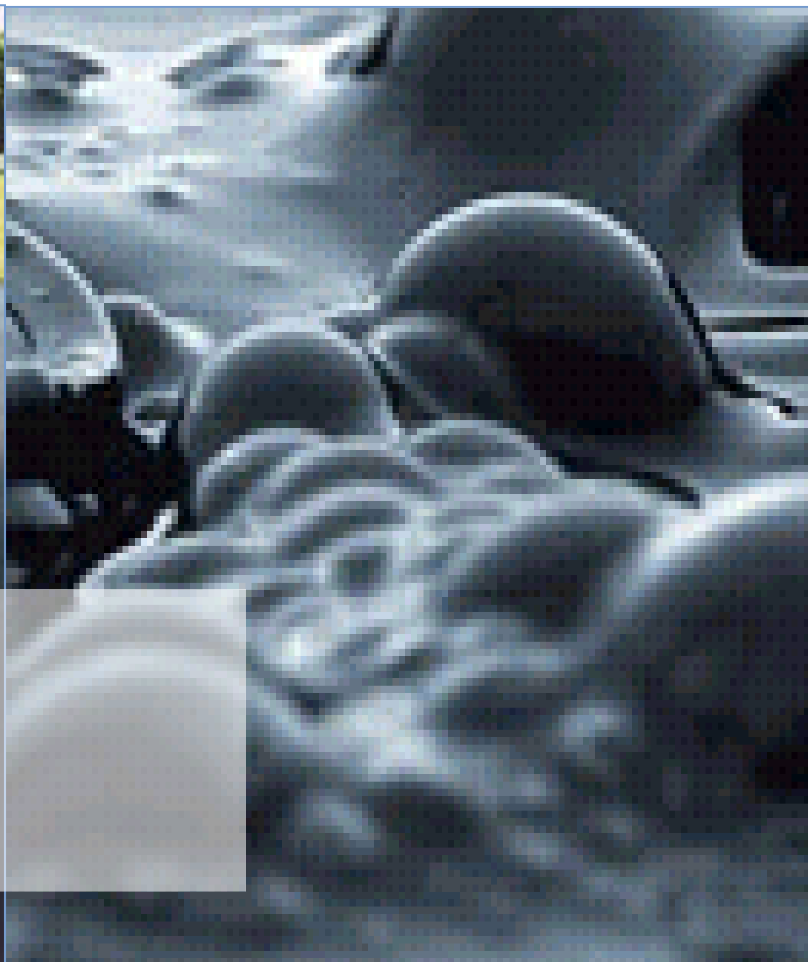
ELEMENTIS

A global specialty chemicals company

Application Leaflet

# BENTONE® organoclays

## Rheological stabilization of solvent based bitumen sealers



**Key Benefits**

- High low shear viscosity
- Éxcellent storage stability
- Optimized application properties

## Introduction

Solventborne bituminous systems are extensively used as waterproofing and sealing materials for buildings. Workability and sag resistance are important properties and can be controlled with the addition of rheological additives like BENTONE® 34, BENTONE® 54 and the super-dispersible grade BENTONE® SD-1.

Depending on the application the described system can be formulated as a sprayable system or as a brushable material.

## Benefits

- Optimized storage stability
- Elimination of sedimentation
- Optimized workability
- High low-shear viscosity

## BENTONE® organoclays

BENTONE organically modified clays are consisting of hydrophilic Bentonite and Hectorite clays which were converted into hydrophobically modified materials by utilizing ion exchange reaction with quaternary ammonium ions. These amine based compounds usually contain various organic groups in order to be compatible with the polarity of the individual end system. As a consequence, the selection of a suitable organoclay has to be aligned with the individually selected solvent composition used (*Figure 1*).

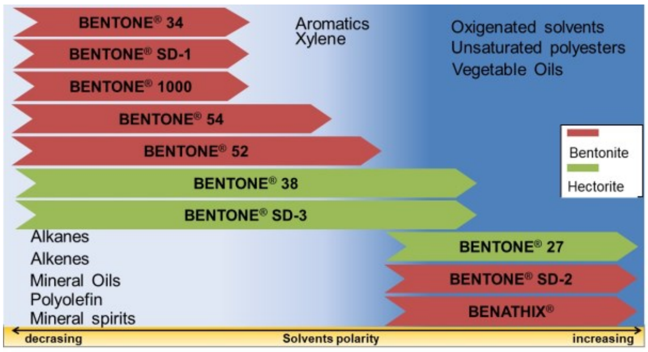



**Figure 1:** Organoclay selection chart

Although organoclays are hydrophobic, they often do require the use of a polar activator to disperse and exfoliate in organic solvent borne systems. Suitable polar compounds are small molecules such as acetone, ethanol (blended with water (95%/5%), propylene carbonate as well as proprietary surfactant blends such as DAPRO® FX 2060 or DAPRO® BEZ 75.

In addition to the described polar activation conventional organoclay often require so called pregelling. This means the manufacturing of of an intermediate concentrate in the proposed solvent.

BENTONE® SD grades are specifically engineered to function without polar activators. Also they do usually neither require pregelling or the use of a polar activator.

As mentioned already briefly, in order to obtain the full functionality of BENTONE® organoclays as rheological additives, a specific activation process out of dispersion and, in case of conventional grades pregelling alongside with polar activation, is required (*Figure 2*).

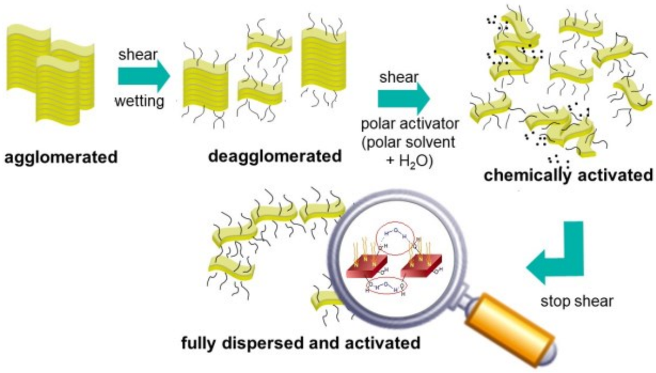



**Figure 1:** Organoclay activation

The organoclay should be mixed in the solvent or solvent/polymer blend to thouroughly wet out, then the polar activator is added. Polar activators such as propylene carbonate or an alcohol/water blend serve a dual function. Due to their chemical nature they will act as dispersant to help seperate the individual platelets from the stacks. They also carry in the molecular water needed to form the hydrogen bonded network. There are a number of proprietary activators which can also be used.

After proper activation, the delaminated, or exfoliated, organoclay platelets "connect" with each other through an edge-edge interaction as a 3D network will provides the viscosity build and the flow of the liquid system.

# Bituminous application

In the following case study, the function of organoclays in a solventbased bituminous sealer system will be describes exemplary by BENTONE® 34 and BENTONE® SD-1. Main goal of the study is to generate a stable viscosity on storage. Furthermore the thixotropic flow behaviour ensures excellent application properties.

All the compared samples have been adjusted to equal viscosities at a shear rate of 23 $s^{-1}$.

The flow characteristics are shown in the following *Figure 3* as a rheogram.

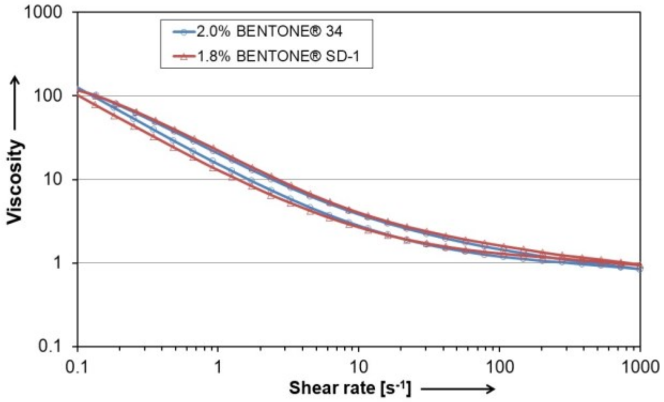



**Figure 3:** Rheology curves

Both grades, BENTONE® 34 and BENTONE® SD-1 provide similar high low shear viscosity and Thixotropy.

With respect to the used concentrations, small differecess have been noticed. BENTONE® SD-1 required slightly lower loadings in order to achieve aqual in-can viscosity. This has most probably been caused by the fact that in this case both tested organoclays, inclusind BENTONE® 34, were directly incorpoarted.  In this processing method the better dispersibility BENTONE® SD-1 could be utilized in terms of a higher efficiency.

Application in a vertical position by a line applicator (4 mm thick) displays excellent sag control with the samples equipped with the organoclays (*Figure 4*).

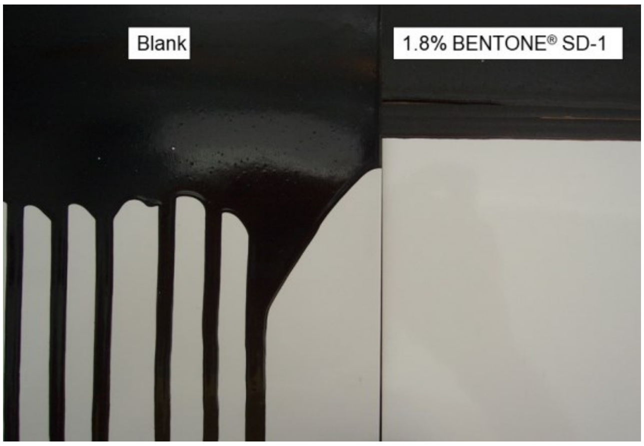



**Figure 4:** Sag stability

This is also the case with the storage stability visualized in *Figure 5*. The formulation of BENTONE® 34 and BENTONE® SD-1 prevent the system from settling.

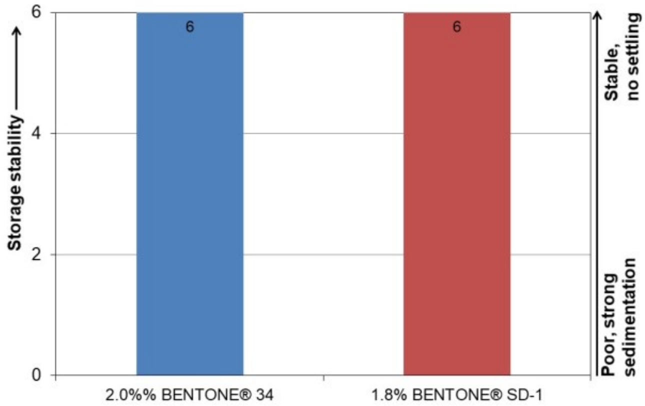



**Figure 4:** Storage stability

The below plotted data (*Figure 4*) show a flat slope of the curve at lower shear stress. In the upper shear stress range, the slope is running more steeply. In between, the flat and the steep part of the curve, a characteristic change of direction is noticed. This „kink“, is indicating the change in the flow characteristics. Whilst the flat curve indicates a  elastic dominated character, the steep part indicates fluid conditions by a strong increase of the deformation.

A determination of the changing characteristics is typically performed by two mathematic regression. The first is taken of the flat, and the second on the steep part of the graph. An elongation of both regression lines are displaying a cross point. This crossover point shows the the yield point value when read of the shear rate scale.

In general, the higher the values are on the strain (deformation) scale, the higher the degree of

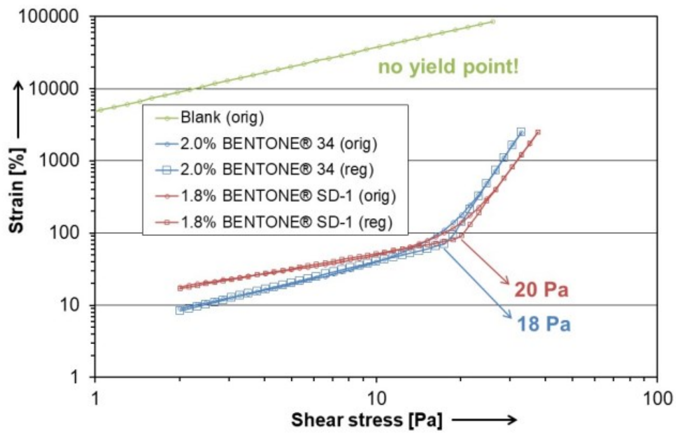



**Figure 4:** Rotational yield point measurement

With both organoclay grades, BENTONE® 34 and BENTONE® SD-1, very similar yield values of approximately 20 Pa could be detected.

A blank sample formulated without rheology módifier did not show any remarkable change of direction. This indicates that there is no yield value at all measureable. As soon as shear stress is applied, the system is flowing. This is also indicated by the much higher values on the strain scale. This results goes in line with the sag control result (*Figure 4*)

In terms of the workability (Figure 7) also excellent results are shown with the bitunious systems equipped with BENTONE® 34 and BENTONE® SD-1. Both samples displayed excellent brushability.

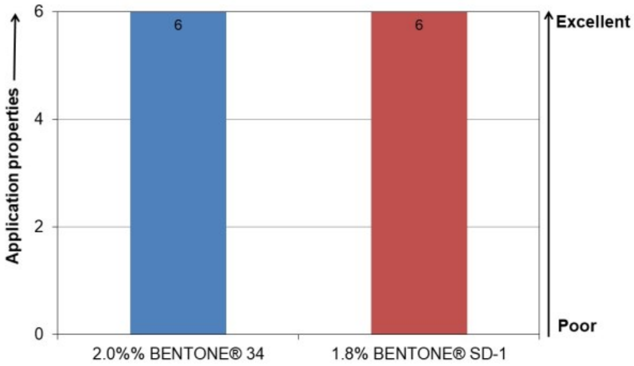



**Figure 7:** Workability

# Conclusion

In this system equipped with BENTONE® SD-1 and BENTONE® 34 display equally high low-shear viscosity, excellent sag and storage control as well as superb brushability.

As BENTONE®SD-1 has been designed as a super-dispersible and self-activating organoclay.The better dispersibility, provides a slightly better effectivity than with BENTONE® 34.

A further suitable organoclay for such systems is BENTONE® 54.

However, in general the selection of suitable organoclay grades need to be done in accordance with the solvent composition and its polarity of the proposed system!


# Appendix

## Test formulation

| Compound | Concentration [%] |
|---|---|
| Bitumen base (62.8% solid) | 63.69 |
| Ardonit Slate dust, max 90 µm | 30.00 |
| Rheological additive | X |
| White spirit K 30 | 6.31 |
| Total | 100.0 |

## Preparation

- Samples were prepared using a lab dissolver
- Organoclays were introduced directly
- Ethanol/water (90%/10%) was used as polar activator for BENTONE® 34
- All samples adjusted to equal viscosity at 23 $s^{-1}$

## Test methods:

**Rheology data**

Viscosity was measured with the Physica MCR 301 rheometer, measuring system CC 37 (beaker/ spindle), at a temperature of 23°C.

**Sag control**

Sag has been measured as the lebgth of the runners after application by a line applicator (4 mm layer thickness).

**Storage stability**

Judged subjectively after 2 weeks storage at ambient condions.

**Yield point**

Yield value was measured with Physica MCR 301, measuring geometry PP 50 (plate/plate; 1 mm gap distance), at a temperature of 23°C. Shear stress was increased over approximately 2 minutes from 0 Pa up to 100000 Pa. Calculation of the yield point was performed using the tangent crossover method. The first tangent was set in the curve interval (flat) of the elastic deformation range with the low shear stress. The second tangent was in the measuring curve at high shear stress (steep). In case the sample flows, this tangent showed higher slope increase than the first tangent. The yield point was taken at the tangent crossover point.

**Application properties**

Evaluated subjectively after application by brush on Leneta charts.

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