ELEMENTIS

A global specialty chemicals company

Application Leaflet

Rheology modifiers for polychloroprene based adhesives

NiSAT and HASE based thickeners for optimized flow characteristics

Key Benefits

- Highly efficient
- Balanced sag and flow properties for good workability
- Highly stable

Introduction

Historically, polychloroprene was used as alternative to natural rubber. Therefore the majority of the currently available polychloroprene material manufactured is used in the rubber industry for applications such as molded goods, cables, conveyor belts. etc. Further material is used in the adhesive industry, for latex applications, rubber modifier, etc.

Adhesives based on aqueous polychloroprene emulsions are often used to produce contact adhesives for bonding of laminate, the automotive industry, shoe soles and many applications where strong and permanent bonding is required. Polychloroprene based adhesives provide good mechanical strength, excellent aging resistance, good resistance towards various chemicals and outstanding adhesion to various substrates.

Rheology modifiers for this kind of systems have to provide stable thickening to optimize the application properties by equalizing sag and leveling characteristics.

Properties	RHEOLATE® 1	RHEOLATE® 310 D	RHEOLATE® 125	RHEOLATE® 212
Composition	Proprietary acrylic emulsion in water	Polyether polyol solution	Proprietary acrylic dispersion in water	Polyether polyurethane resin solution in water
Appearance	Milky white emulsion	Clear to slightly hazy viscous liquid	Milky white	Translucent off-white to white liquid
Specfic gravity, [g/ml]	1.07	1.06	1.01	1.03
Brookfield viscosity, [mPas]	Max. 30 (at 60 rpm)	Max. 6000 (at 60 rpm)	Max. 20 (at 50 rpm)	Max. 6000 (at 20 rpm)
Non-volatile, [%]	30	32	25	20

Incorporation and levels of use

Both associative thickener grades, RHEOLATE® 212 and RHEOLATE® 310 D, can be used as supplied or, if necessary, further diluted with water. Addition can take place at any time during the manufacturing process but incorporation into the mill base before letdown is recommended.

Both acrylic thickener grades, RHEOLATE® 1 and RHEOLATE® 125, are recommended to be used as delivered. Alternatively it might be prediluted with water. Ideally, the products are added into the non-neutralized system after the millbase process. Afterwards, the pH of the system need to be shifted to a range of 8 - 9.

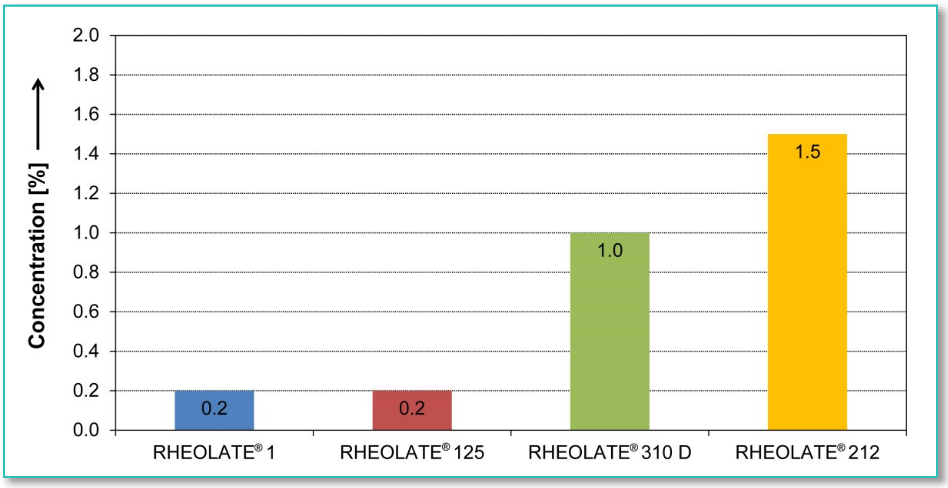
Due to their different characters and efficiency of all tested additives, it is important to assess the effectiveness in the relevant system, as performance might also be affected by other raw material ingredients. Further detailed background information on the technology of nonionic synthetic associative thickeners can be found in the Elementis RHEOLOGY HANDBOOK.

All mentioned rheology modifiers can be combined with each other to achieve the required performance of the individual end system.

Products tested

Figure 1: Efficiency - Concentration to achieve equal viscosity

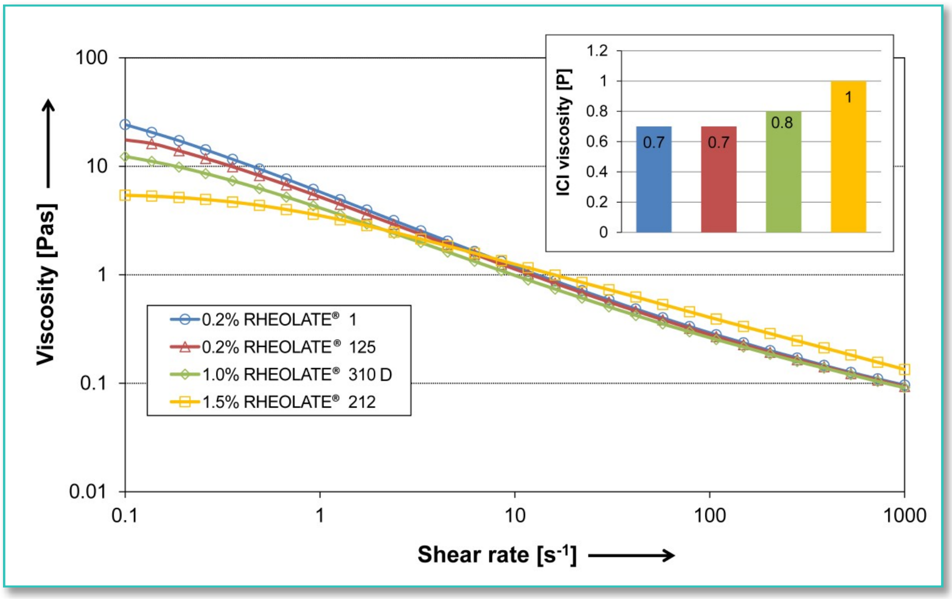
The figure 1 displays the concentration required to achieve equal Brookfield viscosity of 2000 mPas.



Both tested acrylic thickeners, RHEOLATE® 1 and RHEOLATE® 125 require by far the lowest loadings to achieve the required Brookfield viscosity. RHEOLATE® 212, providing Newtonian flow characteristics, needs the highest concentrations.

Figure 2: Rheological character

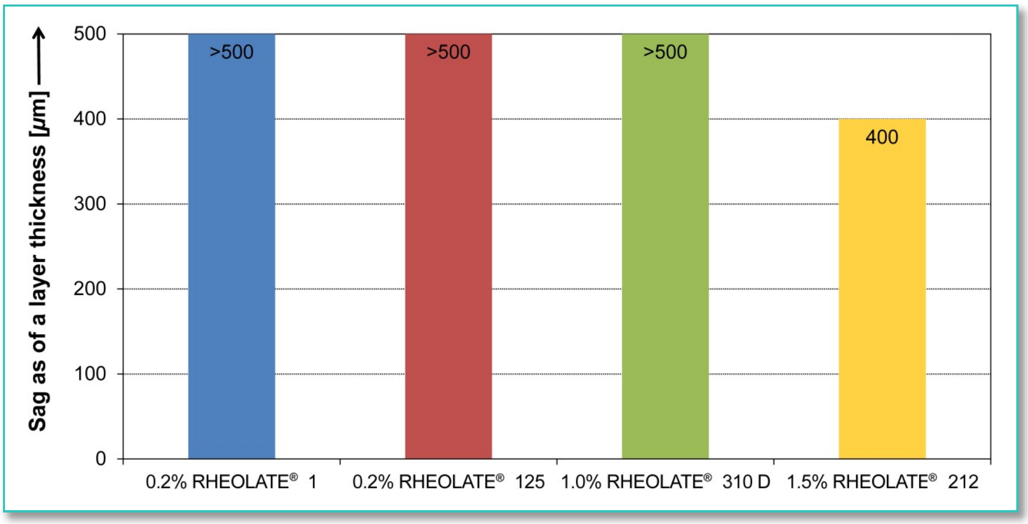
The figure 2 shows the flow characteristics of the aqueous polychloroprene based adhesive, equipped with the individually determined amount of thickener to achieve equal Brookfield viscosities. Parallel the high-shear viscosity at 10000 s^{-1} (ICI) is demonstrated and plotted in the small graph in the upper right corner.



RHEOLATE® 212 provides the highest viscosities at high-shear rates and the most Newtonian flow character. Both ASE grades, RHEOLATE® 1 and RHEOLATE® 125, act most shear thinning. The sample equipped with RHEOLATE® 310 D performs in between.

Figure 3 : Sag stability

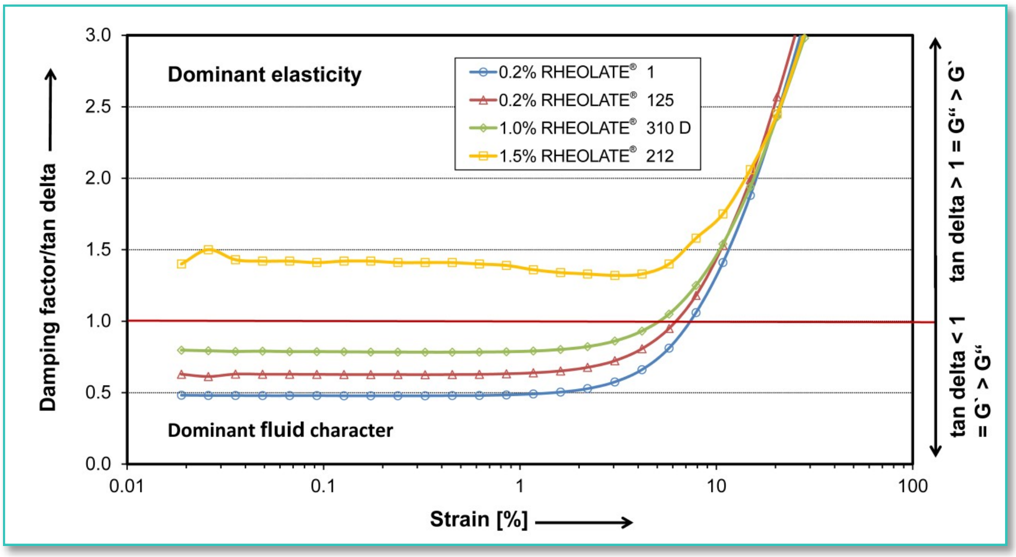
The figure 3 shows maximum applicable layer thickness without flowing off up on blade application. The larger the bar, the better the performance.



Samples formulated with both ASE grades, RHEOLATE® 1 and RHEOLATE® 125, as well as RHEOLATE® 310 D demonstrate the highest sag stabilities with applicable layer thickness of above 500 μm. The sample made with the Newtonian acting NiSAT grade RHEOLATE® 212 was stable up to a layer thickness of 400 μm.

Figure 4 : Viscoelasticity

The figure 4 shows the viscoelastic characteristics determined in an oscillatory amplitude test. Damping factor (tan delta) values of above 1 display dominate fluid characteristics. Values of below 1 indicate dominant elastic properties.



Samples formulated with both ASE grades, RHEOLATE® 1 and RHEOLATE® 125, display the highest elasticities. RHEOLATE® 310 D gave somewhat lower elastic properties. Only the use of RHEOLATE® 212 results in a shift to dominant fluid behavior at lower strain values.

Conclusion

Based on the results shown in this leaflet, the rheological additives presented are ideal options for an rheological optimization of aqueous polychloroprene based adhesives.

The ASE based products, RHEOLATE® 1 and RHEOLATE® 125 provide outstandingly high efficiency, excellent sag stability and a strong elastic character.

Both tested NiSAT grades perform differently compared to each other and the above mentioned ASE grades. RHEOLATE® 310 D imparts only slightly lower effectivity than the tested ASE additives. The use of RHEOLATE® 310 D resulted in slightly lower elasticities and equally good sag stability. Adhesives equipped with RHEOLATE® 212 behave most Newtonian and provide fluid like characteristics in the viscoelasticity test. This might result in optimized flow properties.

As a consequence of the above described differences, the mentioned ASE grades are recommended to be formulated in systems in case stronger sag stability and less leveling character is needed. NiSAT grades are typically selected if better flow character is required. These products are acting in this term usually beneficial which is also visible due to their decreasing effect on the elastic character in comparison to the ASE products.

Note: with none of the tested rheology modifiers, stability issues or flocculation was noticed!

Appendix

Test methods

- Brookfield viscosity was measured using the Brookfield DV-I viscometer, equipped with Spindle 6, at 10 rpm at a temperature of 23 °C.
- The rheograms and viscoelasticity/oscillation curves were determined using the Anton-Paar MCR 301 rheometer, equipped with measuring geometry PP 50, at a gap width of 1 mm and at a temperature of 23 °C.
- High-shear/ICI (at 10000 s^{-1}) viscosity was measured in accordance with the Elementis standard methods of testing, 24 hours after manufacturing the adhesives. The displayed values represent the viscosities at a shear rate of 10000 s^{-1}.
- Leveling was determined using test blade 419. The characteristics were judged visually on a scale from 0 to 10. The higher the mentioned number indicates better performance.
- Sag was tested using a test blade with applicable ayer thicknesses of 100 - 500 µm. The displayed values indicate the maximum applicable layer thickness without runners.

Abbreviations

- ASE is an abbreviation for “Alkali Swellable Emulsion”.
- NiSAT stands for “NonIonic Synthetic Associative Thickener”.

Test formulation

- Above described tests were performed in a commercially available aqueous polychloroprene based emulsion.

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