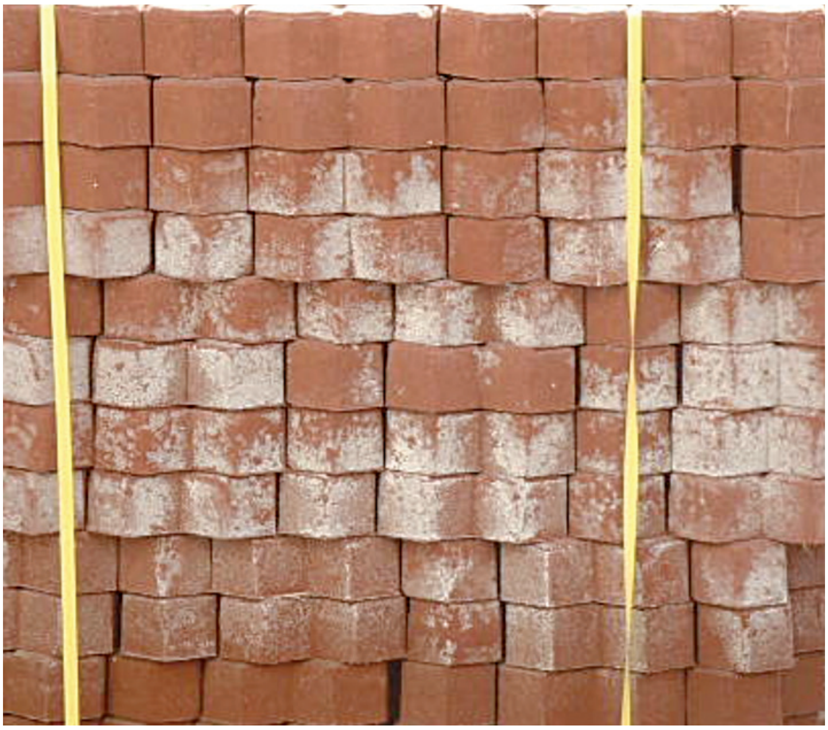
Efflorescence

Complex chemical reactions take place as concrete hardens and these can affect the amount of colour development that can be achieved with our pigments. The most common outcome of these reactions is known as efflorescence which causes a white bloom to appear over the surface of the concrete. This is unrelated to the pigment but masks the true colour of the hardened cement product.

In order for cement to harden it requires a certain proportion of water. However the amount of water needed is quite small and certainly not enough to produce a mix that would flow freely into a mould. Block making plants use a semi dry mix with a water cement ratio of about 0.3, but even this means that surplus water has been used. As the cement hardens, this surplus water escapes to the surface creating a network of fine capillaries.



The body of the hardening concrete contains a solution of calcium hydroxide which migrates to the surface through these capillaries.
At the surface the calcium hydroxide reacts with carbon dioxide in the air to form calcium carbonate leaving a thin white surface layer. The effect is much more noticeable in damp conditions which cause the calcium hydroxide to spread out over the surface before it is converted into calcium carbonate. In dry conditions it only forms at the mouth of the pores and is much less noticeable. In both cases the effect takes place during the primary hardening of the concrete, say within the first three days. Over this period the calcium carbonate builds up to such an extent that the pores are blocked and the process stops.
Although cement gives an initial set within a matter of hours, the process of hardening continues over a period of months. During this period further secondary efflorescence can appear in spite of the capillary pores already being blocked. This is probably caused by moisture penetrating the surface allowing the process to continue by producing more calcium hydroxide at the surface.

Efflorescence tends to diminish as the concrete product ages. In northern climates it tends to be at its worst after one year with a subsequent gradual improvement. It can be removed by acid washing, however they need to be treated with due care paying particular attention to the run off.

It is possible to minimise the risk of efflorescence by paying close attention to the concrete mix design, the compaction and the curing conditions. Factors to take into consideration are the water cement ratio, the sand cement ratio, the cement content and the sand source. All of these can significantly affect the size and number of capillaries that are formed.

Equally the use of Krete admixtures and/or cement replacement materials such as pfa could also be considered. By producing a denser and stronger cement matrix with less water demand they will automatically reduce the formation of capillaries. Well designed mixes using microsilica behave in a similar way.

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