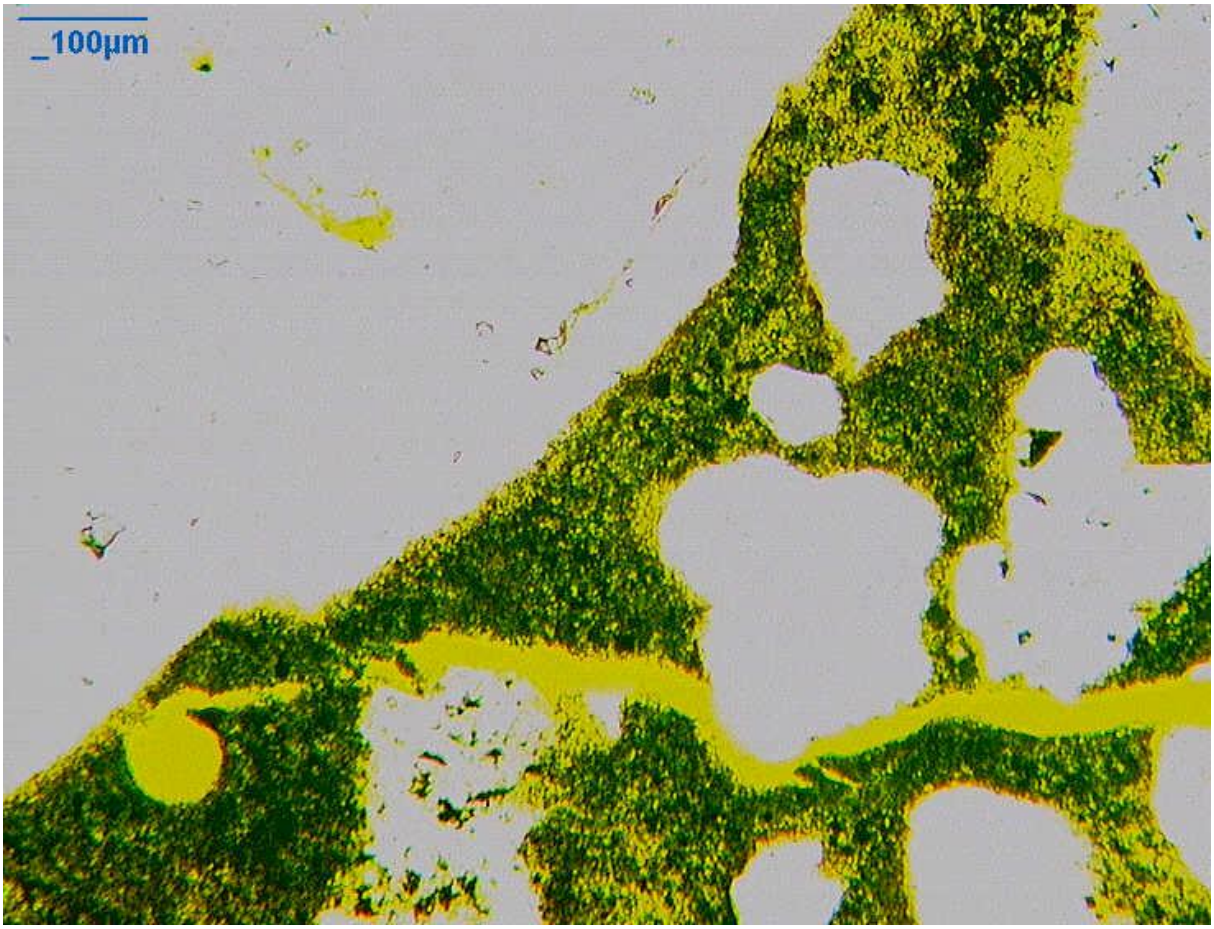
Explanation of the pozzolanic mechanism in a standard mortar

When Portland cement reacts with water about 75% calcium silicate hydrate (CSH = the cement binder) and around 25% **calcium hydroxide** (Portlandite, free lime = a soluble salt) are formed. This **soluble salt** can be **made mobile** with the water and may form efflorescence on the surface of mortars and concrete. Through repeated wetting the porosity of the construction material will increase, and the durability will decrease.

It therefore makes sense to bind the calcium hydroxide with pozzolanic materials to form CSH and CSAH phases to get the cement matrix denser and stronger.

In picture 1 a standard mortar with **CEM I 52,5 100 %,** w/b=0,50, w/c=0,50 (78 N/mm² at 90 d) - polarised light through a thin cross-section - is shown



Picture – temcon solutions

The picture shows quartz particles of different sizes; on the upper left part a large quartz particle can be seen. In the lower part a crack crosses the sample. The crack happens along the quartz particles. The yellow-coloured parts show pores in the cement matrix and especially along the contact zone with the aggregate surface; these are the parts filled with free lime that has developed from the cement reaction and accumulates there. This reduces the binding power to the aggregate. It is known that water and soluble salts like chlorides and sulphates penetrate mostly along this surface area into the mortar. This is the reason why it is important to bind the calcium hydroxide and make it insoluble.

 office@newchem.org

In picture 2, 20% of the cement has been replaced by a spherical pozzolan (this case Microsit): **CEM I 52,5 80 %, Microsit 20 %**, w/b=0,46, w/c=0,58, (94 N/mm² at 90 d). It shows that the porosity has been dramatically reduced. The cement matrix in black shows a **good homogeneity and density** and almost no yellow at the contact zone with the aggregate. The crack has freed a quartz particle in which a crack in the quartz can be seen showing the stress applied to the aggregate.

The good fixing of the particle in the cement binder can be seen.

Picture – temcon solutions

The **higher density** of the cement matrix results in a **reduced water uptake** of mortars and concrete. Damaging components are mostly dissolved in the water and therefore the chemical attack of the construction material will be **reduced** as well as the **chloride migration from de-icing salts or sea water**. As less soluble salts will penetrate the mortar, the **durability** of it will be **increased**. The high density of the mortar will also increase its freeze-thaw resistance.

From a mechanical point of view, the closing of the pores will **increase the compressive strength and abrasion resistance**. The shrinkage and the creep of concrete can also be reduced.

Good pozzolanic materials bind up to 120% of the free lime produced. To bind the complete quantity, one needs by calculation - at about 25% Portlandite - about 20% pozzolanic material, calculated on the cement quantity used.

Newchem offers a wide range of pozzolanic additives to improve the density of your mortars and concretes. Please go to our website at www.newchem.info to find the best product to your application or contact your regional representative.