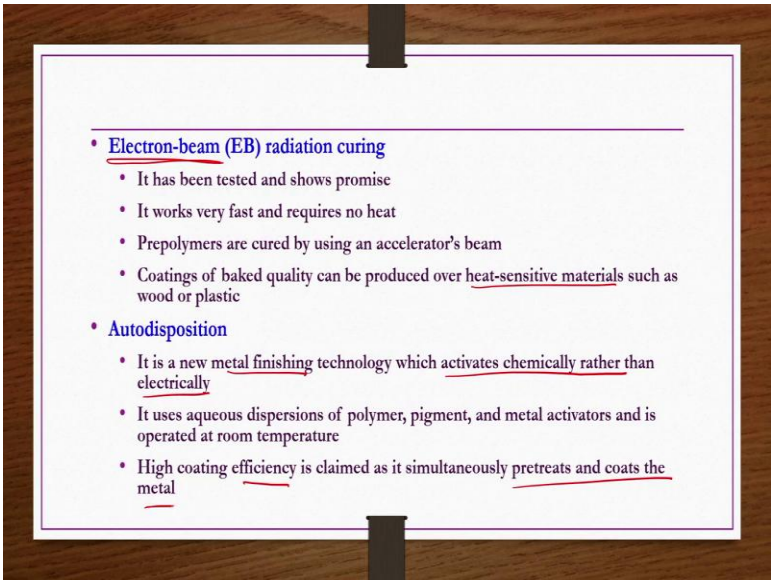

Next one is electron beam radiation curing, it has been tested and shows promise. It works very fast and requires no heat. Pre-polymers are cured by using an accelerator's beam. Coatings of baked quality can be produced over heat sensitive materials such as wood or plastic as well that is the advantage of electron beam radiation curing method. Last method of application is auto-disposition; it is a new metal finishing technology which activates chemically rather than electrically.

It uses aqueous dispersions of polymer, pigment and metal activators and is operated at room temperatures often. High coating efficiency is claimed as it is simultaneously pre-treats and coats the metal. So, these are the some of the types of you know application methods of industrial coatings. Now, we see what are the resins used in industrial coatings, we see in a tabular form what is the application and what kind of resins are used.

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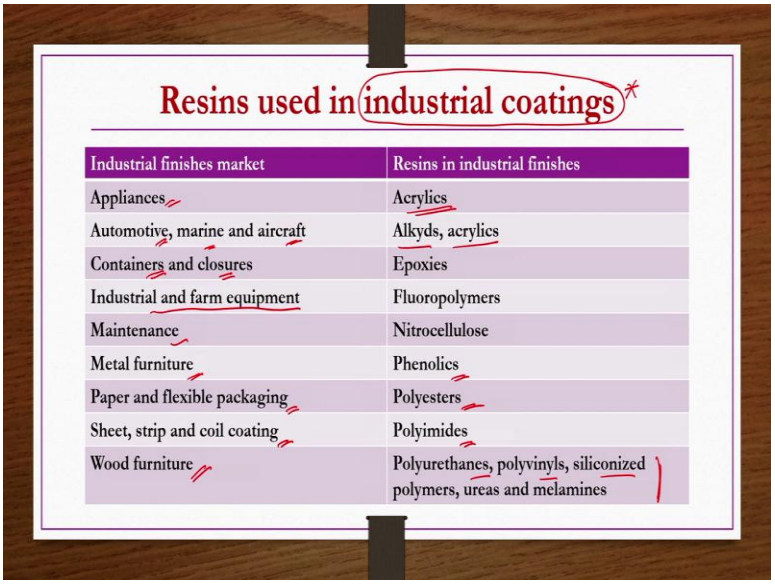

Let us say if you have appliances then acrylic type resins are used in industrial coatings. If you are applying these industrial coatings on automotive, marine and aircrafts then alkyds or acrylics both are used. If you are applying these industrial coatings on containers and closures, then epoxies are used in industrial coatings manufacturing.

Industrial and farm equipment if you are coating, then fluoropolymers are better as industrial coatings. For maintenance related things nitrocellulose are better, metal furniture's then better to use phenolic resins in industrial coatings. Paper and flexible packaging, polyesters are sufficiently good enough to use as industrial coatings. If you are you know applying industrial coating for sheets, strip and coil coating, then polyimides based industrial coatings are good ones.

If you are applying industrial coatings on wood furniture's, then polyurethanes, polyvinyls, siliconized polymers, ureas and melamines can be used. Remember these industrial coatings we call name is given to these products as industrial coatings, because these are applied on or for the industrially produced products ok. That is the reason these are known as industrial coatings that we have seen in the beginning of the lectures in the current chapter already.

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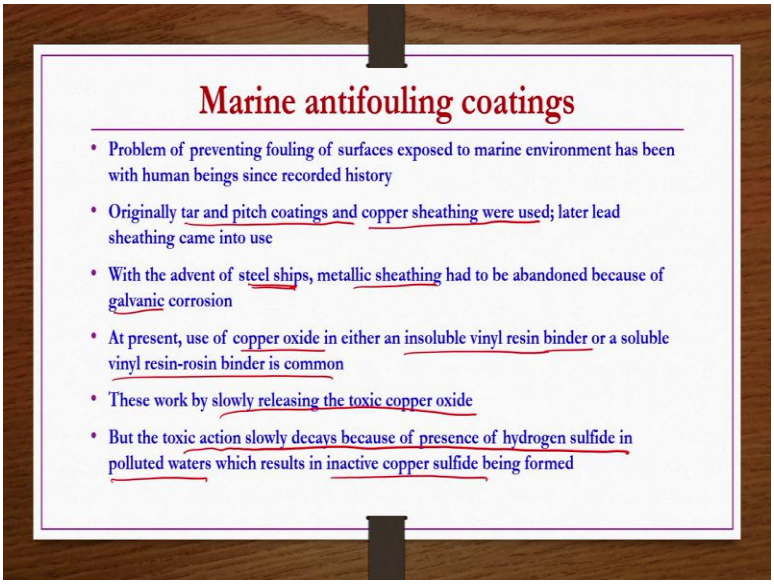

Next one is the marine antifouling coatings in the marines also fouling is a big problem; so, then there should be proper industrial coatings and then this problem is there for the you know for the centuries ok. Originally tar and pitch coatings and copper sheathing were used later, lead sheathing came into the use. However, with the advent of steel ships, metallic sheathing, metallic sheathing had to be abundant because of the galvanic corrosion.

At present use of copper oxide in either an insoluble vinyl resin binder or a soluble vinyl resin rosin binder is common. This work by slowly releasing the toxic copper oxide into the water, but toxic action slowly decays because of presence of hydrogen sulphide in polluted waters which results in inactive copper sulphide being formed ok.

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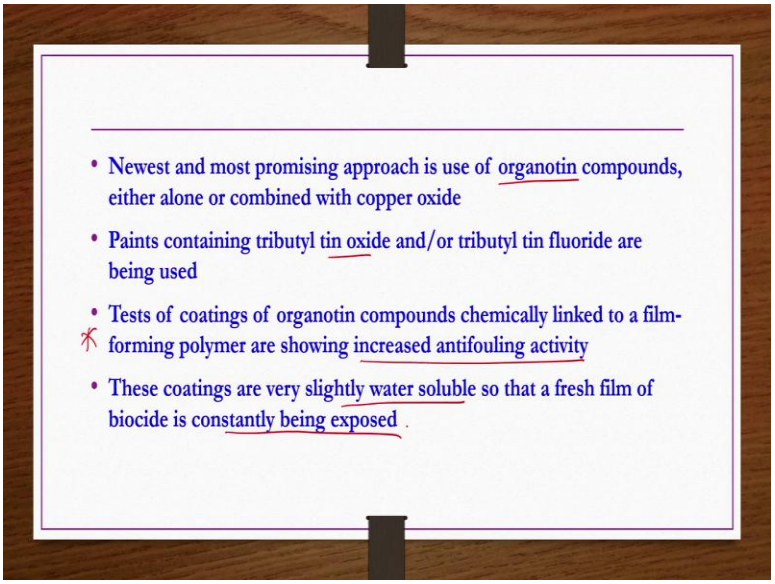

Further, Newest and most promising approach is use of organotin compounds either alone or combined with copper oxide.

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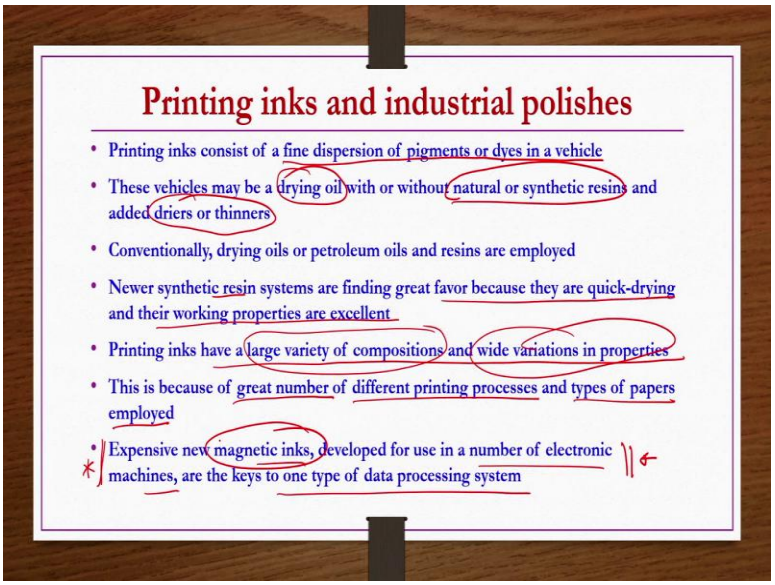

Paints containing tributyl tin oxide and or tributyl tin fluoride are being used. Test of coatings of organotin compounds chemically linked to film forming polymer are showing increased antifouling activity. These coatings are very slightly water soluble; so, that a fresh film of biocide is constantly being exposed; now, we discuss about printing inks and industrial polishes.

Printing inks consist of fine dispersion of pigments or dyes in a vehicle. These vehicles may be a drying oil with or without natural or synthetic resins and added driers or thinners as per the requirement. Conventionally drying oils or petroleum oils and resins are employed in printing inks. Newer synthetic resin systems are finding great favor, because they are quick drying and their working properties are excellent.

Printing inks have a large variety of compositions and wide variations in properties. This is because of great number of different printing processes and types of papers employed, because of this one this you know large number of you know varieties of compositions and then wide variations in properties of printing inks found. Because their applications are like that, different printing processes and different types of papers are employed.

So, you know obviously composition and then properties would change. If the composition is changing; so, then; obviously; so, then; obviously, properties of printing inks will also change. Expensive new magnetic inks developed for use in a number of electronic machines are the keys to one type of data processing system ok. For that specially different types of printing inks are developed which are magnetic inks ok.

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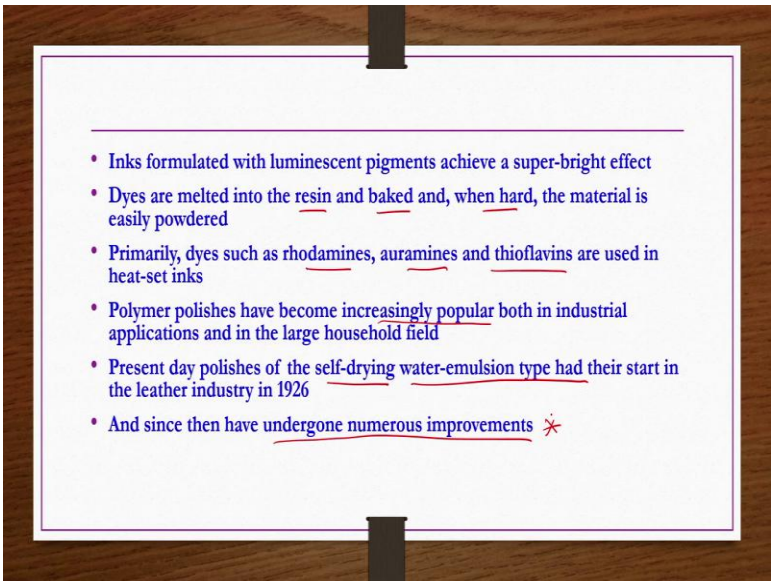

Inks formulated with luminescent pigments achieve a super bright effect obviously. Dyes are melted into the resin and baked and when hard the material is easily powdered. Primarily dyes such as rhodamines, auramines, thioflavins are used in heat set inks.

Polymer polishes have become increasingly popular both in industrial applications and in large household field as well.

Present day polishes of the self-drying water emulsion type had their start in the leather industry in 1926. And since then have undergone numerous improvements as we have seen different types of improvements. So, that is all about different types of surface coating industry products, their constituents, manufacturing, properties, applications, etcetera.

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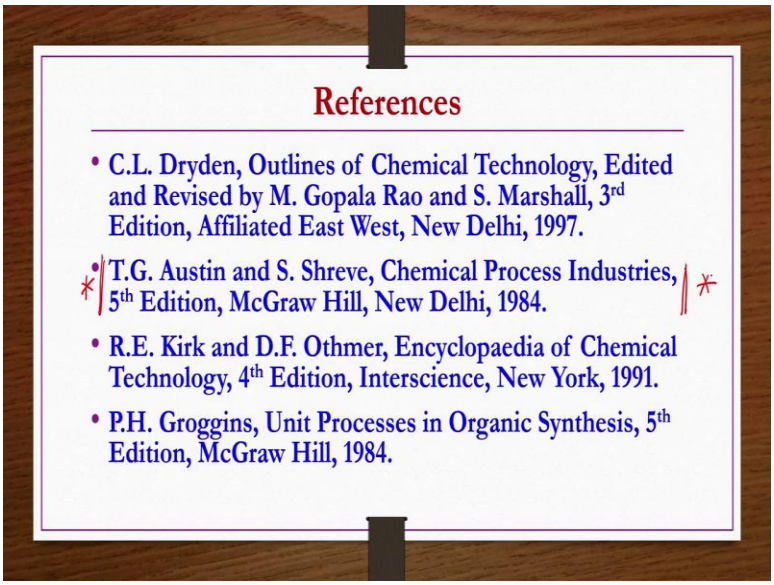

The references for today's lecture are provided here. However, most of the lecture is prepared from this reference book Chemical Process Industries by Austin and Shreve.

Thank you.