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INFO SHEET I RHEOLOGY MODIFIERS I CAVASOL®

CAVASOL® CYCLODEXTRINS FOR VOC-FREE RHEOLOGY MODIFICATION – PRODUCTS AND APPLICATIONS

Rheology modifiers are key ingredients in many of today's coatings and emulsion formulations. They control the viscosity and flow characteristics of the product, e.g. in paints. Without them, the paint would be runny like water, splash everywhere during application by brush or roller, and flow unevenly until it dried. However, some rheology modifiers are being supplied as a solvent solution or with surfactants. These solvents pose a risk to the environment, health and safety, while surfactants can potentially degrade the performance of waterborne coatings. These thickeners could be solubilized in cyclodextrin derivatives so as to obtain VOC-free rheology modifiers.

Classes of Rheology Modifiers

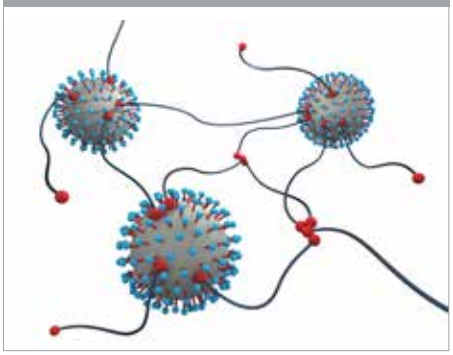
The two main classes of rheology modifiers are:

- **Inorganics** (clays and pyrogenic silicas) and
- **Organics**, such as cellulosics and synthetics.

Synthetic rheology modifiers can be further divided into associative and non-associative thickeners (see chart below).

One group of associative thickeners – hydrophobically modified ethylene-oxide-based urethanes or HEURs – thickens by building networks due to hydrophobic interactions of the end groups with themselves and the latex particles in paint.

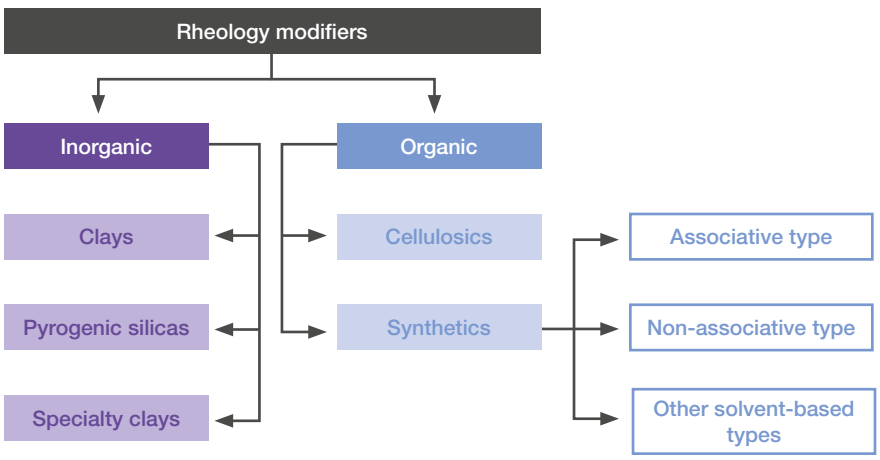
Associative Thickeners Build Networks to Structure Liquids



HEURs are particularly well suited to high- and semi-gloss formulations, as well as applications where water resistance is important.

Rheology modifiers reduce dripping and splattering of the drying paint during application, improve sag resistance of the paint film as it dries, and prevent pigment sedimentation in the can during transport and storage.

Classes of Rheology Modifiers



Solubilization of Hydrophobic Molecules with CAVASOL® Cyclodextrins

CAVASOL® cyclodextrins are a group of highly water-soluble, chemically modified cyclodextrins. Cyclodextrins are a well-known group of natural carbohydrates, which, due to their novel cyclic structure, are able to act as the host in a host-guest complex. This encapsulation product is frequently called an "inclusion complex" or a "molecular encapsulation" and is a reversible, equilibrium-controlled process in water, with a hydrophobic guest.

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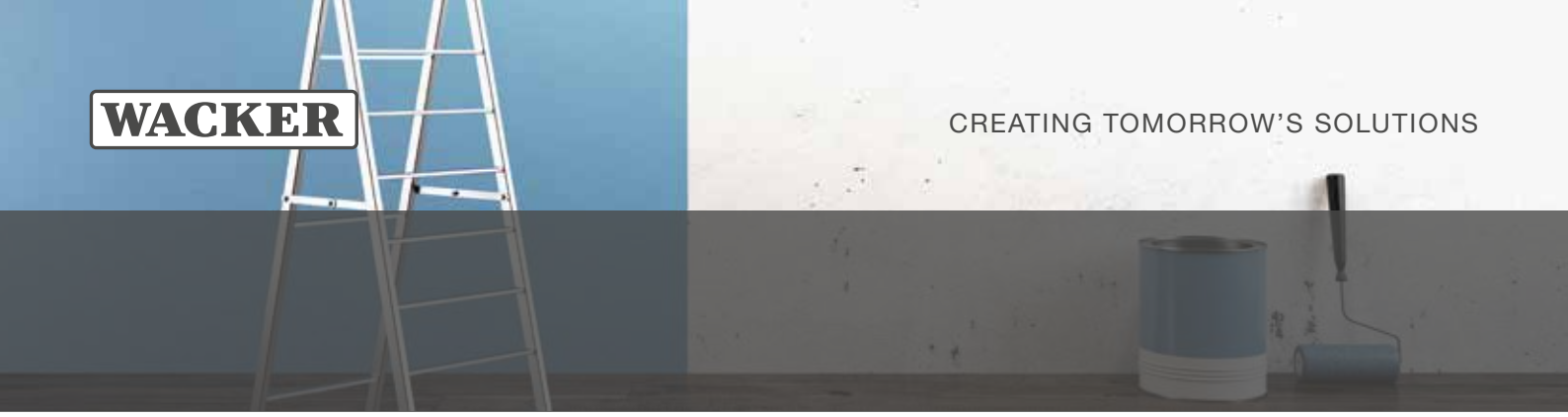
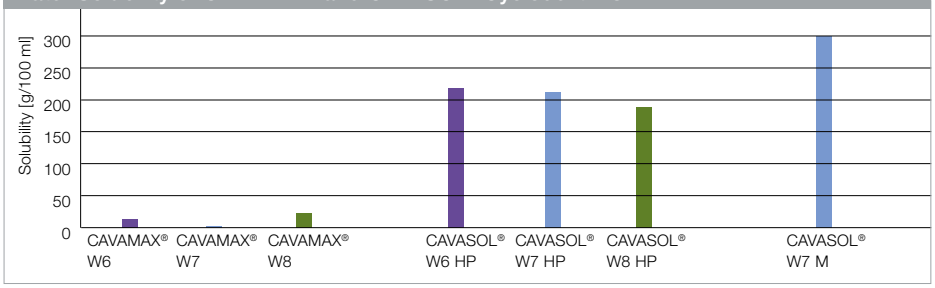


Modification of the parent cyclodextrins leads to the CAVASOL® range of products. The main modification used is either methylation to give CAVASOL® W7 M, or hydroxypropylation to give the CAVASOL® HP products, and results in a dramatic increase in water solubility. This functionalization allows cyclodextrins to be used to replace organic solvents or surfactants in many water-based products and to produce low-VOC products.

Water Solubility of CAVAMAX® and CAVASOL® Cyclodextrins

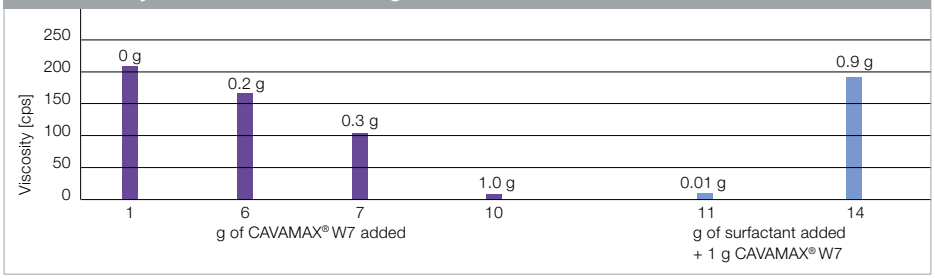


HP = hydroxypropyl, M = methylated

Low-Viscosity, VOC-Free, Water-Based HEUR Formulations

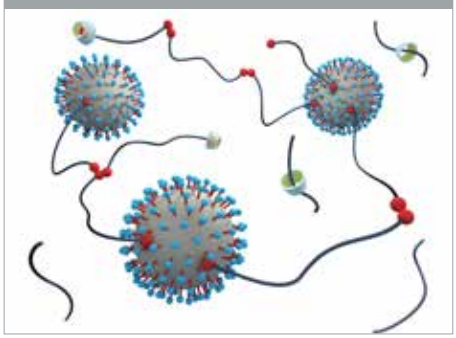
It is known that HEUR rheology modifiers can be dissolved in water containing CAVAMAX® or CAVASOL® cyclodextrins to give a low-viscosity, pumpable, VOC-free, aqueous solution of HEUR. This reduction in viscosity is fully reversible when the solution is formulated into the finished paint, due to the presence of surfactants in the paint formulation.

Viscosity Reduction of a 3% Thickener Solution in Water with Added CAVAMAX® W7, and Recovery of a Solution Containing 1% CAVAMAX® W7 and Added Surfactant



According to Eisenhart US Patent 5,137,571.

Recovery of Viscosity in Paint Formulations



The aqueous CAVASOL® HEUR solution can then be incorporated into the formulated paint, providing the required rheological control of the formulation and coating, without any adverse effect on the performance of the coating as measured using standard industry tests and practices, e.g. efficiency, flow, gloss, colorant and heat stability.*

*According to Lau Patent 5,376,709

CAVASOL®

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