

# NAMEX XA

NameX XA is a unique expansive additive for concrete and mortars mostly based on magnesium oxide. In the literature, there are 3 different expansive agents known for hydraulic systems:

- type E: Ettringite systems that are the most commonly used today
- type C: Calcium oxide that is used for some applications
- type M: Magnesium oxide that has been applied in China in massive concrete

There are big differences between the systems, with advantages and disadvantages in each one such as:

- **Ettringite** systems work within the first hours and days. The reaction is mostly completed after 10 days. Thus, no late expansion due to unreacted relicts are to expect. The disadvantage of this system is that the reaction may already happen without effect in the liquid stage of the cement mix if these are retarded. Ettringite also needs 32 molecules of water to hydrate and with the low w/b factors used today there is often not enough water to build the ettringite, because ettringite formation needs a w/b = 0,85. Another problem is that ettringite starts to decompose at 50°C, a temperature that can easily be obtained in massive concrete, creating internal cracks and stress in big constructions.

Ettringite needs CaO, Al<sub>2</sub>O<sub>3</sub> and SO<sub>3</sub> in solution. These are the same elements as in hydration of cement clinker, GBFS and pozzolana. Mutual interactions and effects of retarders also influence time and amount of ettringite formation.

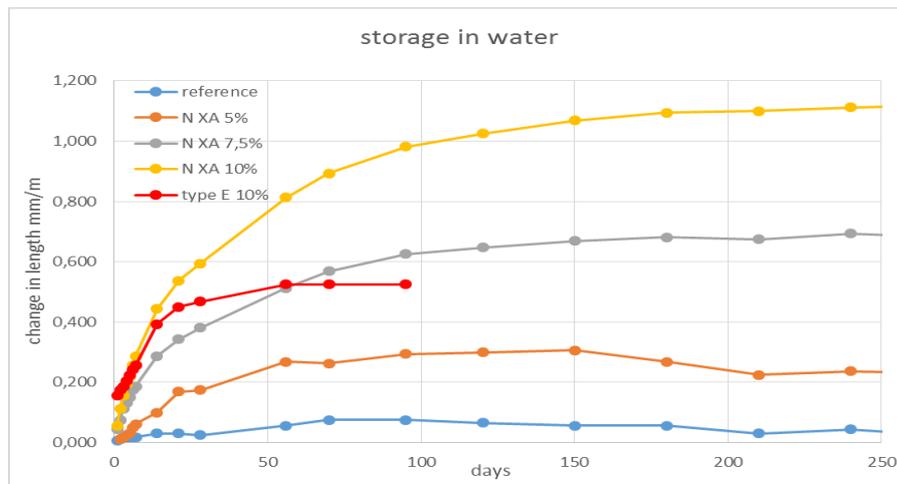
- **Calcium oxide** on the other hand may be difficult to handle. Its hydration starts spontaneously, and the reaction happens partly in solution. Furthermore, the calcium oxide acts as an accelerator to mortars and concrete. The transformation of CaO to Ca(OH)<sub>2</sub> needs only 1 water molecule and is therefore better adapted to today's low w/c values. Some systems of the ettringite type add calcium oxide to get a greater expansion.

CaO increases pH rapidly which may have a negative effect on polymers in construction chemistry.

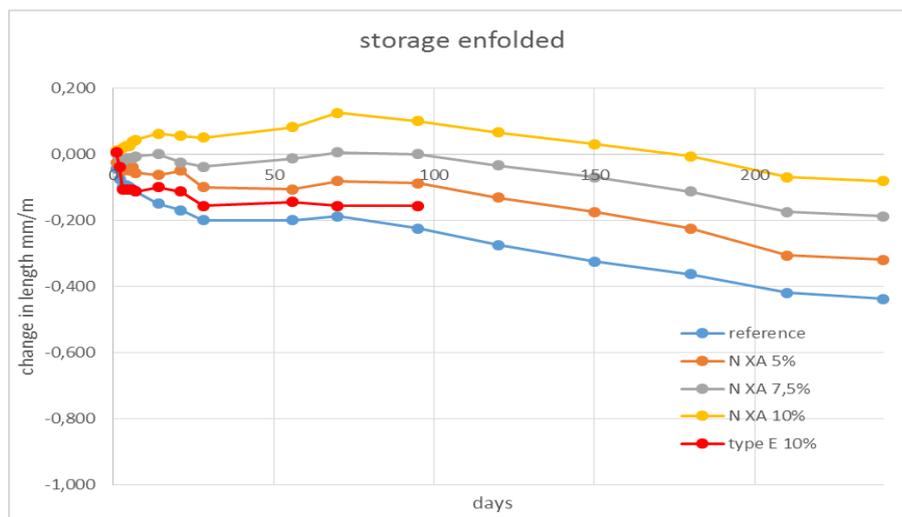
- **Magnesium oxide** works like CaO systems through the transformation of MgO to Mg(OH)<sub>2</sub>. This requires also only 1 molecule of water and needs a w/c of only 0,45. As the solubility of magnesium oxide and magnesium hydroxide is very low, the reaction runs much slower than with CaO and happens around the MgO particle and not in solution. By modifying the grain size and porosity of the MgO, one can modify the reactivity. Depending on the production conditions one can obtain very slow or good reactivity. Therefore, NameX XA is very different to the dead burnt MgO obtained when sintered in OPC clinker in the rotary kiln at around 1450°C. These conditions cause late expansion and are the reason for a limit of 5% MgO in EN 195.

MgO hydrates independently of the hydration of the OPC. No retarding or accelerating actions are expected. Due to the lower water demand the expanding reaction may be obtained for a longer period without external curing.

## Comparison of expansions:



As can be seen the type E has a very fast expansion rate, but the effect fades away after 28 days. Namex XA on the contrary expands a bit slower in the beginning but will also continue to expand in the drying period to reduce drying shrinkage, up to 180 days.



Compared to type E the amount of Namex XA may be reduced to half the amount to get a similar expansion. To verify that most of the MgO had hydrated after 90 days the not reacted MgO has been measured. It has been found that stored under water about 10% was not reacted. This range is on the safe side that no further expansion will cause cracks by expansion with time.

## Conclusion

Namex XA is an expansive additive based on magnesium oxide that is very effective in low addition levels. As it needs only 1 molecule of water it is rather less dependent on low w/c factors in mortars and concrete. It has a low hydration heat and can be used up to over 100°C giving expansion. Because of its reactivity, Namex XA must be stored in a dry place, if possible protected through a PE foil.

The free-flowing powder is easy to handle and it does not dust much with a particle size of 99% under 200µ. This guarantees an excellent dispersion in the cement matrix and a smooth surface of the hydraulic binder system.