

Adhesive & Sealants

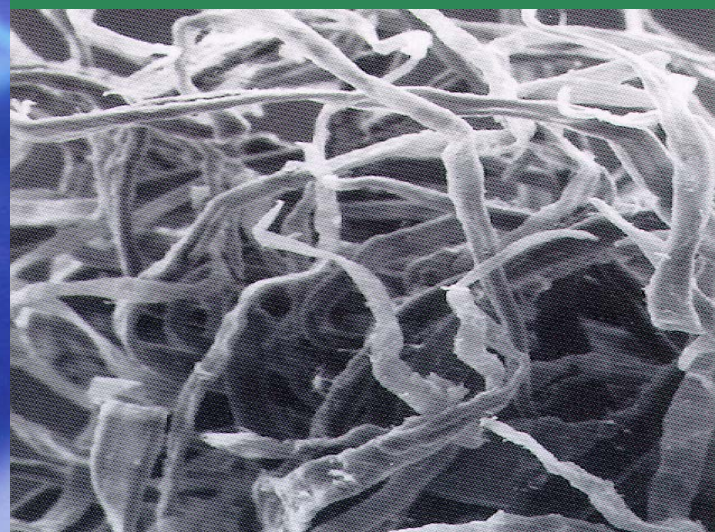
ENGINEERED CELLULOSE FIBERS

Lightweight, High Bulk Reinforcing Fiber for the Chemical Processing Industries.

interfibe™



Engineered Cellulose Fibers





Properly formulated Interfibe cellulose fibers are one of the most cost effective and unique fillers and thixotropes available to the Adhesive and Sealant industry



Gel-Cel W90 in epoxy adhesives

Dr. Dave Dunn, March 2006

Dr. Dave Dunn



- Former VP & Director of R&D and New Business Development, Loctite Corporation
- Managed New Business Development and R&D for all Loctite's automotive and consumer business in the US
- Member of the Editorial Advisory Board of Adhesives and Sealants Industry Magazine and writes monthly Q&A column entitled "Ask Dr. Dave"
- Recently acted as historical consultant and on-screen presenter for the History Channel TV program "Modern Marvels – Glue"

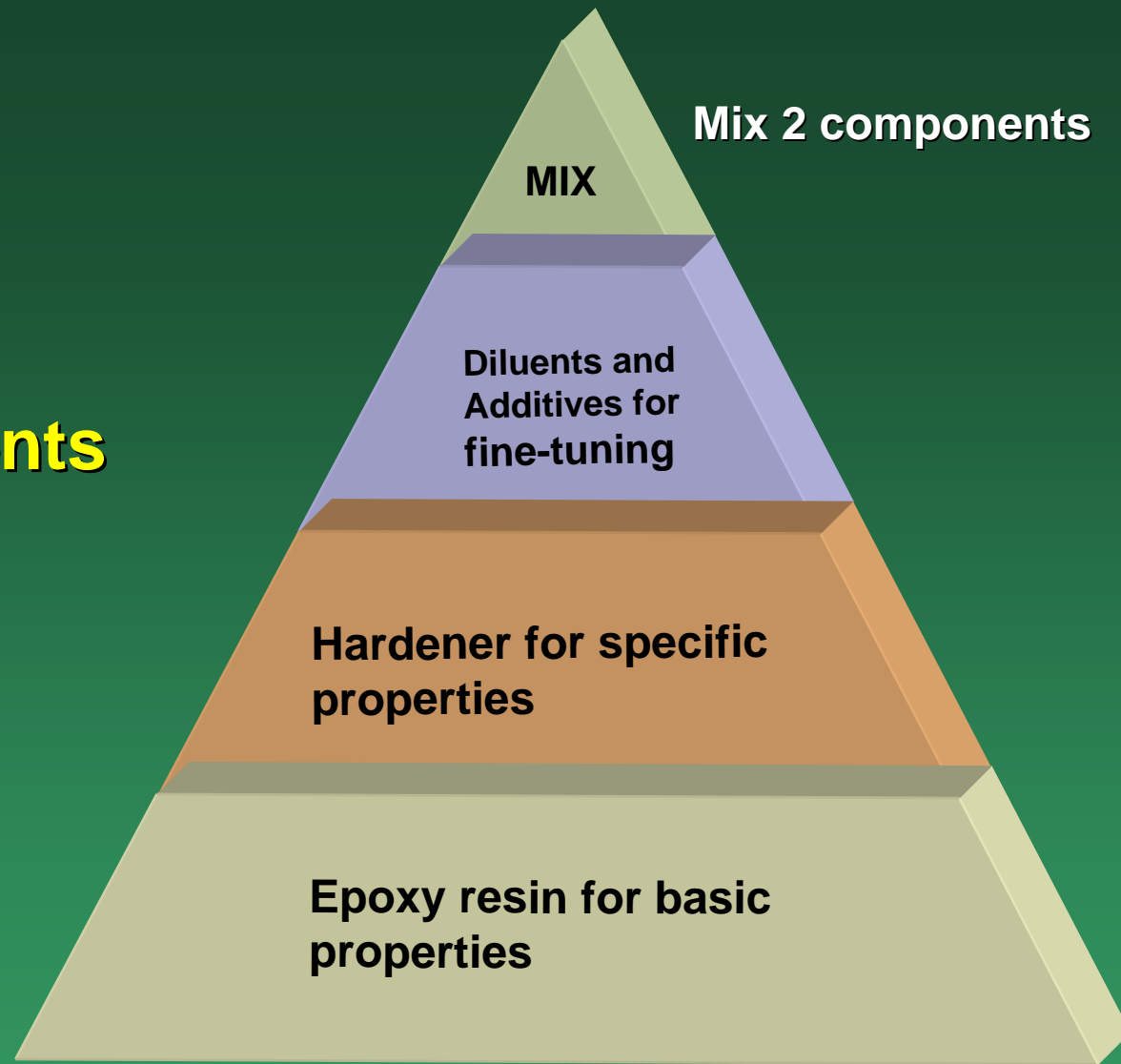


Epoxy adhesives

Epoxy adhesives are widely used in industrial, automotive, construction and consumer markets.

Consumption of two component epoxies in the US is over 30 million lbs

Components of Epoxy adhesive

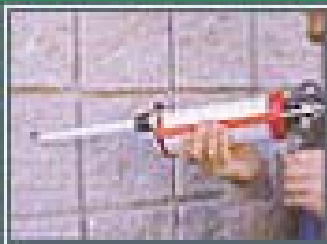
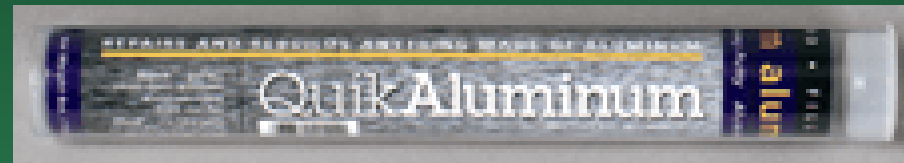
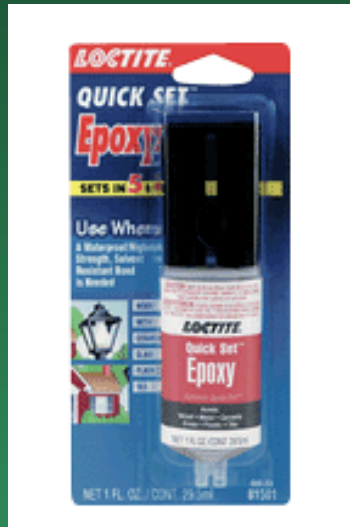


Components of Epoxy adhesive

In practice a typical two-component epoxy adhesive often comprises:

	Examples
Epoxy resin	Epon 828, DER 331
Hardener	DEH 20, Capcure 3-800 Versamids, GPM-800
Fillers	Talc, Ca carbonate, barytes
Accelerators	Versamines
Reactive diluent	Glycidyl ethers
Toughening agents	CTBN rubber
Thixotropes	Usually fumed silica

Examples – epoxy adhesives



Five Minute Consumer adhesive

<i>Resin</i>	<i>Percent</i>	<i>Mixed 1:1 with</i>	<i>Hardener</i>	<i>Percent</i>
DER 331 epoxy	78		Polymercaptan	90
DER 732 epoxy	20		Ancamine K-64	8
Fumed silica	2		Fumed silica	2

Five Minute Metallic Paste

<i>Resin</i>	<i>Percent</i>	<i>Mixed 1:1 with</i>	<i>Hardener</i>	<i>Percent</i>
DER 331 epoxy	45		Polymercaptan	35
Barytes	20		DEH-20	8
Ca carbonate	20		Weston PTP	2
Iron oxide	14		Barytes	10
Fumed silica	1		Kaolin	6
			Ca carbonate	35
			TiO ₂	3
			Fumed silica	1

Thixotropes for epoxies

Fumed silicas:

Hydrophilic

Cabosil M5

Aerosil 200

Hydrophobic

Cabosil TS-720

Aerosil 202

Thixatrol –castor oil derivative - requires heat and shear for activation.

Organo clays –require polar additive. Sometimes cause crystallization

Kevlar pulp – very expensive

Interfibe cellulose fibers

Thixotropes for epoxies

The low cost hydrophilic fumed silicas like Cabosil M5 and Aerosil 200 are rarely used with new epoxy adhesive formulations these days because they tend to lose viscosity on aging and most people are using expensive treated hydrophobic silicas like Aerosil 202 or Cabosil TS-720.

Comments from manufacturers

Why do you use thixotropes in your adhesives?

- “Need predictable stable viscosity”
- “Need sag resistance in some industrial products”
- “ We want anti-settling in filled products
- “We need to get the resin and hardener to look and feel the same to get the best mixing. Also need to have good thixotropy to flow well onto the surfaces but then thicken up so we don't get squeeze-out from the bond”

Comments from manufacturers

How satisfied are you with the performance of your current fumed silica?

Very satisfied	14%
Somewhat satisfied	86%
Unhappy	0

Comments from manufacturers

Are there any negatives associated with using your current fumed silica?

Handleability : Dust is major problem – all respondents say this

Cost: Pay \$2-3/lb for hydrophilic, \$5-6/lb for hydrophobic grades

Comments from manufacturers

Other comments:

“Viscosity sometimes increases over time”

“M5 is used in old products where we have no problems. In products or products where there are viscosity problems we use TS720 and also for new products.”

“M5 doesn't maintain viscosity on aging. If you over-shear the fumed silicas into epoxies, it takes a lot of time for viscosity to stabilize (ie. thicken) so there is a temptation to correct low viscosity batches by adding more fumed silica but this causes high viscosity problems in the future on shelf aging”

Comments from manufacturers

Other comments:

“Fumed silica not nearly as good as asbestos but not as dangerous either!”

Comparison of W90 and Cabosil TS-720 in epoxies

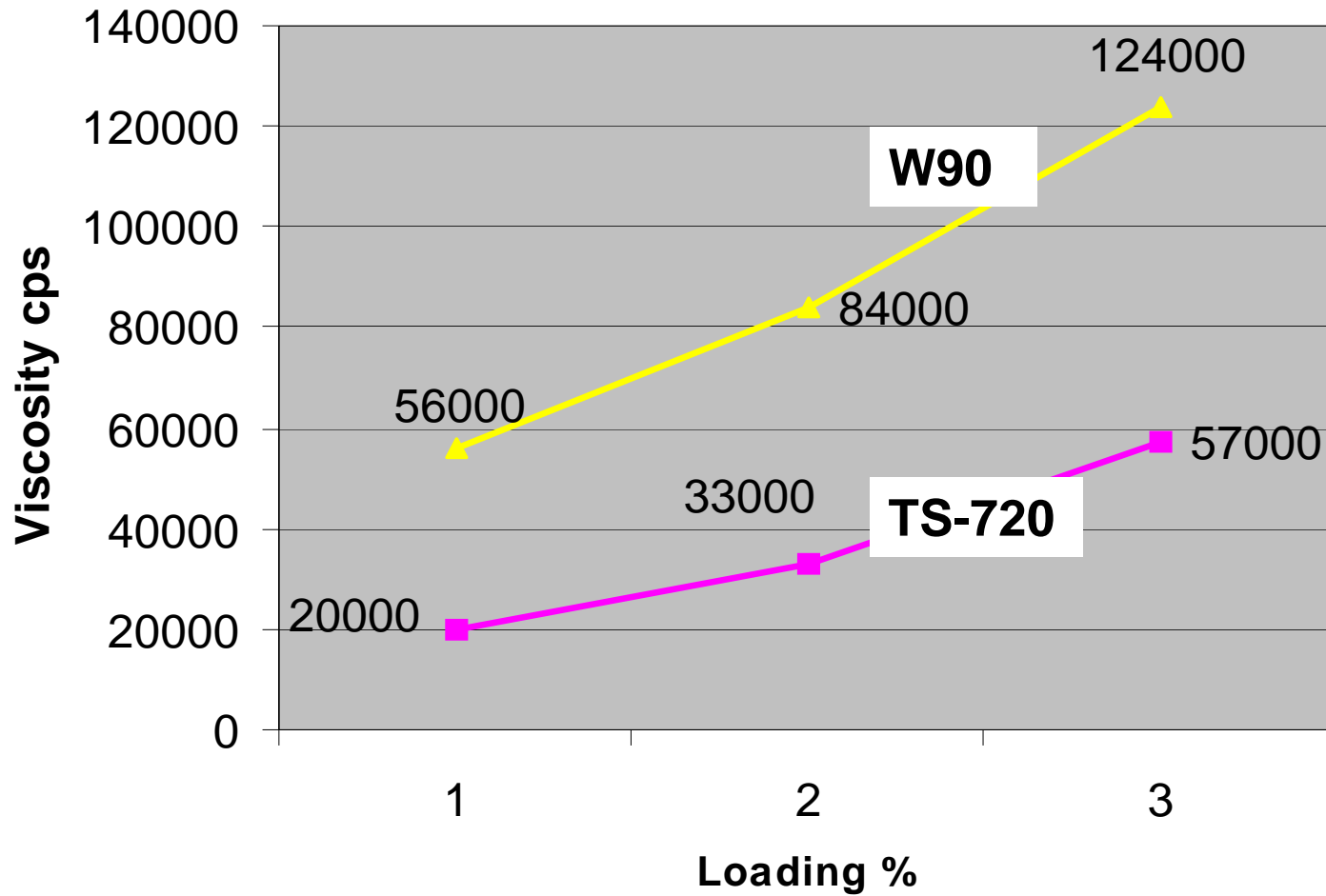
Two systems studied:

1. In base epoxy resin Epon 828
1. In filled Epon 828 – 30% calcium carbonate

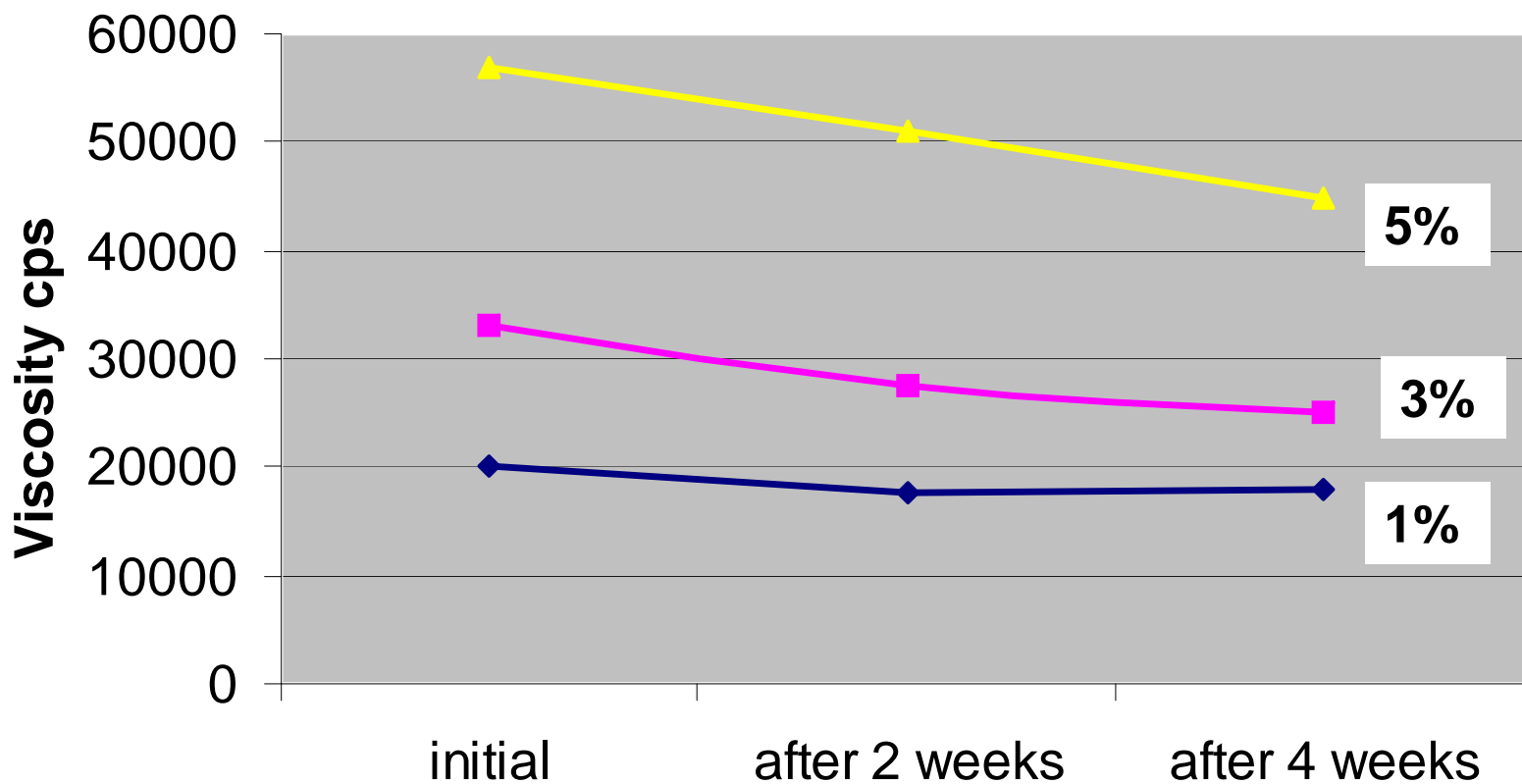
Unfilled systems in Epon 828

Thixotropes Cabosil TS-720 and Interfibe™ W90 were added to base resin and mixed with high shear for 15 minutes

Initial viscosity in Epon 828

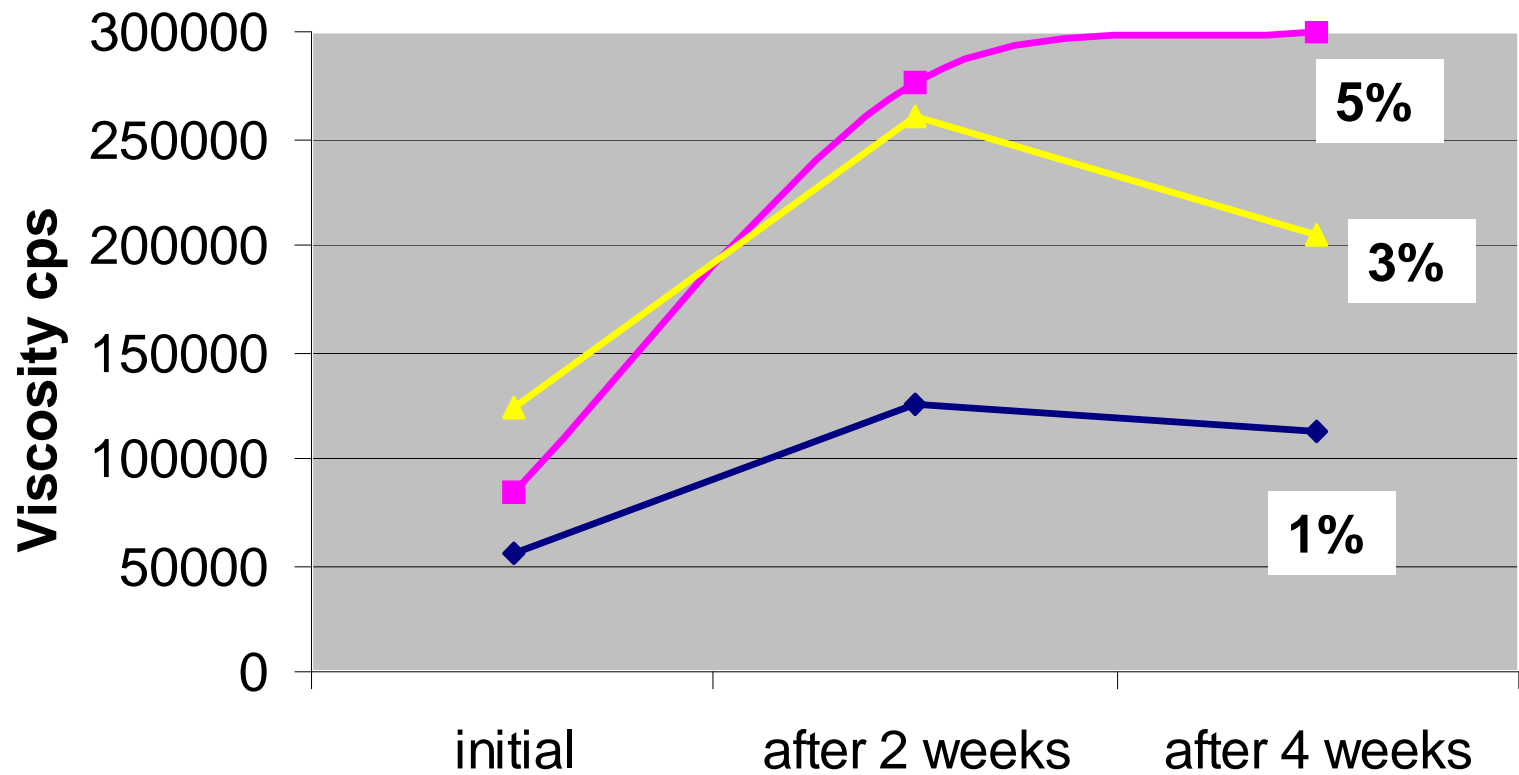


Cabosil TS720 room temp in Epon 828



4 WEEKS AGING

W90 room temp in Epon 828

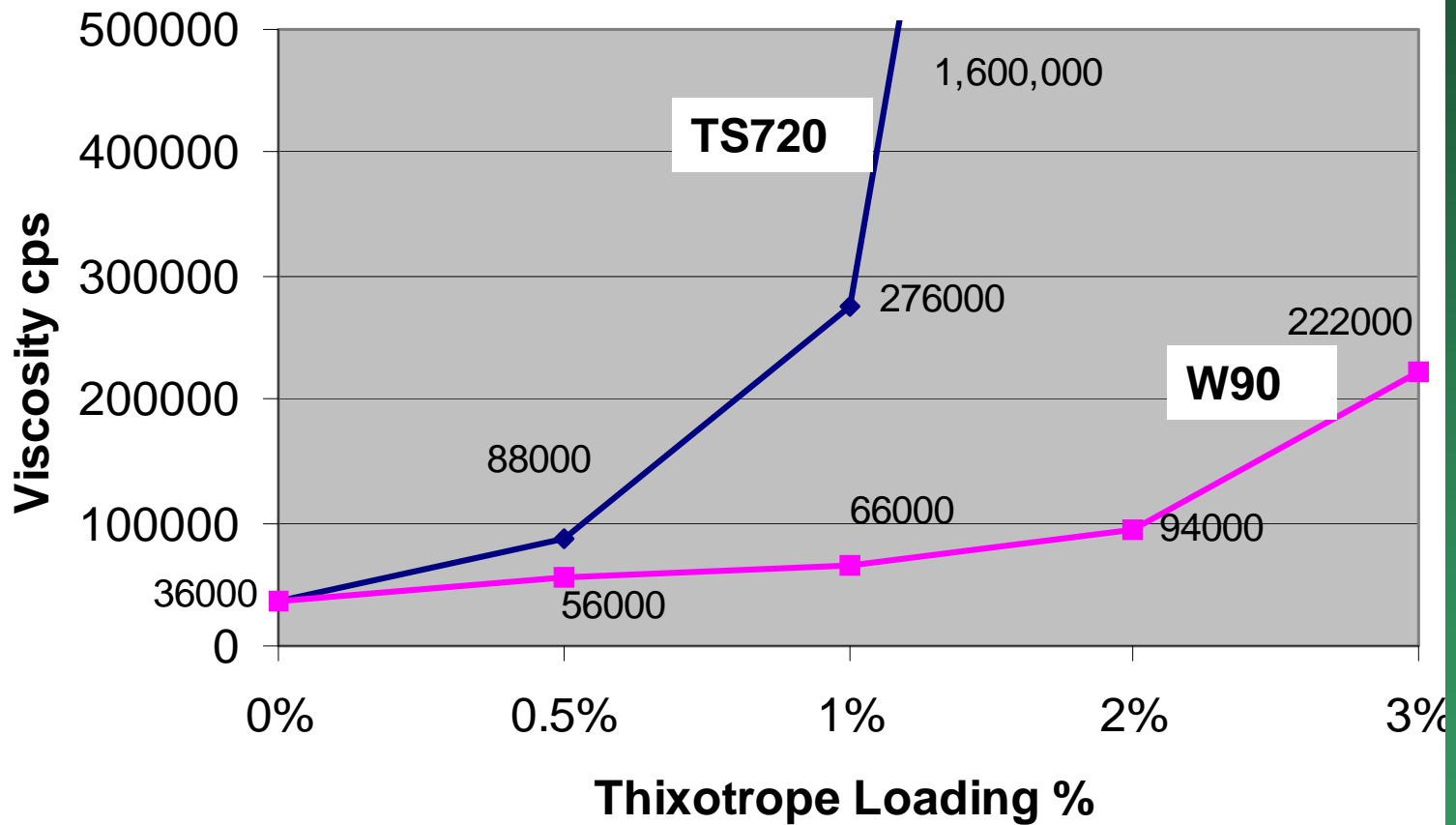


4 WEEKS AGING

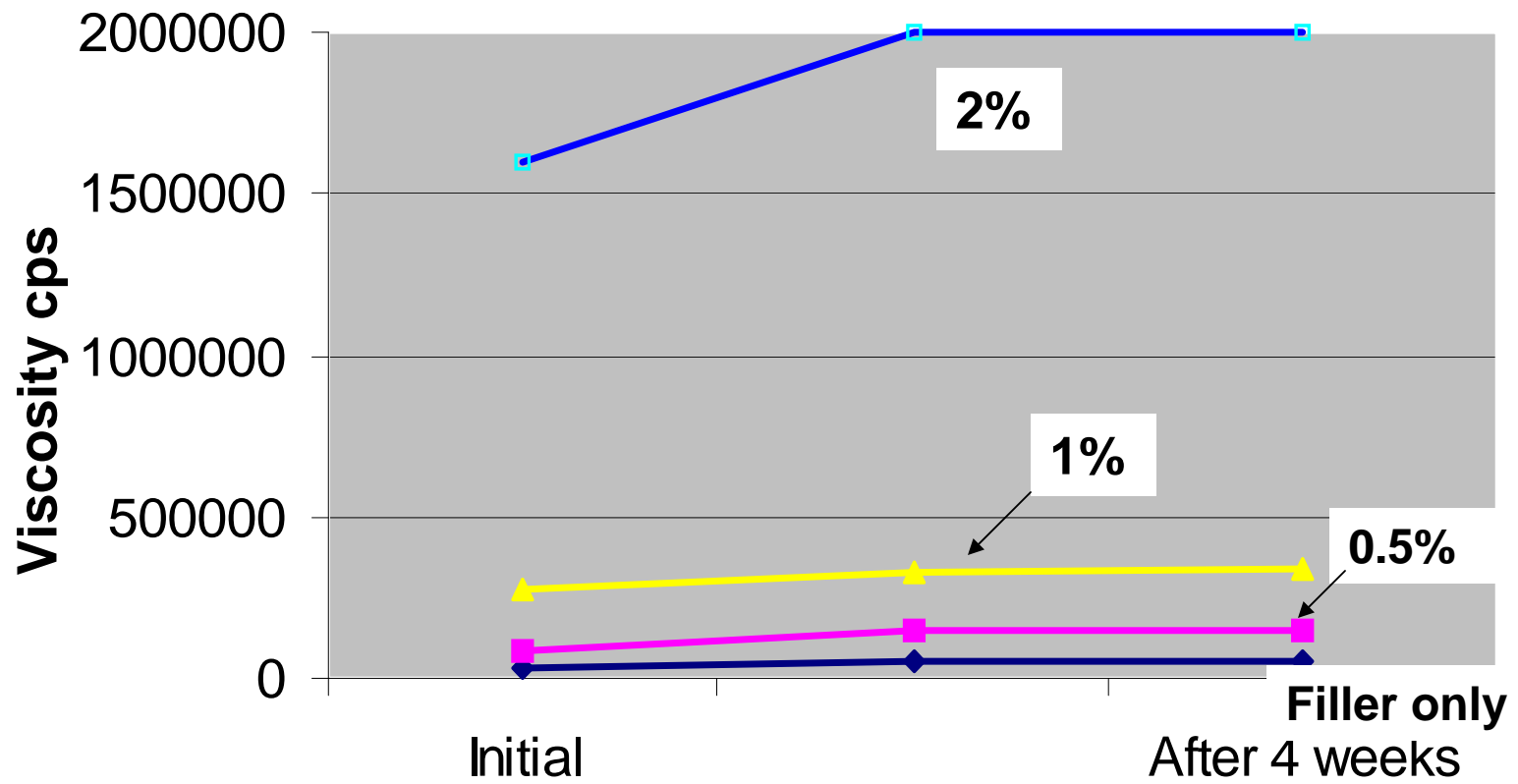
Filled systems in Epon 828

Thixotropes Cabosil TS-720 and Interfibe™ W90 were added to Epon 828 and mixed with high shear for 20 mins. Then Omyacarb UF added and mixed for a further 40 mins.)

Initial viscosity in filled Epon 828

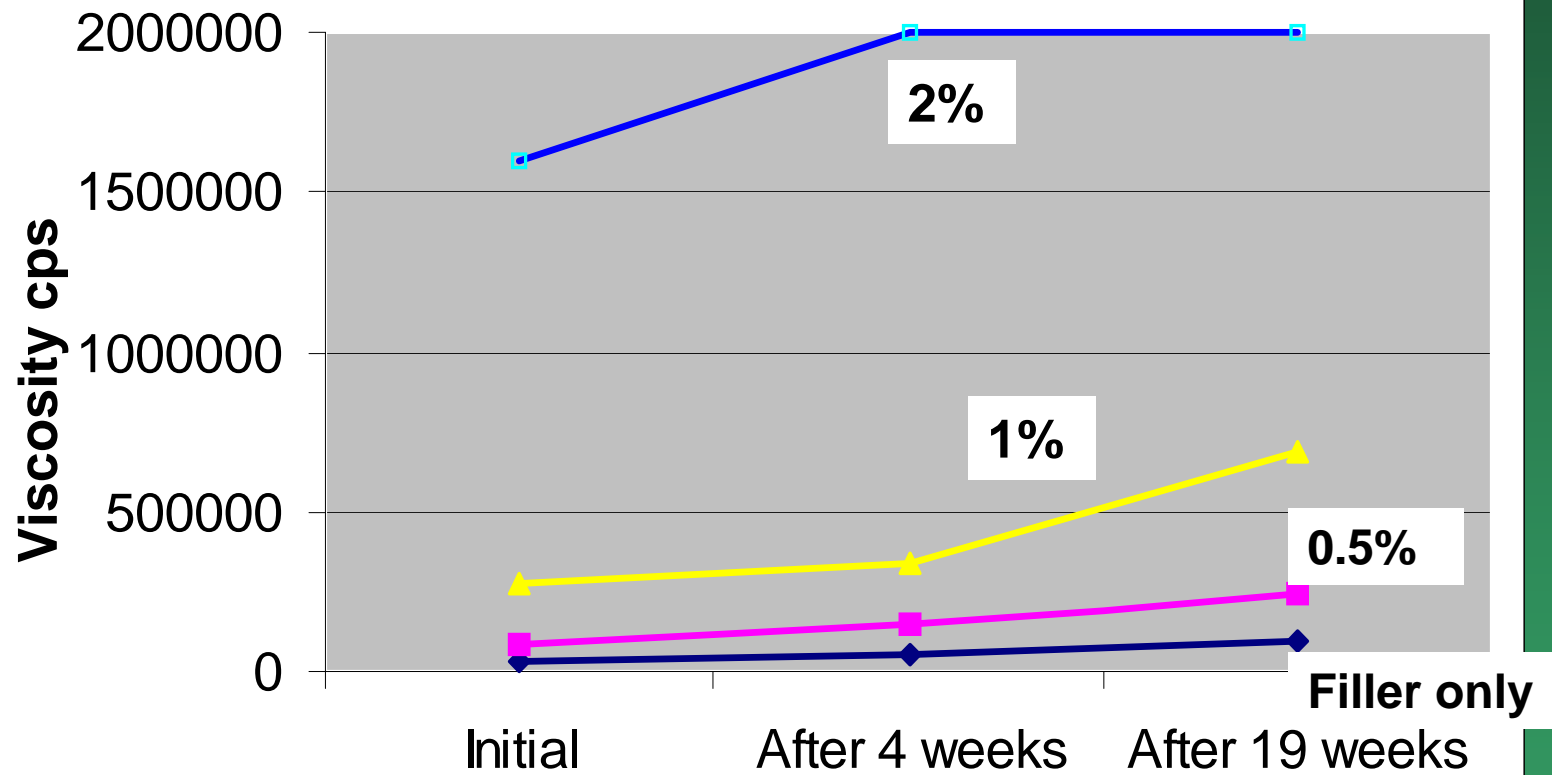


Cabosil TS720 in filled Epon 828



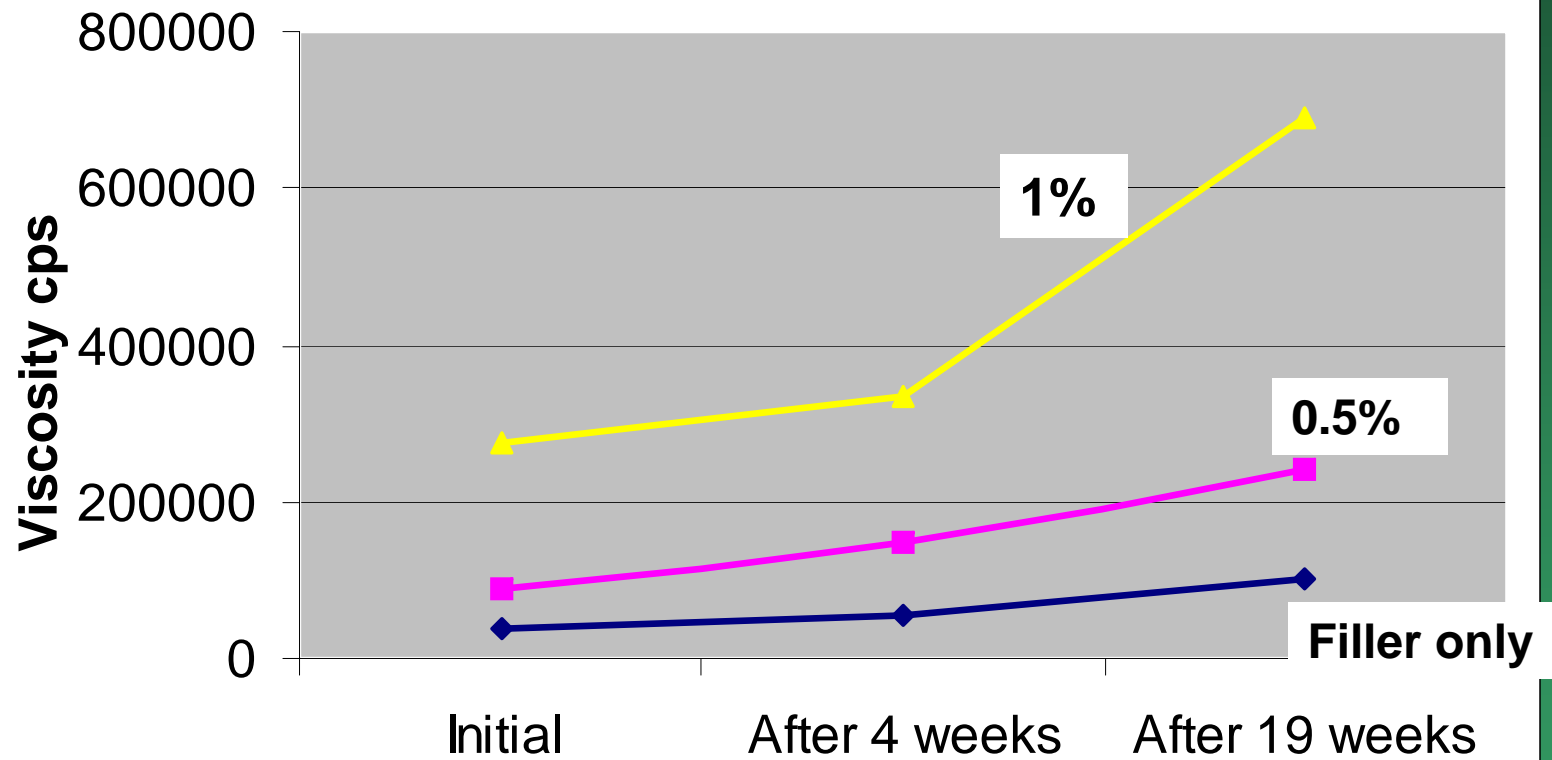
4 WEEKS AGING

Cabosil TS720 in filled Epon 828



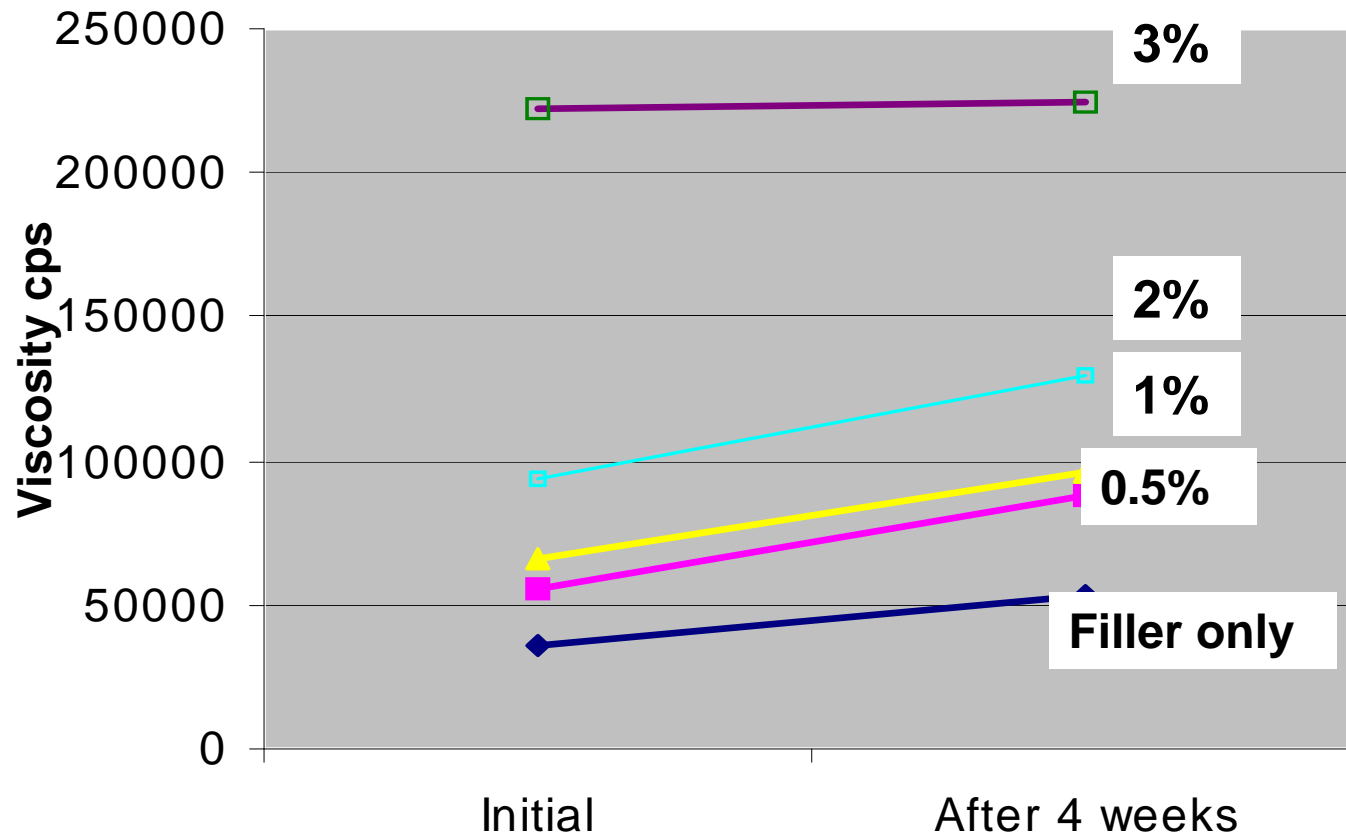
19 WEEKS AGING

Cabosil TS720 in filled Epon 828



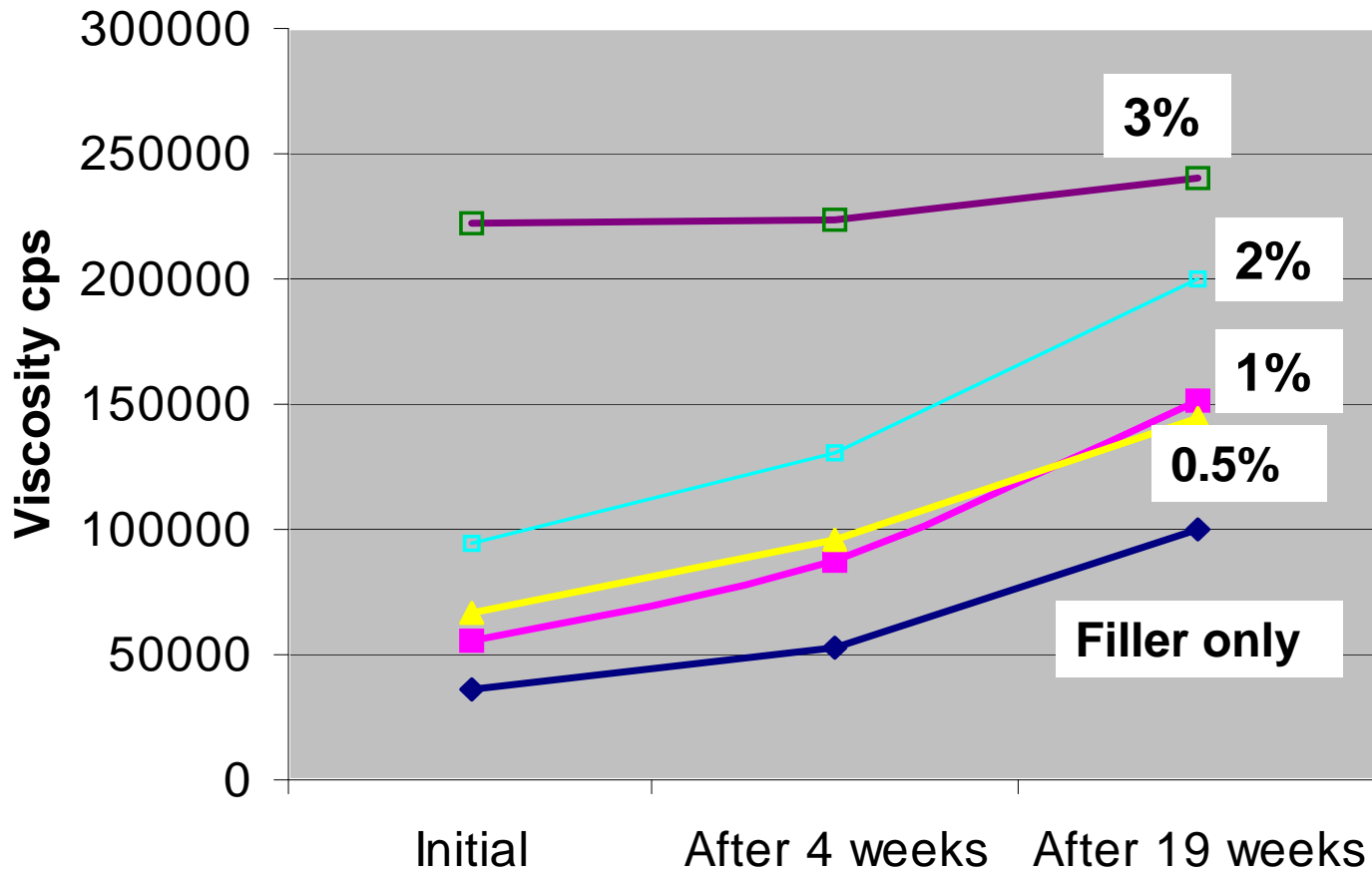
19 WEEKS AGING

Interfibe W90 in filled Epon 828



4 WEEKS AGING

Interfibe W90 in filled Epon 828



19 WEEKS AGING

Conclusions

- Cabosil TS-720 is a widely used, but not perfect thixotrope. In unfilled epoxy resin, viscosity decreases with time
- Interfibe™ W90 is much more effective than hydrophobic fumed silica at thickening unfilled epoxy resins

Conclusions

- In filled systems, Cabosil TS-720 is an effective thickener but viscosity becomes very sensitive to loading at loadings over 1%
- Interfibe™ W90 is not as efficient in thickening filled systems but is much more controllable than fumed silica at loadings over 1%
- Both thixotropes show increases in viscosity on aging
- Interfibe™ W90 is much easier to handle than fumed silica –no dust and incorporates very easily