EXILVA THE NATURAL PERFORMANCE ENHANCER

TECHNICAL BULLETIN

COVER YOUR WIDE PH RANGE

PH STABILITY OF EXILVA CELLULOSE FIBRILS

Exilva is used as a rheology modifier and stabilizer in different kind of systems. Compared to other additives used for these purposes, Exilva has a unique advantage: it is stable in a wide range of pH. This enables Exilva to be used in a variety of products from low to high pH system, for example in detergents or alkaline adhesives, or in manufacturing processes where high or low pH is required.

STABLE VISCOSITY OVER TIME - AT VERY HIGH AND VERY LOW PH

The rheological properties of Exilva are based on the strong three dimensional network of cellulosic fibrils. The fibrils consist of cellulose which does not dissolve or degrade even under extreme pH conditions. The fibrils are mainly connected via physical entanglements which are not affected by changes in pH. These two factors make Exilva stable in alkaline, neutral and acidic conditions. The high stability of Exilva is illustrated in Figure 1 which shows the complex viscosity for 1 % Exilva suspension in water at high, close to neutral and low pH over time. The viscosity does not change during the 12 weeks' storage, showing that the fibrils as well as the network are intact.

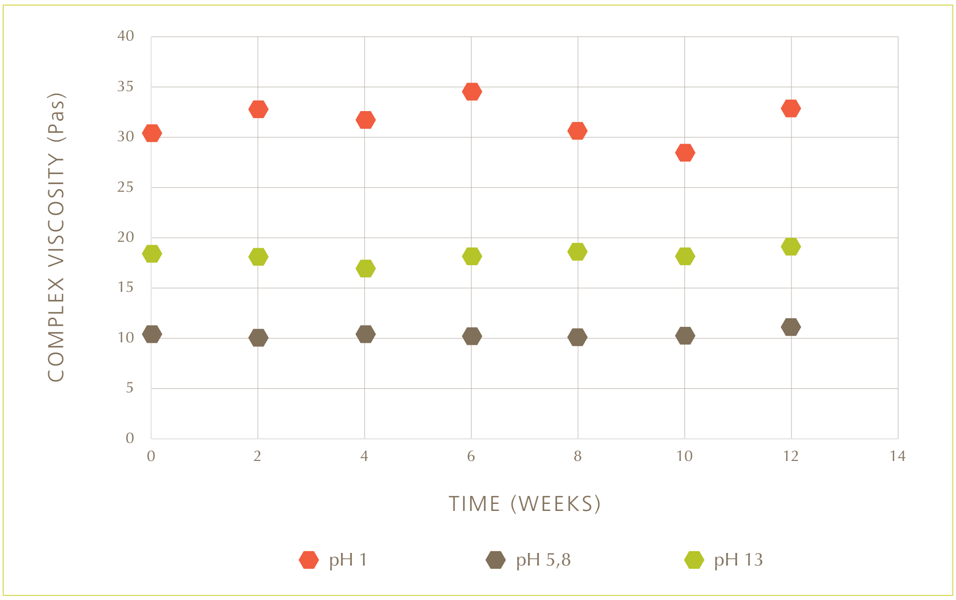

FIGURE 1: *Complex viscosity of 1% Exilva suspension in water at different pH.*

European project funded by the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation program under grant agreement N° 709746.

A product by Borregaard

ENHANCED NETWORK STABILITY AT HIGH AND LOW PH

Exilva is stable at different pH conditions but the network strength is dependent on pH. Exilva has slightly negatively charged surface which causes repulsion between the fibers. Even if the network of fibrils is mainly based on the physical entanglements, these surface charges contribute to the overall strength of the network. The charges are mainly due to occasional carboxyl groups on the fiber surface. Carboxylic groups are weak acids and the higher the pH, the more of them are dissociated and have negative charge. In addition, interactions of counter ions with the carboxyl groups will also influence on the surface charge. In addition, the hydroxyl groups on the cellulose dissociate at very high pH. This means that the surface charge of cellulose is dependent on the pH which in turn means that the repulsion between the fibers is also dependent on the pH.

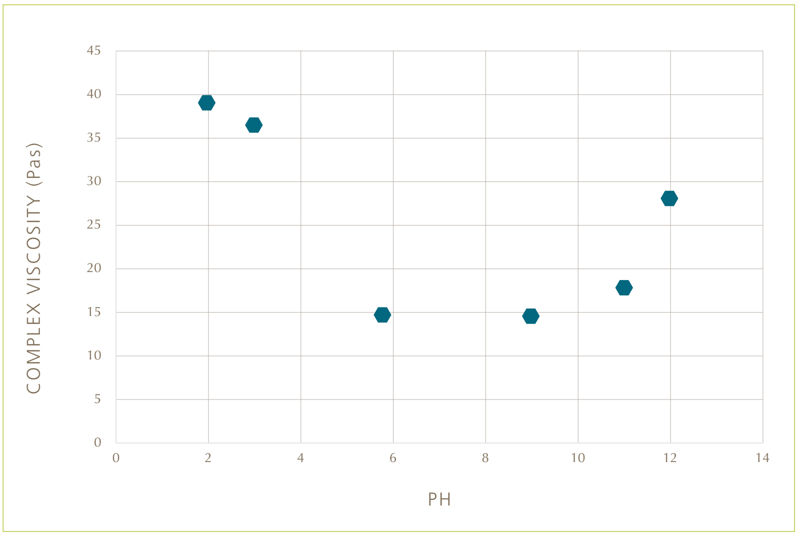

FIGURE 2: *Complex viscosity of Exilva 1% in water as a function of pH.*

Figure 2 shows viscosity of 1% Exilva suspension in water at different pH. If the pH is lowered or increased from neutral region (pH 5-10), the fibril network is strengthened due to the changes in the surface charge. Low pH leads to lower surface charge due to less dissociated carboxyl groups and high conductivity. This means that there is less repulsion between fibrils and more fibril-fibril interactions and stronger network. At higher pH, the carboxyl groups are fully charged and also the higher electrolyte concentration in the suspension contributes to the overall network strength.

EXPERIMENTAL DETAILS

EXPERIMENTAL:

Exilva samples were diluted with deionized water to 1% dry content and then adjusted to the desired pH with NaOH (22% or 2.5%) or HCl (37%, 10% or 2.5%). The complex viscosity was measured with a dynamic rotational rheometer (MCR 301, Anton Paar) using plate-plate geometry (50 mm diameter and serrated/sandblasted surface). The complex viscosity was extracted from the plateau value in an amplitude sweep using 1 Hz frequency.

CONCLUSIONS:

Exilva is stable rheology modifier which can be used both in high and low pH formulations.

The high pH stability enables Exilva to be used in even highly acidic or alkaline formulations.