Building Materials and Composites

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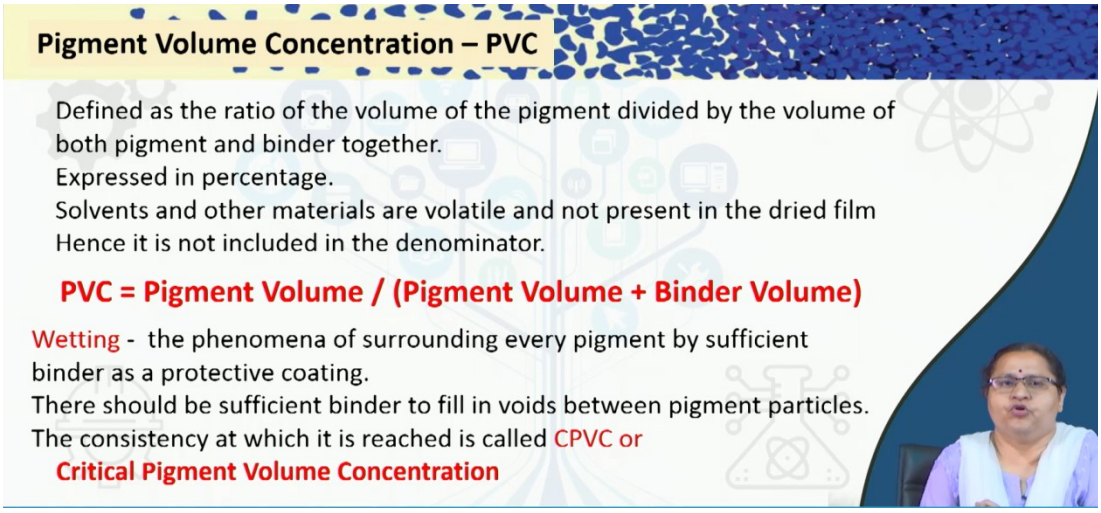
Lecture No. #37

Paints (continued)

So we are in the continuation lecture on paints, which is the second lecture of module 8. So we have learnt in the previous lecture what are paints, what are the major constituents of it and how this thin film is helping that is what is the purpose of paint and also we knew the characteristics of a good paint. (refer time: 01:04)

So in this lecture, we are going to understand how does paint work and we also need to know the critical pigment volume concentration, which is the key to quality of paint. And then we will also come to the defects of paint because, these are very common to all the types of paints which we have not at all discussed and are not going to discuss also in this lecture, we will go to the third lecture where we will discuss on all the different types of paints. So now, let us try to learn how paint works. (refer time: 01:55)

Here you see a phrase like pigment volume concentration. That is also called as PVC of paint. So defined as the ratio of the volume of the pigment divided by the volume of the pigment and the binder. Mind that here the word is binder not the solvent, not the thinning agents what you are adding. So it is the pigment volume divided by the pigment volume and the binder volume.



And it is expressed in percentage. Whatever be it, it is into 100 and you get it as a percentage. Why are solvents not considered? Because as I told you, the solvents are the volatiles part which are the thinner which helps as a carrier of these small particles that is the base to move across very smoothly that is good workmanship. You can carry it very smoothly on top of the surface so that you get a uniform very thin spread.

So you are only using the solvent to give you that consistency, which is volatile, which will evaporate within a very short span of time. So that is why the solvents are not added in the denominator. So it is the pigment volume and the pigment plus binder volume. So it is a ratio expressed in percentage and that is what pigment volume concentration is. Now how does this pigment volume concentration help?

This gives a clue that how much of pigment is being bound by the binder and that is called wetting. So what is wetting? Wetting is the phenomena, so if you are having this base as your particles and your colouring agents which are much further smaller into the base. What is wetting? Wetting is you are allowing the binder to flow in between these particles.

So your binder is moving through or covering or coating each of the base particles such that it enables them to move. So when there is sufficient amount of binder as the coating on each of the particles of base, that is all the voids are filled in, then we say that the critical volume has reached. The critical pigment volume has been reached. And that particular value is called the CPVC or the critical pigment volume concentration of paint.

So that means it is the minimum amount of binder that can cover or coat the pigment. Other way you can say it is the maximum amount of pigment that can be accommodated within a binder. Both way you can say. That is the maximum amount of pigment that can be accommodated within the powder, within the binder.

So if you see the picture on top you see on this end it is having more of base and gradually it is thinning out at this end. So the critical pigment volume concentration is here reached and here maybe there is more of base. At some point here it is reached and on this side it qualifies as paint. So, value below the CPVC we qualify we say it is paint. If it is above the CPVC then it is not paint. (refer time: 08:14)

So PVC value is below the CPVC. Hope you all understood that and if you know CPVC you will have to have the pigment added lesser than the amount which makes it or qualifies it for the CPVC, critical value. Now why it is so important? Why am I discussing this, because this PVC actually controls the hiding power or the opacity of paint?

It controls the glossiness of paint. We talk many a time a matte finish, or gloss finish. Which will have more of PVC? The flat finish will have more of base in it and less of binder in it. The gloss finish will have more of binder in it and less of pigment in it. It also controls permeability, adhesion, washability and durability; I have listed it for you. But basically we have to know paint is glossy or paint is flat.

A flat paint is more durable because it is having more of base in it. And you see here increasing PVC reduces the gloss and makes paint flat and we say usually CPVC is achieved below that 50 to 75% of PVC, we call it flat paint. One next is the semi-gloss paint 35 to 40% PVC value. And the glossier is 25 to 30% of PVC value. You can go further down but then maybe the paint will break.

The base will segregate. You cannot see that continuous uniform layer. So just by adding a lot of binder or lot of thinner would not help to qualify as good paint. So these are known by the workmen who are skilled in the job when they are actually adding some to make a better consistency to work. But that does not mean that you keep on adding thing, but then gradually the quality will go down.

Pigments with platelet shapes, usually these base etc., these are as I told you in micron size. Here you see we can have the shapes usually are considered as spherical, but we can have platelet like shapes like mica, alumina, and aluminium and they can reduce the permeability, if they are aligned parallel to the coating surface. So then that is again a skilful job.

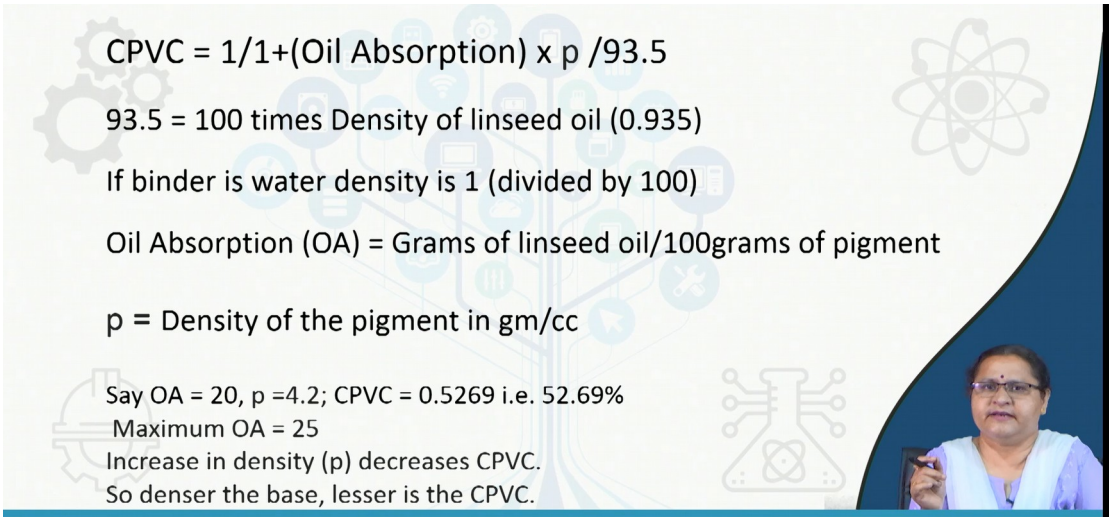
If you are getting that, then with lesser amount of material you can actually have a very uniform spread. So the key takeaway from here is PVC should be below the CPVC and lesser the PVC value glossier the paint, higher the PVC value, flatter the paint. (refer time: 12:38)

Now coming to how do we calculate the CPVC? You can see here that CPVC is given by as the upper part was pigment if that is one unit divided by one plus the amount of binder that is the oil absorption and the density of the material the pigment divided by the density of the hundred times the density of the binder. If we consider linseed oil, its density is 0.935. If it is water, the density is 1.

So you are taking hundred times the density you are dividing by that at the denominator part. So this is 93.5 that is hundred times the density of linseed oil. This is rho which is the density of the pigment that is what has been added the base. Oil absorption is the amount of oil in grams consumed or required for 100 grams of pigment. So you are using 100 grams of pigment grams of linseed oil required and then you are finding out taking the density of the base.

So density when it is more of the material, the CPVC value decreases. So increasing the density of the material or the base you can get a decreased CPVC value. So denser or heavier the base lesser is the CPVC. Because this base are all mineral oxides you can get a clue of this the density rho value. See here if you have the oil absorption or OA as 20, rho as 4.2 which is of that of titanium oxide CPVC comes out to be 52.69%.

So if you have linseed oil and titanium oxide as your base at 52.69% your CPVC is achieved. So you have to have lesser value of PVC to get a titanium oxide base paint, with titanium oxide as base paint. (refer time: 15:55)



So now, let us come to the defects of paint. Now paints as I have told you can be applied on plastered wall surface, wood surface, metallic surface, and concrete surface. They are not all of the same nature. But mostly all these surfaces can be both old and new. That is common for all. Defects of paints are also more or less common for all.

If we look into the types of defects not going into the types of paints, we will see that defects are mainly of three types majorly and other is always the weathering action. So if we say talk of defects or manmade human involved defects, it will be three types. And nature is always there which can lead to defects. So quality of ingredients is one of the primary cause of having different defects.

Next is the defects related to bad workmanship. And the third is improper surface treatment. Why I am telling improper surface treatment? Because not always we are painting a new surface. Many a times we are actually painting old surface. So if you are not doing proper treatment to whatever be the surface, plastered surface, concrete surface, wood surface, or metallic surface you are entering into a set of problem which may be related to improper adherence.

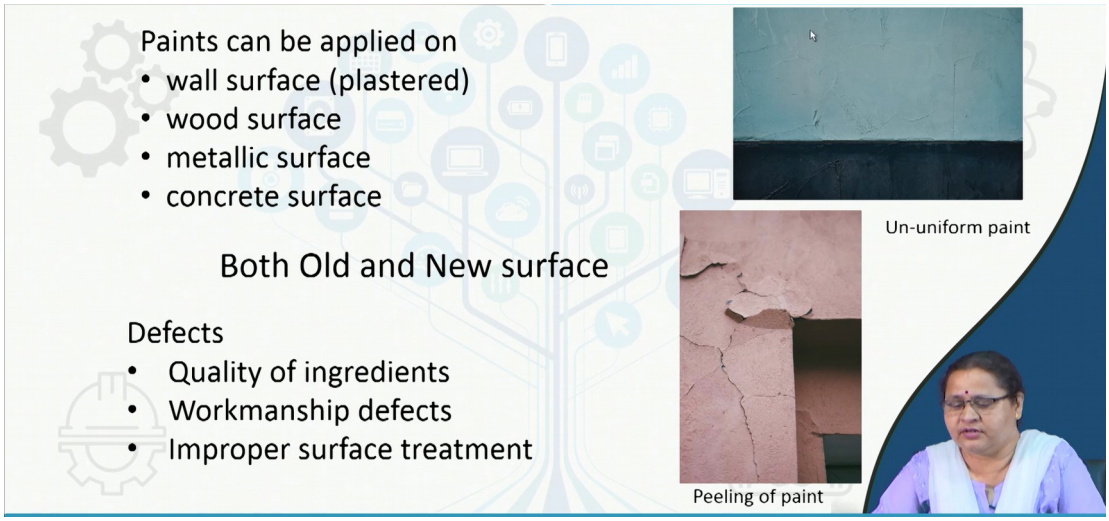
That is the paint is not adhering to the substrate. So these are mostly observed in old kind of surfaces. So proper surface treatment has to be done. So these are the key areas which have to

be kept in mind. So whenever you see paint with some defect, you as an architect should be capable of through your trained eyes to find out why this defect has happened.

As I had shown you that when you see a patchy wall you have to look for whether it is any service line passing through it what is the space or whether some water leakage, whether it is the topmost floor or whether it is some patch some water coming from the ground level. So location can give you a clue. Similarly, the paint nature can give you a clue. Oh this is not a good quality paint!

Okay, the material has sagged at different points. It is fat at some points. So the brush marks are seen that is workmanship defect. So it was not done by good people. The quality of paint may be good. And sometimes things come out. As I told you, the thickness: it has to be as thin as possible. If it is not, sometimes because of that it may come out, flake out.

And sometimes it may be because of improper surface treatment, it comes out. We have two pictures here. In one picture you see ununiformed paint. You can see lots of lines here and there, wavy things. Maybe the wall was not cleaned properly. Here you see the layers are so thick, it has actually come out, flaked out, or peeled out. So you can actually pull it from that point and you can see the inner surface.



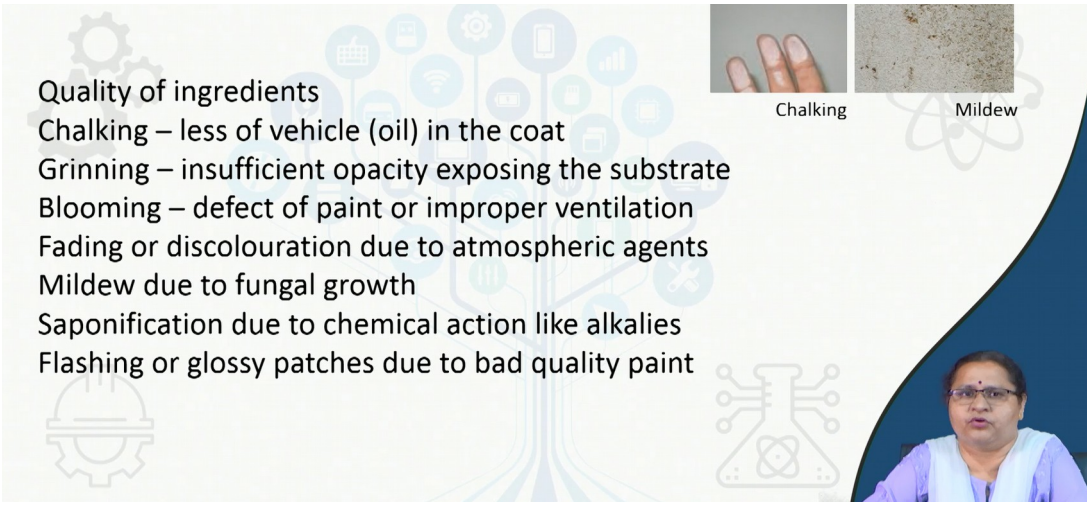
So there could be lack of adherence between the substrate and the paint. So maybe proper cleaning was not done. So adherence did not happen at some points. (refer time: 21:43)

So we can just go through finding some defects. Sometimes you sit and your back becomes dirty. It is not dust, it is not something bad, it is basically the base coming out because the binder was less in it. That means the base was more in it. So the base is eventually not being held in position and the excess amount is actually coming out. Insufficient opacity can expose the substrate.

You can see the substrate from your naked eyes. That is called grinning. So you will see patches of inside seen through the paint layer. You can see the blooms have come out. So the surface did not dry properly. So the vapour got entrapped. So the wall did not get sufficient

time to evaporate out its entrapped water or entrapped moisture. And later on it came out in forms of blooms.

Fading, discoloration that could be because of sunlight, that could be because of exposure to rain, continuous exposure of one particular facade to rain because sometimes the monsoons come and fall in one particular facade. So that particular facade can discolour. Sunlight, ultraviolet rays can discolour. Mildew, what you can see in the picture also. That is fungal growth, organic growth. So the organic items could grow on top of the paint surface.



Another is saponification due to chemical action, say alkalis, some pipes which are carrying some chemicals can actually or eventually lead to saponification of the top coating or the covering paint. Some acid fumes, alkali fumes can actually help in saponification also. Flashing that is glossy patches due to bad quality paint is also seen in cases when it is not of that good quality. (refer time: 24:54)

We have some more workmanship defects. You can see some paint which was uncontrolled by the workman has eventually ended up into thick or fat edges. So wherever the travel stopped, from there the paint was not carried up. So that has left to some blunt droplets. Brush marks because of not correct consistency of paint. The paint left brush marks.

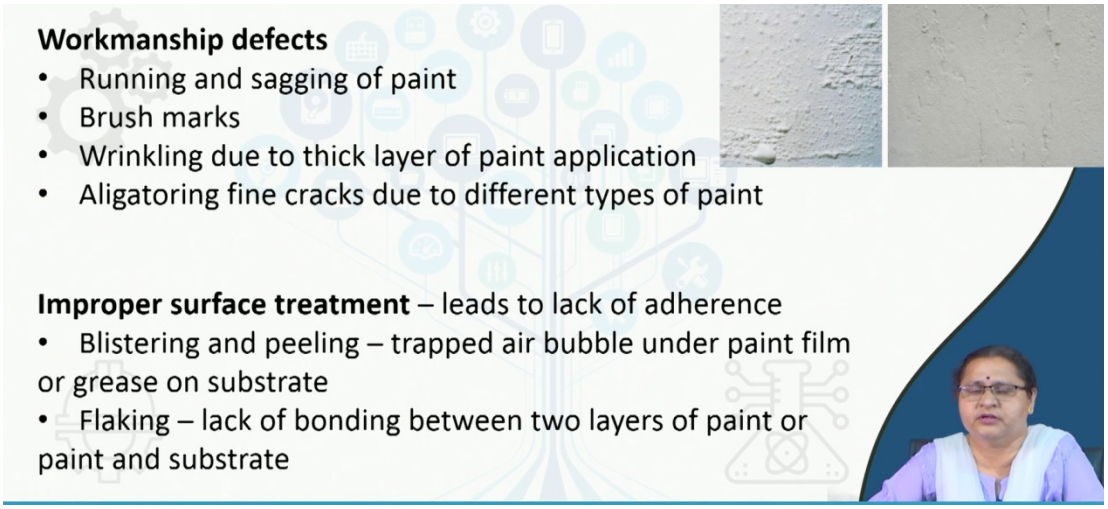
When the brush moves the marks remain. So that is because of not perfect consistency which the workman is supposed to control. Wrinkling due to thick layer of paint application. So as in one particular layer, if you add amount of say two layers, then it might get because it is getting dried gradually. So the inner vehicle or the solvent cannot come out.

That will lead to some entrapments of gas. The volatile gas cannot come out. So that will entrap and create wrinkle on the entire surface. So thick layer just to escape in one go I will do it would not help. The inside layer which cannot get dried up immediately will lead to such wrinkle formation. Same type is developing fine cracks due to different types of paints.

Two layers are of different types that is called aligatoring. So you can see these defects with your own eyes, maybe in your own house, maybe in some neighbour’s house, maybe in some

areas where you visit regularly. You try to look into these around you and try to find out whether you can find out what it is. Improper surface treatment as I have told you this leads to lack of adherence.

Blisters, locally, you will see a portion has swelled up. You can see in this picture, these are blisters. Trapped air bubble under paint film or grease as or grease on substrate. So if there is grease on substrate, the paint could not adhere to it. So you require proper surface treatment. So that means before applying the paint, the treatment of the surface is very important particularly when it is an old item, old substrate.



Flaking, lack of bonding, I had shown you in the first in the slide where I started defects. So peeling off or flaking off is again very common kind of defect which arises because of improper surface treatment. So substrate or treating the substrate is very important to be known allowing it to dry hundred percent to stop items like blistering etc., you can just go, you can just avoid those.

Workmanship you need proper skilled workman for painting because it is your final layer to the building. So you have to go for good workman. And we will discuss at length in our next lecture on different types of paints. Because after knowing all these, you must be curious enough to know which kind of paint should be applied on which type of substrate. And we are only discussing or every time we are talking of paints and paints.

In case of wood we want to show the grains to the people because that gives value to it. We want to show the grains of wood. There we put some coating, which is called varnish, which does not hide the substrate rather it exposes or reveals the substrate at the same time keeping it protected against whatever points we said. So we will have to know the different types of paints and where it is applied, which we will discuss in our next lecture. Thank you.