BYK
Additives & Instruments

Substance for Success.

Technical Information PVC-TI 1

Viscosity Depressants

PVC Plastisol Applications

A member of ALTANA

Viscosity Depressants

Content

Why Viscosity Depressants?

It is important to adjust the viscosity for each type of manufacturing process. This ensures consistent processing and high product quality.
Viscosity (η) is the key factor in describing flow behavior. In most plastisol systems, viscosity is not a constant.
It depends on a variety of parameters. To a great extent, it determines the usability and user-friendliness of the PVC plastisol.

The three most important factors encountered in PVC plastisol formulating are:
1. Raw material properties
2. Temperature parameters
3. Rheology factors.
Rheology is the interrelationship between viscosity and shear forces, which can be very complex.

The most important rheological parameter from the application standpoint is the mechanical stress the liquid system is exposed to.

Shear Rate Calculation Example

$$\text{Shear rate} = \frac{\text{Line speed x Conversion factor}}{\text{Coating gap}}$$

Speed	25 m/min	82 ft/min
Coating gap	0.1 mm	2.5 mils
Conversion factor	~ 16.7	~ 127
Shear rate =	$\frac{25 \times 16.7}{0.1}$	$\frac{82 \times 127}{2.5}$
	~ 4170 s^{-1}	~ 4170 s^{-1}

figure 1

VISCOBYK-4000 Series
are unique viscosity depressants that have application in most plastisol formulations. They provide maximum raw material, formulation and application flexibility.

Typical Shear Ranges

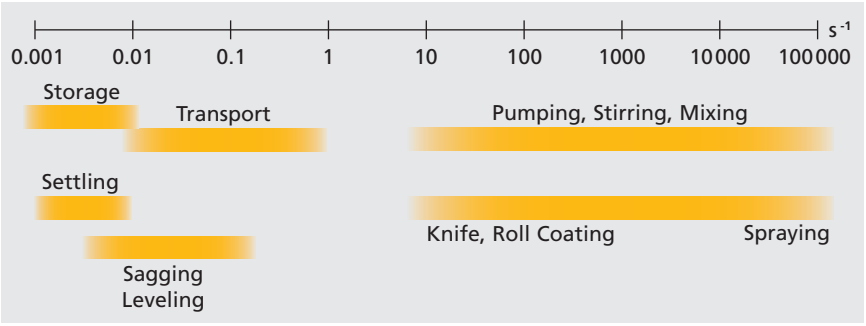
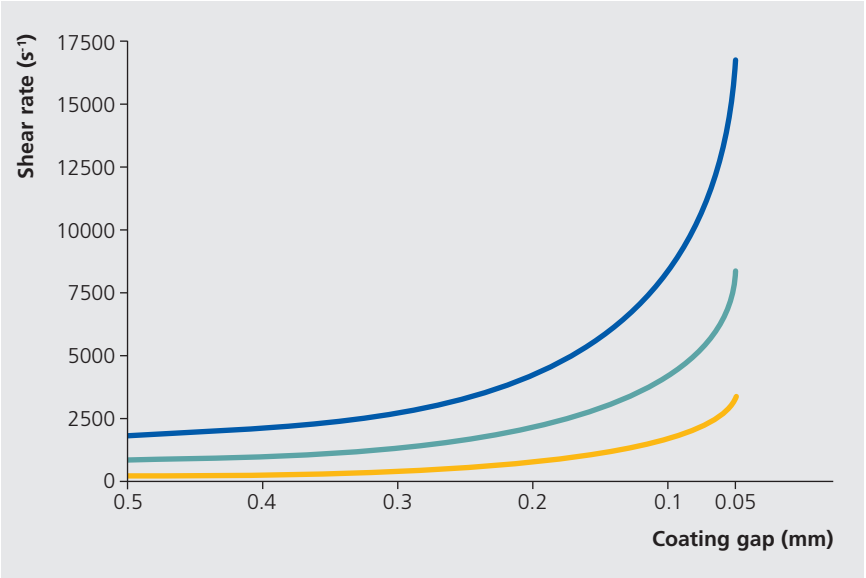


figure 2

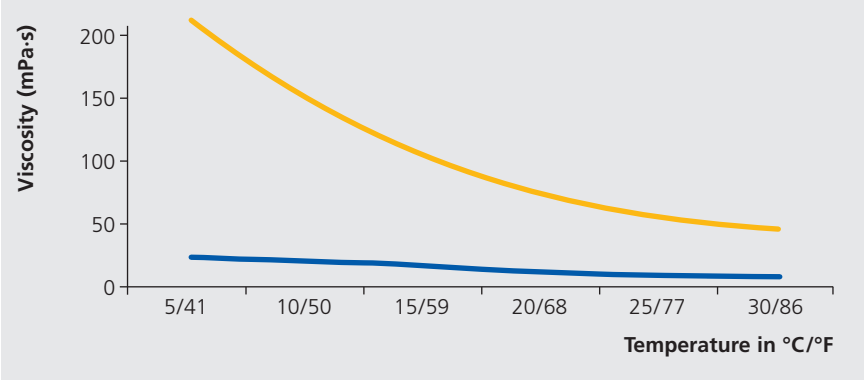
Shear Rate Dependent on Coating Gap



Line speed (m/min) 10 25 50

figure 3

VISCOBYK Product Viscosity Independent from Temperature



VISCOBYK Primary plasticizer

figure 4

Plastisol Without VISCOBYK

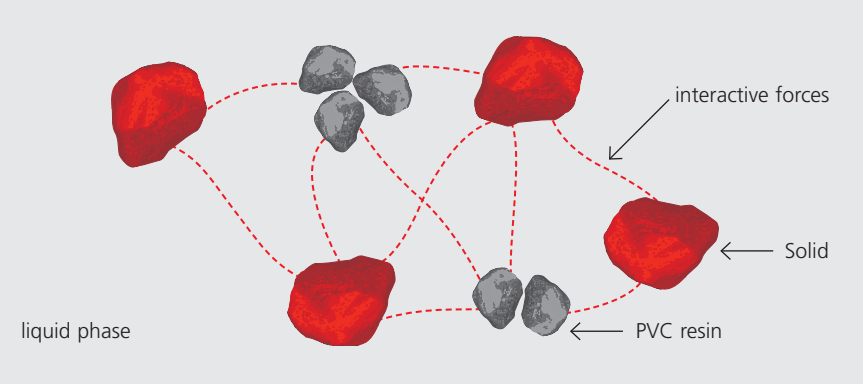


figure 5

Plastisol With VISCOBYK

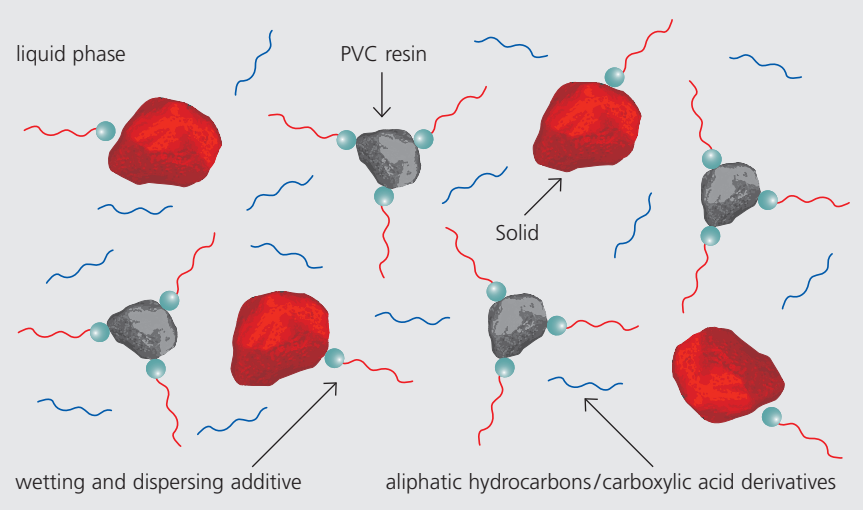


figure 6

Volatility Behavior

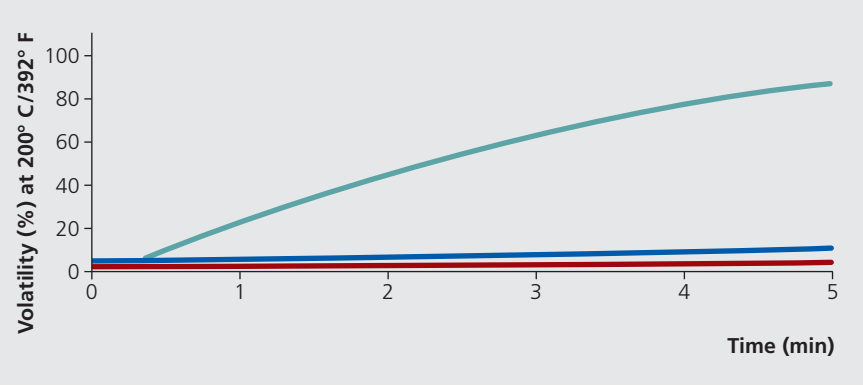


figure 7

- Conventional viscosity depressants and secondary plasticizers
- VISCOBYK-5000 series
- Primary plasticizer

How does VISCOBYK work?

VISCOBYK Viscosity Depressants work in two steps:

1. The mixtures of aliphatic hydrocarbons or carboxylic derivatives are specially developed to reduce the viscosity in the liquid phase of the PVC plastisol.

2. The special wetting and dispersing components adsorb onto the particle surfaces, reducing the interactive forces between them preventing reagglomeration.
VISCOBYK viscosity depressants allow for easier movement of the particles. This stabilizes the viscosity and storage behavior of the whole system (figure 6).

Note:
For increased flow improvement of highly filled plastisols, we recommend a combination of VISCOBYK and DISPERPLAST additives.
This includes PVC plastisols that are used for fiber impregnation.

Product Volatility

Additives of the VISCOBYK-5000 series are low volatile viscosity depressants. During production the process emissions are reduced significantly compared to conventional viscosity depressants (figure 7).

These additives perform similarly to primary plasticizers in regards to their low volatility. This is in sharp contrast to secondary plasticizers (e.g. TXIB, Dodecylbenzene).

Emission Test Methods

To determine the VOCs (Volatile Organic Compounds) of building materials (e.g. Cushion Vinyl Floorings), the analytical laboratory of BYK uses the following instrumentation:

1. Nord Test (Chamber Method)
This test specifies a procedure for the determination of emission of volatile organic compounds from building materials in a small, ventilated climate (figure 8).

2. FLEC Test (Field Laboratory Emission Cell)
FLEC is a small piece of equipment that is easy to handle and easy to clean (figure 9). It was designed to measure volatile, organic compounds emitted from smooth and even surfaces. It can be used for emission testing in the laboratory and at building sites.

The FLEC system is widely used due to its measurement flexibility.

With both types of test equipment, the sample material's emissions are collected in a tenax tube (figure 10). The quantity and quality can be determined by use of analytical equipment, such as the gas chromatograph and mass spectrophotometer.

The air velocity over the test material's surface area can be 50 to 100 times greater with the FLEC equipment than the Chamber method.

Nord Test (Chamber Method)

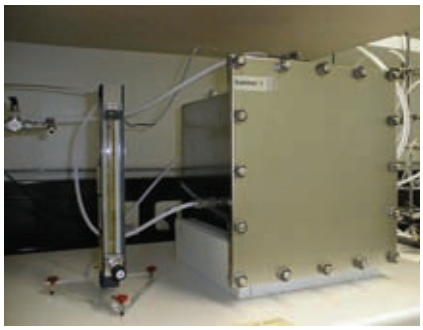


figure 8

FLEC (Field Laboratory Emission Cell)

figure 9

Flow Chart of VOC Measurement

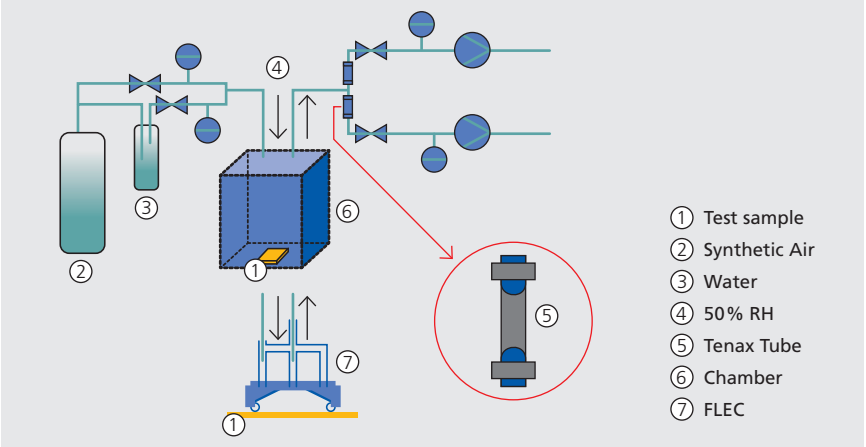


figure 10

Application Examples

VISCOBYK viscosity depressants provide high efficiency independent of the shear rate. In addition they offer good storage stability. It is possible to increase the filler loading at a constant viscosity (figure 11).

Higher Filler Load at Constant Viscosity

Basic formulation:
100 pts PVC
75 pts plasticizer
75 pts filler
1 pt stabilizer

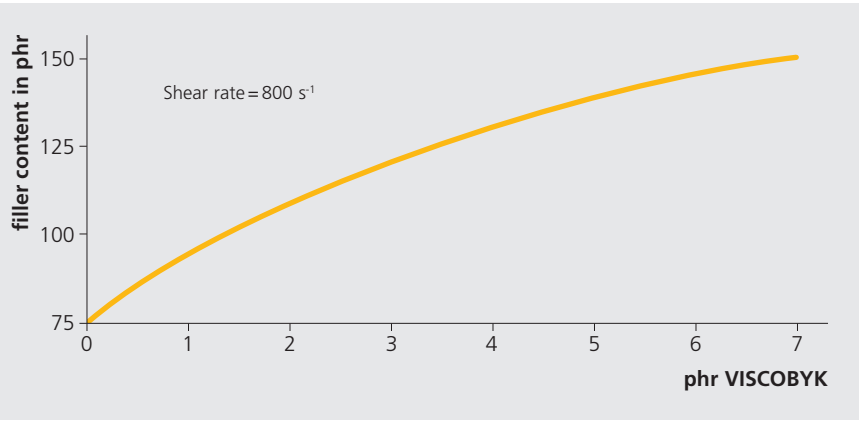


figure 11

The use of **VISCOBYK** viscosity depressants results in improved price performance, drier surface and reduced surface resistance (figure 12).

Reduction of Surface Resistance

Basic formulation:
100 pts PVC
75 pts plasticizer
75 pts filler
1 pt stabilizer

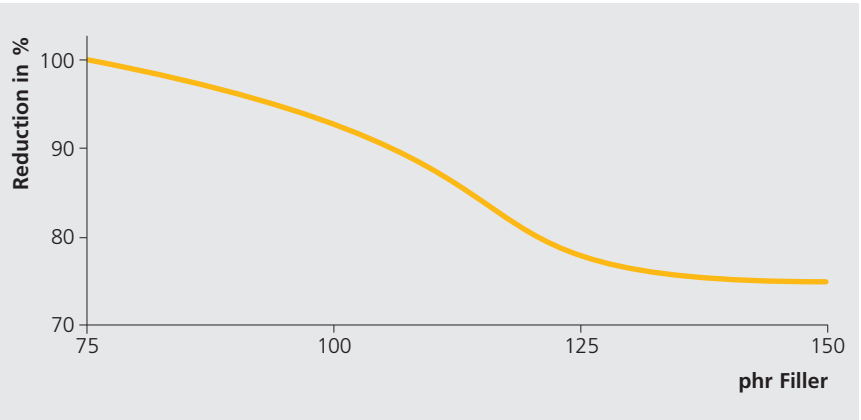
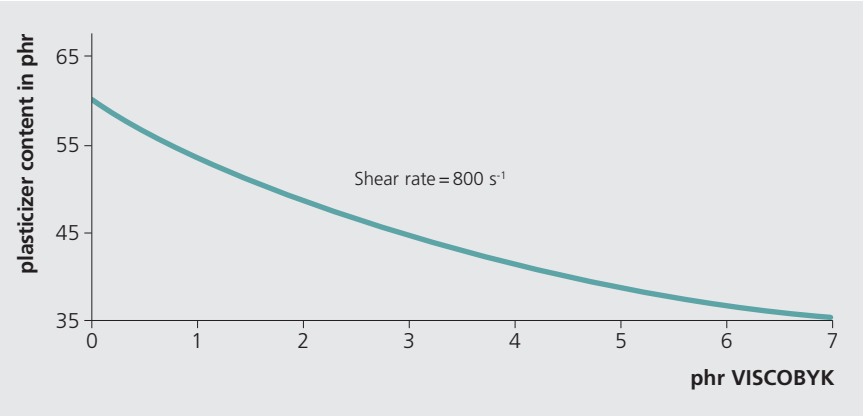


figure 12

VISCOBYK viscosity depressants enable reduction of the plasticizer content at constant viscosity (figure 13).

The reduction of plasticizer using **VISCOBYK** viscosity depressants can improve stain and scuff resistance.

Lower Plasticizer Content at Constant Viscosity

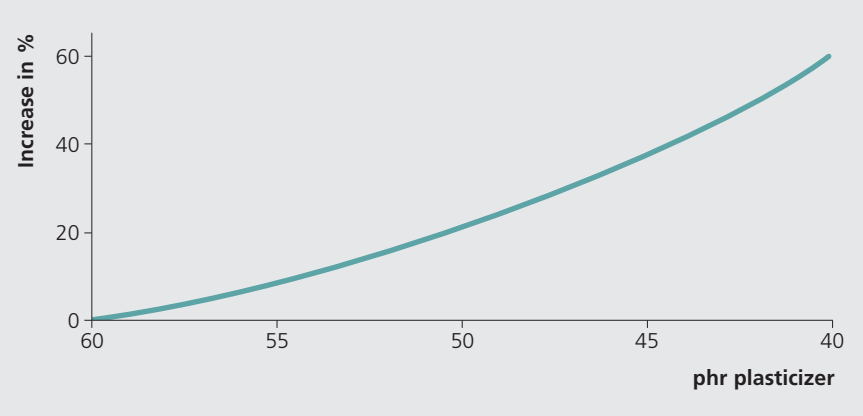


Basic formulation:
100 pts PVC
60 pts plasticizer
1 pt stabilizer

figure 13

VISCOBYK viscosity depressants provide increased product stiffness, a drier surface and greater flexural strength (figure 14).

Increase in Flexural Strength



Basic formulation:
100 pts PVC
60 pts plasticizer
1 pt stabilizer

figure 14

Products and Applications

BYK Additives

Additives are used during the production of coatings, printing inks and plastics to optimize the production process and to improve the quality of the final product.

Product Range Additives
- Additives to improve surface slip, leveling and substrate wetting
- Adhesion promoters
- Defoamers and air release agents
- Foam stabilizers
- Processing additives
- Rheological additives
- UV-absorbers
- Viscosity depressants
- Waxes
- Wetting and dispersing additives for pigments and extenders

Application Areas
- Ambient curing resins (FRP)
- Architectural coatings
- Automotive OEM
- Automotive refinishes
- Can coatings
- Coil coatings
- Color masterbatches
- Industrial coatings
- Leather coatings
- Marine paints
- Molding compounds
- Paper coatings
- Pigment concentrates
- Polyurethane foams
- Powder coatings
- Printing inks
- Protective coatings
- PVC plastisols
- Thermoplastics
- Wood and furniture coatings

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