

Decorating with colour and style

What is colour?

How colour is perceived depends on four factors:

1. **The colour of illuminating light.** Most of us are not aware of this until we go into the disco with the UV lights flashing away. Or perhaps we notice when wearing our shades. Different light sources indoors and outdoors may make colours that are quite identical in one environment quite different in the other. This is known as metamerism.
2. **The reflectance characteristics of the object.** Sadly life is not as simple as it seems and the colour we see depends on the chemical structure of the surface of the object. Different chemicals on a surface absorb specific wavelengths of light (or colour bands). These chemical groups are known as chromophores. The very cleanest or purest colours are achieved by using a single chromophore. The addition of several chromophores may give very interesting and subtle colours, but always duller than the single chromophore. (We have used the term chromophore here to denote single 'packets' of colour rather than pigment, which can already contain 'mixed packets' of colour). Paints then, rely on coloured pigments that work by absorbing (or taking away) parts of the light spectrum and only emitting that part of the spectrum by which we characterise colour. For example, ultramarine absorbs the yellow and red part of the spectrum and only emits blue, which our eye then recognises. Every additional coloured pigment or tinter that is added to a base paint will take away light, and hence this method is known as 'subtractive' colour matching. This is why when you have added a lot of different tinters or mixed a lot of different coloured paints together you always end up with black or at least a dirty grey. In contrast, televisions produce colour by blending coloured light sources in a process called 'additive' colour matching.
3. **The ability of the eye to receive the colour.** Colour also needs a detector that can distinguish between mixed packets of light waves and we humans have been blessed with one of the best. The two million rods and cones in the human eye can detect up to ten million overlaid shades of colours. About 8% of the male population have some difficulties seeing colours. Monet, the great impressionist painter, was greatly disturbed to find his perception of colour changing as he became older.
4. **The ability of the neural system and brain to interpret what the eye sees.**

It is also important to realise that what an individual calls a colour also depends on their upbringing. Never assume that someone else is visualising 'turquoise' or 'cerise' as the same colour you are.

Metamerism

Two colours may match under daylight conditions but not match under fluorescent lamps. This is because they have been made using chemically different pigments of similar shade. For example a green shade may be created by adding either adding 'D' tinter (based on an organic pigment called phthalocyanine green) OR by adding 'K' tinter, which

is based on an inorganic chrome oxide pigment. The green shade could also be created by mixing blue and yellow toned pigments or tinters.

Fading

Special care is needed when specifying colours for exterior use (especially on trim), to ensure that they are lightfast (or resistant to fading). With enamel paints, chalking can protect the pigments on the surface from fading but the chalkiness results in a similar effect anyway. Fading occurs because UV light chemically destroys part of a pigment's molecular structure. Coloured pigments that fade are usually organic pigments in yellow, orange and red shades. The degree of fading will vary according to the tinter combination used and the exterior aspect. Walls facing south should not present problems. The use of complementary tinters of which only one fades results in changes of 'hue' rather than a change of 'value' and this type of colour change is much more noticeable.

How long will a colour last before it fades?

There is no precise answer to this question because no-one knows exactly what future weather patterns will be, however, certain things are predictable. For example, there are some pigments which are absolutely lightfast (principally the oxide colours and black) and the appearance of colours based on these pigments (or mixtures of them) will only be affected by film erosion (or chalking).

Chalking

Chalking occurs when the combined action of sun and moisture degrade the paint binder and force the release of the paint's surface lying pigment particles. It is called chalking because it resembles the chalky surface of a blackboard at school.

The term 'chalking' refers to the formation of a white, chalky powder on the surface of the paint film. This condition often occurs as the paint weathers and the binder is slowly degraded by sunshine and moisture from rain, dew, or some other source, releasing the binder's hold on the pigment. Over time, nearly all paints will show some chalking when they are subject to outdoor exposure. However, chalking is especially prevalent with flat paints and white or very light coloured paints that contain high levels of titanium dioxide and extenders. A low degree of chalking is often beneficial in whites and off-whites, since it tends to rid the surface of a certain amount of dirt and mould.

The New Zealand Railways used to paint white railway wagons using an alkyd paint made from a special chalking grade of titanium dioxide. The chalking was so severe that it kept the wagons looking clean. This was no mean feat with all the steel dust floating about.

Excessive chalking can harm a paint job in at least three ways:

- Chalk can 'run-down' onto underlying structure (brickwork for example) and deface the appearance of the surface.
- It can lighten the colour of the paint.
- It can erode the paint film, resulting in a loss of protection to the substrate.

Chalking is influenced by the inherent durability of the binder and the initial gloss level - onset of chalking will be a lot slower for a glossy, 100% waterborne finish than for a low sheen styrene/waterborne finish. Chalking can be virtually prevented by the use of overglazes with a corresponding increase in the long term appearance of colours based on the aforementioned pigments.

These pigments, however, are generally quite dull and use must be made of a range of organic pigments in order to achieve the full palette of light, bright and bold colours demanded by today's market. Some of these organic pigments (in the blue-green range) approach the oxides for durability, while many (particularly in the red, orange and yellow range) fall somewhat short. What then becomes crucial is the mixture of pigments chosen to produce a colour. As the top layer of colour is destroyed by the U.V. light the next row of particles comes to the fore without any changes in hue. All that happens is that the opacity of the colour changes minutely. It is possible to make a bright red which incorporates about 5% titanium oxide white pigment with the Red 112. As the red fades out the balance of red to white in the top layer of pigment changes dramatically as the red is destroyed, favouring the titanium dioxide. This results in unacceptable fading. It is worth noting that if one cut through the top faded layer, the red would be restored.

Chalking, especially with titanium dioxide white pigment, can vary with the grade of pigment chosen. Grades with better hiding power or gloss may be inferior in chalk resistance.

Exposure direction can have a significant impact on colour retention. Northern facing exposures get the most direct sunshine and, thus, have the greatest tendency for colour loss. Southern facing exposures typically fare much better.

Quality waterborne paints weather better than lower grades of waterborne paint and much better than solventborne exterior paints.

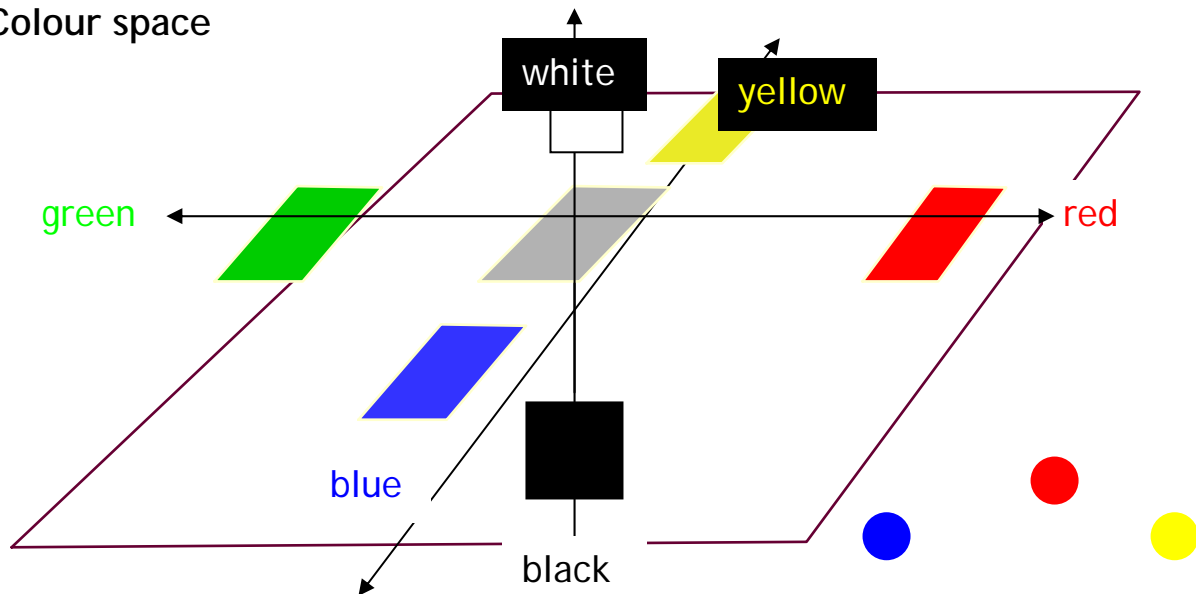
Several paint formulation factors impact the capability of a coating to maintain its colour. For example, a low level of binder relative to the level of pigments and extenders in the paint can harm colour retention, which is often the case with low-cost exterior flat paints. Use of an interior paint for an exterior application can lead to colour loss. Some of the binders commonly used in interior formulations do not resist chalking well when subjected to exposure out-of-doors. Furthermore, certain high-hiding extenders, such as clay pigments, used in interior paints (and even some lower quality exterior paints) may cause excessive chalking and thus colour loss.

Colours

Differently coloured paints will vary in price, hiding power and durability. Customers may be able to slightly change their colour choice and avoid the need to apply three coats. Resene normally only specify two coats of colour but with certain colours, such as yellows and oranges, three coats may be needed.

Different cans of paint tinted to the same colour may not always be exact matches to each other. The likelihood of exact can to can matching will be even less if different batch numbered bases are used. Large wall areas that require more than one container or paint per coat should have enough paint boxed together to complete the final coat. This will not apply if a single factory batch of paint, rather than shop tinted paint is supplied. The same rules apply to wallpaper and knitting wools. If clients know of the potential problem they can avoid it.

Colour space



Colour matching

The colour space three dimensional grid shown above is the basis of the Hunterlab computerised colour matching system. It is very useful to visualise the 3D grid if colour matching. Start off by placing the colour to be matched at the centre spot of the colour grid. Assess if your colour is bluer or more yellow than the standard. If it is OK you are on the red-green axis. Get this OK and you are on the black-white axis. Try and leave any additions of black until last.

How can different batches of the same colour look so different?

When you look at colour differences you need to think of colour in three dimensions. With most colours the colour differences between different batches are not one dimensional. Colour is made up of red-green and blue-yellow components, which can be varied along a black-white axis. When colour matching limits are set, the position of the colour being matched is checked to ensure it is within acceptable limits of the standard. It is therefore possible to have three colours matched to the same standard that may be positioned alongside, above or below the standard in colour space. In the worst case positioning these 'matches' may be well outside acceptable limits if they were to be compared to each other.

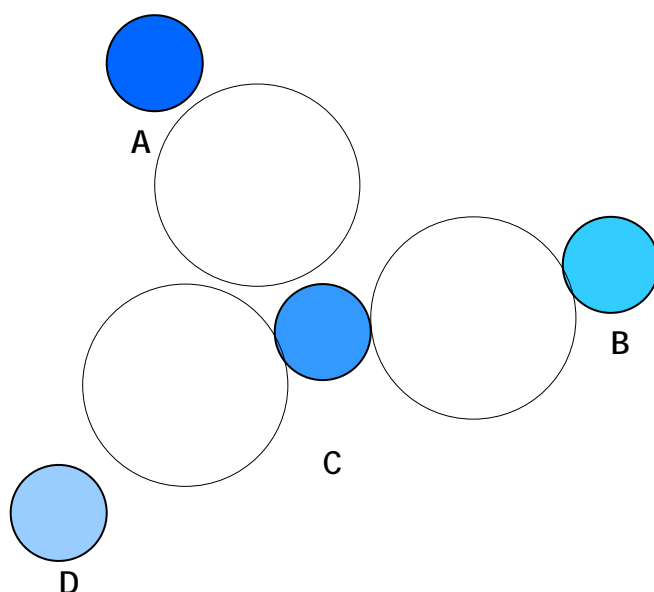


Diagram of worst case colour match. A, B & D all match C (within 1 circle). However A & B are about 2 circles apart as are B & D and A & D. It is possible to decrease the tolerance allowed in matching colours (size of the circle) but this would result in a drastic increase in the time needed to complete factory colour matching. In some cases batches may even need to be reworked (if made too dirty).

This kind of effect also explains how different companies can supply colour matches to the same standard colour that look so different.

The answer to the problem is to always have enough paint in the current can to be able to finish the monolithic area being painted. Before another wall is started check there is enough paint or box together enough to finish that wall. It is common practice for knitters and wallpaper hangers to ensure they have enough wool or paper to complete a job. The same applies to paint.

Colour perception

Colour perception is affected by the background on which it is viewed and also the size of the object viewed. The smaller the size of the coloured object the less one is able to distinguish the colour. The following sized colour chips are preferred for evaluating colour:

Approximate evaluation	14.5 sq. cms.
Guide	24.2 sq. cms.
General evaluation	130.6 sq. cms.
Critical evaluation	440.3 sq. cms.

The need for large samples for critical evaluation of colour led Resene to develop the concept of testpots. Resene testpots provide enough satin acrylic paint to cover significantly more than the area needed for critical evaluation. This makes possible the viewing of a colour on site where individual interpretation can be confirmed.