EXILVA® BY BORREGAARD

EXILVA CELLULOSE FIBRILS IN SELF-COMPACTING CONCRETE (SCC)

APPLICATION BULLETIN

Concrete products are complex mixtures of cement, water, chemicals, fines, and heavy particles. The biggest challenges are typically related to the control of stability, flow, placement, finishing and strength.

Bleeding and particle segregation are two significant challenges with fluid concrete (S3-S4/F4-F6). These issues are normally managed by adding fine particles, a filler, stabilizers or combinations of these. Viscosity modifying agents (VMA) like cellulose ethers, natural gums (xanthan, gellan) and starch are often used in concrete as stabilizers. They mainly act by increasing the paste viscosity thereby reducing the risks of bleeding and segregation.

WHY CAN EXILVA HELP YOU? – YIELD STRESS, WATER RETENTION AND SHEAR THINNING

By forming a non-soluble three-dimensional network, Exilva stabilizes the various particles, present in concrete, physically inside this network, preventing settling and enhancing the stability of the concrete at rest. The high hydrophilicity of Exilva ensures that water is bound strongly to the fibers, providing sufficient water retention to the concrete, without having any negative effect on the setting time. Exilva possesses extreme shear thinning properties, allowing you to pump and spray efficiently even with thick concrete mixtures. Exilva is highly tolerant and stable under a wide range of different conditions (temperature, pH 1-13 and shear), enabling you to create stable concrete mixtures for use in a high variety of geographical markets. Exilva provides constant performance regardless of the surrounding temperature (10-90 °C), even during hot summer months.

SELF-COMPACTING CONCRETE MIXTURES

The effect of Exilva to the bleeding, segregation and flow of SCC mixtures were studied. Exilva P 01-L was added as is and the amount of water in the mixtures was adjusted accordingly, taking into account the water present in Exilva P 01-L.

TABLE 1. Concrete mixes. [1] Water to cement ratio, [2] Liquid by weight of cement.

Gravel	Reference Amount (kg)	With Exilva P 01-L 0.75 % lbwc[2]. Amount (kg/m^3)	With Exilva P 01-L 1.50 % lbwc[2]. Amount (kg/m^3)
20/10	105	105	105
10/4	703	703	703
4/0	289	289	289
2/0	604	604	604
Std cement CEM II	376	376	376
Water	235	220	204
Exilva P 01-L	–	2.82	5.60
w/c[1]	0.63	0.63	0.63
PCE lbwc %	0.40	0.40	0.40

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EVALUATION

The performance of SCC mixtures were measured using the flow test. The setting time and strength were analyzed according to EN 123 and EN 456.

TABLE 2. Evaluation of SCC mixtures.

	Reference	With Exilva P 01-L 0.75 % lbwc	With Exilva P 01-L 1.50 % lbwc
Slump flow (mm)			
Initial	695	665	655
60 min	665	655	645
120 min	660	670	635
180 min	655	635	615
Time of spread (s)			
Initial	15	13	15
60 min	16	17	18
120 min	16	18	18
180 min	16	18	15
Setting time (h)	9.9	9.7	9.8
Strength (MPa)			
2 days	10.4	10.8	9.6
7 days	18.3	18.2	18.3
28 days	34.4	35.5	32.3

The following figures (1-3) demonstrate how Exilva P 01-L stabilizes concrete mixtures, compared to the reference mixture. An addition of 0.75% sbwc of Exilva P 01-L prevents segregation and bleeding without impacting the “time to flow”, which can, to some extent, be related to viscosity. Increasing the amount of Exilva P 01-L results in degrease in flow, but without having any effect to the setting time. In addition, Exilva P 01-L has no detrimental effect on workability retention on low dosage levels, contrary to silica fumes for instance, which are also frequently used to stabilize highly fluid mixes.

FIGURE 1. Reference concrete mix at initial spread.

FIGURE 2. Concrete mix with 0.75 % lbwc of Exilva at initial spread.

FIGURE 3. Concrete mix with 1.50 % lbwc of Exilva at initial spread.

SUMMARY

Exilva prevents effectively segregation, settling and bleeding of concrete. Exilva provides water retention without impacting set times nor strength development of concrete. Exilva also increases the workability of concrete, providing sag resistant, non-sticky and easily spreadable concrete mixtures. Exilva is delivered as a pre-activated product, meaning that no additional hydration steps are needed.

UNIQUE ADVANTAGES

- Rheology control – enhances yield stress, giving strong thickening and shear thinning
- Creates non-sticky and non-plastic concrete
- Versatile and robust – stable in extreme environments, including pH, temperature and shear
- Increases stability of end products
- 100% natural and infinitely sustainable – can reduce the CO2 footprint in concrete
- Very efficient at low dosage
- Odor free, clean and white

OTHER POTENTIAL APPLICATIONS

- Underwater concrete
- Sprayed concrete
- Sprayed micro-concrete and mortar
- Oil well cementing
- Bore piled concrete
- Grouting
- Mass concrete
- Non-sticky overhead (repair) concrete
- Cement skim coat
- Self-leveling underlayment
- Compacting aid for vibrated precast concrete

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