Resene

Architects Memo

NO 35 APRIL 1984

COLOUR AND DURABILITY

It has been a commonly held opinion for years that durability of paint systems declines with the increasing darkness of the colour chosen. Like most beliefs this has some validity but increasing knowledge shows that the relationship is not as simple as that expressed above.

To examine the relationship between colour and durability one has to look at three separate areas:—

1. Durability of the pigment. Originally pigments were crushed natural ores dug up out of the earth. Having withstood everything that Mother Nature could throw at them they could be considered highly stable. Pre-historic petroglyphs using natural ochres demonstrate this high durability. Modern synthetic equivalents of these ochres show equal durablity whilst having improved brightness and cleanness of shade.

   Really bright metal ores are very rare and the exceptions had other drawbacks e.g. the highly poisonous vermillian. It was not until the mid nineteenth century, with the discovery of aniline dyes, that the foundations were laid for the organic dye and pigment industry with its present wide range of bright, clean colours.

   The first synthetic organic pigments were naturally fairly simple molecules that were easy to synthesise. Unfortunately molecules that are simple to put together are often easy to knock apart (i.e. they lack durability). An example is Lithol red. If two paints were made, one on red ochre and one on lithol to the same depth of colour and exposed; the ochre would maintain it's colour as long as any paint film was left whilst the lithol would be broken down completely in two months. This shows that it is not depth of colour which is important but the chemical make up of the pigment.

   Increasingly more complex and stable (and expensive) organic pigments have been synthesised until there is now available a full range of highly stable bright colour pigments. Durability can be predicted from a knowledge of the pigment type used but unfortunately the descriptive names of these types generally only have meaning to a trained chemist.

   Some pigments whilst remaining stable in colour themselves, can catalyse breakdown of the paint film. Titanium Dioxide is a major example of this phenomena and a lot of technology goes into suppressing this effect. It is interesting to note however, that there are distinctively different durability grades in white.

   Another phenomena exhibited by some colours is a marked enhancement of that colour when it is wetted by a liquid. As a multi-coloured pebble can catch the eye when wet and yet be quite dull when dry, so it is with some pigments. Phthalocyanine are an example of this. This very stable pigment produces rich colours in fresh paint (i.e. wetted with the paint vehicle) which apparently "fade" when the pigment surface is exposed by eventual chalking of the vehicle (i.e. dry state). This "fading" is illusory as the original colour "comes back" when rewetted, even with water.

2. Durability of the Paint Film. Most oil-based films are characterised as being "thermoset", that is they cure and harden with the application of heat. With oils this hardening process continues over a long period resulting in embrittlement and loss of flexibility. Colours which absorb a lot of heat and this heat can accelerate the breakdown of oil-based films. This is the major fact underlying the opening sentence of this memo.

   If the vehicles used to make paint are either passive to, or resistant to heat, then this rule no longer holds. Acrylic vehicles which are passive to heat can be formulated such that a dark chrome green for example is more durable than a white. A similar situation exists when using heat resistant silicone alkyds.

   Mention was made earlier of the catalytic effects of some pigments in degrading binders. Maximum durability can only occur when the binder can resist this degradation.

3. Durability of the Substrate. The effect of heat on a paint film has been discussed but the transfer of that heat onto the substrate is important. On a fine summers day with an air temperature of about 20 °C the surface of a white paint will be very little above this; a dark paint however, can achieve a surface temperature of up to 70 °C. This can have some deleterious effects on unstable substrates. For example it can rapidly cause the breakdown of old underlying oil-based paints; it can change the e.m.c. of timber at such a rate as to cause splitting and cupping; it can mobilise resinous materials which have been quiescent for years in timber in a lower temperature environment.

   These failures are often attributed to lack of durability of dark paints, when the fact of the matter is that it is a problem of lack of heat resistance of the substrate.

   To conclude, dark colours per se are no barrier to durability if the pigment is carefully selected by chemical type, the binder is resistant to heat, and the substrate is stable at the surface temperatures expected.

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