



Ultra-Efficient Polymer Pre-Dispersion

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CRODA

Introduction

- Dispersion of Particulates
 - Wetting, de-agglomeration, suspending
- US2006/0051486A1: combination of esters and non-ionic surfactant/s that enable low energy mixing to disperse pigments/inorganic particulates
- Polyacrylic acid polymers



Materials

- Polyacrylic acid polymer
- Capric/Caprylic Triglyceride
- 3 Propylene Oxide Myristyl Alcohol Adipate Diester
- Sorbitan Isostearate
- Mineral Oil
- Liquid Polymer Dispersion (Sodium Polyacrylate, Mineral Oil, Trideceth-6)

- Brookfield Viscometer DVII RVT
- Rheostress 600 Rheometer



Methods

- Part 1: Comparison of viscosity building performance
 - Effect of polymer concentration
 - Effect of sodium chloride concentration
 - Effect of pH



Methods

- Part 2: Effect of order of addition of the dispersion system
 - Carbomer dispersed in water directly, then neutralized
 - Carbomer pre-dispersed in the Dispersion System
 - Dispersion system mixed with water first, then Carbomer added into the mixture & neutralized
 - Carbomer dispersed in water, neutralized, then dispersion system added.
 - Carbomer dispersed in water, neutralized, then added mineral oil



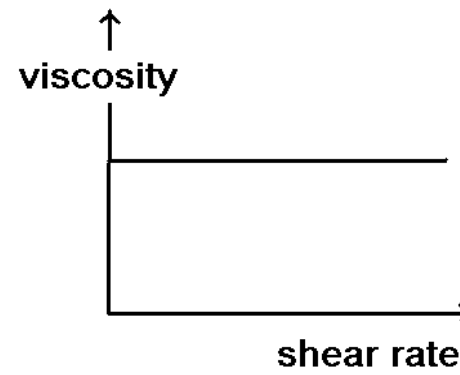
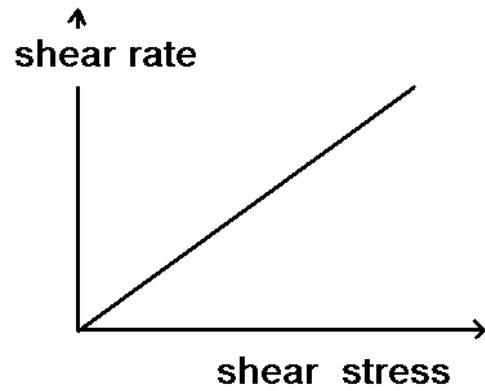
Methods

- Part 3: Rheological Measurements
 - Controlled shear strain to determine the flow characteristics
 - Plasticity
 - Pseudoplasticity
 - Thixotropy
 - Controlled shear stress to determine the yield points



Methods

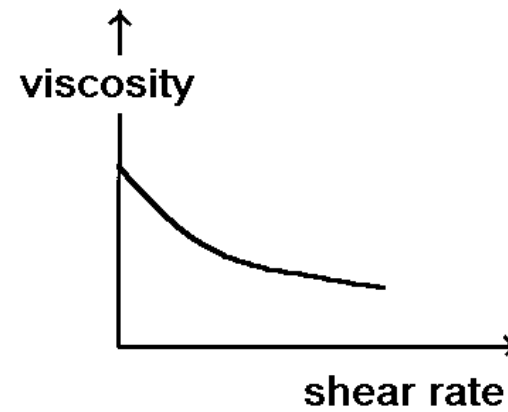
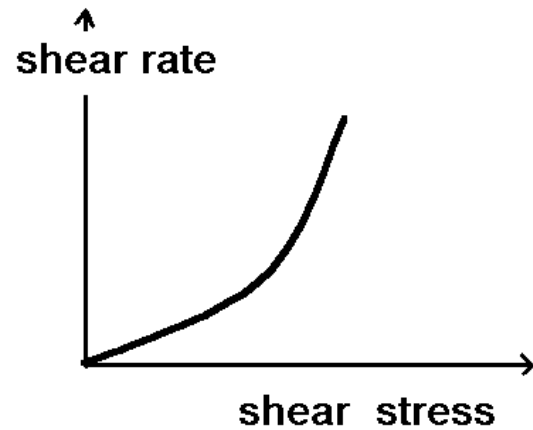
- Flow Characteristics
 - Newtonian



Methods

- Flow Characteristics
 - Non-Newtonian
 - Time independent

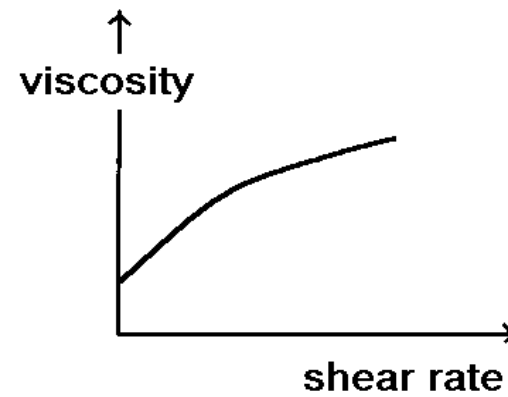
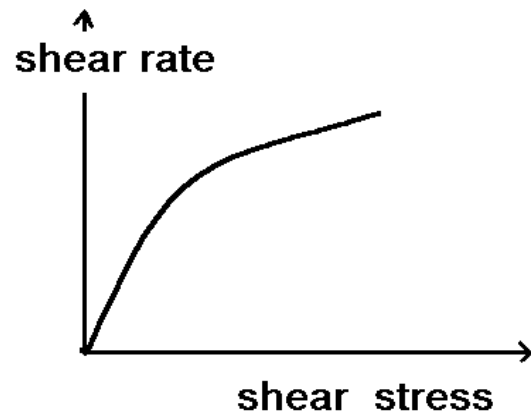
Pseudoplastic (Shear Thinning)



Methods

- Flow Characteristics
 - Non-Newtonian
 - Time independent

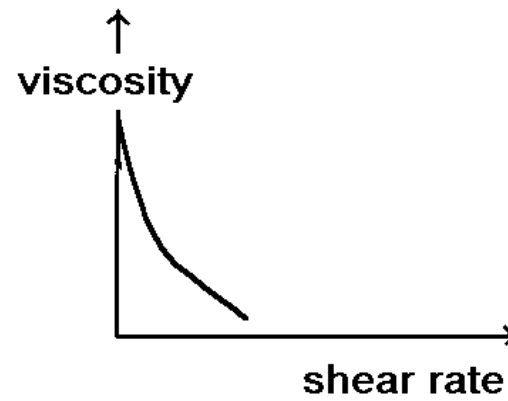
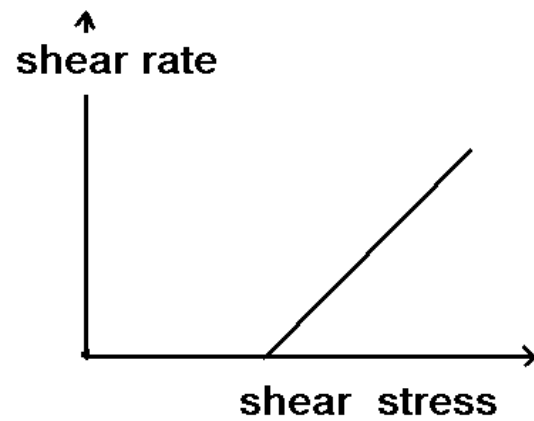
Dilatant (Shear Thickening)



Methods

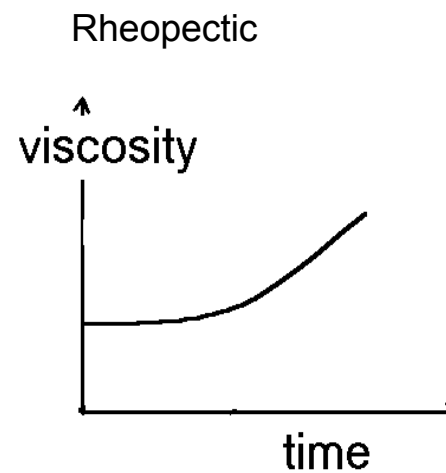
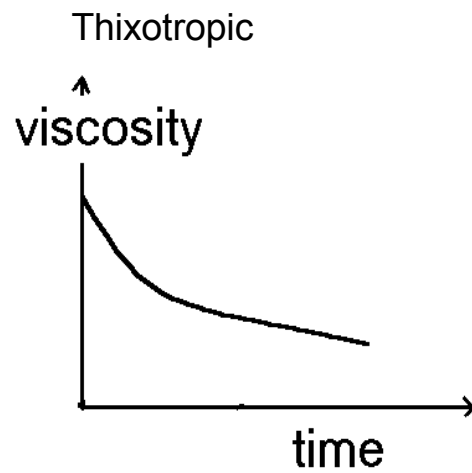
- Flow Characteristics
 - Non-Newtonian
 - Time independent

Bingham (exhibits yield value)



Methods

- Flow Characteristics
 - Non-Newtonian
 - Time dependent



Methods

Part 4: Dynamic Testing

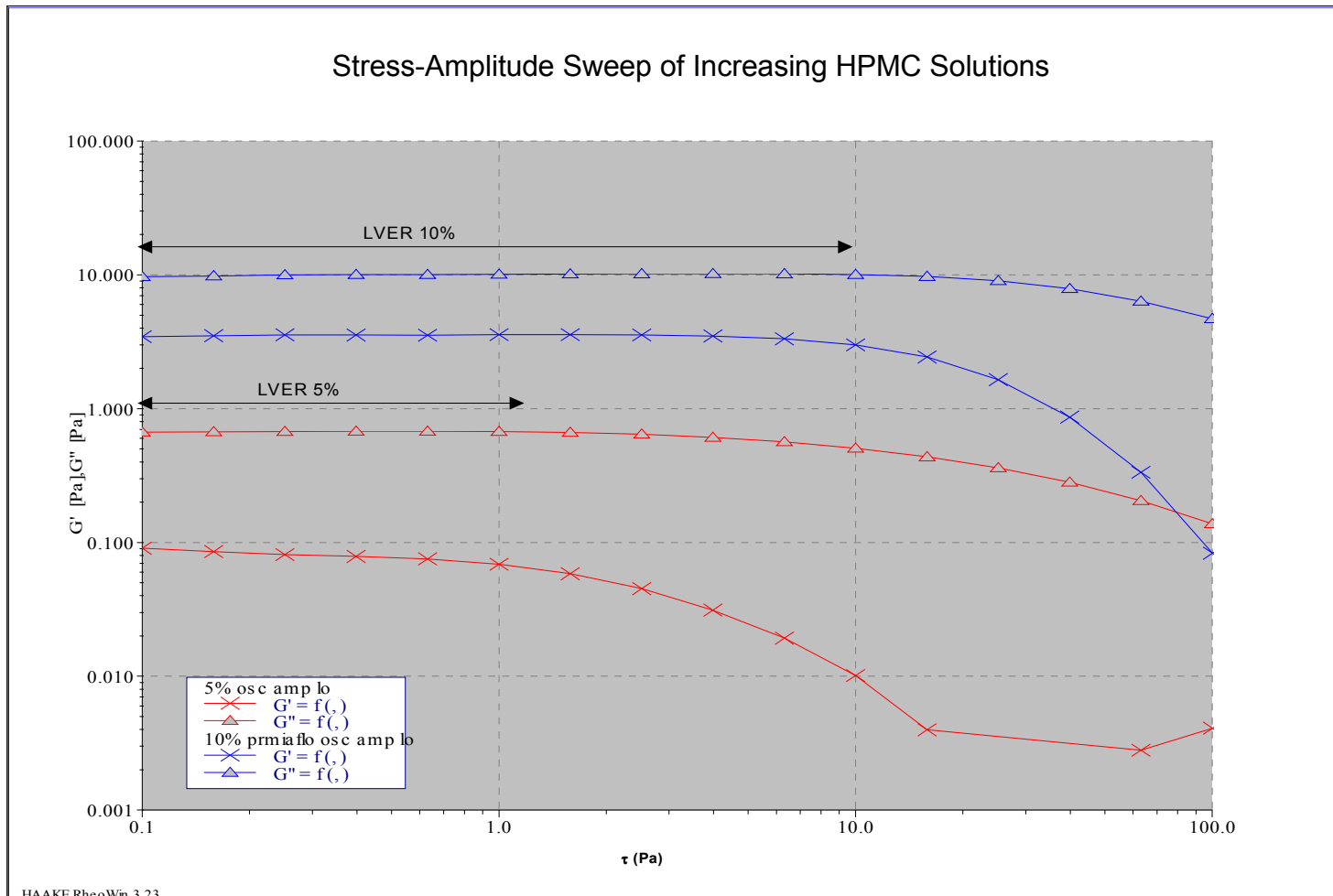
- Storage Modulus (G'): quantifies the *elastic* behaviour of a substance
- Loss Modulus (G''): quantifies the *viscous* behaviour of a substance

- Stress Sweep – sample is subjected to sinusoidal stress at constant frequency
 - Determines the Linear Viscoelastic Region (LVER)

- Frequency Sweep – constant stress within the LVER



Methods



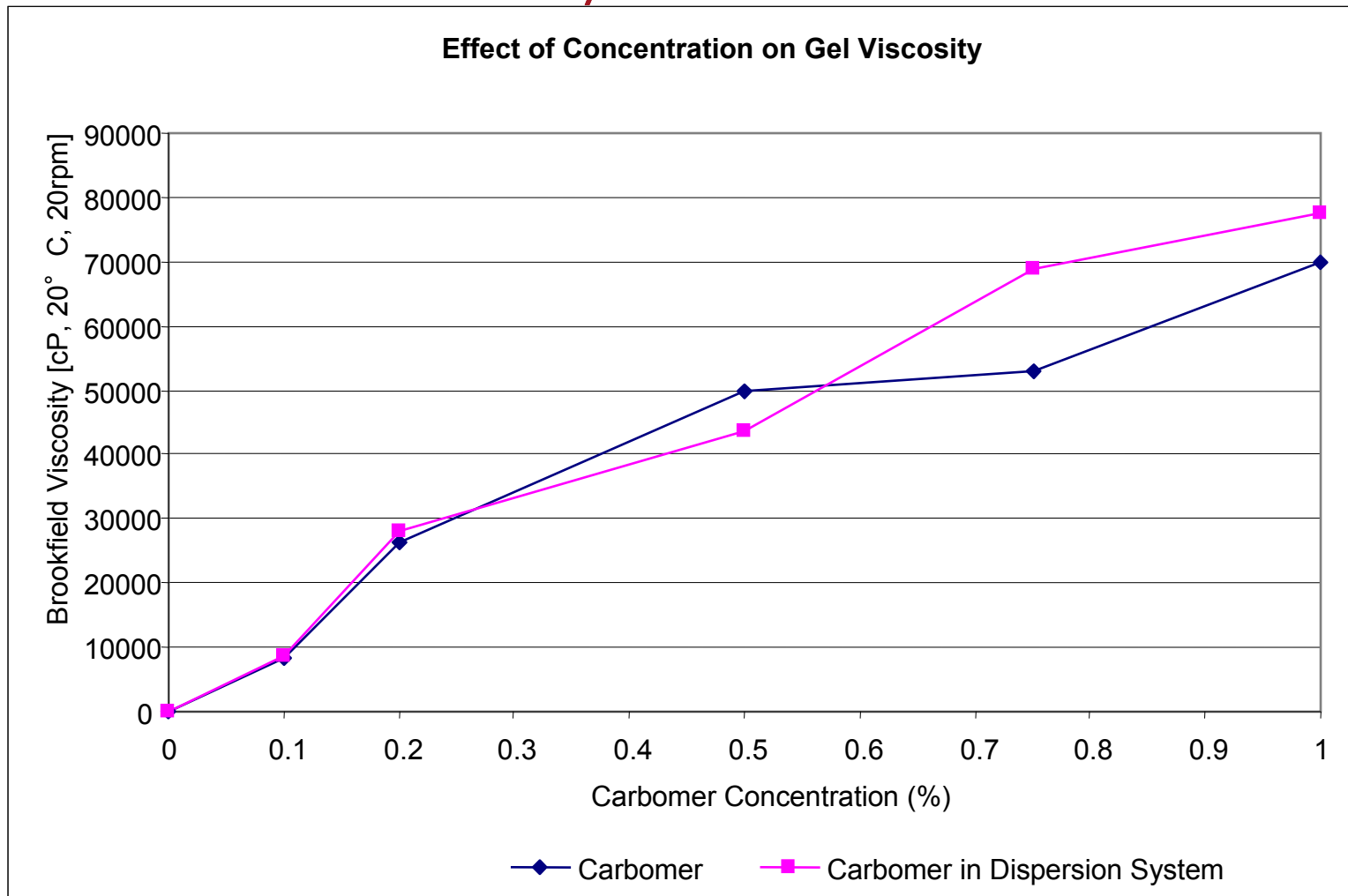
Methods

Part 5: Applications Testing

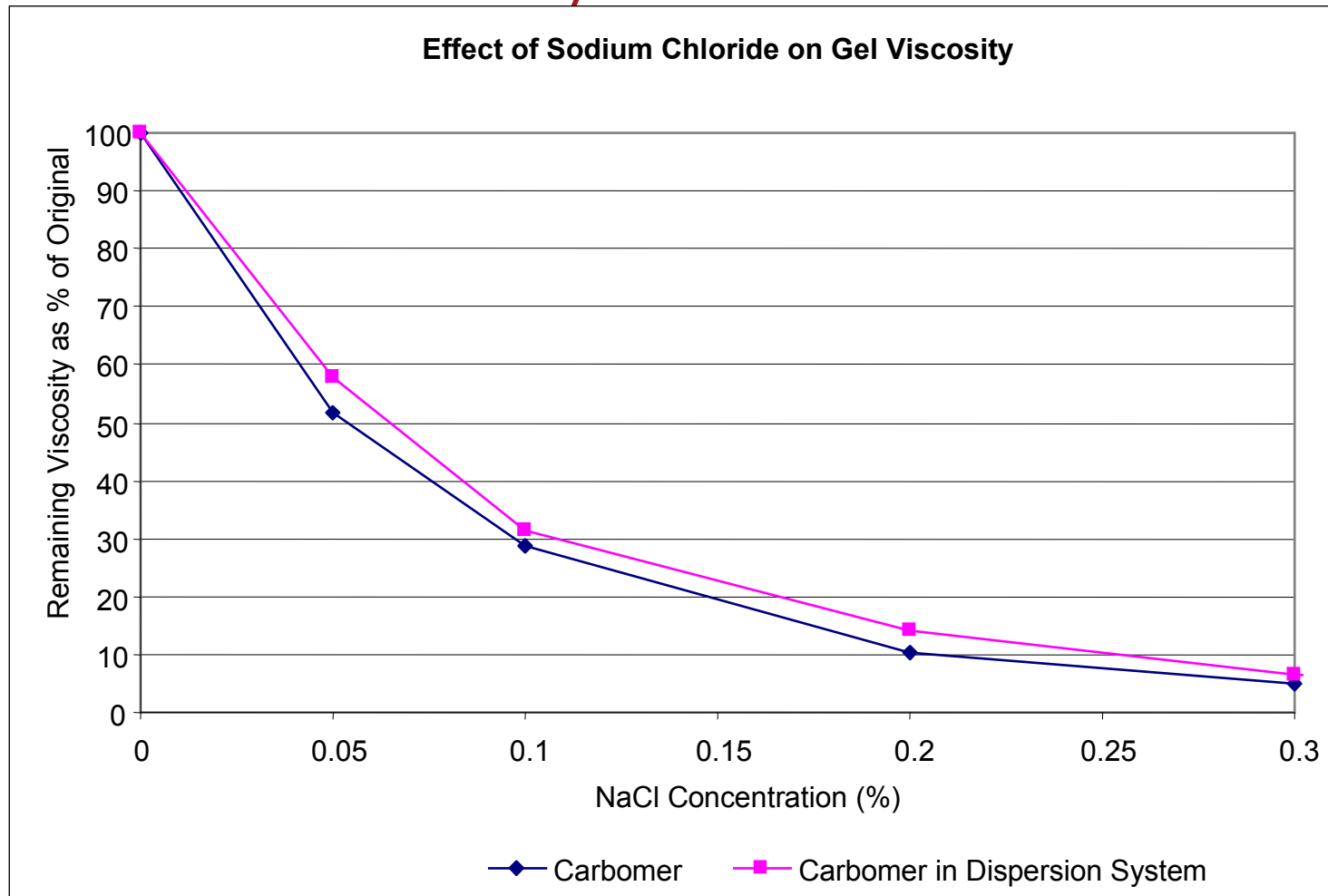
- Comparison of viscosity building performance versus a traditional liquid dispersion polymer
- Behaviour in o/w formulations



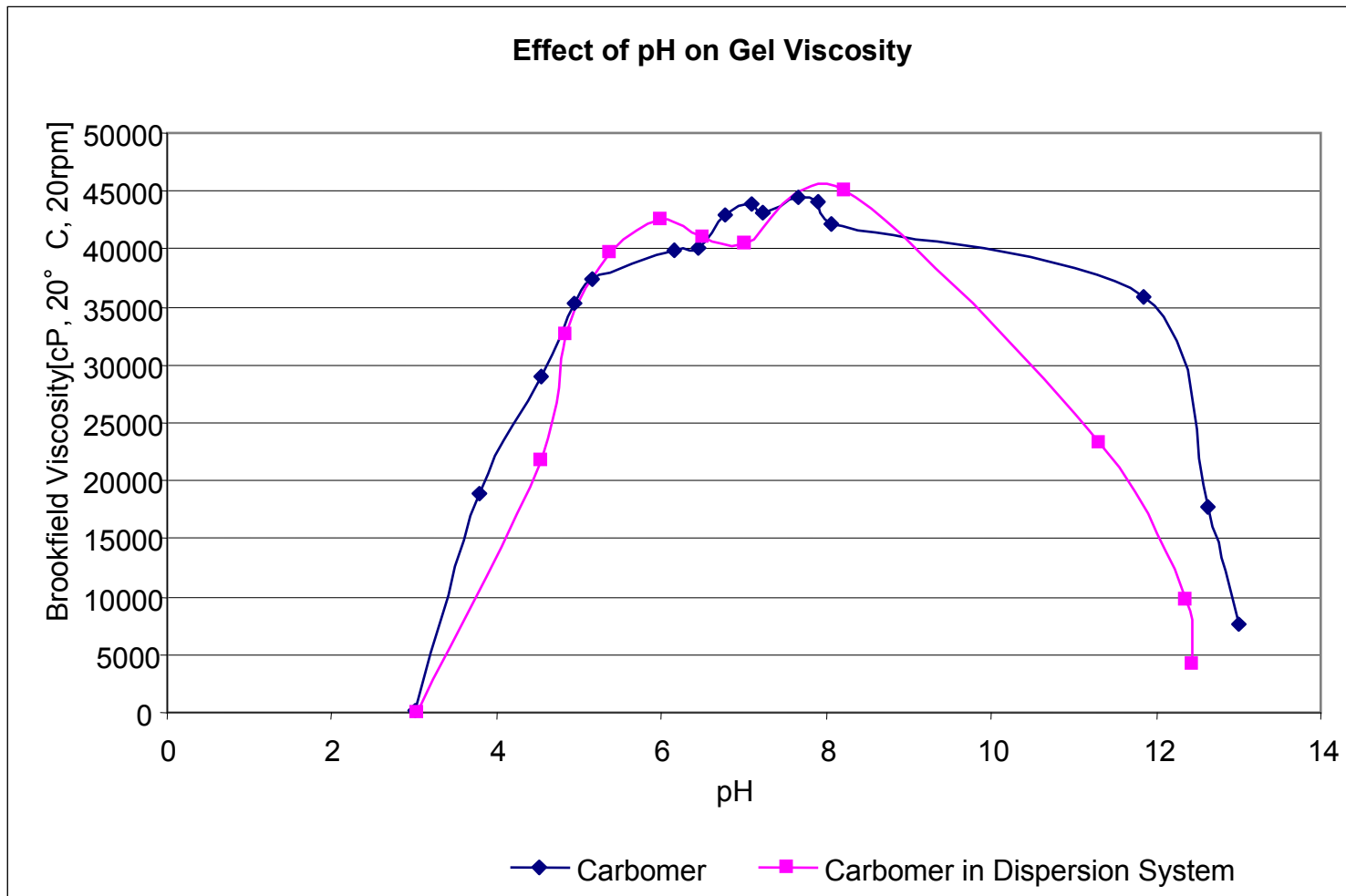
Results: Viscosity Measurements



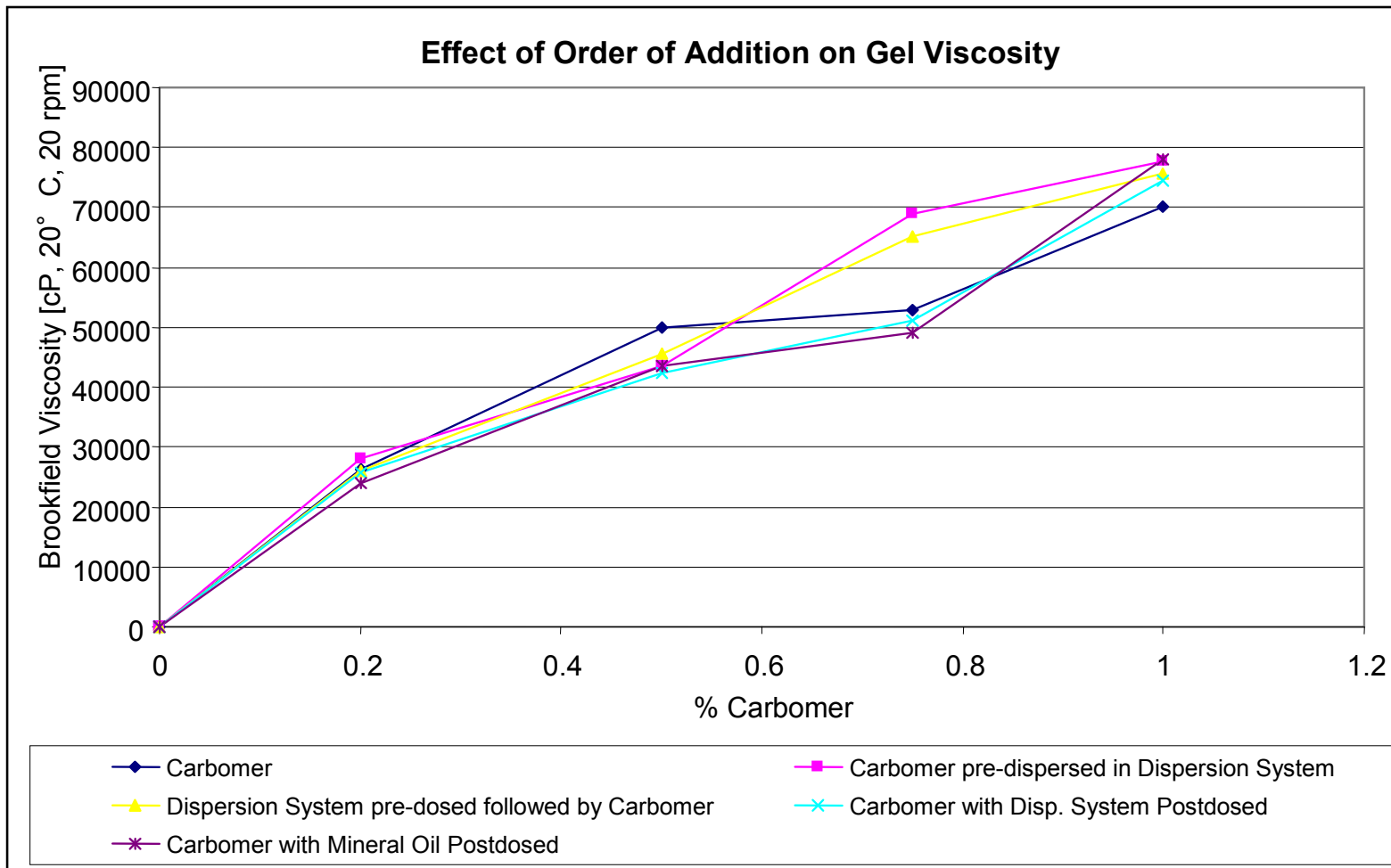
Results: Viscosity Measurements



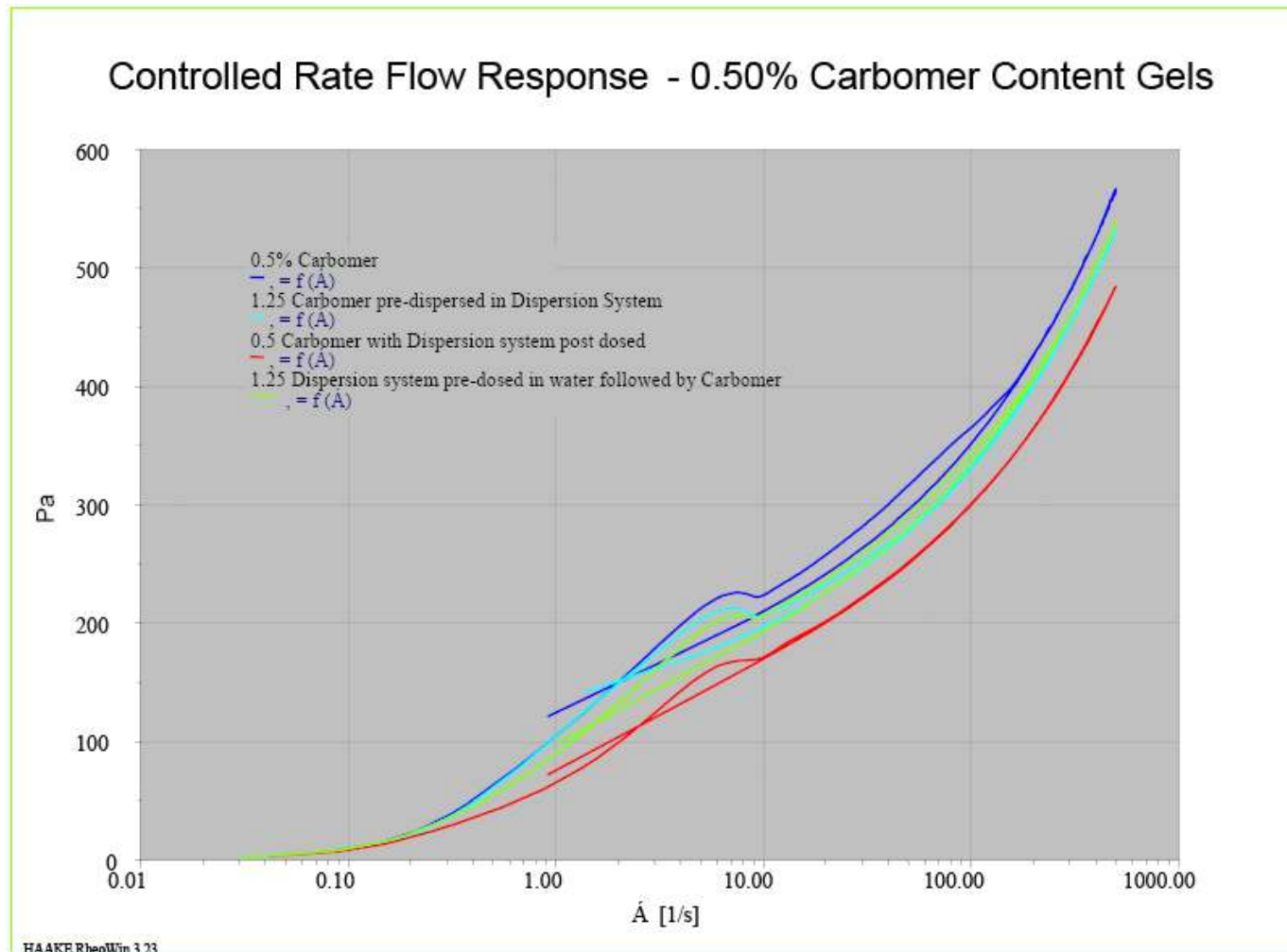
Results: Viscosity Measurements



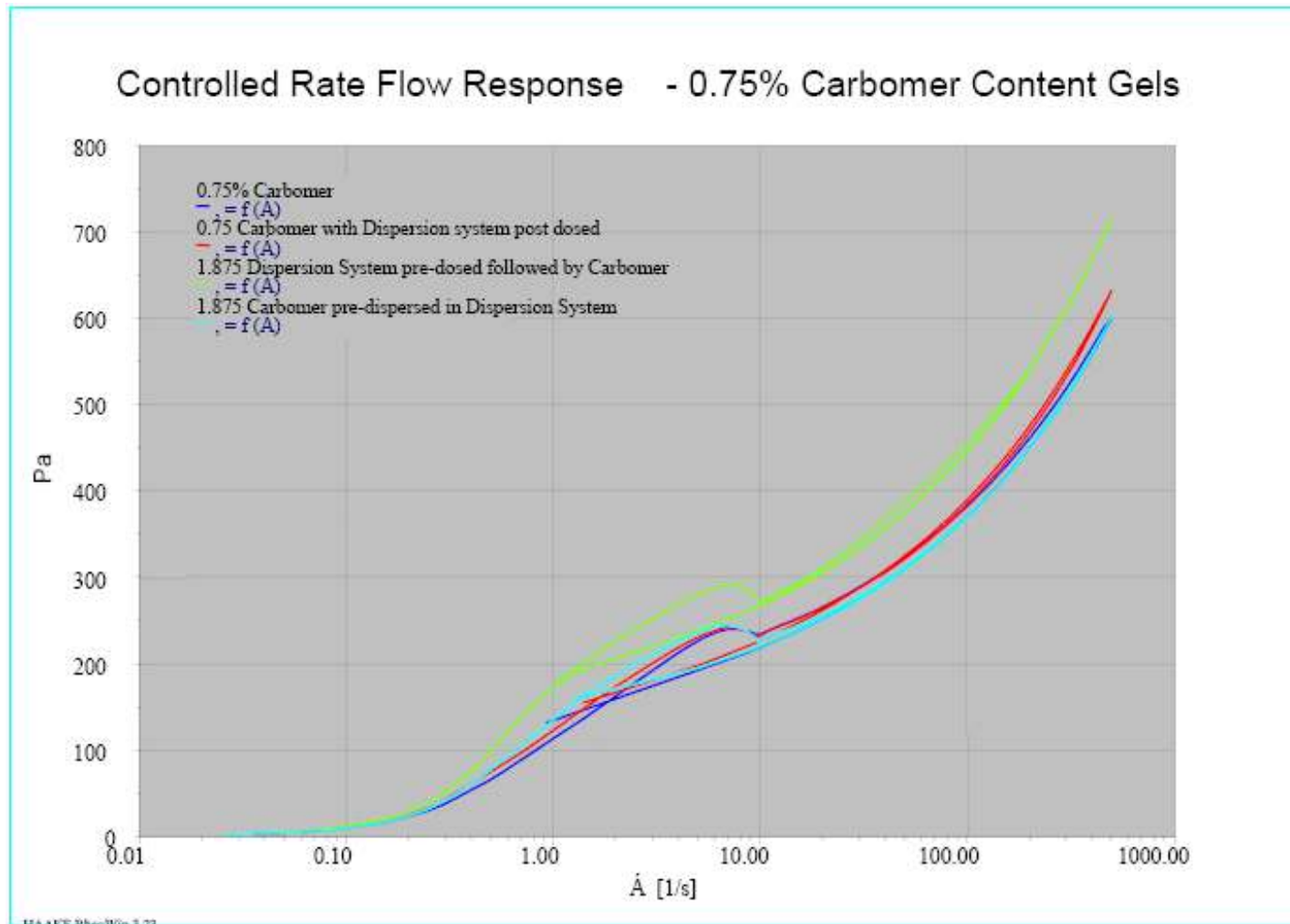
Results: Order of Addition



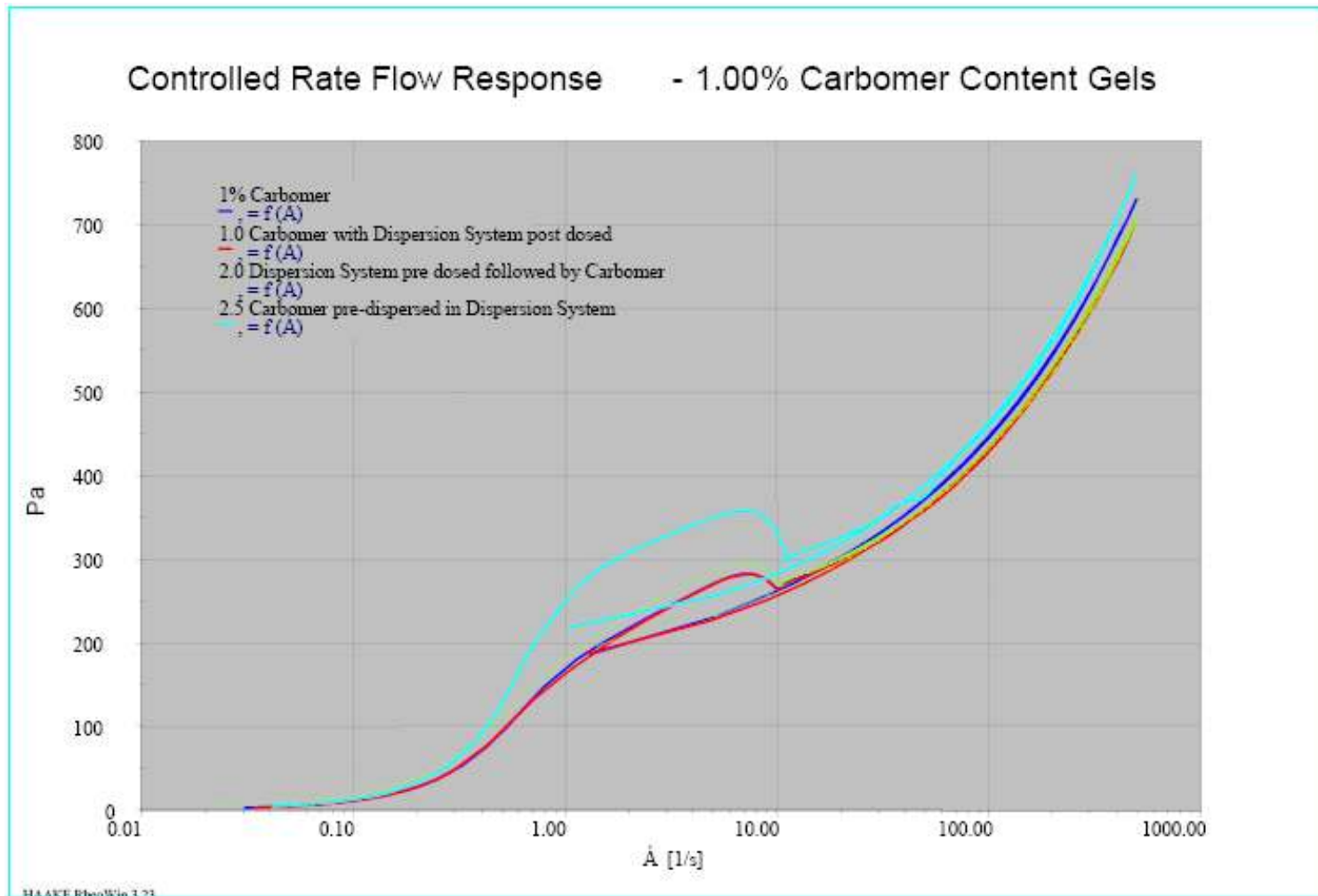
Results: Rheological Measurements (Controlled Shear Strain)



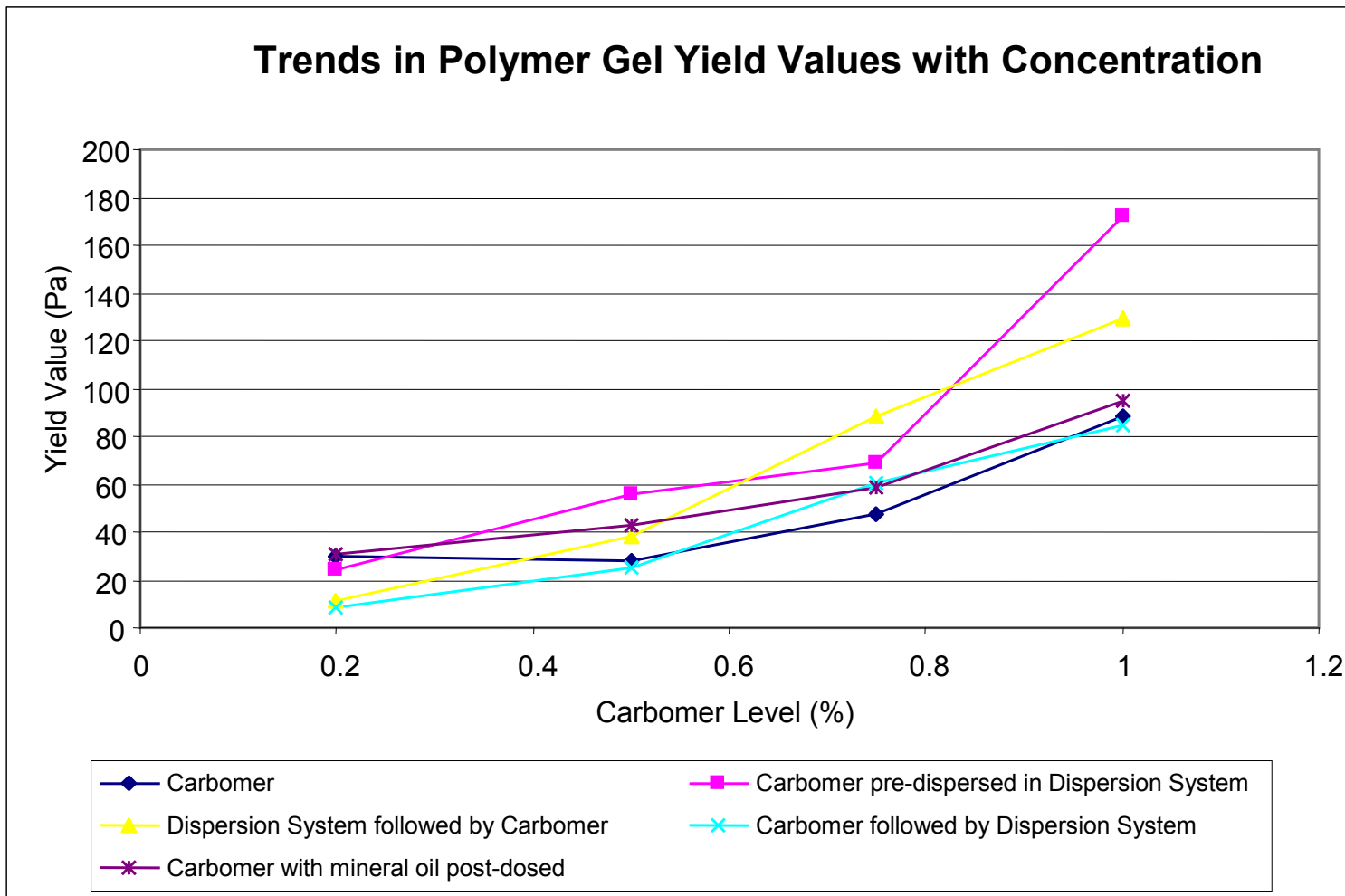
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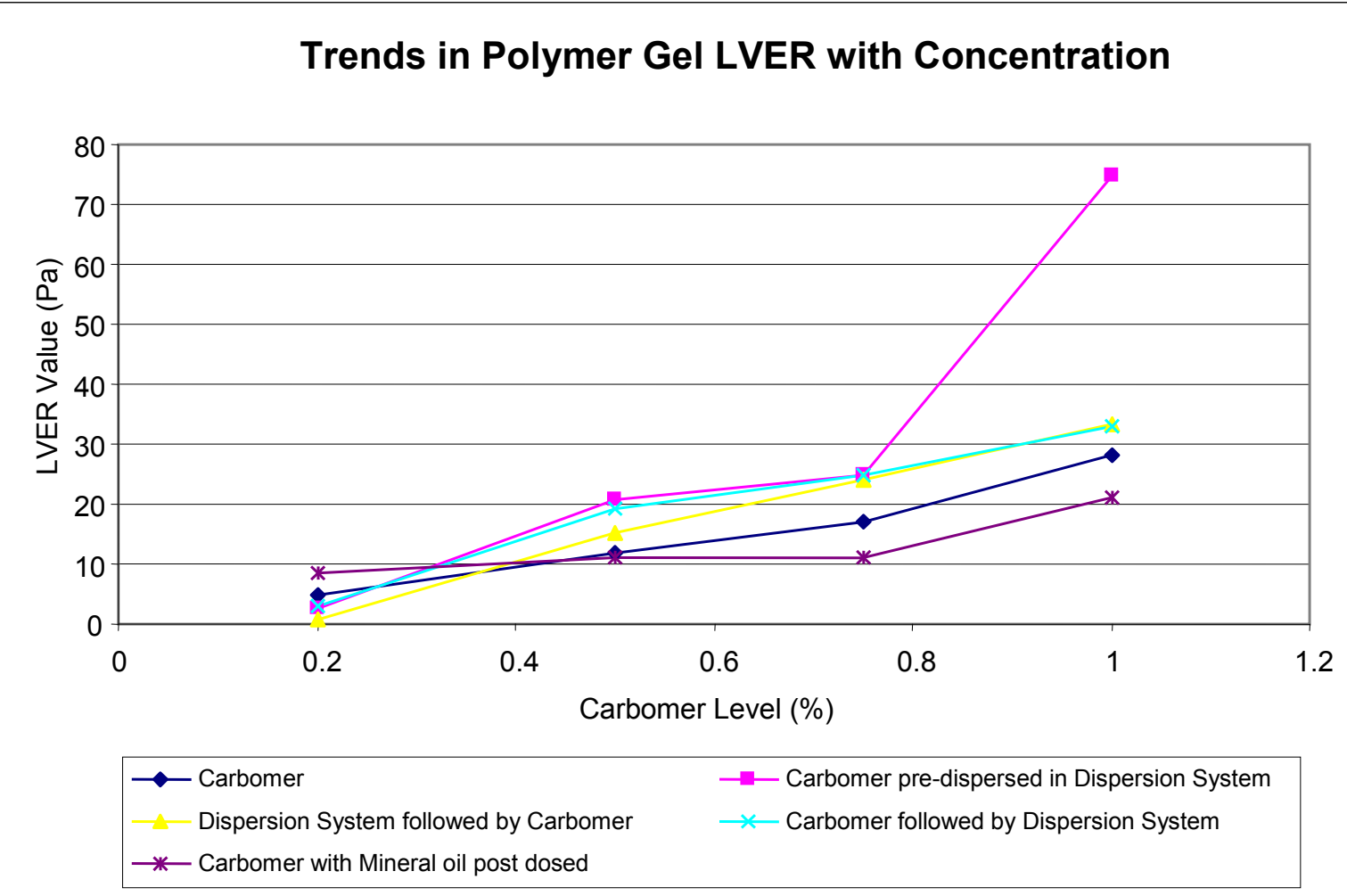
Results: Rheological Measurements (Controlled Shear Strain)



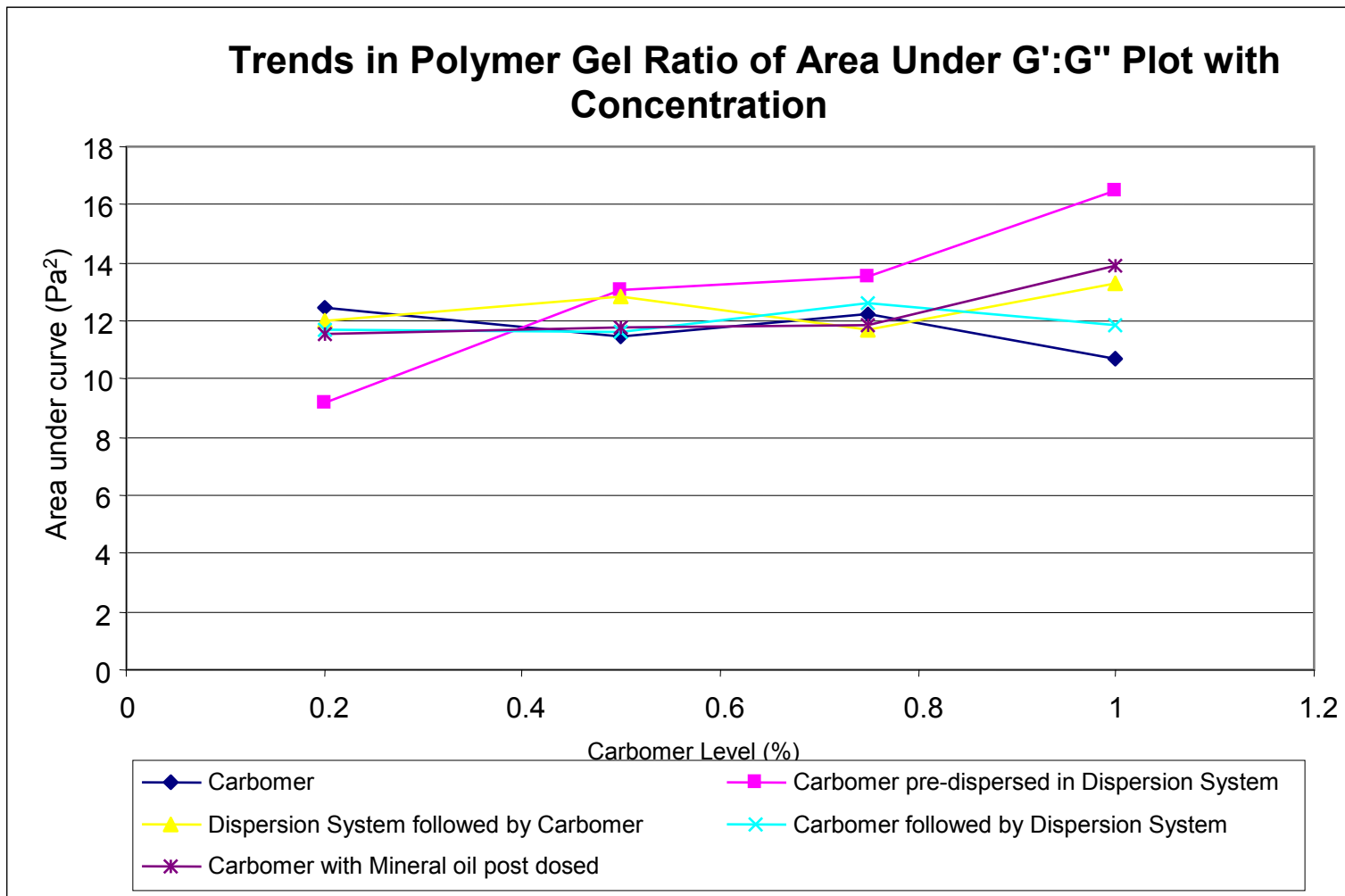
Results: Rheological Measurements (Trends in Yield Value)



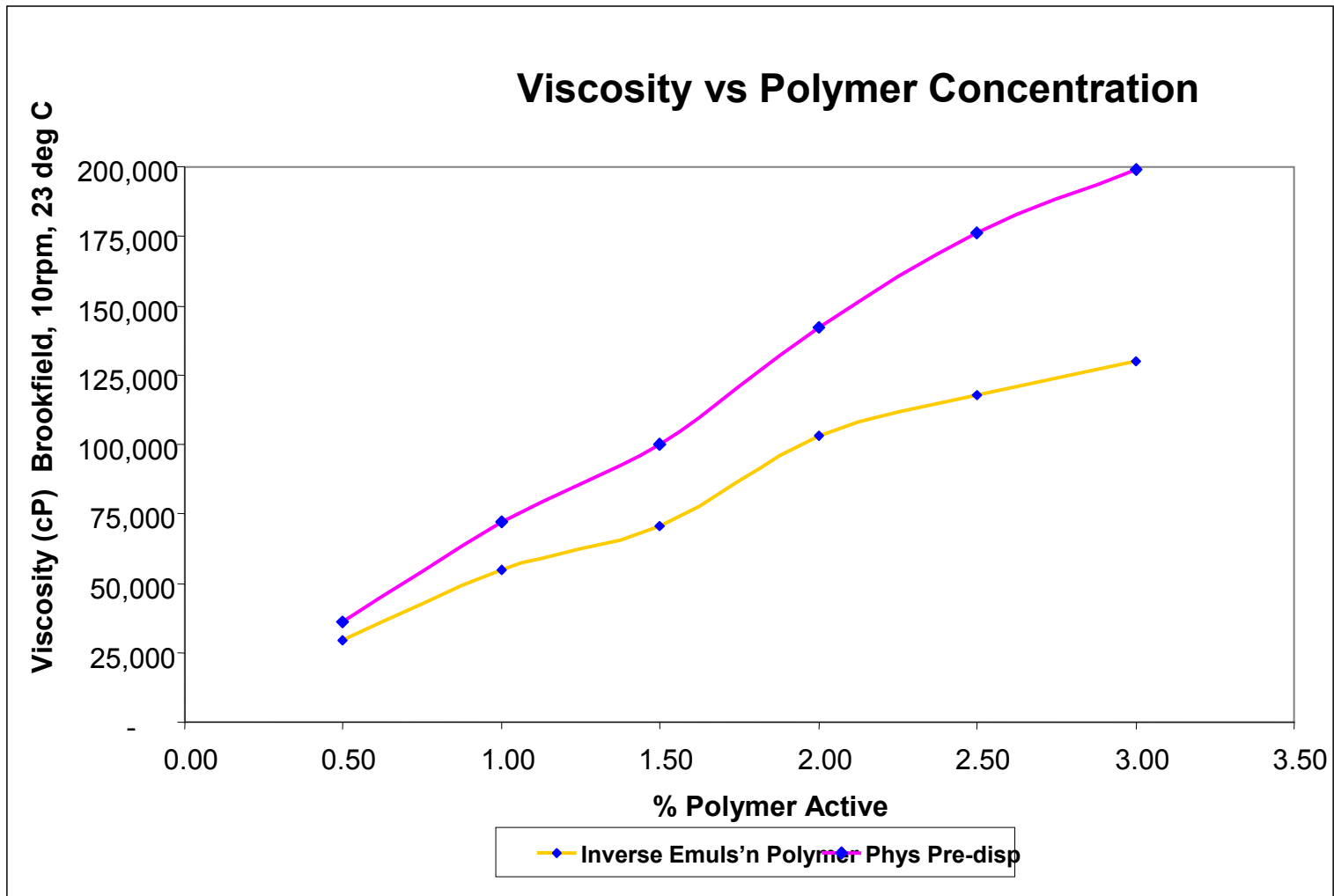
Results: Rheological Measurements (Trends in LVER)



Results: Rheological Measurements (Ratio of Area under G' , G'')



Results: Comparison with Traditional Liquid Dispersion Polymer



Results: Application in o/w Formulation

	Original	CSBY 011
Part A	% w/w	% w/w
Water, Deionised	To 100	To 100
Polymer	0.35	
Dispersion System with 46.5% Polymer		0.80
Glycerin	5.00	5.00
Part B		
Oleth-5	2.66	2.66
Steareth-20	1.33	1.33
Mineral Oil	10.00	10.00
PPG-2 Myristyl Ether Propionate	7.00	7.00
Cetearyl Ethylhexanoate (and) Isopropyl Myristate	6.00	6.00
Part C		
Triethanolamine	q.s	
Phenoxyethanol (and) Methylparaben (and) Ethylparaben (and) Butylparaben (and) Propylparaben (and) Isobutylparaben	0.50	0.50
Viscosity, cP (RVT DV-II Sp#5, 10rpm)	11,280	13,700

Results: Application in o/w Formulation

	Original	% w/w Modified
Deionized Water	qs	qs
Caprylic/Capric Triglycerides (and) Glycol Stearate (and) PEG-3 Glyceryl Cocoate (and) Steareth-7	15.00	8.00
Methyl Salicylate	30.00	30.00
PPG-5 Ceteth-20	4.00	4.00
Triethanolamine	qs	qs
Preservative	0.50	0.50
Dispersion System with 46.5% Polymer	-	0.25
<i>Viscosity, cP (Brookfield, 10 rpm)</i>	3,720	9,670

Results: Application in o/w Formulation

	% w/w
Part A	
Water, Deionised [Aqua]	To 100.00
Dispersion System with 46.5% Polymer	1.10
Part B	
Ethylhexyl Palmitate	7.00
Cyclomethicone	5.00
Vitis Vinifera Seed Oil	2.00
Part C	
Phenoxyethanol (and) Methylparaben (and) Ethylparaben (and) Butylparaben (and) Propylparaben (and) Isobutylparaben	0.50
Total	100.00
Viscosity, cP	26,400

Conclusion

- General trend pointing to the dispersion system giving gels that are more structured and stable
- The Dispersion System delivers efficient carbomer dispersion that results in incremental benefits over carbomer alone.
- Nonionic surfactant in the dispersion system contributes to the stability of the gels.



Conclusion

- Potential practical benefits to formulators:
 - Ease of use
 - Thickening and stabilising performance similar to powder polyacrylic acid polymers
 - Cold processing



Thank you.

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