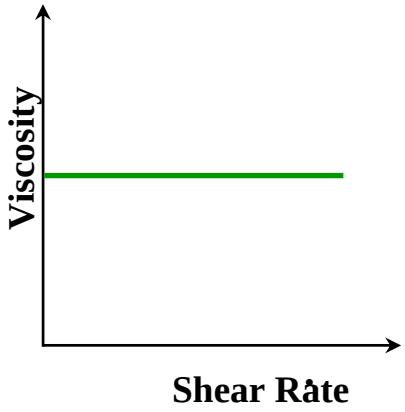
RHEOLOGY

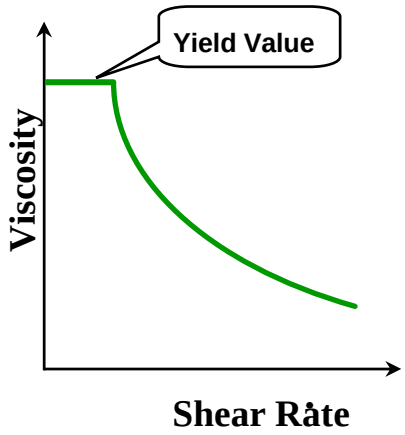
TYPES OF RHEOLOGICAL BEHAVIOUR

NEWTONIAN FLOW



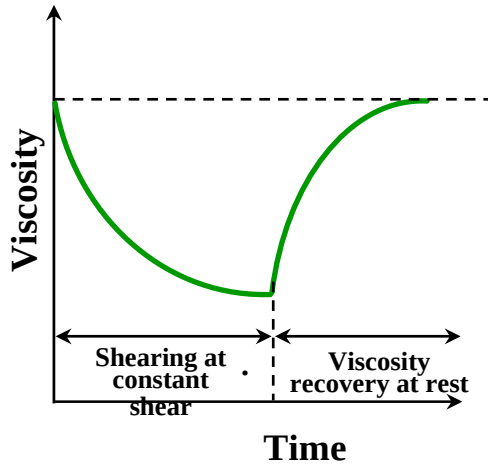
- Increased shear does not impact viscosity.

PSEUDOPLASTICITY SHEAR THINNING FLOW (case with Yield Value)



- Flow starts at a given shear (yield)
- Increased shear rate induces lower viscosity
- Multiple viscosity measurements required to have rheology profile

THIXOTROPY



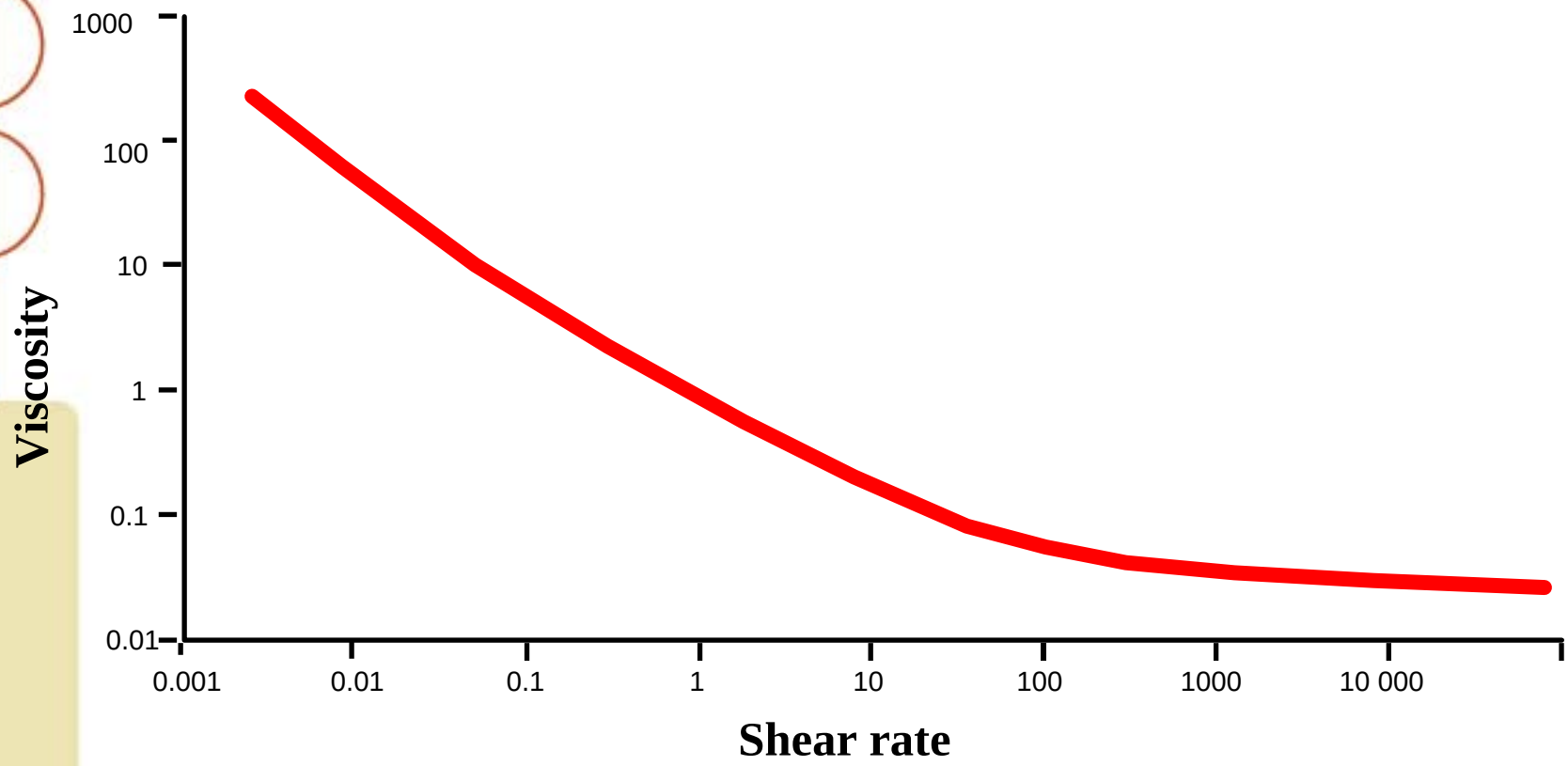
- At constant shear viscosity drops
- When shear is stopped viscosity recovers

TYPES OF RHEOLOGICAL BEHAVIOUR

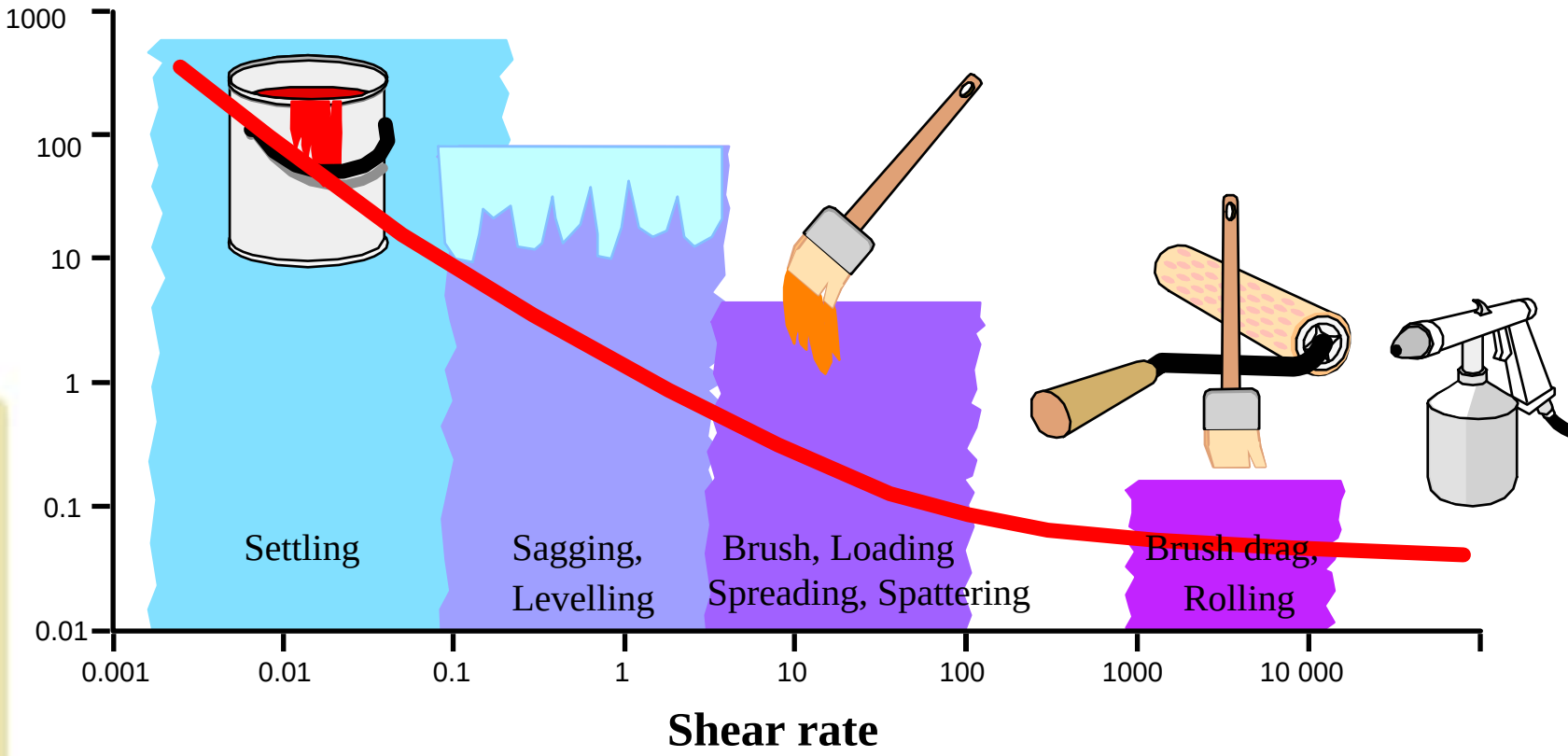
SHEAR RATE DEPENDANCE

TIME DEPENDANCE	YES	NO
NO	• Plastic • Shear Thinning • Shear Thickening • Viscoplastic	• Newtonian
YES	• Thixotropic • Rheopectic (anti-thixo)	

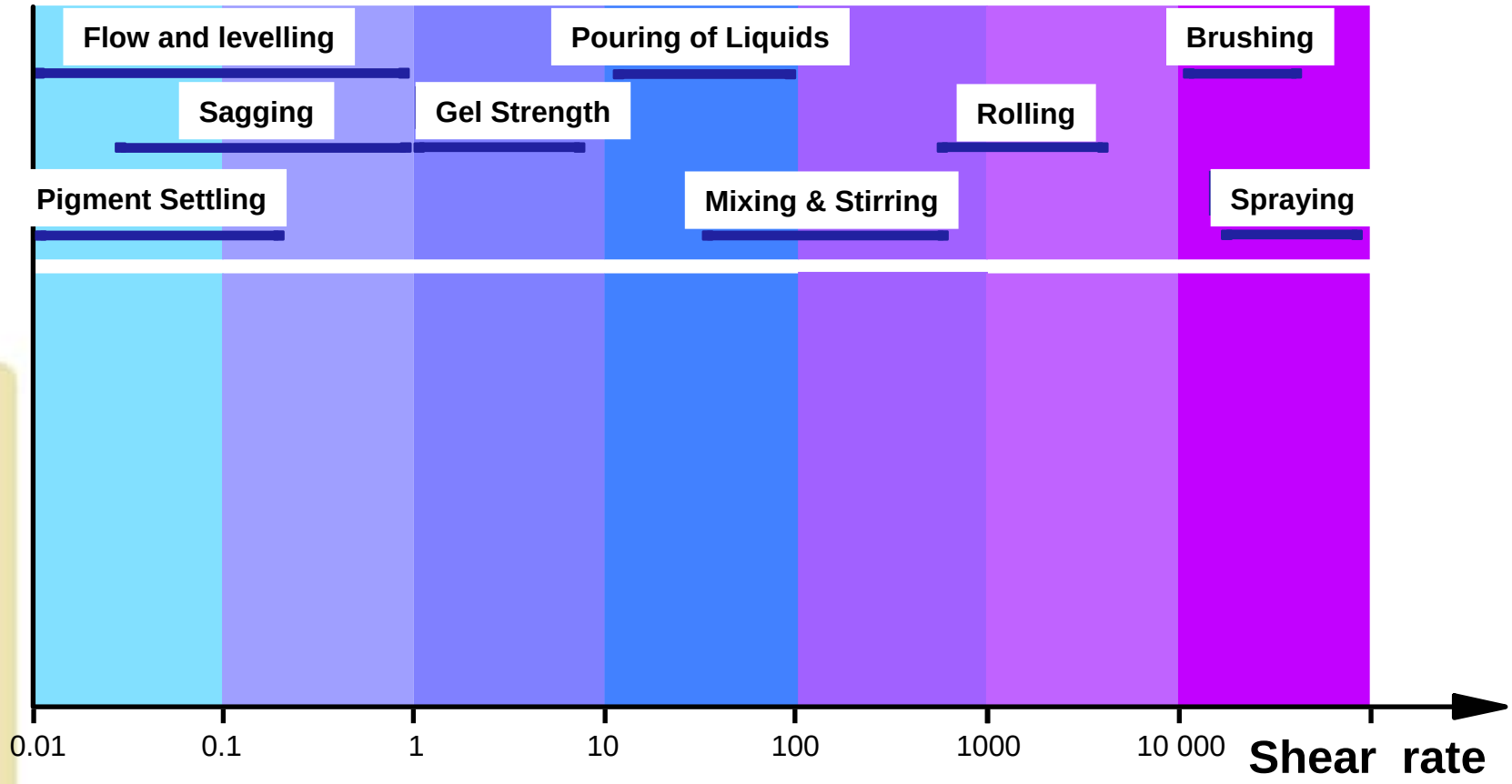
Applications versus Rheology Profile



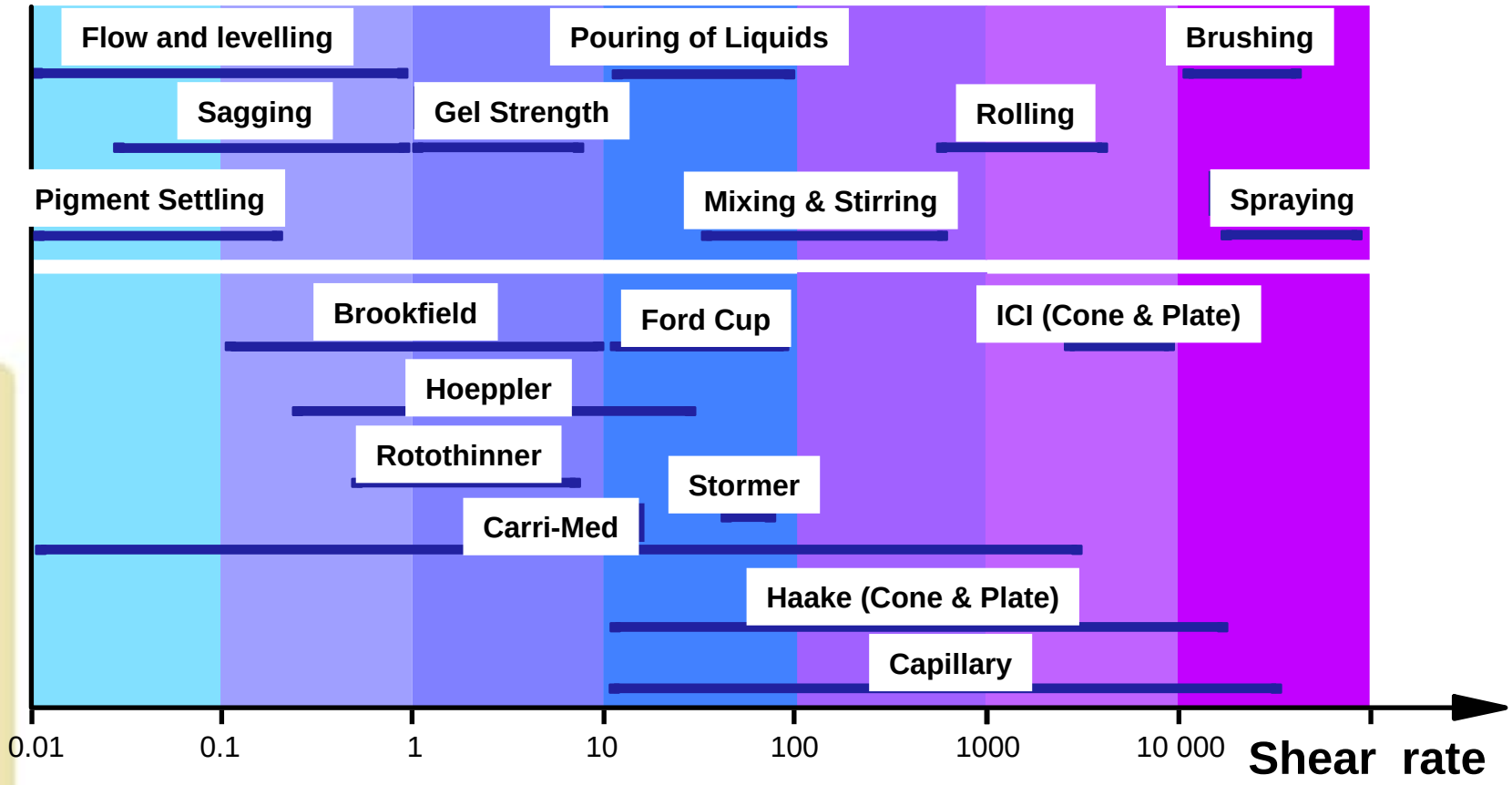
Applications versus Rheology Profile



Viscosity Measurement



Viscosity Measurement



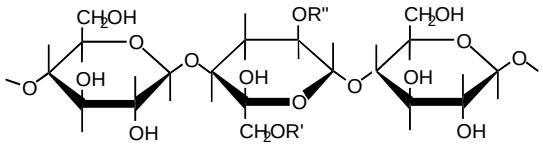
Thickener Types

	SYNTHETIC	NATURAL DERIVATIVES
CONVENTIONAL	• Polyvinyl alcohol • Polyacrylamide • Alkali Soluble Emulsion - acrylic - styrene/maleic • Polyacrylic acids	• Cellulose ethers - CMC - MC, HEC, EHEC, etc.. • Other polysaccharides • Protineacious thickeners
ASSOCIATIVE	• HASE • HEUR	• HM-HEC

THIXOTROPY:
- Clays (Bentonite, Laponite)
- Titanium chelates

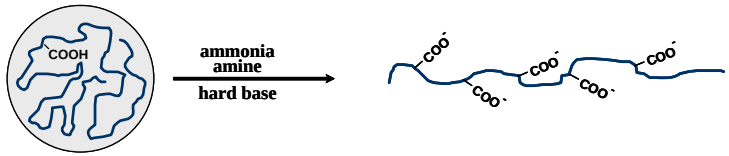
Conventional Thickeners

CELLULOSIC THICKENERS (Cellulose Ether)



- EFFICIENT VISCOSITY BUILDERS
- FLOCCULATE MANY LATEX BINDERS AND PIGMENTS
- RESTRICTING GLOSS DEVELOPMENT AND LEVELLING
- MICROBIAL DEGRADATION

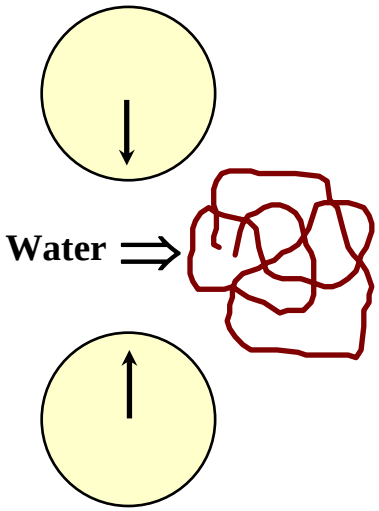
ACRYLIC THICKENERS (ASE) (Alkali Soluble Emulsion)

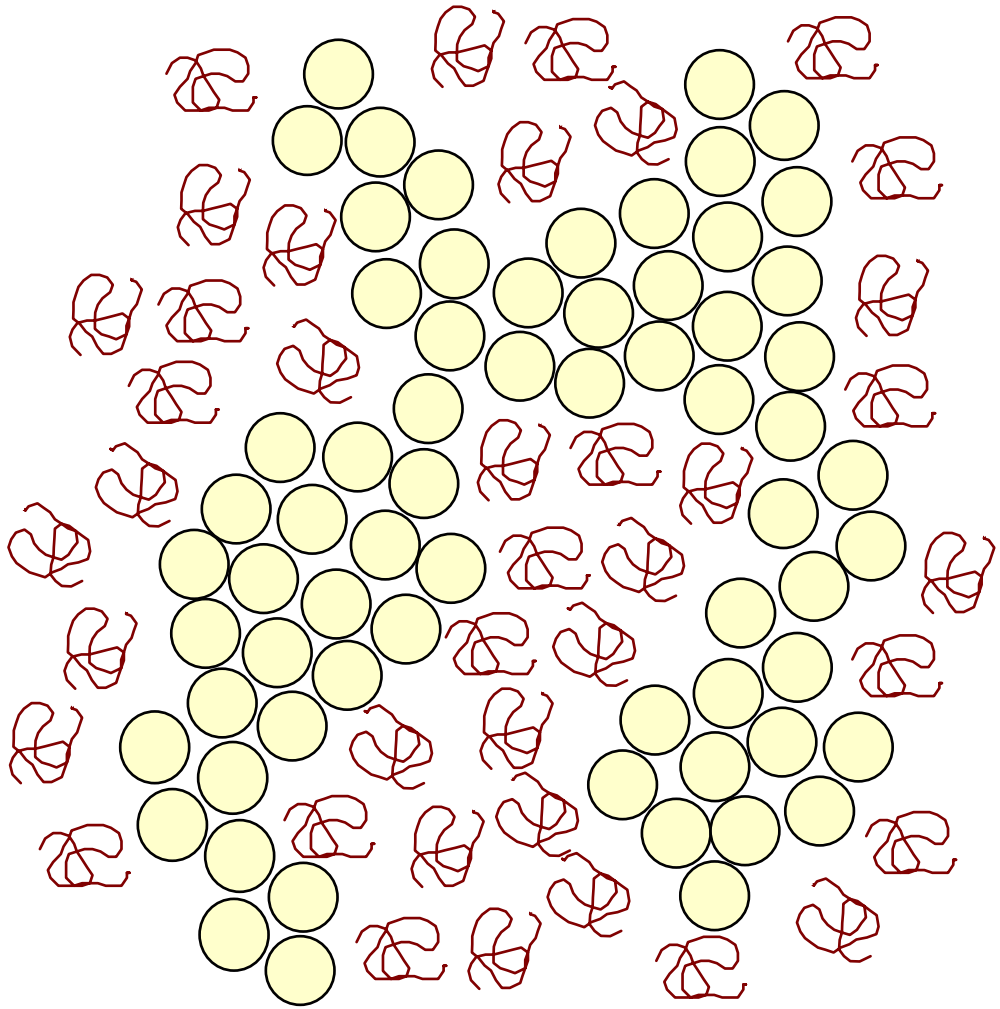


- EASY TO FORMULATE WITH
- RESTRICTING GLOSS DEVELOPMENT AND LEVELLING

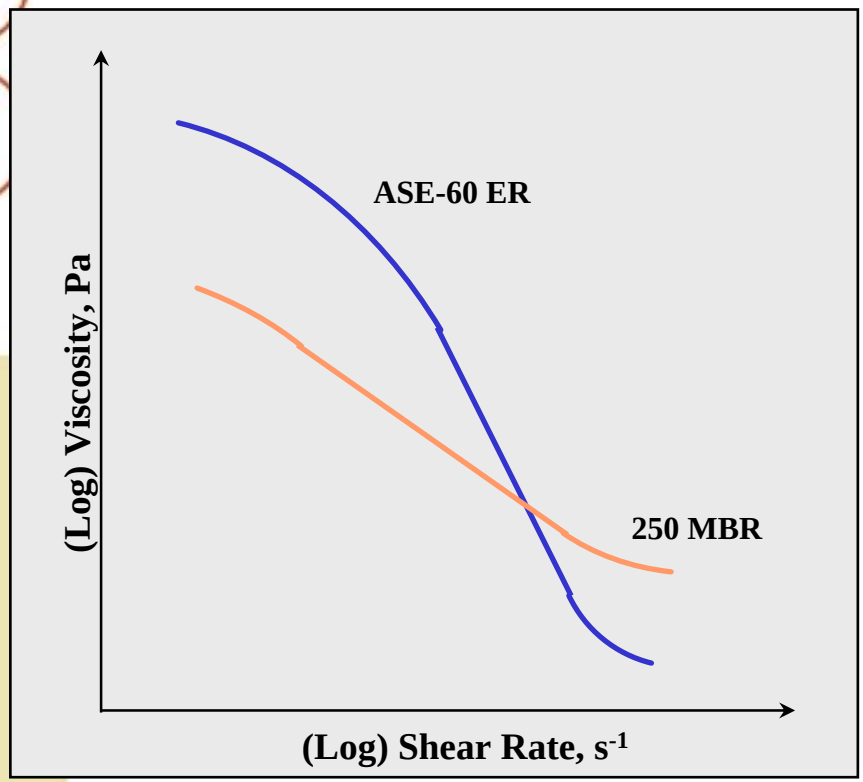
LIQUID PHASE THICKENING

VOLUME RESTRICTION FLOCCULATION





ASE: COMMERCIAL PRODUCT



ACRYSOL ASE-60 ER

- Acrylic thickener (30% solids)
- Specifically designed to develop a high level of structure
- Generally used as a co-thickener
- Recommended for:
  - structured paints
  - settling & sag resistance

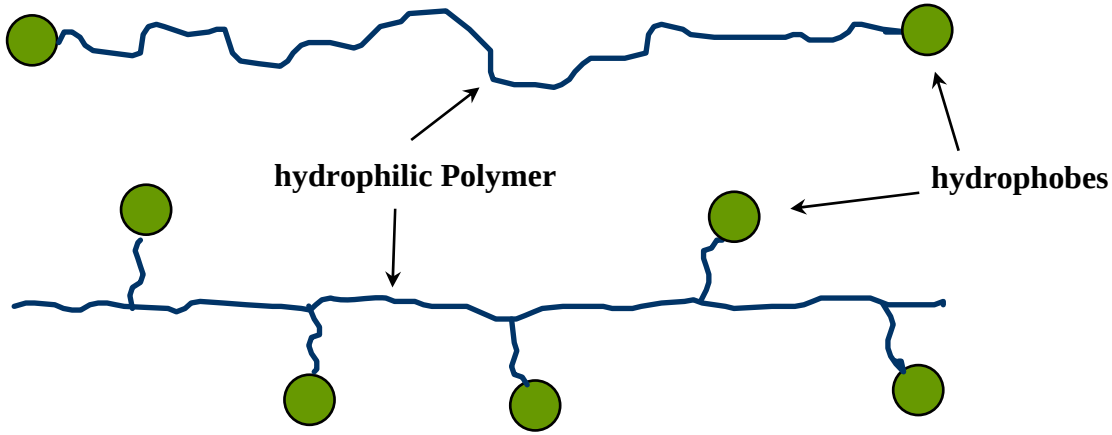
Associative Thickeners

- **HEUR : Hydrophobically modified Ethylene oxide URethane**
- **HASE : Hydrophobically modified Alkali Soluble Emulsion**
- **HM-HEC : Hydrophobically Modified HydroxyEthyl Cellulose**

- **Nonflocculating - excellent gloss and levelling**
- **Easy to manipulate high and low shear rheology**
- **Good roller spatter resistance**
- **Very formulation dependent - complex interactions**

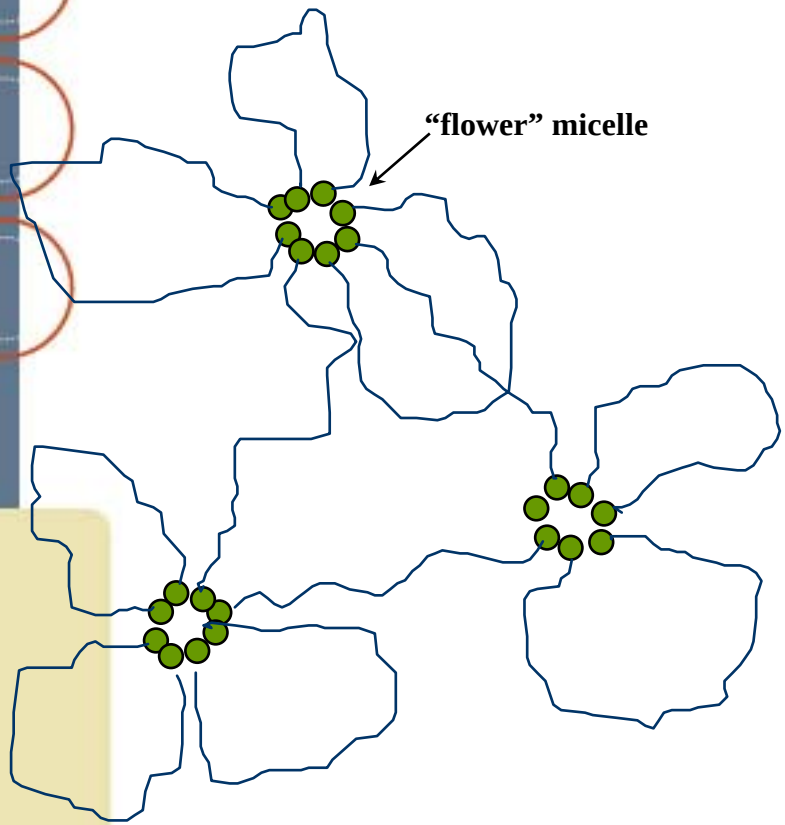
ASSOCIATIVE THICKENER CONCEPT

Non-ionic Surfactant

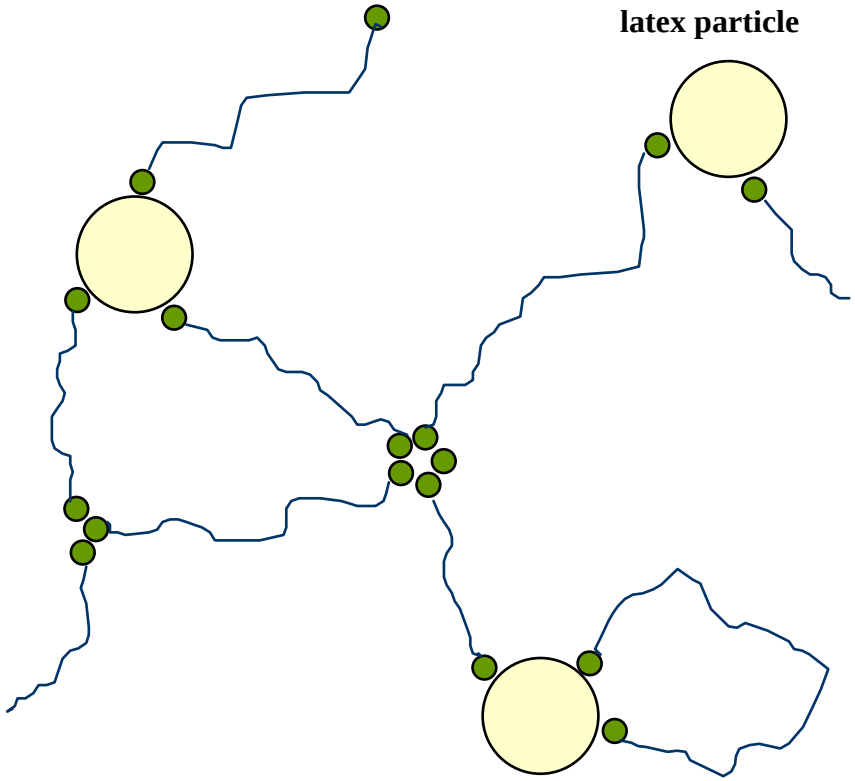


Associative Thickener

THICKENING MECHANISM OF AT's

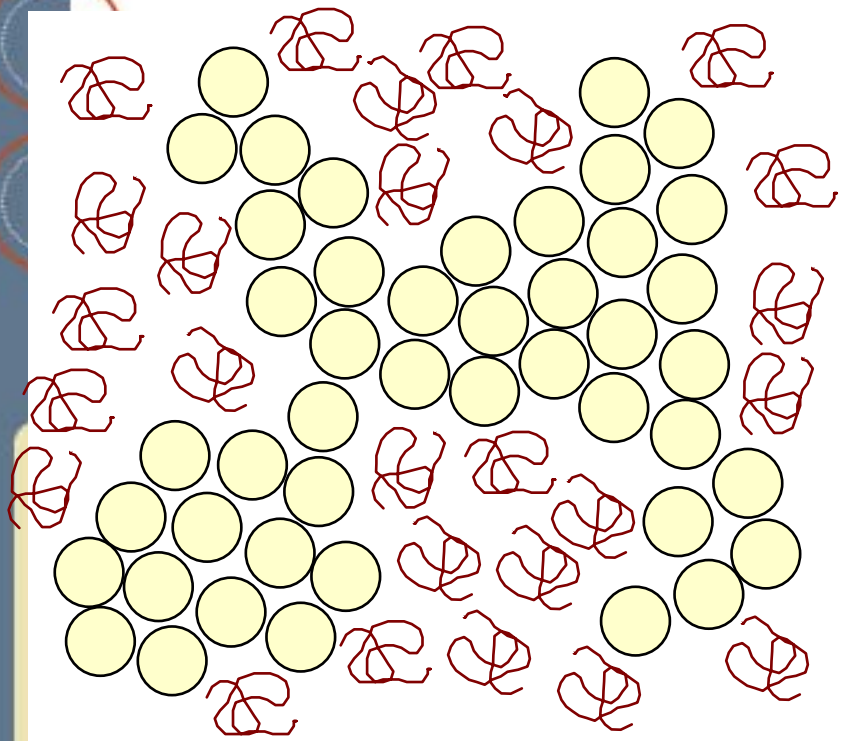


AT in water

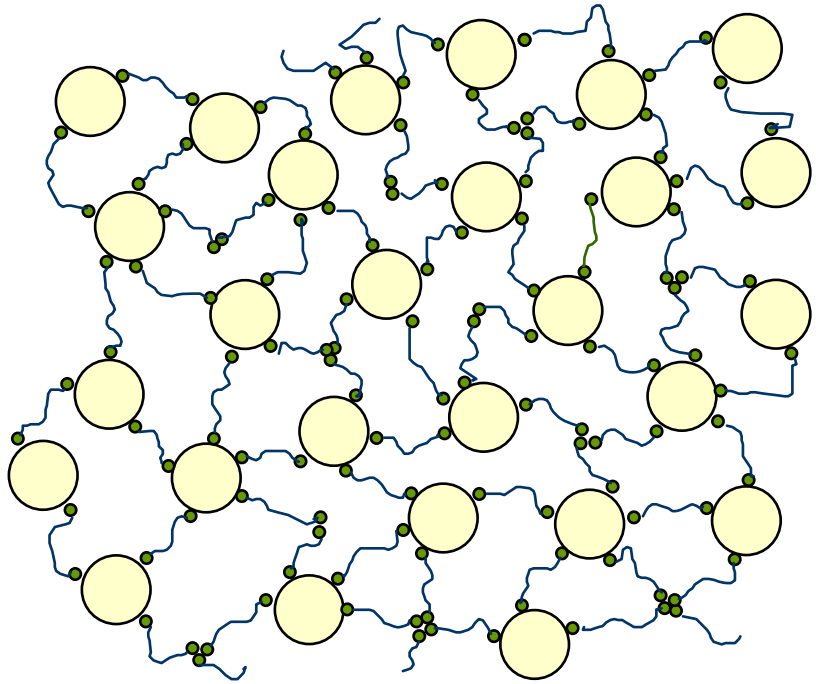


AT in a latex polymer

CONVENTIONAL / ASSOCIATIVE THICKENER IN A LATEX

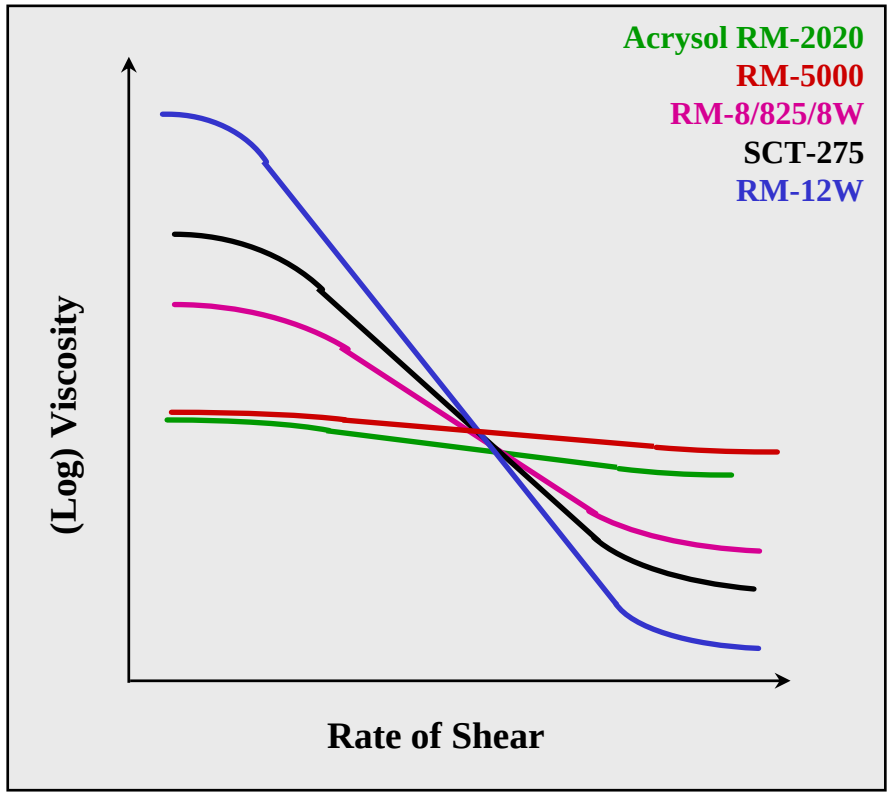


Conventional thickener



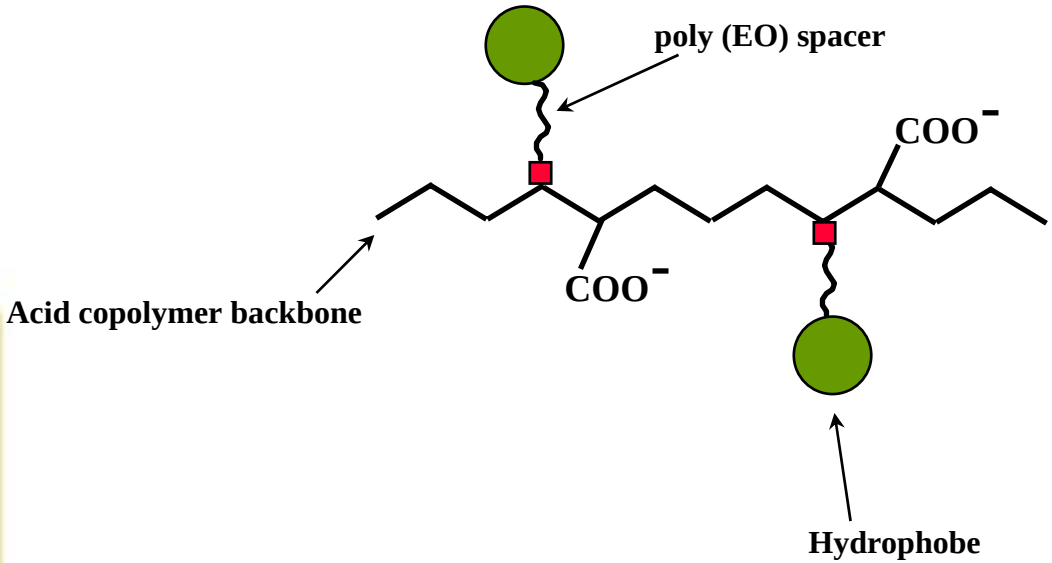
Associative thickener

HEUR: COMMERCIAL PRODUCTS

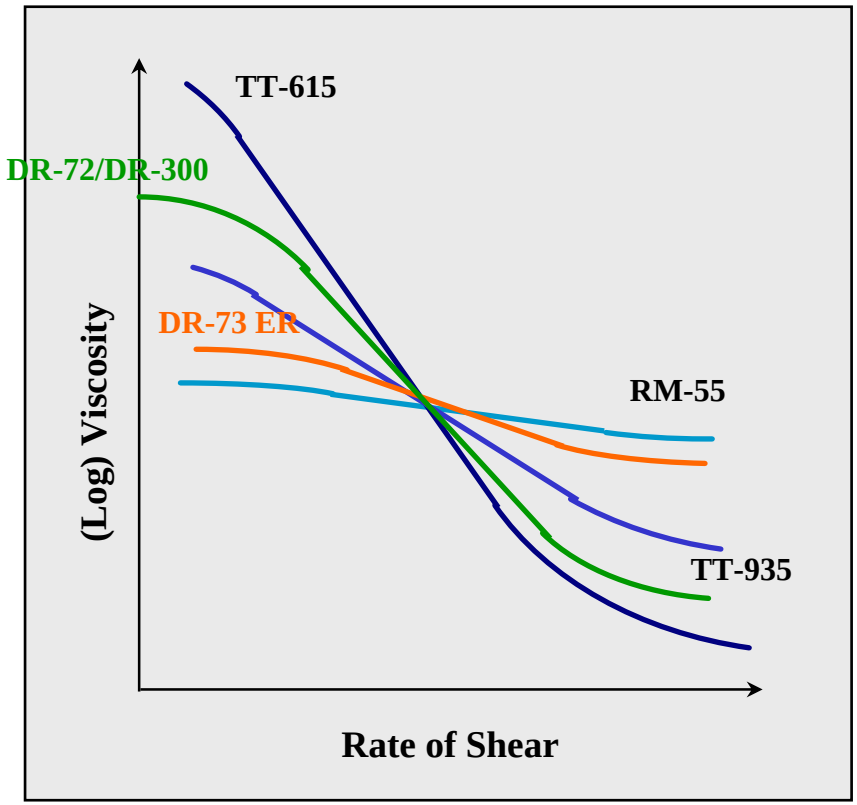


HASE

(Hydrophobically modified Alkali Soluble Emulsion)

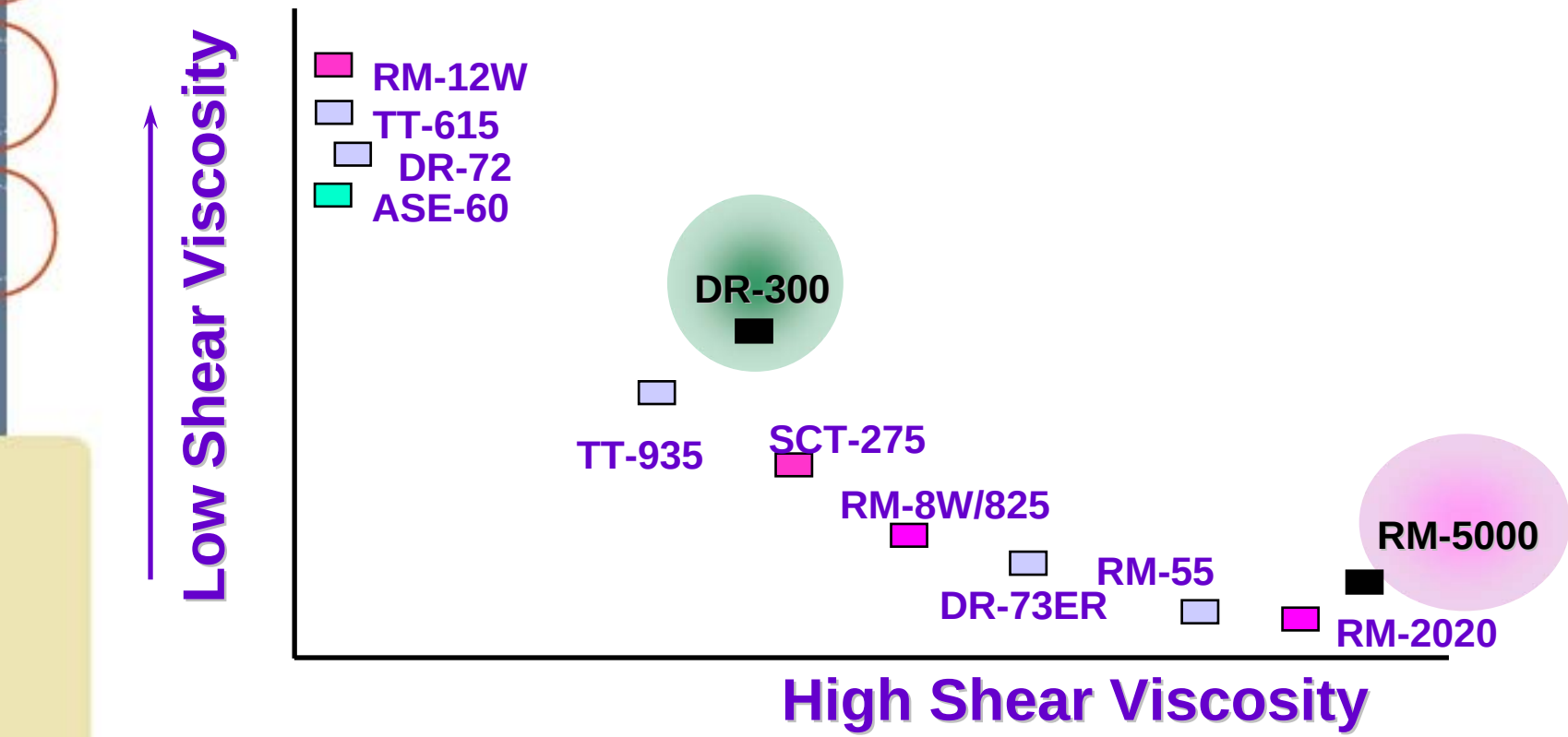


HASE and Acrysol DR : COMMERCIAL PRODUCTS



Acrysol ™ Rheology profile

at constant mid shear viscosity



KEY INTERACTIONS OF ASSOCIATIVE THICKENERS WITH PAINT INGREDIENTS

- Effect of latex particle size
- Effect of latex stabilization
- Interaction with pigments
- Interaction with dispersants
- Interaction with surfactants
- Interaction with solvents