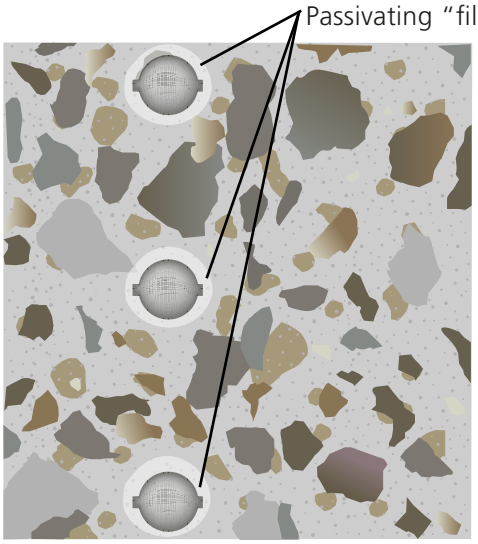
Reinforcement corrosion in concrete

FORMTEX®
Controlled Permeability Formwork (CPF) liner

The durability properties of a concrete structure will determine the service life. Engineers design the structure to withstand a given load and these theoretical numbers will last forever but the materials, unfortunately, do not. Therefore preventing deterioration by early planning can be very cost efficient, and it is all about delaying ingress of aggressive elements.

Under the very alkaline conditions of freshly poured concrete, a passivating "film" of oxides is created around the reinforcement. This "film" is maintained by the alkalinity, and protects the reinforcement from corrosion. However, the passivating "film" can break down if:

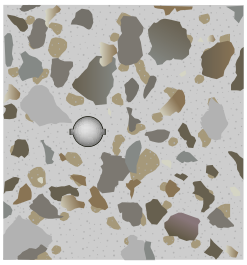
1. chloride ions (Cl^-) reach the passivating "film"
2. the pH-value in the passivated region is reduced



Chloride contamination

Chloride contamination from de-icing salts and/or seawater occurs mainly by diffusion, but can also be carried through the concrete with water. The negative ions are able to break down the passivating "film", thereby initiating the corrosion process. The speed at which chlorides travel depends on the porosity and the permeability of the concrete. The main transport mechanisms are described in more detail in the flyer "Chloride transport in concrete".

1. The passivating "film" breaks down due to penetration of aggressive elements.



Carbonation

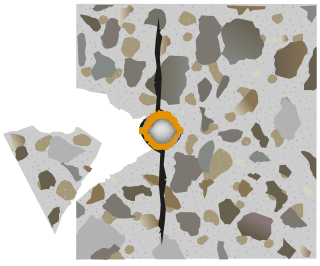
Carbonation occurs due to ingress of carbon dioxide from the outside air. Carbonation will begin at the surface, and propagate into the concrete. The speed of the ingress depends on the porosity and permeability of the concrete. The carbonation reaction will lower the concentration of hydroxide ions (OH^-) and the pH-value falls to below 9 - thereby destroying the passivating "film". More details of the carbonation process is described in the flyer "Carbonation of concrete".

2. Corrosion of the re-bar causes expansion, and the concrete starts to crack internally.

Corrosion

Break down of the passivating "film" will allow oxygen and water to initiate corrosion in the steel. The corrosion product, known as rust, has a higher volume than the steel it originates from, resulting in spalling of the concrete cover, and the reduction of the rebar cross section will reduce the load bearing capacity of the reinforced concrete member.

3. Corrosion continues and the cover spalls off as a result of the volume increase.



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