EXILVA MICROFIBRILLATED CELLULOSE

A SUSTAINABLE CONCRETE VISCOSITY MODIFYING AGENT (VMA)

APPLICATION BULLETIN

Choosing the correct mix-design for a concrete is often complex and challenging. The right water to cement (w/c) ratio must be chosen as well as the quantity of other additives, such as superplasticizers (SPs) and viscosity modifying agents (VMAs). A low w/c ratio often gives a concrete with higher strength and durability at the expense of good flow properties.

Superplasticizers, such as poly-carboxylate ethers (PCEs) or lignosulfonates, help with increasing the flowability of the concrete mix-design at a low w/c ratio. However, using SPs can leave the concrete matrix susceptible to bleeding and segregation. To combat this VMAs are used to enhance the resistance to this segregation and bleeding by increasing the yield stress value of the concrete.

A higher yield stress value1 (the energy needed to give complete deformation of a concrete matrix) leads to a more stable and adhesive concrete, reducing the segregation and bleeding. Most VMAs are either oil-based polymers (hydrophobically modified ethylene oxide urethane), inorganic compounds (colloidal silica) or semi-synthetic biopolymers (cellulose ethers, starches and gums). The use of these VMAs also reduces the sustainability of the concrete mix-design. A fine balance of SP and VMA must be used in each concrete mix-design to get the right properties needed.

In this study, we demonstrate how Exilva increases the yield stress of a mortar. Testing was performed by using Exilva P 01-L as a VMA in a cement based mortar, with a SP. Testing a mortar will give a good indication of the type of properties to be expected in the corresponding concrete.

The mortars contained a 3:1 ratio of sand to cement. The SP used was PCE based and was dosed at 1 wt.% (as delivered) solids by weight of cement (sbwc). The Exilva P 01-L was dosed at 2.5 wt.% (as delivered) sbwc. The w/c ratios tested were 0.4 and 0.45. All mix-designs can be seen in Table 1 below.

TABLE 1. Mortar Mix-Design

COMPONENT	REFERENCE (g)	EXILVA P 01-L (g)	REFERENCE (g)	EXILVA P 01-L (g)
W/C	0.4	0.4	0.45	0.45
SAND 0/8	667	667	660	660
STD CEMENT CEM II	222	222	220	220
WATER	89	83,5	100	94,5
SP	22	22	20	20
EXILVA P 01-L	–	5,5	–	5,5
TOTAL (g)	**1 000**	**1 000**	**1 000**	**1 000**

[1] The rheology of each mortar was measured for yield stress with a rheometer, using the parameters set out in Ouattara, D., et al.2. The results for each mortars' yield stress are shown in Figure 1 (overleaf).

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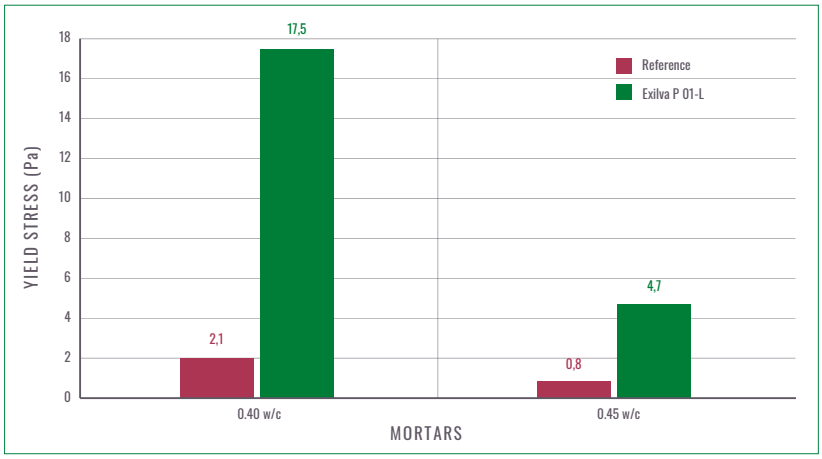

FIGURE 1. Yield Stress Values of the Mortars Tested

Addition of Exilva P 01-L into a cement mortar increases the yield stress values of the mortar dramatically, even with the presence of the SP. This will produce a corresponding concrete with less segregation and bleeding giving a more cohesive, uniform and workable matrix, as seen in the previous technical bulletin[3]. The increase in the w/c ratio, from 0.4 to 0.45, also shows the robustness of Exilva P 01-L at increasing the yield stress over varying w/c ratios. As generally known, an increase in yield stress will improve adhesion and stability onto the applied surface[2]. This has implications for application with pumping and spraying of concrete by reducing rebound loss, again increasing the sustainability of the concrete.

KEY POINTS

- Addition of Exilva P 01-L, with a PCE based SP, gives an increase in yield stress.
- Increase in Yield Stress – reduces the propensity for segregation and bleeding of concretes.
- Robustness of Exilva P 01-L – addition of Exilva P 01-L increases yield stress across different w/c ratios.
- Very efficient at low dosages – 2.5 wt.% sbwc.
- 100% natural and infinitely sustainable – can reduce the CO2 footprint in concrete by replacing oil-based or carbon intensive VMAs[3].

[1] Ouattara, D., Yahia, A., Mbonimpa, M., & Belem, T., 2017, Effects of superplasticizer on rheological properties of cemented paste back-fills. International Journal of Mineral Processing 161, 28-40. https://doi.org/10.1016/j.minpro.2017.02.003

[2] Leeman, A., Winnefeld, F., 2007, The effect of viscosity modifying agents on mortar and concrete. Cement & Concrete Composites 29, 341-349. doi:10.1016/j.cemconcomp.2007.01.004

[3] Exilva: A Multifunctional Concrete Additive

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