

BENTONE[®] organoclays

Is pregelling a suitable quality test?



Introduction

Organoclays are used as rheological additives for non-aqueous application for a long time. These product class providing excellent low shear viscosity build and excellent anti-sedimentation stability alongside with good levelling properties of the final system. However, as organoclays require appropriate handling and activation, consuming industries and organoclay manufacturers are requiring suitable methods to screen the performance, e.g. in quality control and incoming goods inspection. Also in performance comparison of various organoclays this way of testing is often used.

In the majority of the cases a pregel viscosity test is utilized. In such the relevant organoclay will be dispersed into the proposed solvent and activated. The viscosity of such pregel is then taken as an indicator for the performance to provide a certain gel strength.

However, experience has shown that the results of the pregel testing is often inaccurate.

Pregel testing

Pregels of organoclays, often called concentrates or intermediates, are recommended to ensure proper wetting and solvation as well as to allow the solvent to permeate into the clay structure. This step is especially recommended for conventional organoclays and, in exceptions for super-dispersible grades of the BENTONE® SD series, in order to achieve the optimum performance and effectivity of the product. The efficiency benefits strongly and ensures optimum performance in system providing low solvation such as high solids. Otherwise interferences as encapsulations of the dry powder are possible.

To prepare a pregel, the organoclay is dispersed in the solvent at a concentration range from 8-10%. After 10-15 minutes of dispersion at high shear of 16-18 m/s by for instance a tooth bladed/cowls dissolver, the polar activator, e.g. a blend of ethanol and water, will be added. After further dispersion the gel is readily prepared. After a certain maturing time the viscosity of the gel is measured.

To illustrate the importance of proper solvation and wetting of the organoclay, BENTONE® 34 was taken as an example. Two different lots of BENTONE® 34 were therefore dispersed at two different shear forces, 8 m/s and 16 m/s, at a concentration of 9.1% into an aliphatic hydrocarbon based solvent. Propylene carbonate was in all cases used as a polar activator.

As visible in *Figure 1*, the resulting pregels of both lots are differing strongly in the viscosity.

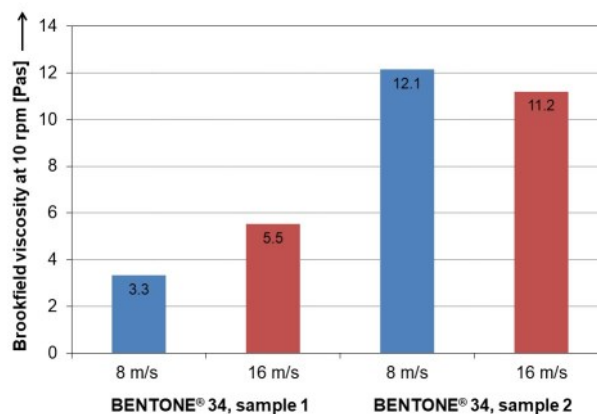


Figure 1: Pregel concentrate test

Based on the Brookfield viscosities shown it might be concluded that sample 1 performs inferior in comparison to sample 2. This difference is especially visible when manufactured at the low shear of 8 m/s. BENTONE® 34 sample 1 did not even provide the gel strength of sample 2 when processed at the highest tip speed of 16 m/s.

Pregel addition to paint

However, as visualized in *Figure 2*, all organoclay pregel samples provide very similar Brookfield viscosities in an alkyd based paint after incorporation into the millbase.

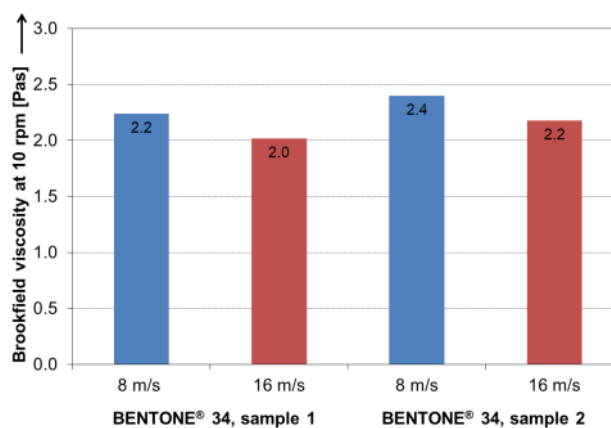


Figure 2: Brookfield viscosity alkyd paint

Also a comparison of the sagging stability of the paints after blade application are showing an equal picture as it can be seen in *Figure 3*.

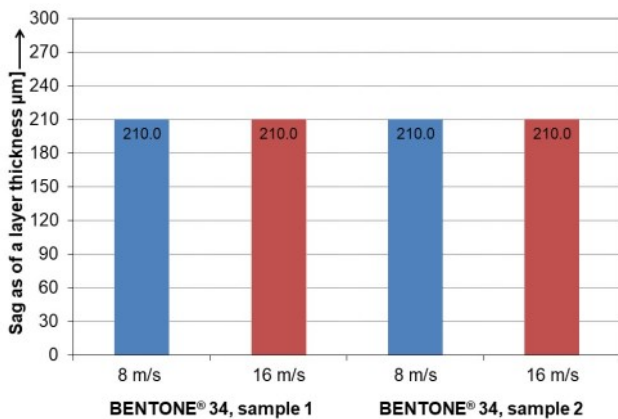


Figure 3: Sag stability of alkyd paint

Based on the results shown it appears unlikely that the pregels viscosity is providing an accurate assessment of the organoclay quality when compared to the performance in the final system.

Although the BENTONE® 34 samples have been processed identical, their gelling capability in the same solvent was significantly different.

Efficient development of an organoclay as a pregel by high speed dispersing in a pure solvent system is not possible. For proper gel development, proper flow and high friction generated by a high pigment and/or extender concentration in the grind stage is needed. In a pregel, the particle density is not high enough to provide the required shear rates in order to disperse all of the organoclay. In case of lower shear dispersing, e.g. devices as such as propeller mixer are used to prepare the pregel, the predictability of the organoclays performance by pregel viscosity would be even worse.

This is the reason that the pregel addition to the millbase of processing is recommended rather than using as a post-add.

If the application requires post-addition of the rheology modifier, the alternative use of the preactivated organoclay gels BENTONE® P 380 MS and BENTONE® P 270 CO is recommended.

Pregel particle size

As the dispersion of organoclays strongly depends on the applied shear forces, the utilized equipment also has got a strong influence on the resulting particle size. This was examined in the following by Scanning Electron Micrographs (SEM) of individually prepared BENTONE® 34 pregels at a concentration of 10% aliphatic hydrocarbon based solvent. The pregels have been manufactured by different dispersing/mixing aggregates. The photographs illustrate various levels of pregel development viewed at 3000x magnification.

The white bar below each image indicates 10 µm of length and will give a reference to the particle measurement. In *Figure 4* the particles of a pregels manufactured by a propeller mixer at 1500 rpm is shown.

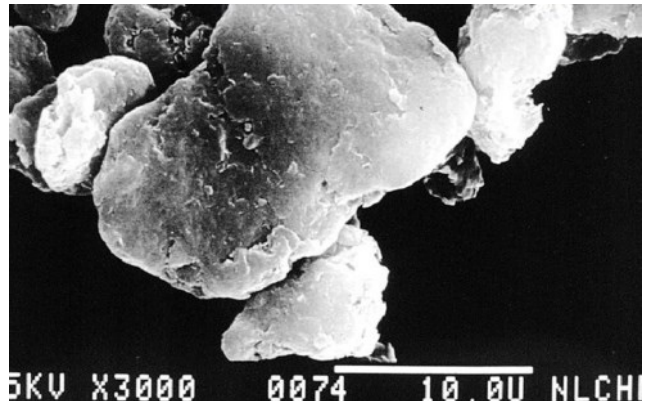


Figure 4: SEM after propeller mixing

It is visible that by propeller mixing practically no delamination of the organoclay platelet structure is the result. The particle size measured by grindometer in this case was in a range of ~20 µm.

In case a high speed tooth bladed/cowls dissolver has been used, the resulting particle size is significantly smaller as visualized in *Figure 5*.

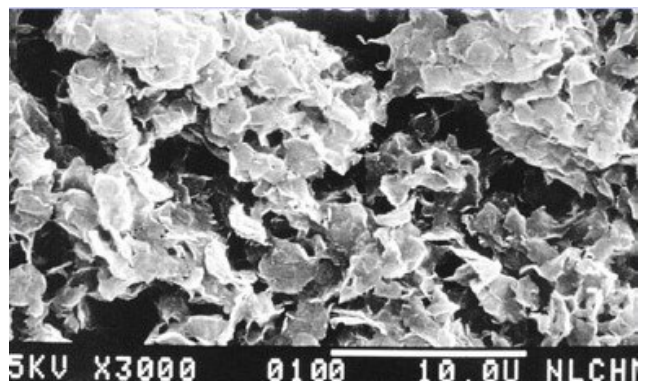


Figure 5: SEM high speed disperser activation

This type of equipment is able to produce tip speed values of up to 20 m/s. A noticeable gel development of the organoclay can be generated by the many thin platelets being separated, or as it is also called delaminated, from larger original particles as previously seen in *Figure 4*.

However, depending on the solvent or the type of polar activator, the resulting pregel viscosity might show variations.

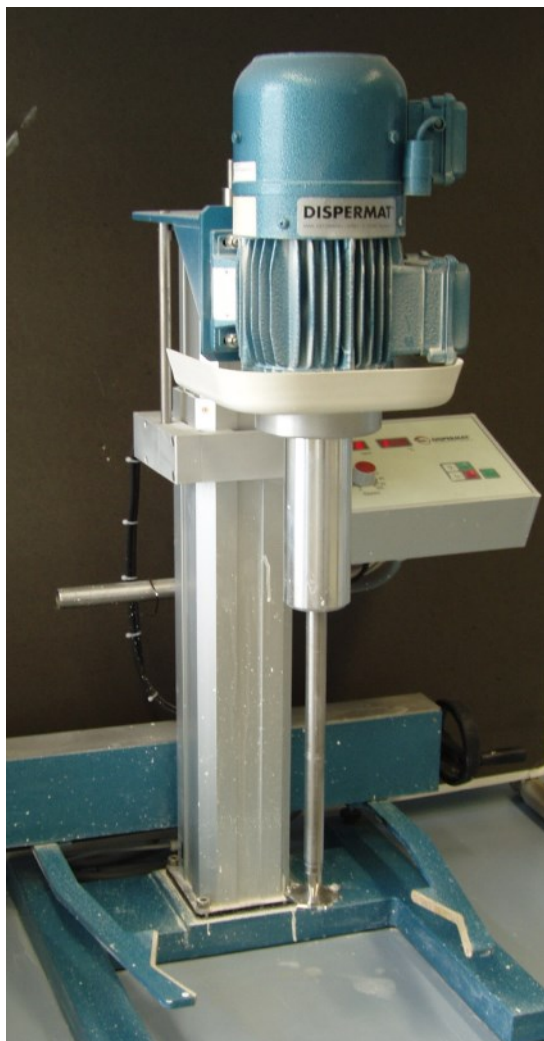
Conclusion

Comparing the shown data makes the strong dependency of the delamination and activation from the provided shear obvious.

Low shear equipment alone is not suitable to be used as main equipment to achieve proper activation. By using such, inappropriate delamination, visible as larger particles in a grindometer draw-down, alongside with to low viscosity development is the result.

By using high shear dispersing equipment, such as cowles and tooth bladed dissolvers the dispersing result in the pregels stage is significantly better. However, as the resulting viscosity of a pure pregel in the pure solvent displays strong viscosity variations. Consequently, solvent pregels exhibit inconclusive data when used as a predictor of BENTONE[®] organoclays quality and how it will behave in a final system.

Rather than utilizing a pregel test to determine quality and effectivity of an organoclay, it is indicated that testing in a final system, e.g. a paint, is providing more reliable and representative data.



BENTONE[®] overview

Organoclay based on	
Hectorite	Bentonite
BENTONE [®] 38	BENTONE [®] 34
BENTONE [®] 27	BENTONE [®] 52
BENTONE [®] SD-3	BENTONE [®] 54
	BENTONE [®] 1000
	BENTONE [®] SD-1
	BENTONE [®] SD-2
	BENATHIX [®]

Table 1: Overview available organoclay grades

NOTE: The information herein is currently believed to be accurate. We do not guarantee its accuracy. Purchasers shall not rely on statements herein when purchasing any products. Purchasers should make their own investigations to determine if such products are suitable for a particular use. The products discussed are sold without warranty, express or implied, including a warranty of merchantability and fitness for use. Purchasers will be subject to a separate agreement which will not incorporate this document.

© Copyright 2020, Elementis, Inc. All rights reserved. Copying and/or downloading of this document or information therein for republication is not allowed unless prior written agreement is obtained from Elementis, Inc.

® Registered trademark of Elementis, Inc.

North America

Elementis
469 Old Trenton Road
East Windsor,
NJ 08512, USA
Tel:+1 609 443 2500
Fax:+1 609 443 2422

Europe

Elementis UK Ltd.
c/o Elementis GmbH
Stolberger Strasse 370
50933 Cologne, Germany
Tel:+49 221 2923 2066
Fax:+49 221 2923 2011

Asia

Deuchem (Shanghai) Chemical Co., Ltd.
99, Lianyang Road
Songjiang Industrial Zone
Shanghai, China 201613
Tel:+86 21 5774 0348
Fax:+86 21 5774 3563