

# ChemBrief



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## Optiflo® TVS mechanisms behind reduced viscosity loss upon colorant addition

Southern Clay Products, Inc. introduces Optiflo® TVS, Tinted Viscosity Stabilizer, the latest generation of its patented nonionic associative thickener line. TVS is designed for use in deep to neutral based systems. Nonionic associative thickeners have found only limited use in these systems despite the advantages of near alkyd like rheology, improved application and film properties, and improved flow and leveling. TVS addresses the main problem experienced with the use of other nonionic associative thickeners in these systems - severe viscosity loss when colorants are added. This loss is most pronounced when 8 to 16 ounces per gallon of colorant are added using universal tint pastes.

Unlike cellulosics which are aqueous phase thickeners, and HASE thickeners which function by both aqueous phase thickening and hydrophobic association, nonionic associative thickeners achieve their rheological performance almost exclusively through associative interactions between the thickener and other hydrophobic solids dispersed throughout the system. This article discusses the mechanisms by which Optiflo® TVS performs.

### Nonionic Associative Thickeners How they work

*Nonionic associate thickeners have short chains with surfactant like hydrophobes that "associate" with themselves and other hydrophobic solids dispersed throughout the system*

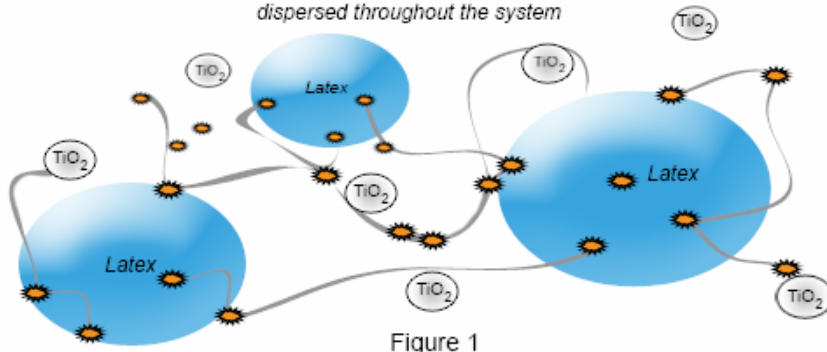


Figure 1 illustrates how the associative mechanisms enable low molecular weight polymers to perform similarly to higher molecular weight cellulose and HASE thickeners in building viscosity. The

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short-chained thickener backbone has hydrophobes which associate with the latex to yield an extended network. This network of linked associative thickener “bridges” acts like other higher molecular weight thickeners in the water phase. The difference is the hydrophobic associative thickener “bridges” can be easily broken when large amounts of surfactant and glycol containing colorants are introduced. Optiflo® TVS enhances stability because it better maintains the integrity of the network after heavy doses of colorant are added.

### Formulating Methodologies

High levels of solvents and surfactants, accompanying the pigment dispersions in colorants, disrupt the mechanisms by which associative thickeners function and often lead to unacceptable rheological and application performances.

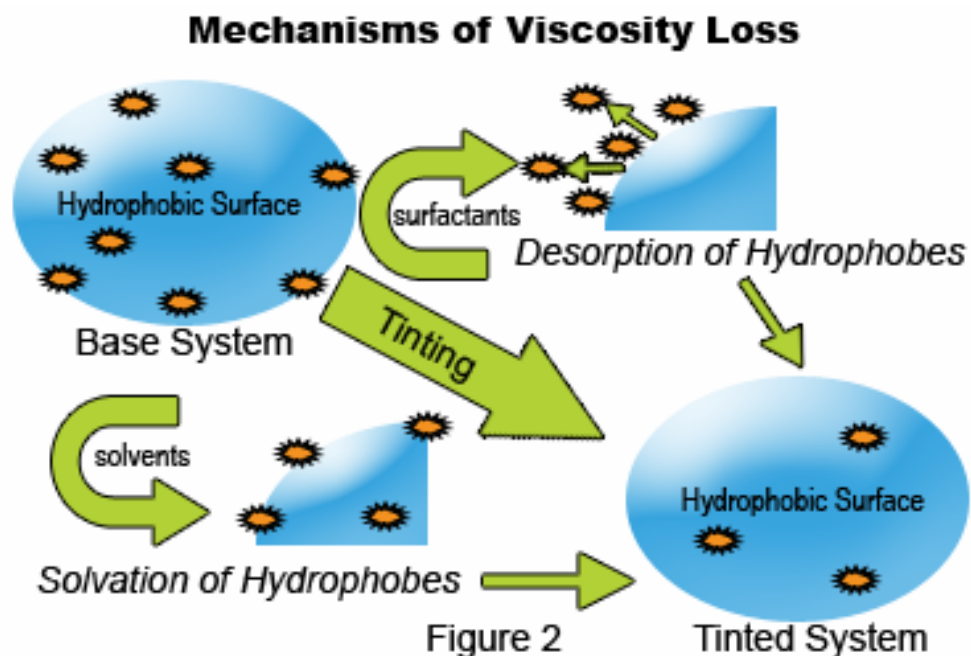


Figure 2

Tinted System

Figure 2 illustrates how tinting disrupts an established associative network by reducing the numbers of associative interactions and ultimately reducing viscosity. In the past cellulose and/or HASE based thickeners were used as the rheology modifiers of choice in these deep to neutral base systems. Their ability to maintain viscosity is the primary reason for their widespread use; however, the formulator often had to deal with the disadvantages associated with each product class. Cellulose based thickeners offer excellent stability and color acceptance but suffer from poor flow and leveling, along with processing and handling concerns. HASE based thickeners offer a better balance of rheological properties but introduce problems with stability and incorporation, as well as pH and water sensitivity. This limits their widespread use in high humidity and exterior applications.

Determined to take advantage of the benefits offered by nonionic associative thickeners, formulators learned to deal with these shortcomings in deep and neutral base systems using a variety of methods. Frequently these systems were designed with excessive base viscosities (130-140KU) so that the tinted systems would be acceptable after the extreme drop in viscosity. In some cases drops of 35 KU or more have been documented with as little as 5 ounces of colorant. KU viscosity losses as high as 45 KU are common in many deep and neutral base systems thickened with nonionic associative thickeners. In many of these systems, simply replacing the KU developing thickeners with Optiflo® TVS has reduced the viscosity drop to less than 10 KU.

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By design TVS is more resistant to attacks on its associative network and thus retains more of its initial viscosity in post-tint systems. It provides formulators many distinct advantages over traditional nonionic associative thickeners due to its ability to maintain viscosity, particularly in the low to mid-shear viscosity ranges. Figures 3 and 4 illustrate the impact that TVS can have on nonionic thickener based systems. Each contains equal amounts of an ICI generator similar in performance to Optiflo® L100. The HEUR based system is comprised of two KU builders used at levels totaling 7.0 wet pounds/100 gallons. In the TVS based system both KU generators were replaced with TVS at a use level of 6.0 wet pounds/100 gallons.

In Figure 3 each system is formulated to yield similar base viscosities in each respective shear region: low, mid, and high. Low shear is defined as being in the viscosity region near 0.1 s<sup>-1</sup>. Viscosity measurements in this region are good predictors of flow and leveling, as well as sag resistance. Mid-range or apparent viscosity is typically measured using the Stormer Viscometer which relates to the in-can appearance of the paint. High shear is typically measured using cone and plate viscometers.

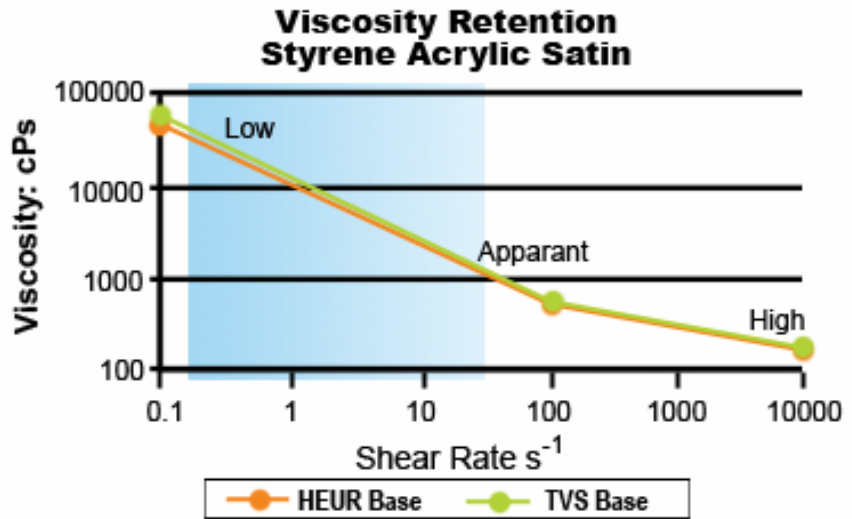


Figure 3

Figure 4 clearly indicates how the low shear and KU viscosities of the HEUR system is adversely affected by the addition of 12 oz of colorant. The tinted Optiflo® TVS system yields viscosities very near those of the un-tinted HEUR base. The resulting flow/sag balance would be considerably better for the TVS based system. The ability to effectively control or eliminate such dramatic viscosity drifts, and yet still give all other advantages of nonionic associative thickeners, is what gives TVS its value-added performance.

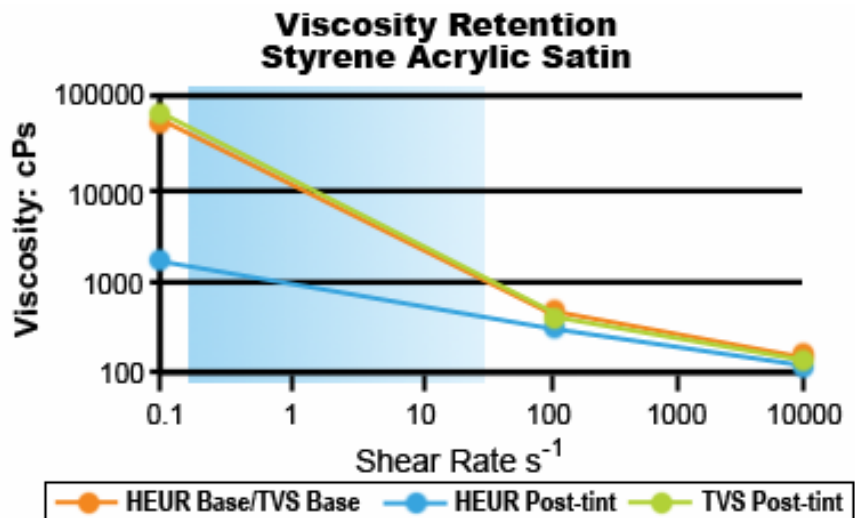


Figure 4

### Formulating Guidelines

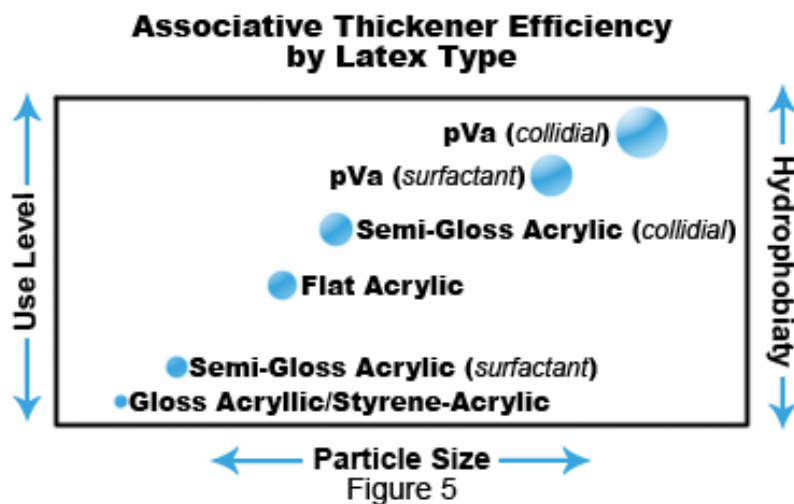
Optiflo® TVS is a unique product that offers a multitude of potential advantages to the formulator. As with any additive, laboratory evaluations should

be performed in order to determine the optimum conditions of use. By its very nature TVS is an aggressive low shear viscosity and a moderate apparent viscosity generator. Its use level in formulation



should be determined by the level required to give the balance of rheological, application, and performance properties that the formulator desires. Like all associative thickeners, the performance efficiency of TVS is greatly affected by the resin system with which it is used. Use levels will be less in small particle sized acrylics and styrene-acrylics, with levels increasing as one moves away from these types of systems. Resin stabilization (surfactant, colloidal, or covalently bound surfactant) and hydrophobicity also affect thickener efficiency and thus have an affect on overall thickener use level.

Figure 5 illustrates conceptually how the resin type affects associative thickener use levels. Opportunities for synergism do exist. Optiflo® TVS can be used as either the primary KU developer or in conjunction with other commercially available rheology modifiers, giving the formulator the ability to achieve the balance of properties they desire. TVS can be used to augment the performance of existing systems, often at very low use levels. In most acrylic/styrene-acrylic based systems, use levels of 1 to 5 wet pounds should provide sufficient viscosity control. Higher tint levels may be possible, requiring increased TVS use. Use levels in vinyl-



acrylics and other resin systems may be on the order of 10 –15 wet pounds/100 gallons.

#### Some additional formulating suggestions:

- Ladder studies are encouraged to help determine the appropriate use level. This is true whether one is developing the system around Optiflo® TVS or adding TVS to improve the performance of an existing system.
- Incorporation of TVS should take place as early in the manufacturing process as possible. This can have positive effects on product efficiency, but is recommended primarily to improve the thermal stability of the system.
- Reductions of co-solvents such as DPnB, DPM, Butyl Carbitol, etc also improve the viscosity retention of systems that contain TVS.
- The formulator should determine critical performance parameters desired, and evaluate the systems based on those parameters and not solely by viscosity results. Because Optiflo® TVS generates a distinctive sag/flow balance, acceptable sag resistance is often achieved at lower KU viscosities. Formulate to achieve a good balance of properties that include physical, rheological, and application considerations. Do not eliminate a potentially viable formula based on the viscosity results in any single shear region.
- Optiflo® TVS has shown very good compatibility with a broad range of dispersants, but displays the best overall compatibility with the more hydrophobic dispersants and, in particular, with dispersants neutralized with ammonia or amines.
- Optiflo® TVS has shown good compatibility with the most commonly used surfactants, although adjustments to usage levels may be required to achieve optimum performance. In general, usage levels of TVS with acrylic/styrene-acrylic systems will be lower than with other latex types.

For more information on how Southern Clay Products can assist you, please contact us at (800) 324-2891 or visit us on the internet at [www.scprod.com](http://www.scprod.com).



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