

Building Materials and Composites

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Well, we are in the last module of this particular course building materials and composites. We have come through many different kinds of materials. And we last finished on damp proofing, insulation and composites. We are left with a very important finished material which is paint. And the other important is plastics. So this module is on paints and plastics.

And we will begin with paints because plastic is independent of maybe paints. Why? Plastics do not require a paint on top of it. But many other materials whatever we came through more or less require a coating or protective coating on top of it. And that we collectively called as paints. Yes, paints, varnishes, distempers etc., maybe you are exposed to these terms.

And whatever paint which we put inside a building may not be applicable outside a building. Because inside it is dry. Outside it is facing the weather. Now surfaces are again of different kinds. You may have a plastered wall, you may have exposed brick wall. You may have a concrete façade. You may have wooden elements, you may have metals. So we have come across basically all these kinds of items.

So we need to cover them. Otherwise, most of these are or having organic components, ingredients. Say it brick, it is made from silica, sand, clay. Again if you think of concrete, all the ingredients are made from earth by different methods. We have gone through those. Coming to wood, it is direct application of an organic item. And metals they have, yes their own particular mechanism which aluminum does.

It has a coating on top of it, oxide oxidation. So aluminum usually does not require a paint, but yes you can. But other ferrous metals you usually apply paints to make it or keep it free from corrosion. (refer time: 03:41)

So if we ask what is paint? we have to learn. What is the purpose of paint we have to know. When to call paint a good paint? Composition and functions of the ingredients what makes the paint. And maybe as we learnt most of the materials, we will just go through the steps of manufacturing paint. (refer time: 04:12)

So if we come to the basic question, what is paint, it is a solution or a suspension, which after application to a substrate that is the material onto which it is applied in a thin layer converts

to a solid film. So this substrate may be wood, may be metal, may be plastered wall, may be concrete, maybe even brick. So we have a thin layer which converts into a solid film.

So obviously there is some material which helps it to become solid and to get applied when it is when it is in a thin layer. How thick is a layer of paint or the film of paint? It is around 60 to 150 micron. So you have to understand that the solid film is made of certain particles which are at most maximum 150 micron in dimension. So how many layers are to be put? We start with two layers and we can we can go up to four.

Usually two to three coats are mandatory. Now that also depends on what is the type of substrate. We will elaborate them little later. Why we put multiple coats? Because we are trying to hide the material. Because you cannot see a painted layer and say what is behind it. If you can see what is behind it, there is no point of putting paint.

So it can hide the imperfections, it can save it from the weathering action which we will talk later. But basic primary purpose of multiple layer is to hide the surface imperfections. So when you see the layer it should be only the colour or only the layer you want to see with a very uniform distribution without any breaks or gaps. How much can one litre of paint cover?

Usually 10 to 12 square meters, but it depends on other factors. So it has to be of correct consistency. The substrate should be such that it just not absorb the entire thing. So we will discuss when we go into the further details. But usually it is 10 to 12 square meters done by one litre of standard paint. (refer time: 07:38)

Purpose of paint

- Provides a coating to the building surface for **protection** against
 - Weathering action of sun and rain, makes surface waterproof
 - Mechanical stresses
 - Chemical actions like corrosion of metals, alkali reaction
- Protects all surfaces against **organic growths**, termites, fungal attacks like wood or brick
- Provides **aesthetic value/ identity** to the building surface applied – both interior or exterior
- Paint **increases the surface durability** and also can give **fire protection**
- Adds functionality **modifies light reflection or heat radiation** of a surface
- Paints help to **identify hazards** or to identify the **functions** of equipment and pipelines.
Oxygen pipe line in Hospitals, A/C ducts, Fire service lines, oil and other gas lines in factories

So what is the purpose of putting paint? As I told you one was hiding the surface imperfection. But what are the other major purposes? It provides a coating to the building surface for protection against weathering action. Who are the enemies? Sun, the ultraviolet rays, the rain. So you need an impervious layer. Mechanical stresses. Heat.

Within the changes, thermal changes the paint should be elastic enough to take care of such thermal changes. So these mechanical stresses are to be taken care. Chemical actions. One is corrosion. Other is some alkaline medium, acid fumes. Your building cover should take care of these kind of chemical actions. So paint is protecting.

Hence, it should be inert against chemicals, it should be inert against corrosion, it should be inert against thermal stresses. So expansion, contraction that is elasticity of it should be such that it is not getting affected. It should not get affected by ultraviolet rays. So the colour should remain intact. Now it should protect all surfaces against organic growths, termites, fungal attacks, wood or brick both.

You see the two pictures. The green moss has grown on the exposed brick wall and same with the wood surface. So you have to give a coating or a cover to these surfaces so that no such growth is allowed. Provides aesthetic value, be it building interior or exterior. So you can see the interior of a house picture with a blue shaded wall. So you can create your background for your furniture, you can create different moods inside the house.

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Source: pixabay.com,exels.com,unsplash.com,wikimedia.org,stockvault.com,pixivizart.com

So when you go for interior design course or class for the subject, you will see how to give different colours of paints inside of the house. Now paint increases the surface durability and also can give fire protection. Fire protection mostly I refer to when it is metal surfaces. It is also giving fire protection for building facades. So we can give such characteristics to paints so that you get fire protection.

It adds functionality. We had learned this when we did reflective paint, insulation, reflective materials as insulators. So you have reflective paint, white paint, metallic paint on rooftops. You allow the heat to get reflected back. And paint gives identity. You see the fire lines all painted red. So you have oxygen lines in hospitals, you have air conditioning ducts, you have these fire service lines, you have different gas lines, you have different oil lines, all get an identity.

There are standard colour codes, which are to be followed. As we see yellow buses for the school bus. That was once decided across the country. So colour gives the identity particularly for building industry. We are talking of paints giving identity to the services, the gas lines for hospitals, for firefighting. So one can easily access the point by the use of appropriate colour. (refer time: 12:35)

Now coming to the characteristics of good paint. When we are talking of paint, we all have done some amount of artwork in our childhood. So there you use watercolour. You mix some colour in a bowl and create palette and you keep on making green for the grass and sky etc., etc. But that painting scores good mark which gets uniform or identifiable color schemes.

So uniformly it has to be done. It should have uniform spread. When we are thinking of a building the jacket should not be a patchy one. So it should be very uniformly spread on the entire surface. It should have high surface coverage. So that means what I had talked of the amount of paint required to cover say 10 to 12 square meters per litre that means that is the coverage.

More you can cover, what will happen the layer will be thinner. 60 to 150 micron is a big range. So the paint will be thinner because you are going to add another layer on top of it, again another layer on top of it. So what is eventually happening, if it is very thick, then it can come out very easily. So you have to think of how one layer can adhere on top of the other.

So high surface coverage is very important. Then we come to the point of good workability. You and I cannot do a painting job particularly when it is a large expanse of wall. You have to have control. Maybe with a paintbrush you can have a control. But when it is a big large surface, it should be the workman's skill and the fluidity of the paint that will help in having or achieving good workability.

We came to this term through this term workability when we did concrete. So you have to spread that concrete with all its mix uniformly without any void. Similarly, here you have to pass the ingredients within the paint which are not as crude as concrete but very very fine across the entire wall to get that uniform spread and uniform coverage, thin coating. Yes, the next point is durability.

It should be long lasting. Elastic property as I have told you to stand differences in temperature, weather conditions etc. Paints should also give water tightness. So if there is a visible break in the paint layer, it will allow water to enter and damage. So this impervious to air and water is important because those are the slow poisons or enemies and that can attack the main structure.

So particularly for the external facades, one should be very particular in looking into this imperviousness characteristic of the paint. Further, paint should be cheap and economical, easy to procure and protect surface for longer duration of time. Because it is not a very easy job to keep on painting building now and then. Particularly buildings which are public in nature, there is a program say every 5 years, 10 years you actually repaint it.

So it is very important to remember that you have to have a protective surface which should also be cheap and economical for people to buy and use because that is a protector, this layer is a protective coating for the entire building from any kind of damages, which we discussed just in my previous slide. (refer time: 18:32)

Now let us come to the composition of paint. You see two words written here, base and the vehicle. What is base? Base is the basic material. What is vehicle? We call a vehicle which is a carrier that will carry the base on the top of the substrate. So the vehicle is the carrier of the base. (refer time: 19:17)

Now if we come to what is base comprised of? Base is comprised of principle and the pigment. Principle is the component which is in all the paints of similar nature. But the pigment is the colouring agent added to it. So base is obviously as I told you in the previous slide, it should be cheap. And here I mention I had mentioned this when we did make nonferrous metals, lead was extensively used.

Lead oxide was extensively used as base which kept the cost of paint very economical or cheap. But because of health hazards of lead oxide the use of lead in the base has been stopped. So we use zinc oxide, zinc carbonate, iron oxide, titanium oxide these as bases and yes the cost has gone little high. But if we could have continued with lead we could have got cheaper paints, but at the cost of health hazards.

So when paint is left to stand too long, what happens? This principle or the base segregates because they may be in suspension. So you need to stir the material always. So where does the base go? This base goes into the vehicle or the carrier. So this base actually saves the surface against cracking, moisture, ultraviolet rays. Because that is the major part which is visible.

What you see is actually the base and the pigment or the colouring agent. Now what are these pigments? The pigments are the colouring agents which are mineral powders. It may be mica, it may be aluminium. When it is aluminium, we say it is aluminium paint. These may be organic substances also. They are in dimension 0.1 to 5 micrometre. So these pigment hide the surface imperfection.

So the base is being carried by the vehicle along with these pigments which are hiding the surface imperfections and the fineness of the pigments reinforces the paint film. So finer the pigment size or these base and the pigment sizes, more tightly or closely packed they are and the paint is becoming more impervious. So it strengthens.

Lower the size the stronger is the paint film. Better is the quality. So that again I just spell out here like you have silk emulsion, you have velvet touch, more fine it is, more costly it is, more durable it is. We will discuss that in some other lecture. So this pigment, the base or the principle and the colouring agents together gives, holds the entire thing or the or actually forms the layer which is visible to us. (refer time: 23:51)

Now coming to the vehicle. Vehicle or the binder and along with it we add the thinner. So what is the binder? Binder is one which binds the principles and the pigments that is the base

together to form continuous hard film. So when the paint dries, the vehicle evaporates and binds the base particles to the surface of the substrate. What is it? Glue, linseed oil, synthetic resins, alkyds, acrylic vinyl, polyurethanes.

These all can form the binder. We say glue-size. Linseed oil is the most commonly used binder. So binder or the vehicle is the carrier, but apart from the binder if we keep on adding more of binder the cost goes high. So when you are working with it, you can add the thinner, which is the solvent or the carrier and it usually is volatile in nature and also termed as volatile organic compounds or VOC.

It is also to be limited because these are these organic compounds, which evolve carbon are also not healthy. Petroleum, spirit, naphtha, turpentine, all these are solvents or carriers or thinners. We will discuss at length. Yes, water is also a thinner. (refer time: 26:10)

Now apart from these two basic things, we have additives which reduce the cost. We had learnt adulterants in concrete also. We could add them to reduce, in low percentage to reduce the cost. Here also you add additives to get different properties of which one is reducing the cost without affecting the other properties. So these are added to paints to increase the bulk that is increase the base without affecting the useful properties of paint.

So chalk, gypsum, barite, which is barium sulphate, silica and magnesium silicate, these all can go as adulterants which are additives. The other is the plasticizers or driers. So these can be added up to 3%. Helps in the oxidation process or condensation process of the vehicle. And if you add excess of it, the paint may break or flake out.

What happened in mode of plasticizers in concrete? It had happened for it had gone for segregation. Here also if you add plasticizers more in amount, it will flake out. So plasticizers are added to modify surface tension, to improve some flow property, to improve the finish appearance or give stability. So these four items, basically the base, the vehicle, the adulterants and the driers together form paint. (refer time: 28:38)

Once we have gone through the basic ingredients we come to the steps of manufacturing of paint. So when we are talking of manufacturing of paint we have to mix all these ingredients in given propose in known proportion and that becomes the first step that is batching. So you are bringing all these materials in fixed proportion into the grinding mill which is a kind of mortar and pestle where you grind the basic items with very measured amount of vehicle or binder into it.

To be precise, binder not vehicle, binder into it. It is just like grinding masala, making masala paste. So what happens? The particles are getting further reduced in size. And then they are passed into the thinning tank where the solvent is added to get the desired consistency. So that is step three, where you are doing the thinning and going for quality check so that you are getting the desired consistency of the paint.

Now you need to keep the entire thing agitated. As you see in the ready mix concrete you were carrying concrete with the agitation or vibration that was not to allow segregation. Here also you are agitating not to allow segregation of base from the binder and the thinner or

collectively the vehicle. So once you are keeping it agitated, it is not separating out and when there is order placed you only then tap it out and pack it.

So until the order is placed you are not packing it because once you pack it you cannot agitate it. So once the order is placed, the packaging is done and sent to the store. So we will further go to the next lecture and we will try to see how paint or the proportion is being controlled and we will thus move to our next lecture.