

Before and after – left, mineral oil;
right, vegetable oil.

Discolouration of concrete

Long gone are the days where stained concrete surfaces were acceptable. Even with concrete elements that spend their lives underground, the pressure to make surfaces more durable and more aesthetically pleasing continues. Phil Scarlett of Ecoratio reports.

The drive to increase quality, in the author's opinion, came with the increasing need to use self-compacting concretes in the early 1990s, when concrete producers became solvers of problems and customers started to benefit from increasingly new technologies entering the marketplace.

Self-compacting concrete is now a widely recognised product and commonly used, so let's look at some of the most common problems that you may have when trying to achieve that 'perfect' concrete finish, along with some of the possible solutions.

Causes of discolouration

To prevent discolouration, you first need to understand where your change in colour is coming from. Sounds straightforward? Maybe not.

Water

This is probably one of the main and most common causes of concrete discolouration.

Over-addition of water within a mix will significantly change a concrete's colour.

Care should be taken at all stages of the mixing process to keep a stable water:cement (w/c) ratio. Adjusting for aggregate moisture content – not only to keep the correct yield but also to maintain a consistent water content – will help prevent discolouring.

Increases or variations in w/c ratio in normal concretes will cause a lightening

of the surface. If the process also contains pigment then you may find you have to increase your pigment dosages to compensate for any inconsistency, thus causing your concrete costs to increase.

Concrete constituents

This topic may not be as simple to solve as it sounds as producers are sometimes limited to material availability, but changes to aggregates and cement away from the original mix design will have an impact on concrete colour.

The use of cement replacements will also change the colour of a concrete, so it's advisable to keep the same percentage proportions within the mix design.

Changing water-reducing admixtures could also alter the concrete colour as these are designed to reduce w/c ratio, each to a varying degree.

Calcium chloride powder

Throughout the industry, accelerators are commonly used to decrease the setting times of concrete, but the use of calcium chloride accelerators, especially in pigmented mixes, can have a detrimental effect on concrete colour.

While these excellent accelerators are usually very cost-effective, they tend not to disperse very well within the mix, causing them to 'clump' together; this clumping can lead to a darker concrete with an undesirable mottled effect on the surface.



..... Friable concrete surface due to the over-application of oil.



Mineral-oil-stained concrete.

Release agent

The application and the type of release agent used will have an impact on the surface finish of concrete.

Barrier-type release agents tend to fall into two general categories, namely mineral oil- or vegetable oil-based, with sometimes a vast difference in the quality of constituents.

All release agents, when applied correctly, will give concrete some form of a release; it's just that some may also give you a few of the problems below.

Some of the older mineral oils tend to be more viscous and more prone to staining, and with the lower viscosity can trap air against the formwork, causing unsightly blowholes and trapped air pockets.

Staining using these oils can also be increased by over-application as the oil tends to 'puddle' in the bottom of the mould. In extreme conditions a more friable and porous surface is created as the oil has found its way into the concrete matrix before hardening has taken place.

These oils also will require a level of personal protective equipment (PPE) for employees as excess vapour from spraying will be hazardous to health.

The more modern vegetable oil-based release agents tend to be less viscous and, like

the Ecoratio Betopro range, come completely label-free as they are 100% environmentally friendly.

Applied correctly by hand or using a custom-built spray system, these oils eliminate staining, have excellent surface adhesion and form the thinnest film against the formwork, allowing excess air to escape, resulting in virtually blowhole-free surfaces.

With minimum PPE required, these oils can be hand-sprayed and, if needed, the mould surface wiped without any detrimental effect to the employee's health. (Note: while most vegetable-based release agents are white in colour, please check your own containers to make sure they are label-free and, if not, please follow the recommended PPE advice.)

Consistency

The key to all the above is consistency. If you can keep consistent materials, mix design and mould-release application then you have the best opportunity to avoid concrete discolouration.

Our industry is placing more demands to achieve environmentally friendly and aesthetically pleasing concretes than ever before. The list above is not exhaustive, but if followed, will help achieve the perfect finish. ■



..... Over-applied mineral oil left to accumulate in the bottom of a mould.



..... Stained concrete – left, before with over-application of mineral oil; right, after with vegetable oil release agent.