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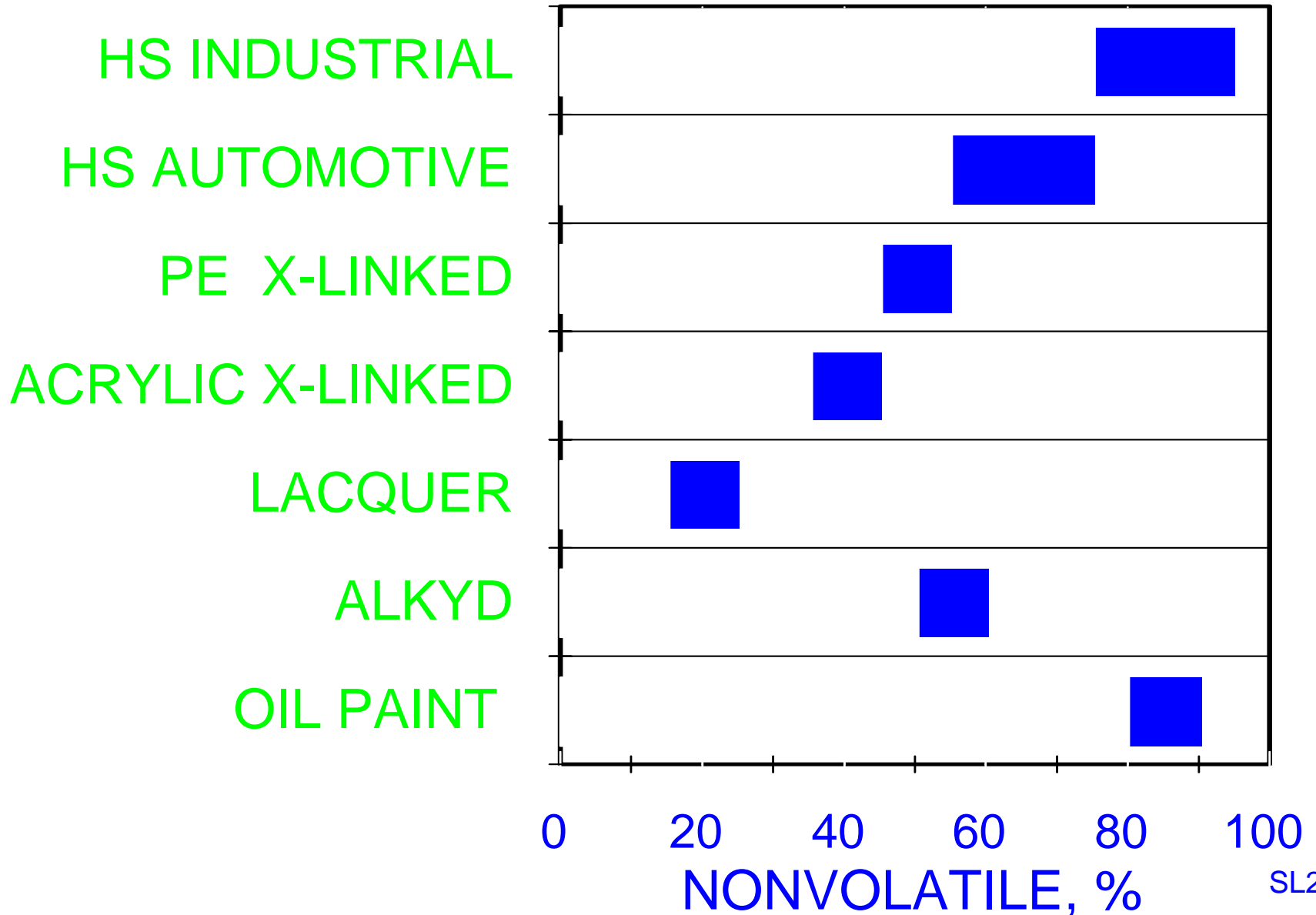
HIGH SOLIDS COATINGS

WERNER J. BLANK

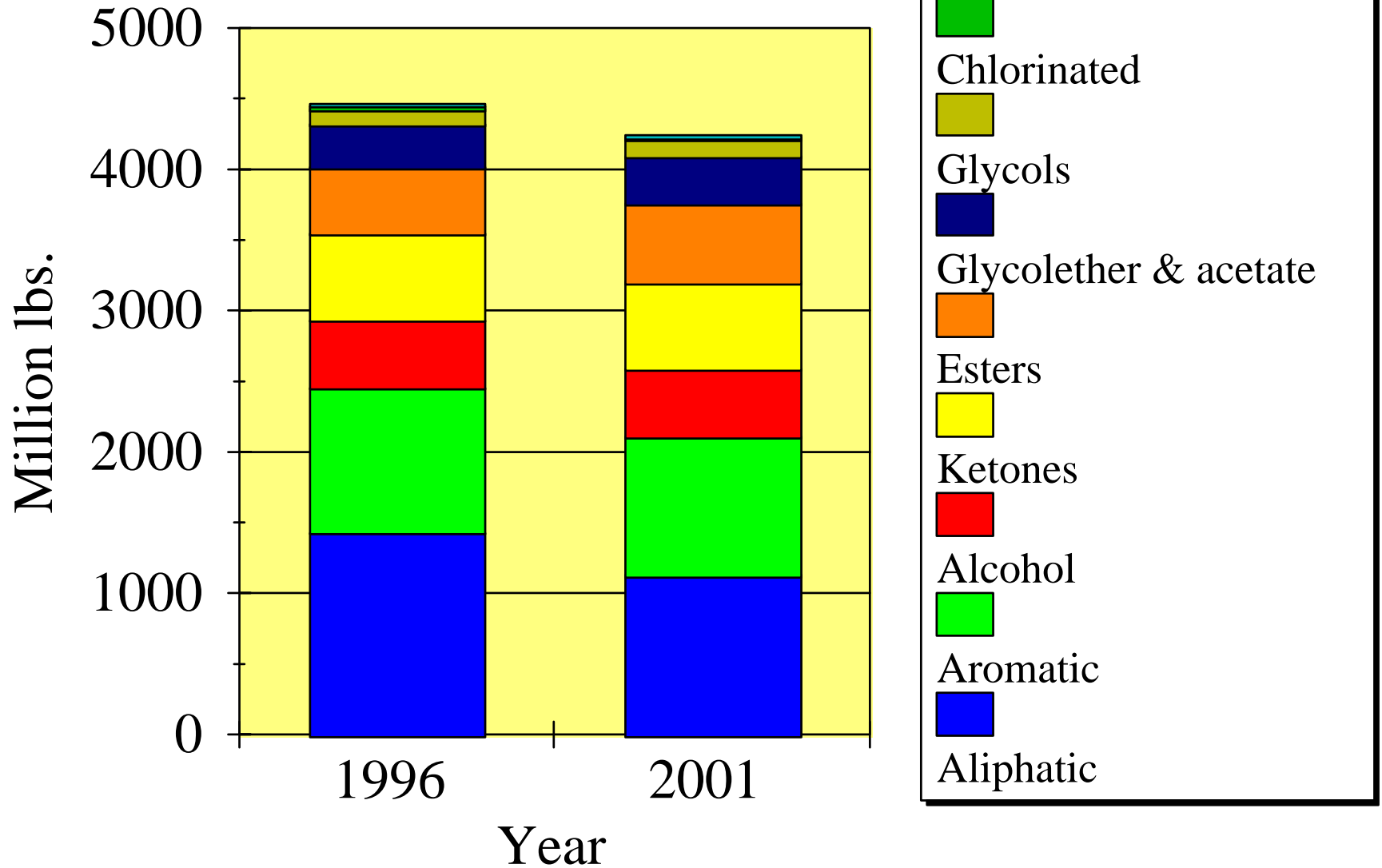
KING INDUSTRIES

wblank@kingindustries.com

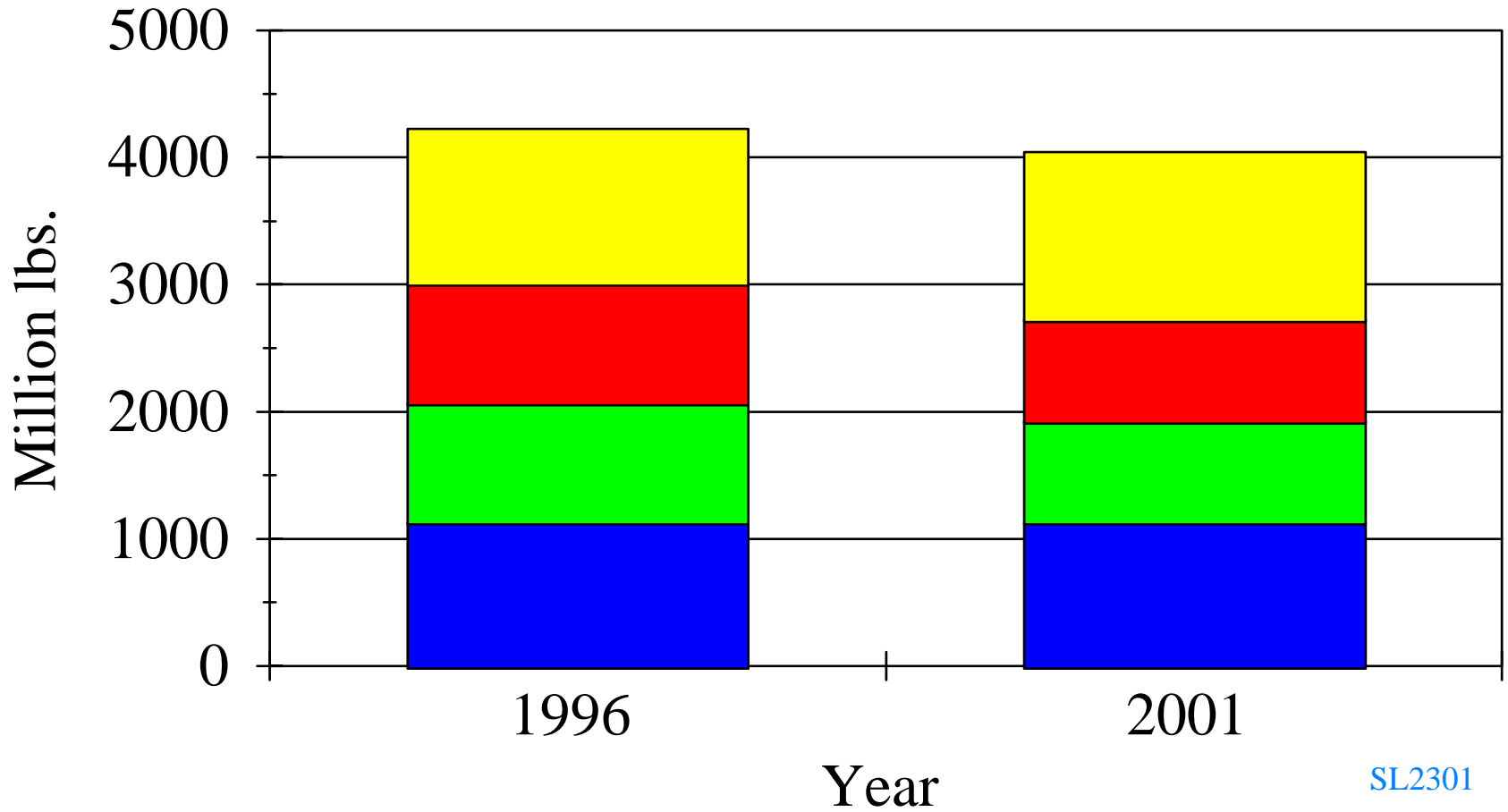
NONVOLATILE OF COATINGS



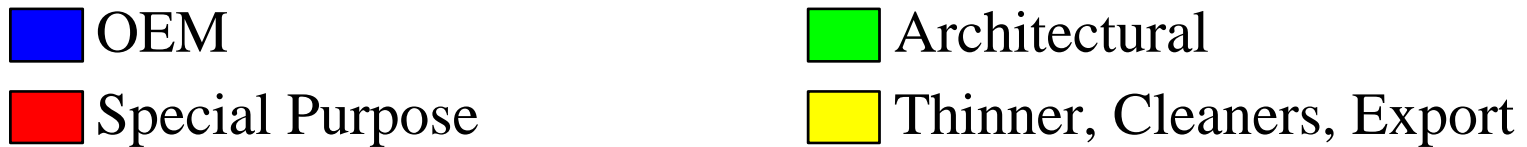
Coating Solvents USA



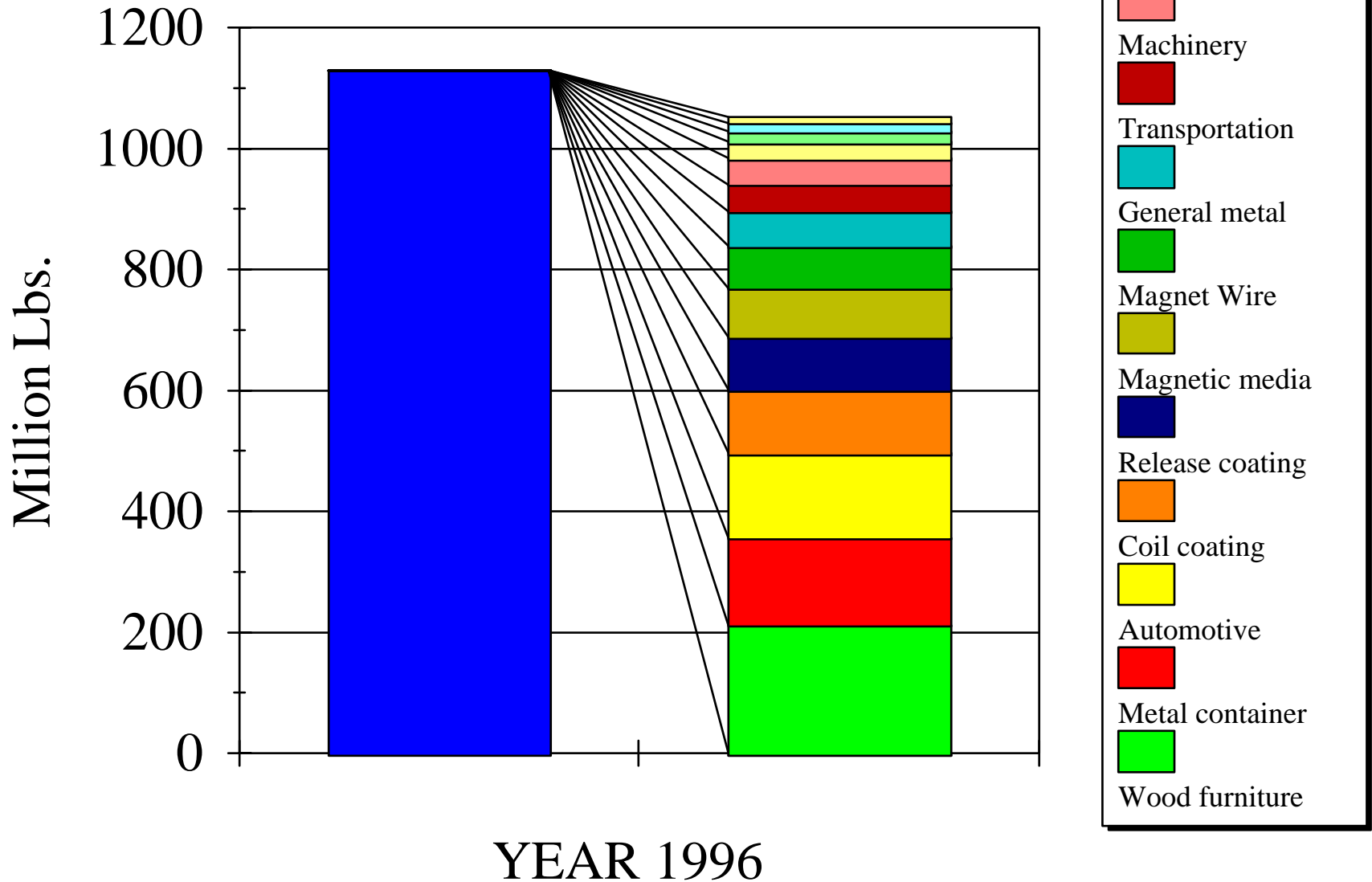
Coatings Solvents End Use



SL2301

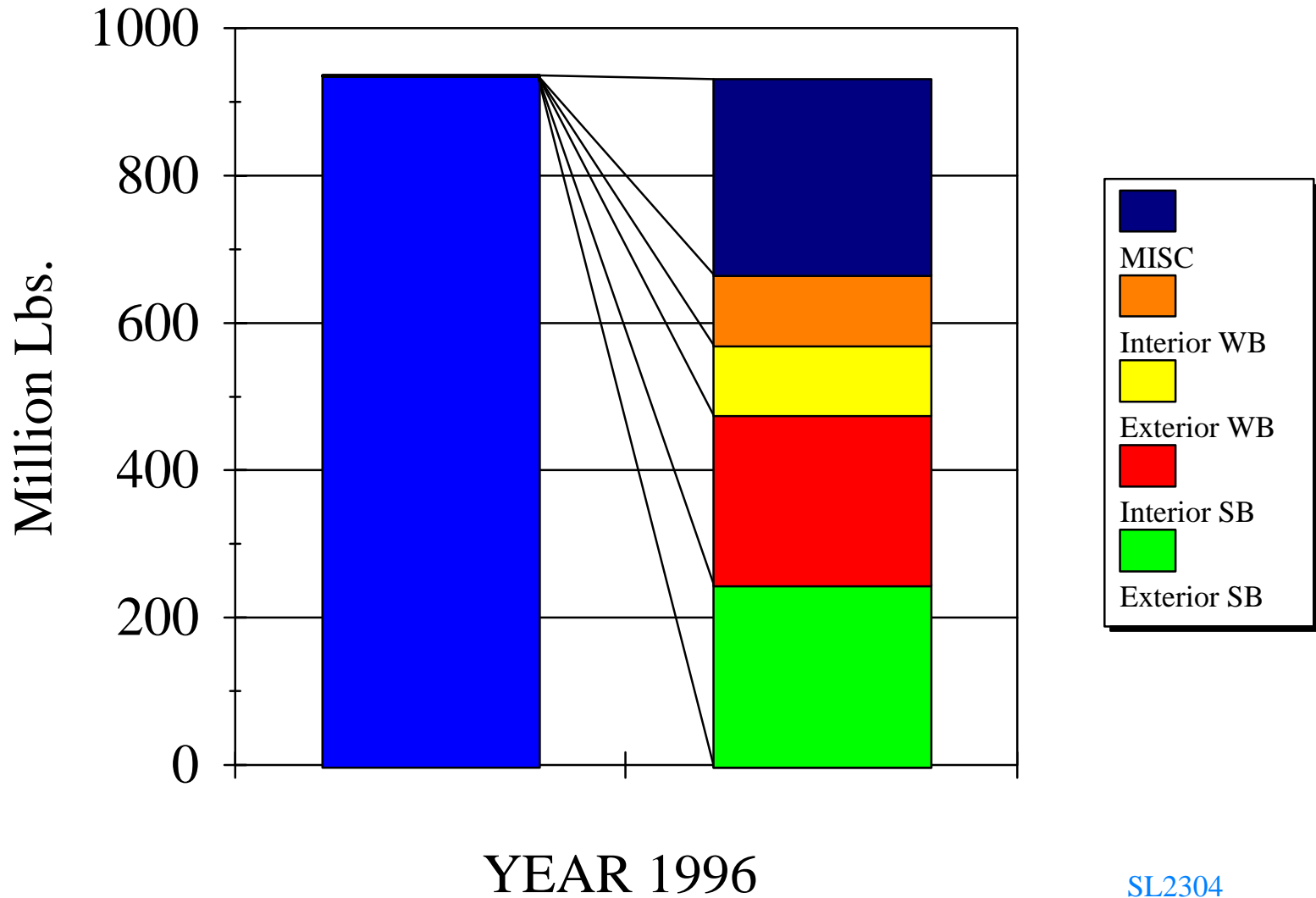


Solvents Coatings OEM



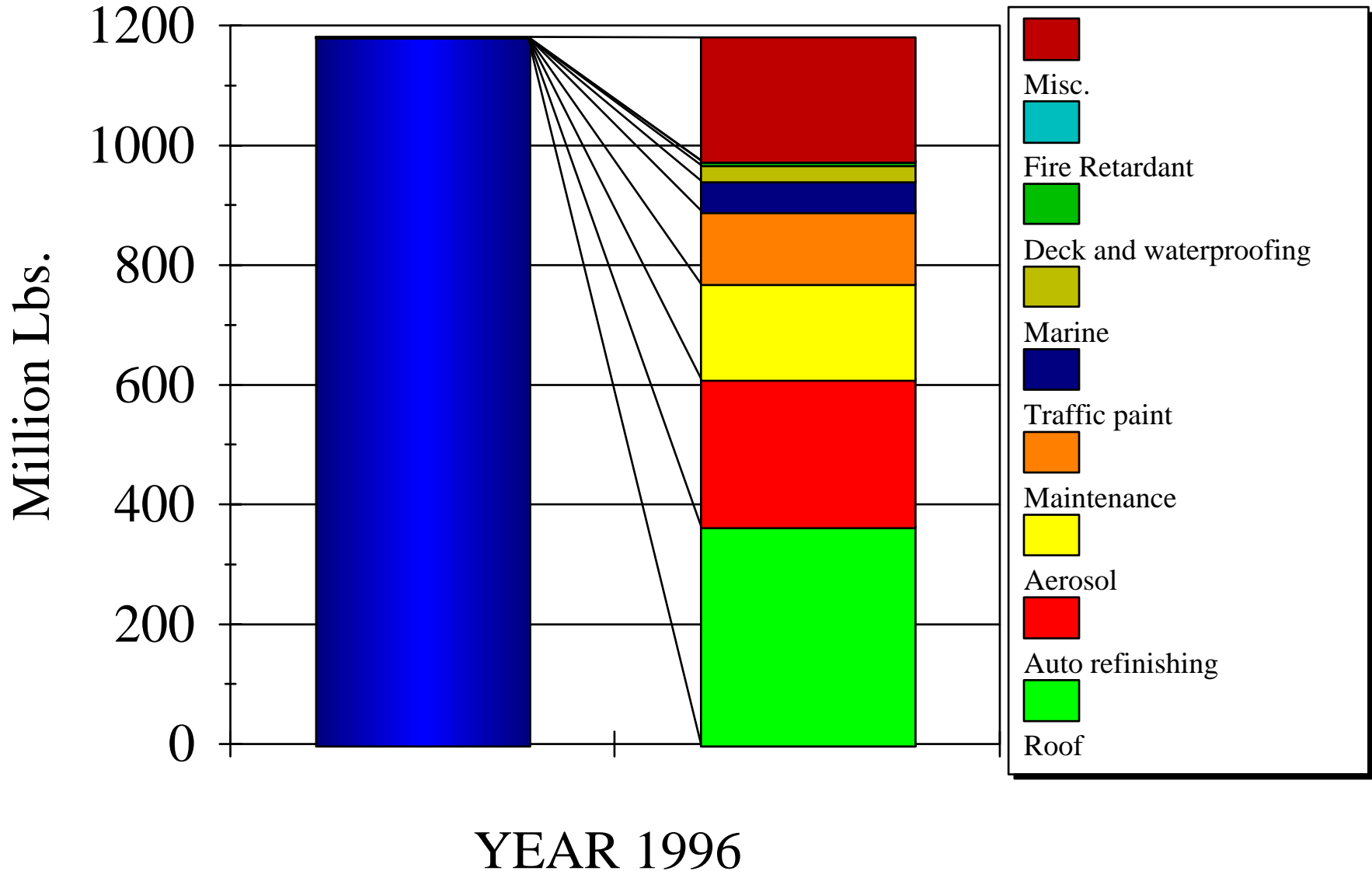
SL2302

Solvents Coatings Architectural



SL2304

Solvents Coatings Special Purpose



APPLICATION OF HIGH SOLIDS

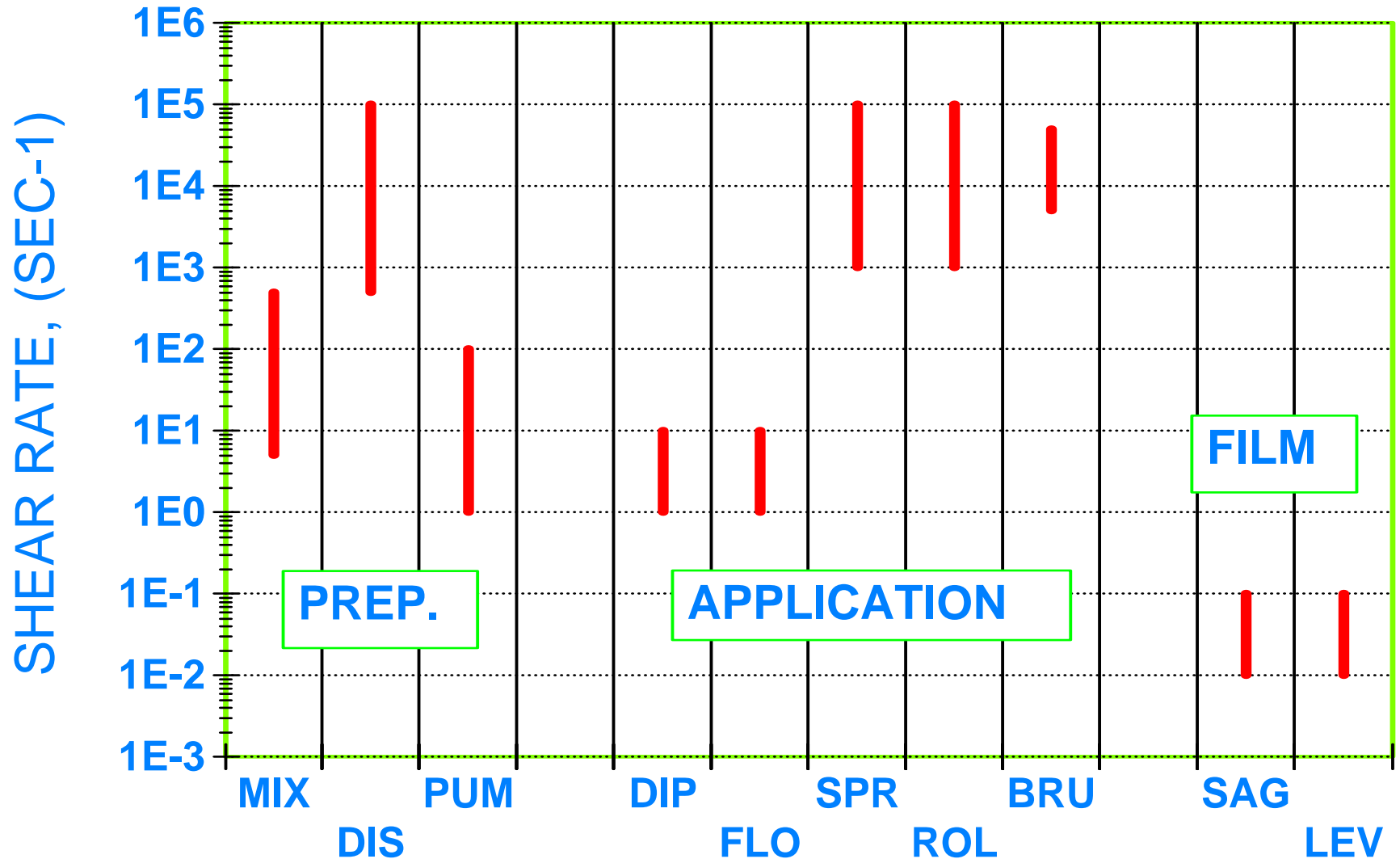
METHOD

BRUSH
ROLLER
SPRAY
DIP

VISCOSITY

RHEOLOGY
SHEAR RATE
SAGGING
LEVELING
VITRIFICATION

SHEAR RATE DURING COATING OPERATIONS



DIFFERENCE

REGULAR-HS-WATER

	REGULAR	HIGH SOLIDS	WATER
MW	1500-5000	300-1200	+1500
VISCOSITY 100 P, °C	50-120	10-50	50
OH #	50-100	120-300	0-100
COOH #	<10	<10	20-100
SOLUBILITY PARAMETER p	LOW	MEDIUM	HIGH

PROBLEM AREAS HIGH SOLIDS

VISCOSITY
RHEOLOGY

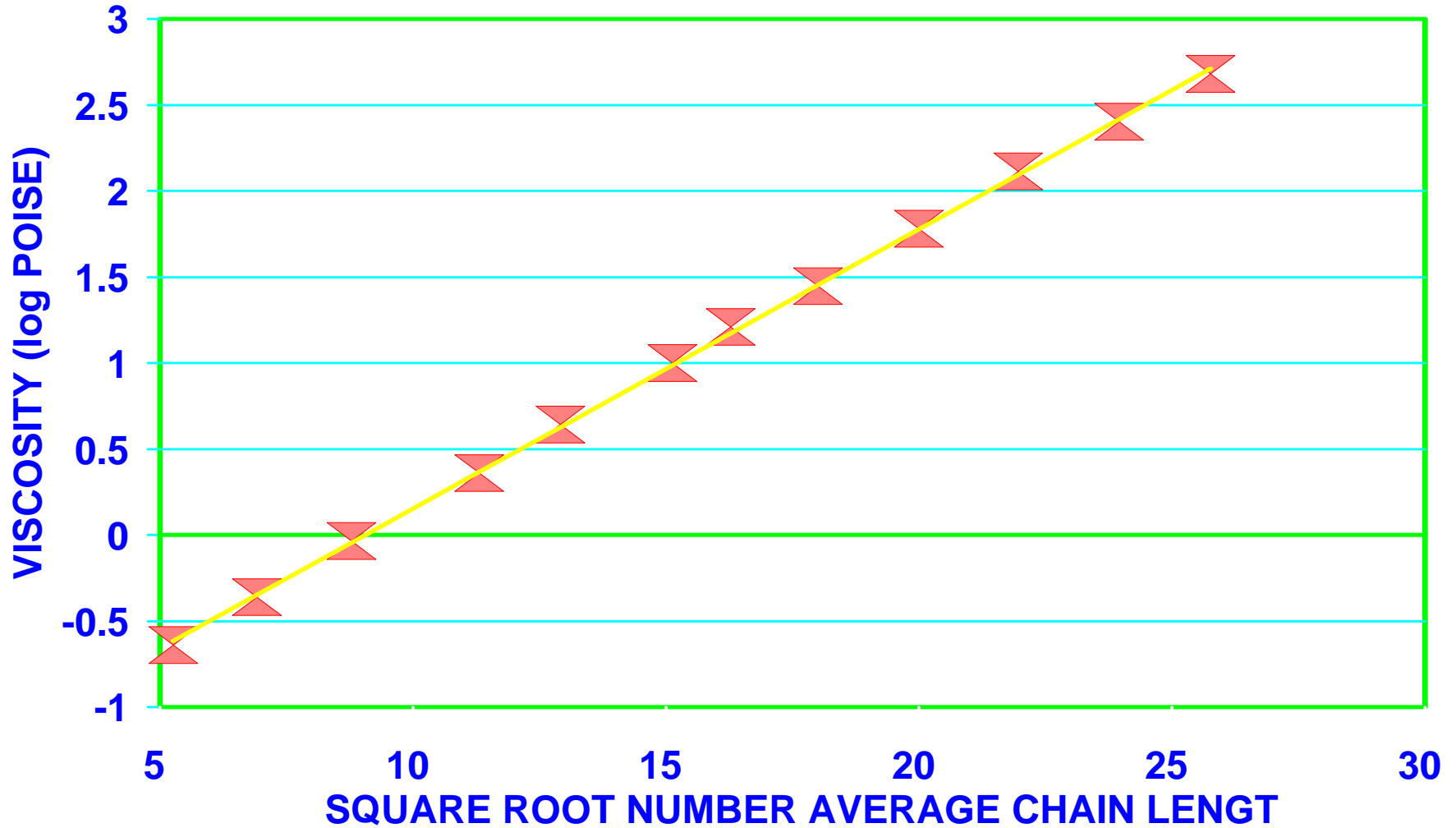
SURFACE TENSION

STABILITY
DURABILITY

SOLIDS
SAGGING
ORANGE P
CRATER
CRAWLING
BERNARD
REACTIVITY
NETWORK

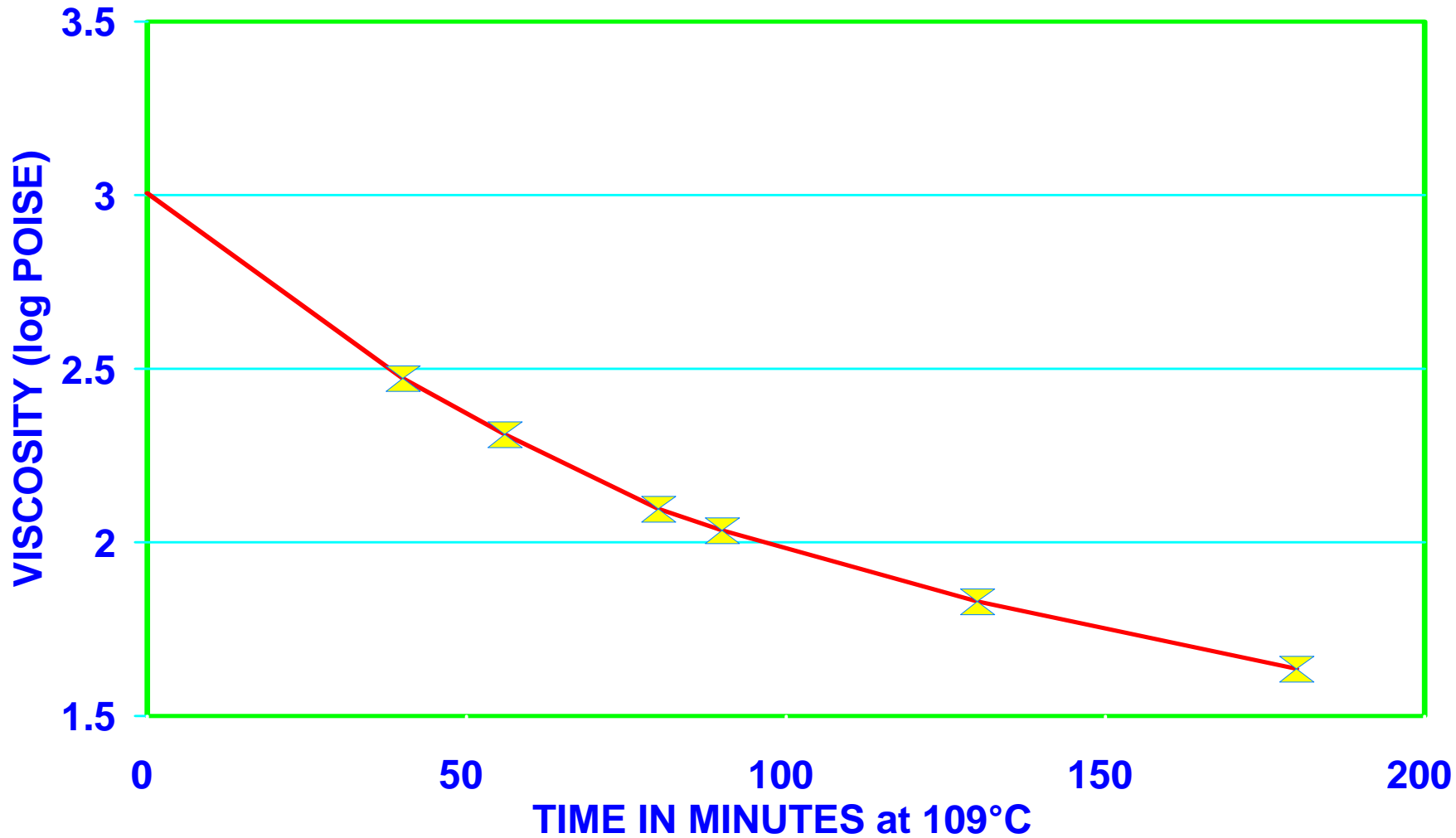
VISCOSITY vs. CHAIN LENGTH

DECAMETHYLENE ADIPATE POLYESTER



 VISCOSITY MEASURED  VISCOSITY CALCULATE

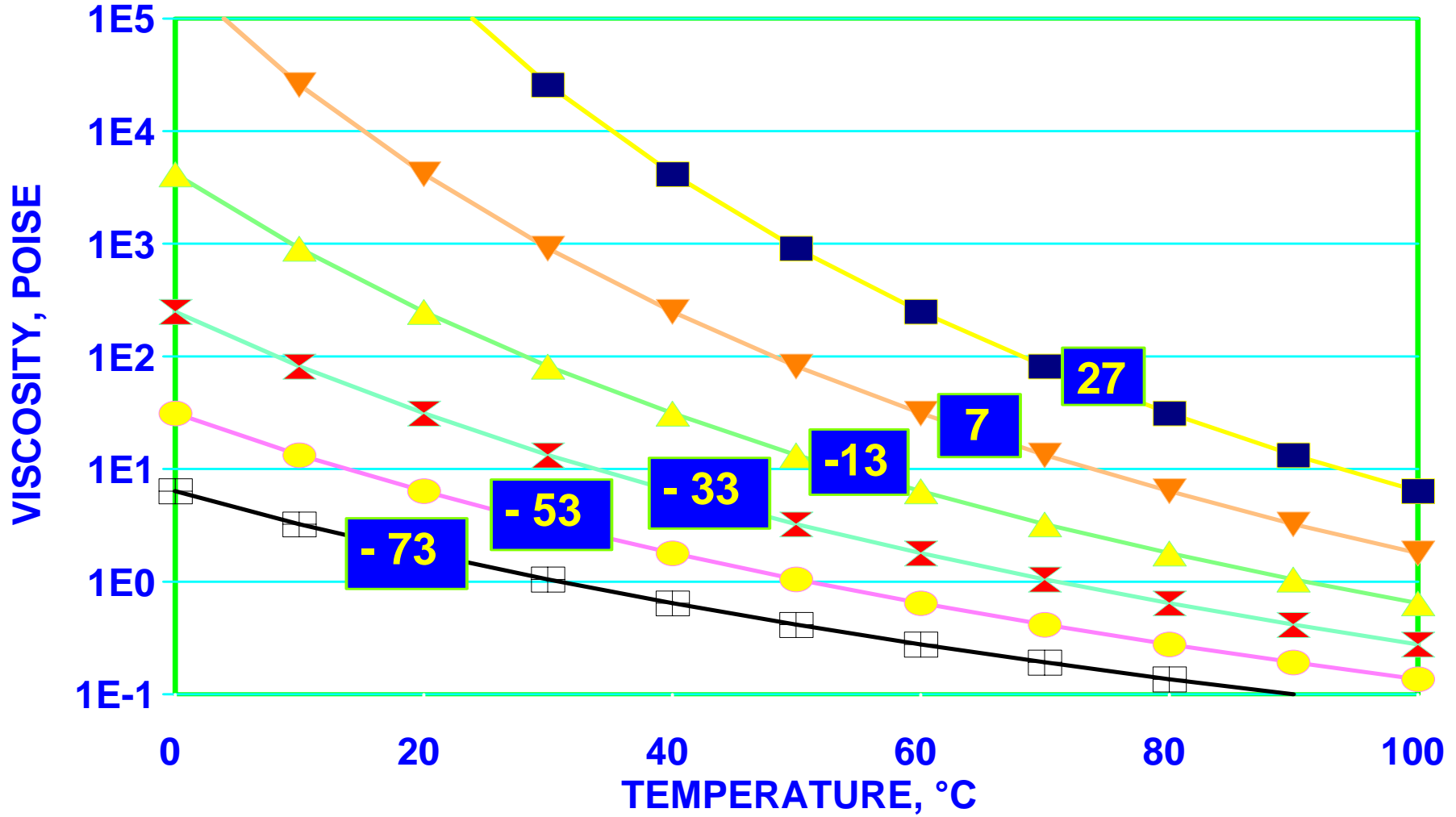
VISCOSITY OF POLYESTER BLEND



— CALCULATED

⌘ MEASURED DATA POINTS

VISCOSITY as a FUNCTION OF T_g, WLF EQUATION

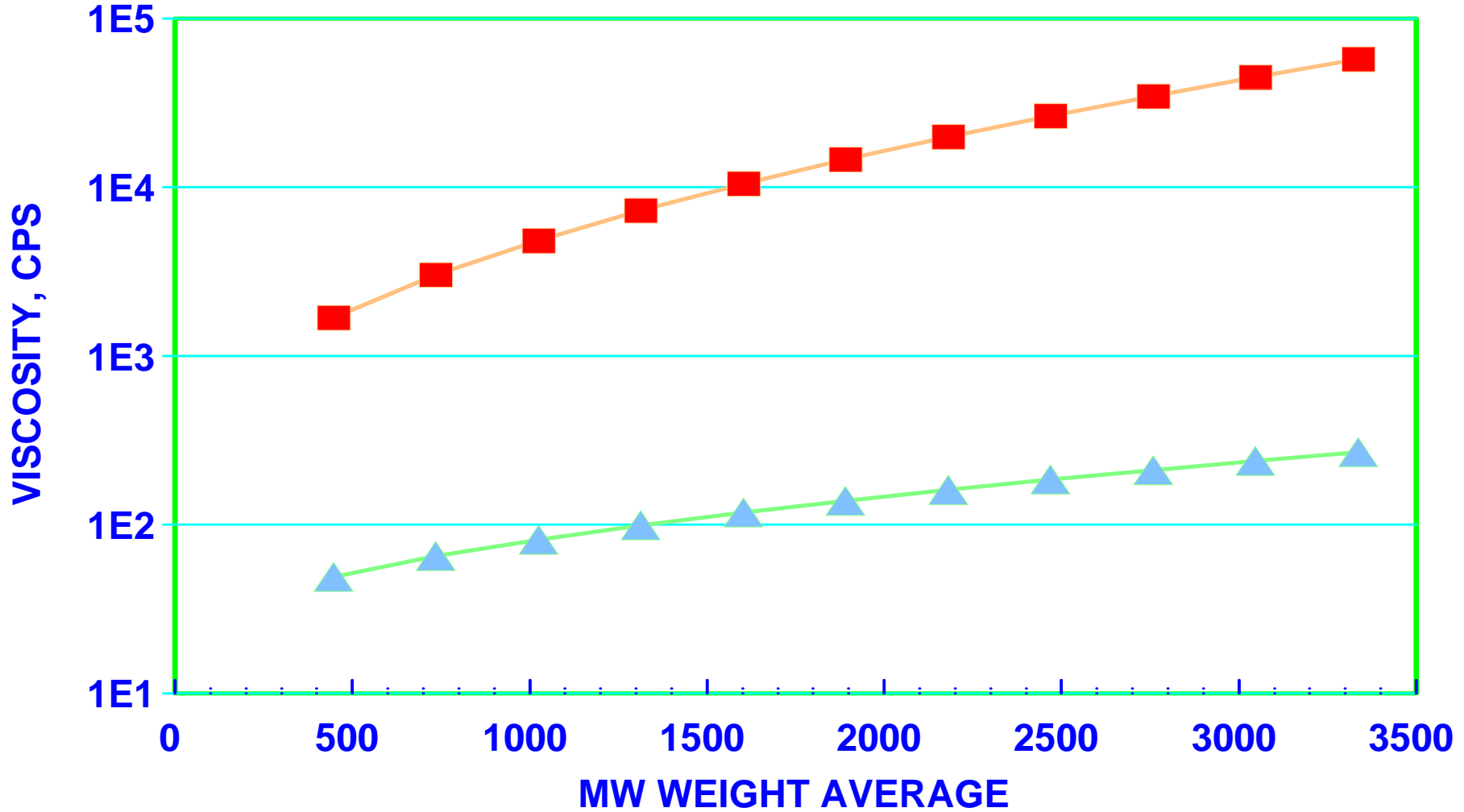


WLF EQUATION

$$\log \mu = 13 - \frac{17.44(T - T_g)}{51.6 + (T - T_g)}$$

VISCOSITY-MOLECULAR WEIGHT 65°C

$$\text{LOG(VISC)} = A + C \cdot \text{SQRT}(Z)$$



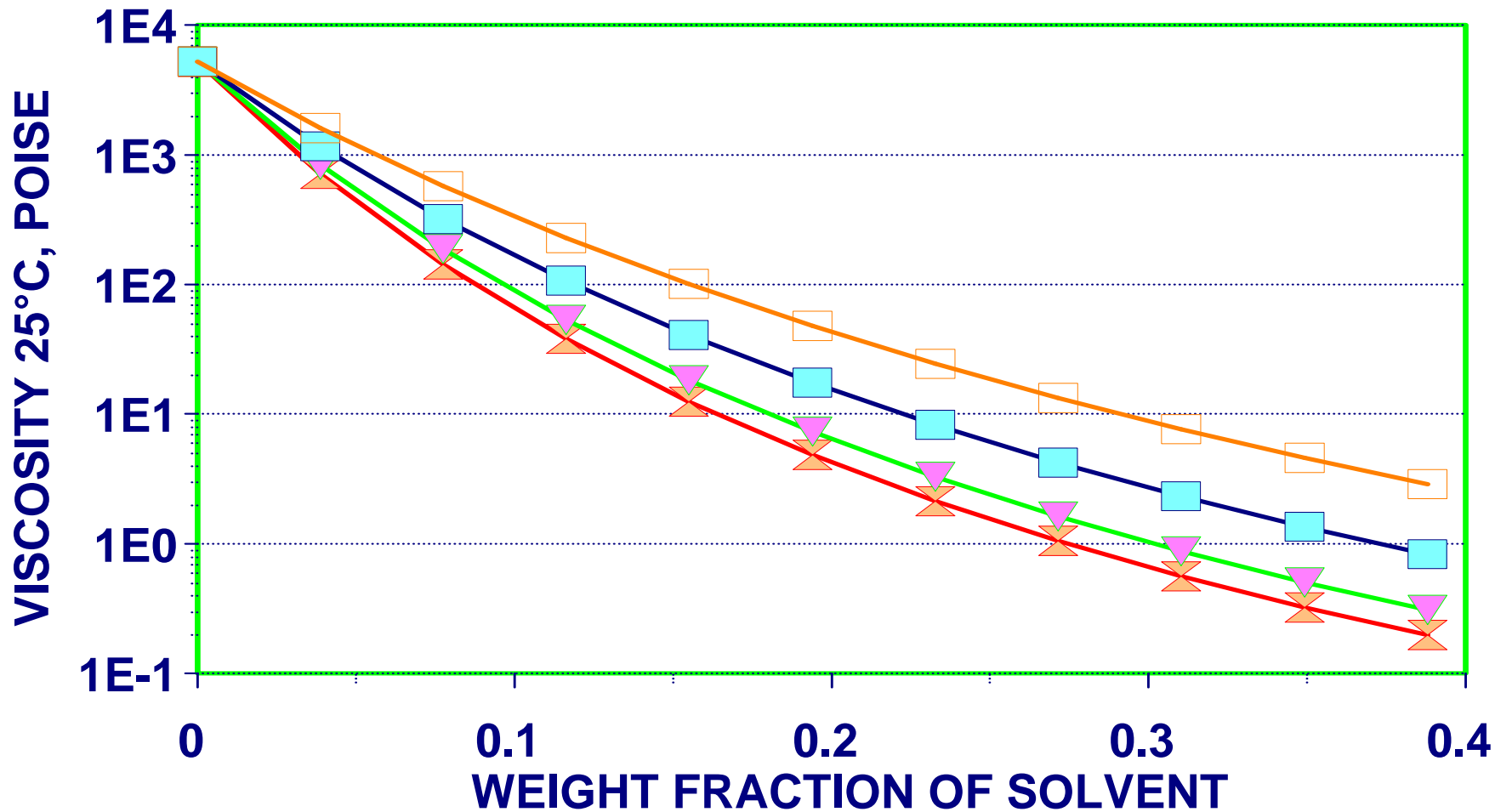
▲ POLYMER A Tg=190°K ■ POLYMER B Tg=250°K SL2310

VISCOSITY OF POLYMER SOLUTIONS

$$Tg_s = Tg_p - c * W_s$$

$$\frac{1}{Tg_s} = \frac{W_1}{Tg_1} + \frac{W_2}{Tg_2} + W_1 * W_2 * K$$

VISCOSITY OF K-FLEX UD-320 IN KETONES



ACETONE

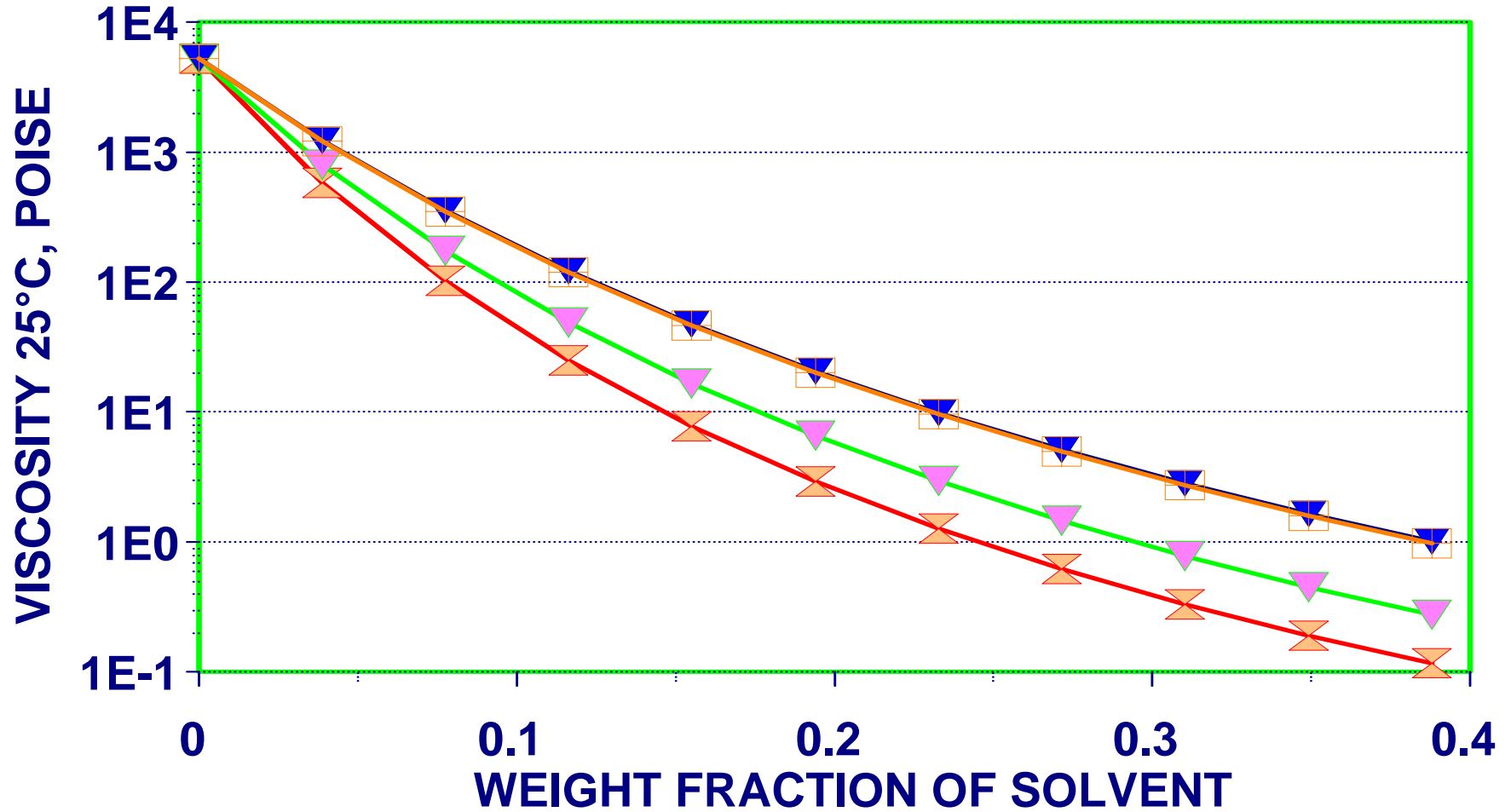
MEK

MIBK

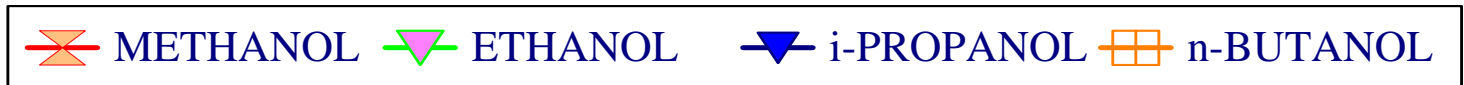
CYCLOHEXANONE

SL2314

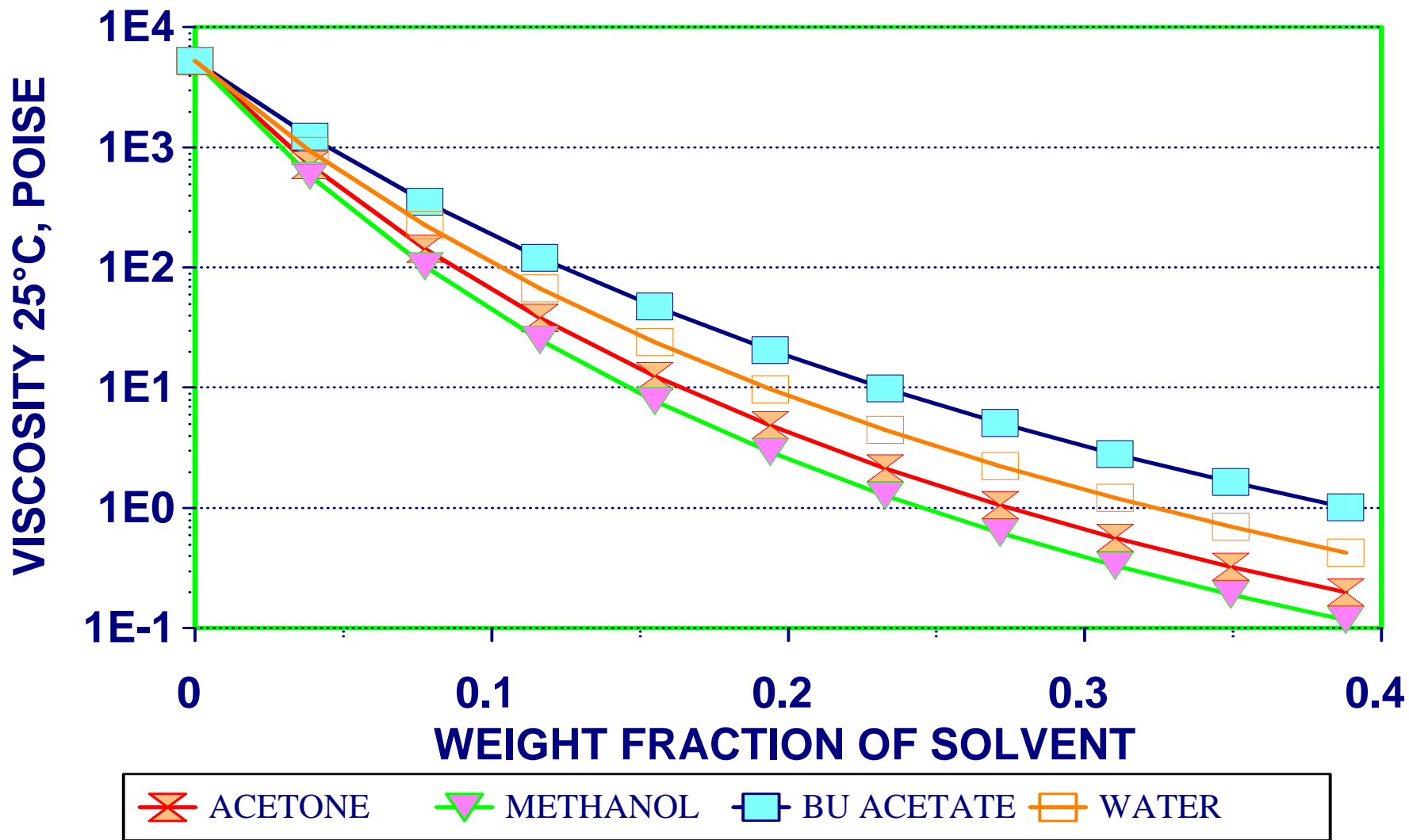
VISCOSITY OF K-FLEX UD-320 IN ALCOHOLS



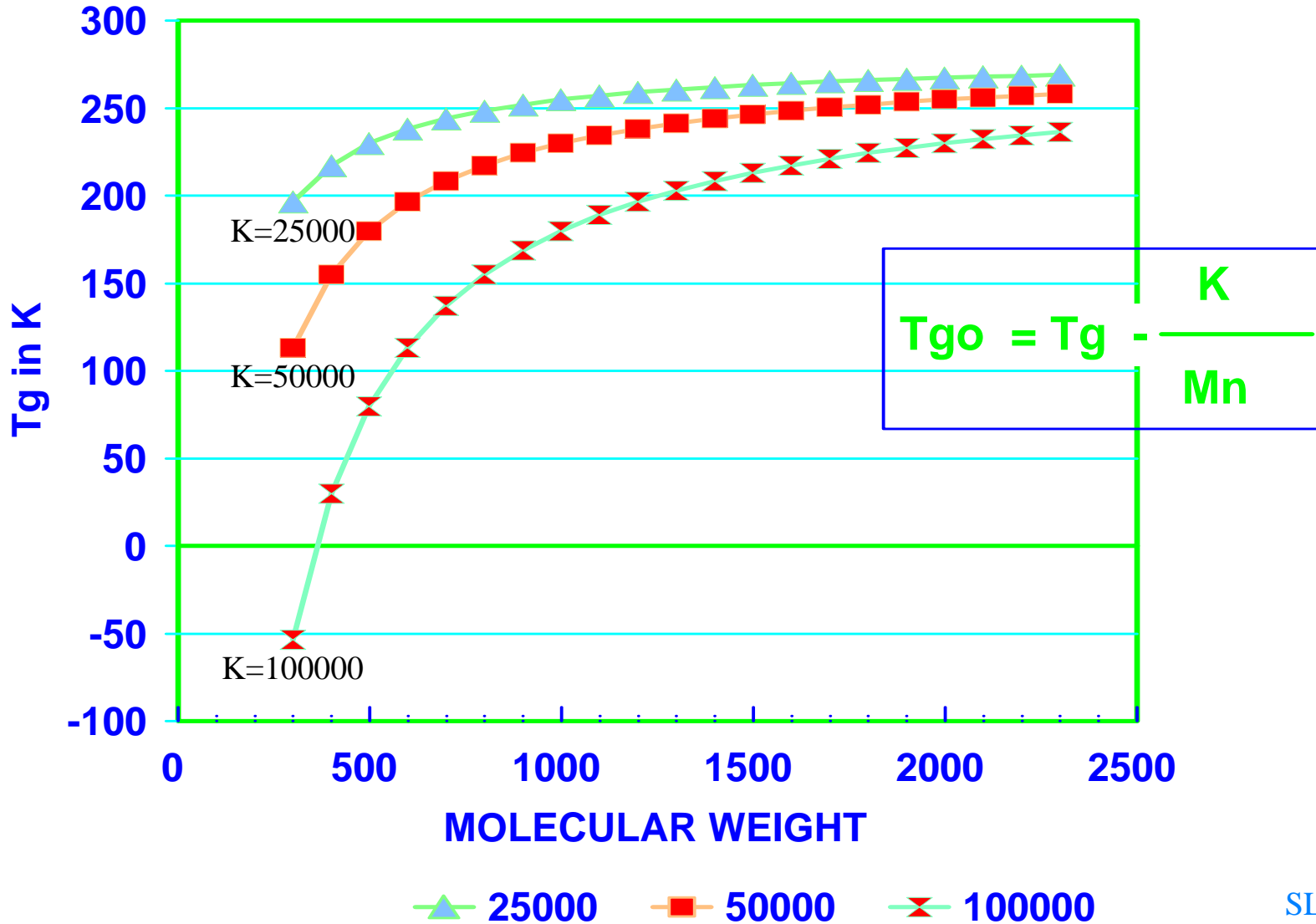
SL2315



VISCOSITY OF K-FLEX UD-320 IN SOLVENTS



Tg vs MOLECULAR WEIGHT OF OLIGOMERS

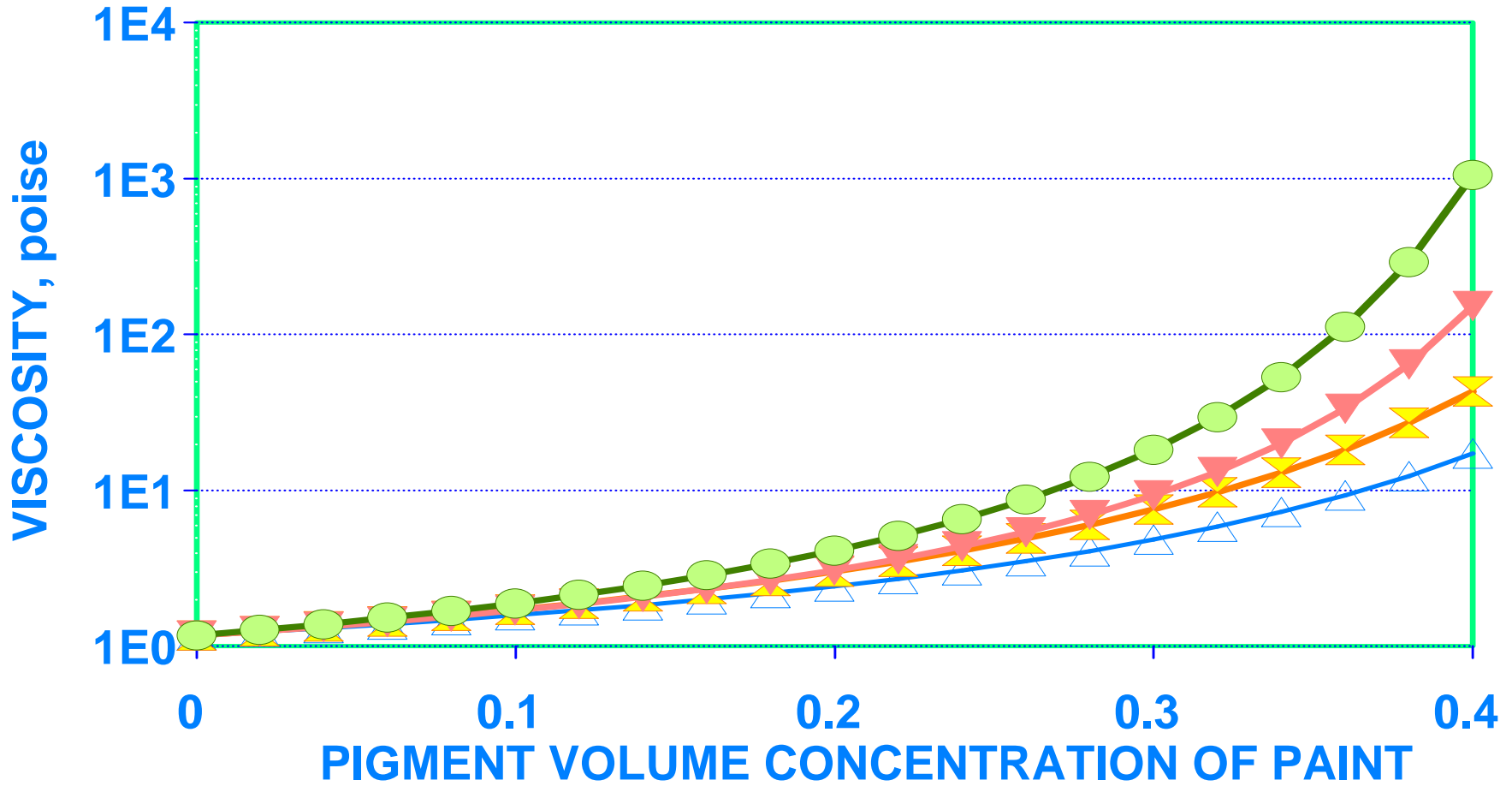


Glass Transition Temperature of Polyester Resins °K

<u>Dicarboxylic</u>	<u>Diol</u>	<u>Tg exp</u>	<u>Tg calc</u>	<u>exp-calc</u>
Succinic	1,2-ethylene	272	255	17
Succinic	1,4-butane	233	239	-6
Succinic	1,6-hexane	220	230	-10
Succinic	1,7-heptane	228	226	2
Adipic	1,10-dodecane	217	215	2
Sebacic	1,4-butane	216	219	-3
Sebacic	1,4-butene	233	225	8
Sebacic	1,4-butyne	246	231	15
Terephthalic	1,2-ethylene	345	346	-1
Terephthalic	1,4-butane	307	302	5
Terephthalic	1,6-hexane	264	277	-13
Terephthalic	1,10-dodecane	268	251	17
Terephthalic	bisphenol A	478	465	13
Isophthalic	1,2-ethylene	324	346	-22

MOONEY EQUATION

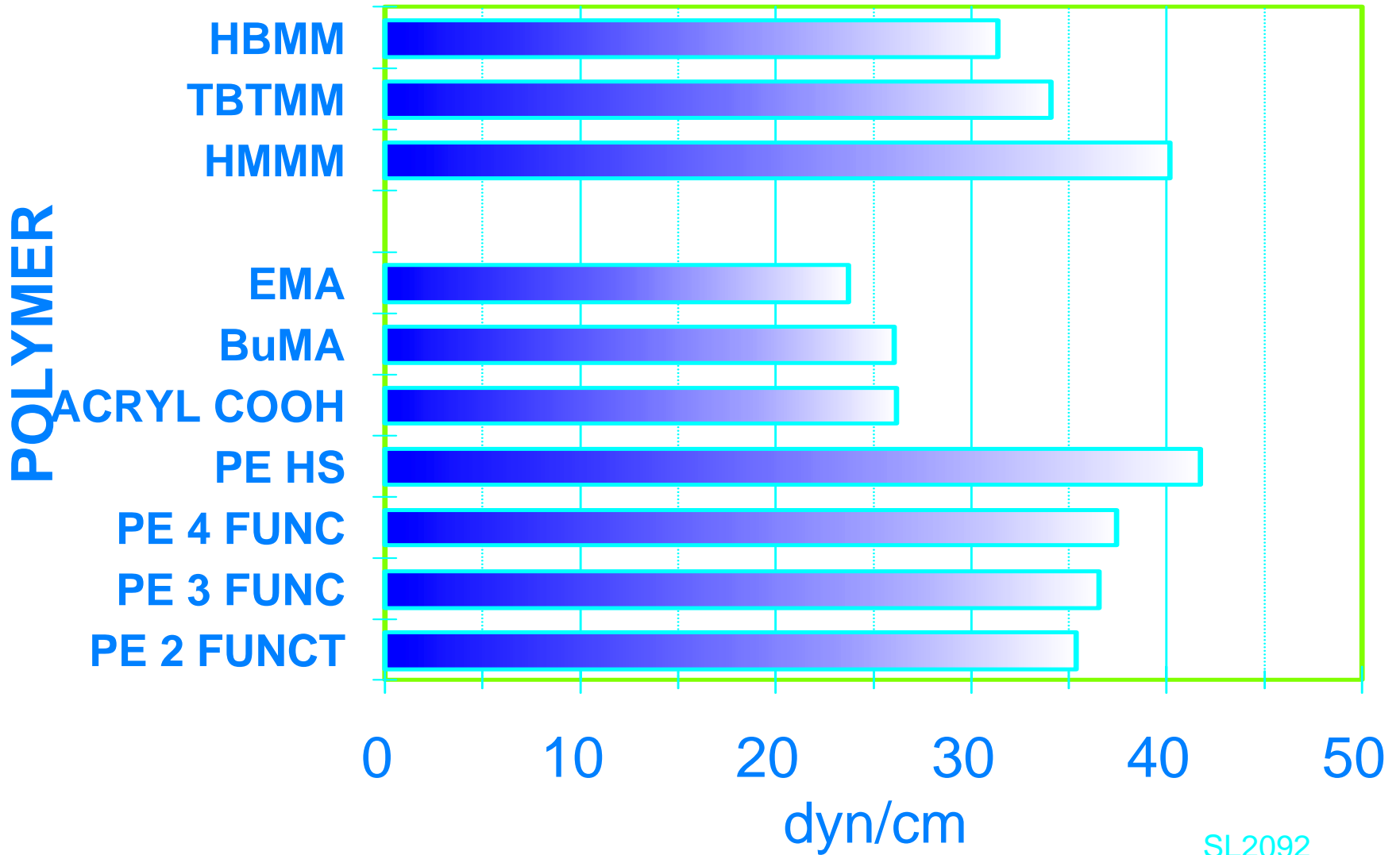
TiO2 PIGMENTED COATING



SL2318

- △ PAINT
- ▽ PAINT ADSORB.
- ⊠ PAINT FLOCC.
- PAINT ADSORB. FLOCC

SURFACE TENSION



CRAWLING



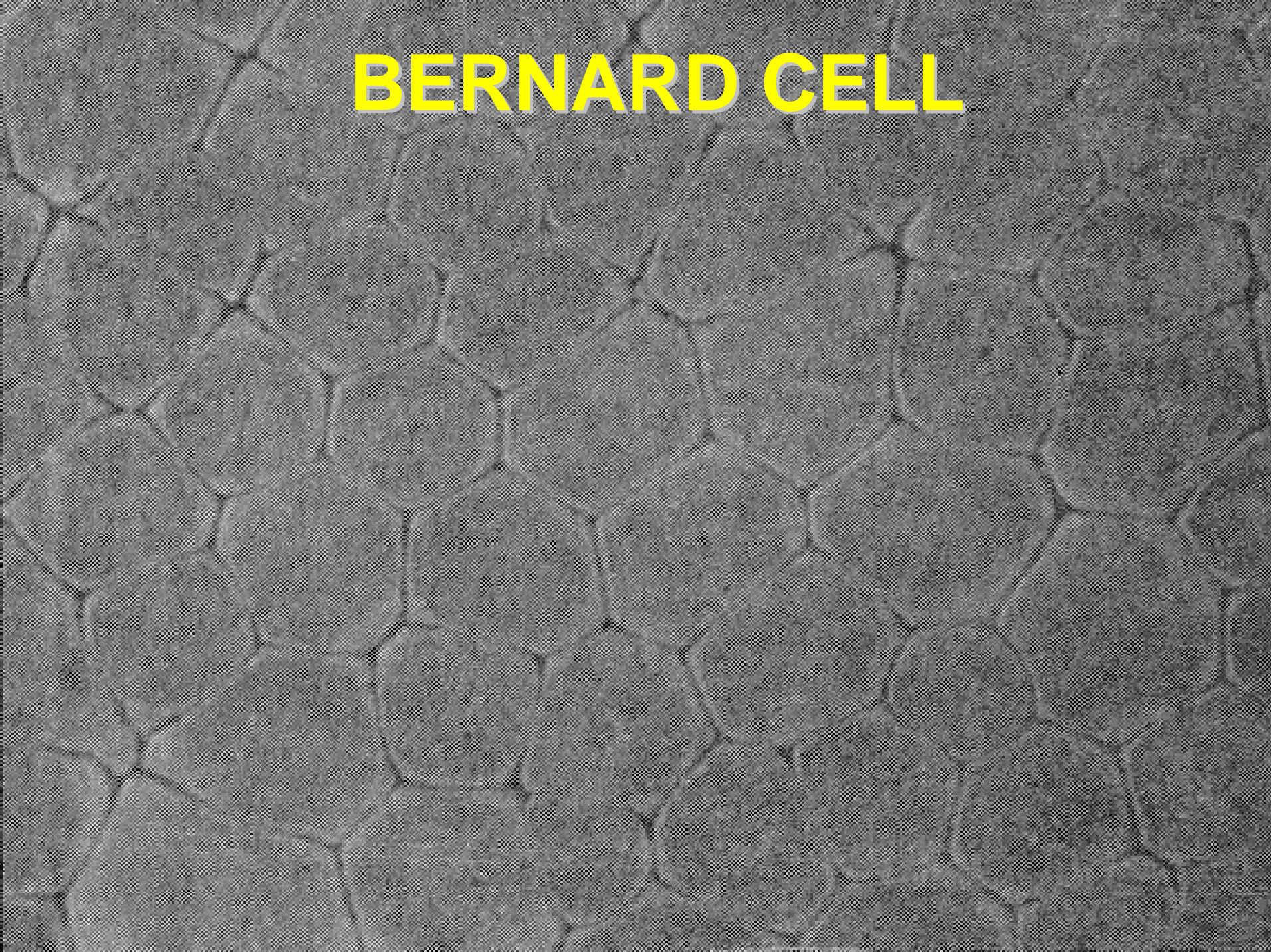
CRATERS



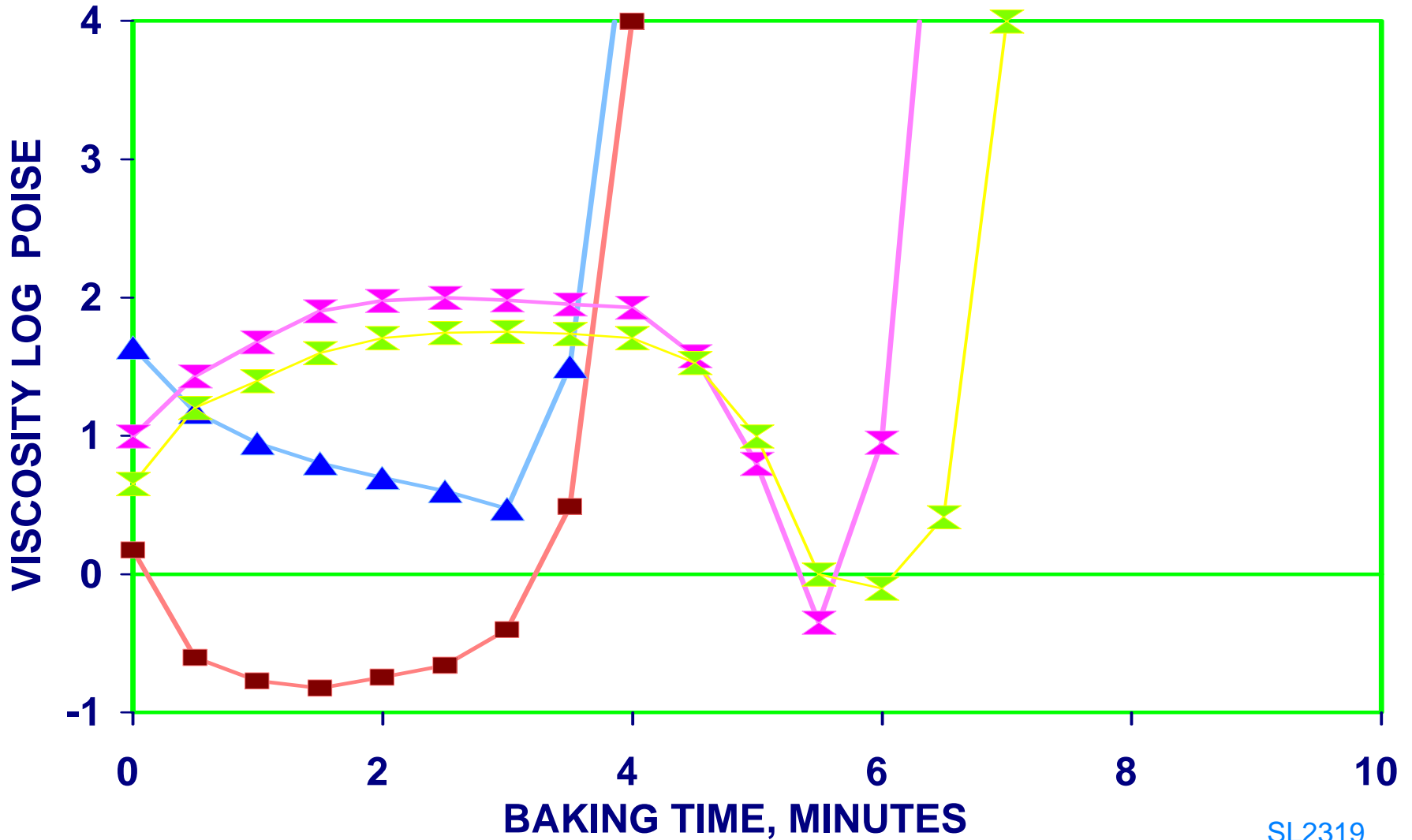
WETTING



BERNARD CELL



SAGG CONTROL AGENT

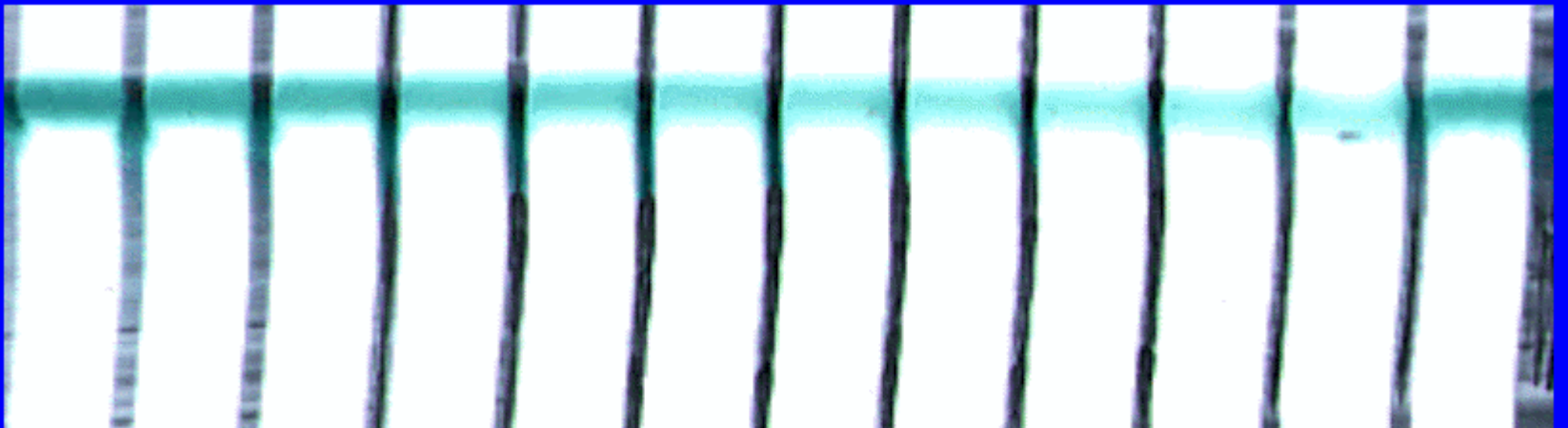
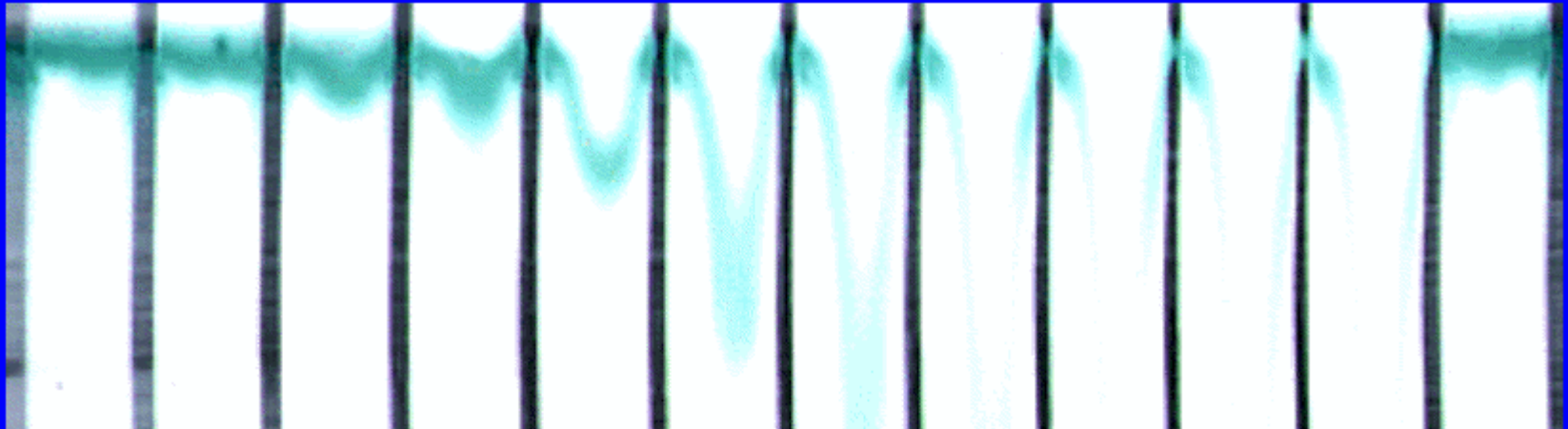


SL2319

■ PTSA NO SCA ▲ PTSA SCA ✕ PTSA BL1 SCA ✕ PTSA BL2 SCA

SAG TEST

4 6 8 10 11 12 14 16 18 20 22 24



RHEOLOGY MODIFIER

- ATTAPULGITE
- SMECTITE
- ASSOCIATIVE
- SILICA
- TITANATE
- POLYESTER
- POLYACRYLATE
- POLYOLEFIN
- ORGANO CLAY
- ORGANO SULFONATE
- POLYAMIDE
- CASTOR DERIVATIVE
- POLYUREA
- CATIONIC OLIGOMER

FACTORS INFLUENCING VISCOSITY

POLYMER

MOLECULAR WEIGHT & DISTRIBUTION
GLASS TRANSITION TEMPERATURE , T_g
FUNCTIONAL GROUP CONTENT
TEMPERATURE

SOLVENT

SOLVENT POLYMER INTERACTION
SOLVENT VISCOSITY
SOLVENT CONTENT

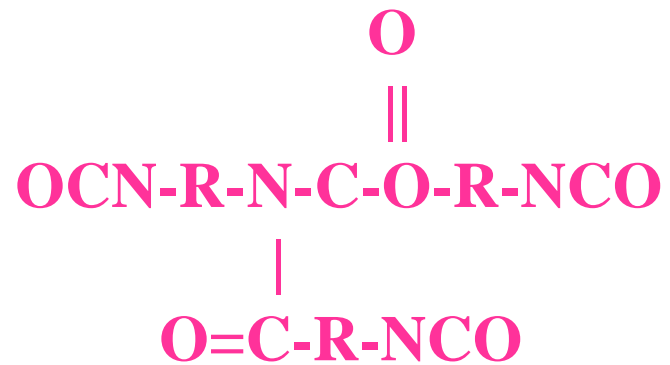
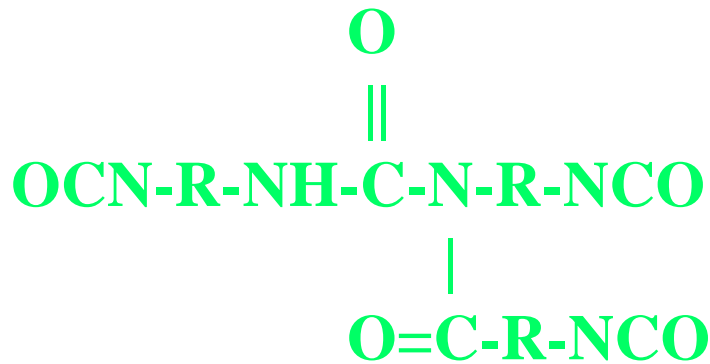
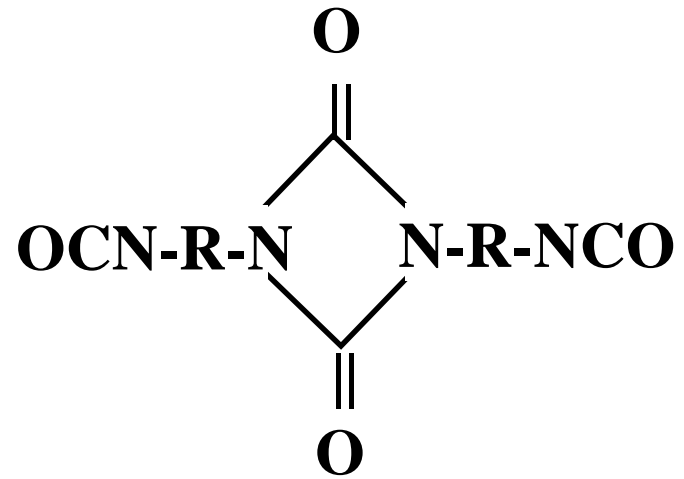
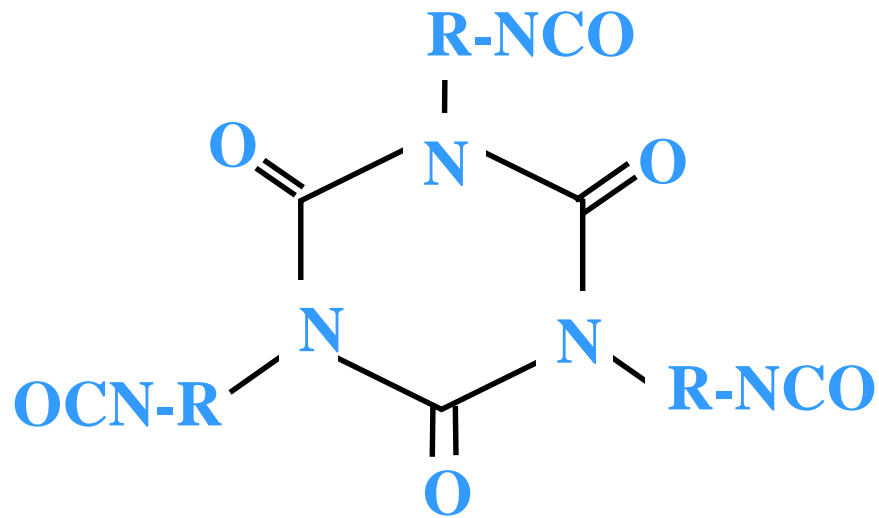
CROSSLINKER

ADDITION VERSUS CONDENSATION

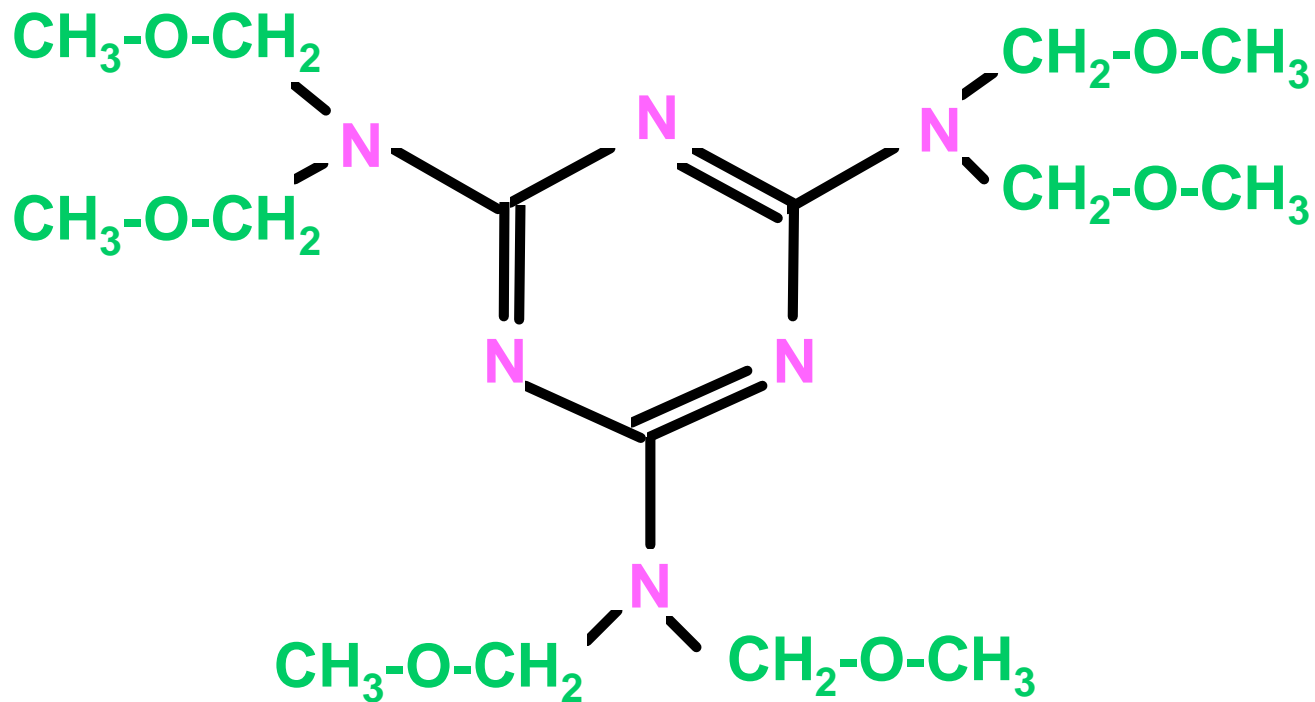
PIGMENT

PARTICLE SIZE AND SHAPE
LOADING AND DISPERSION

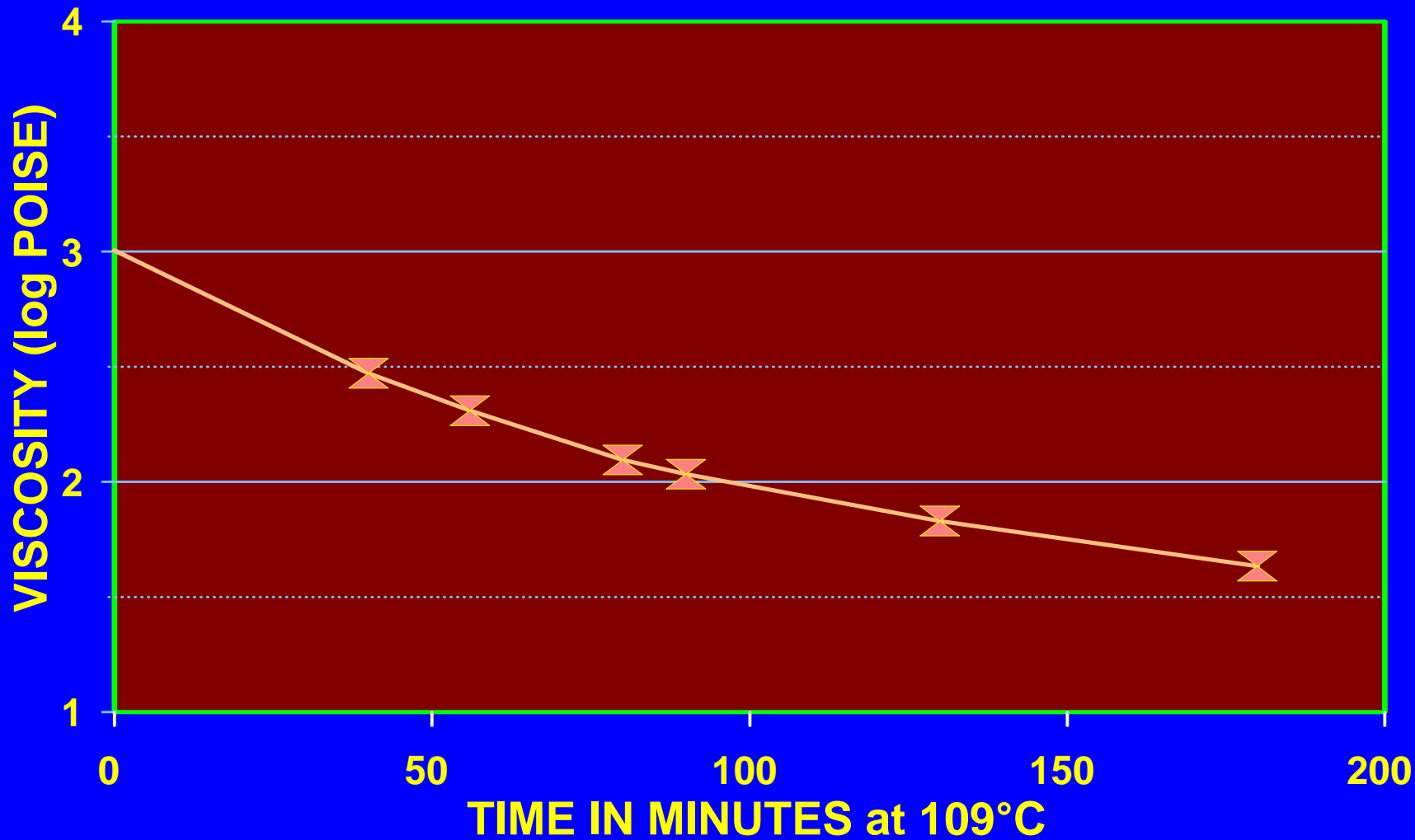
ISOCYANATE CROSSLINKER



HMMM



VISCOSITY OF POLYESTER BLEND

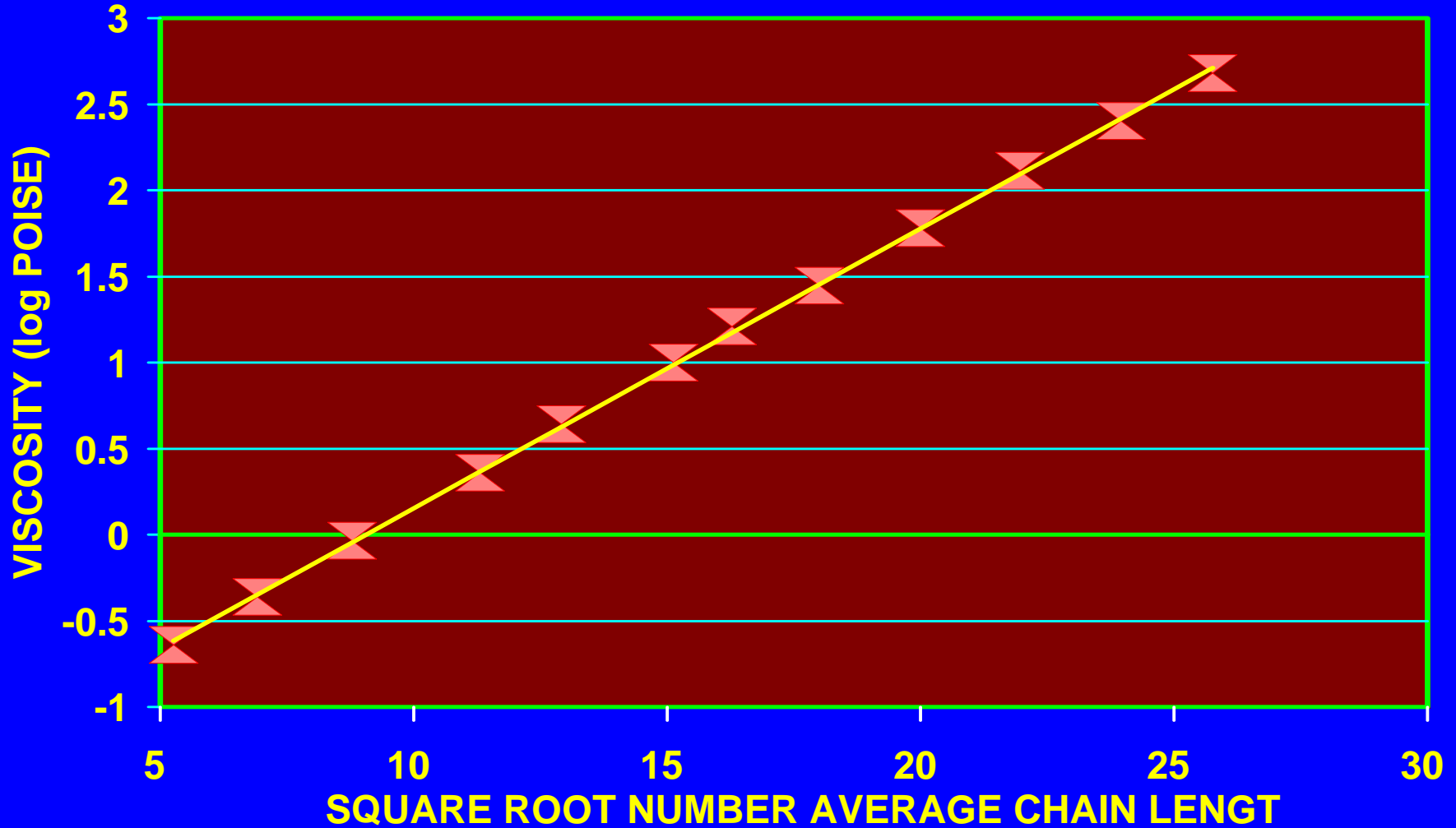


— CALCULATED

⌘ MEASURED DATA POINTS

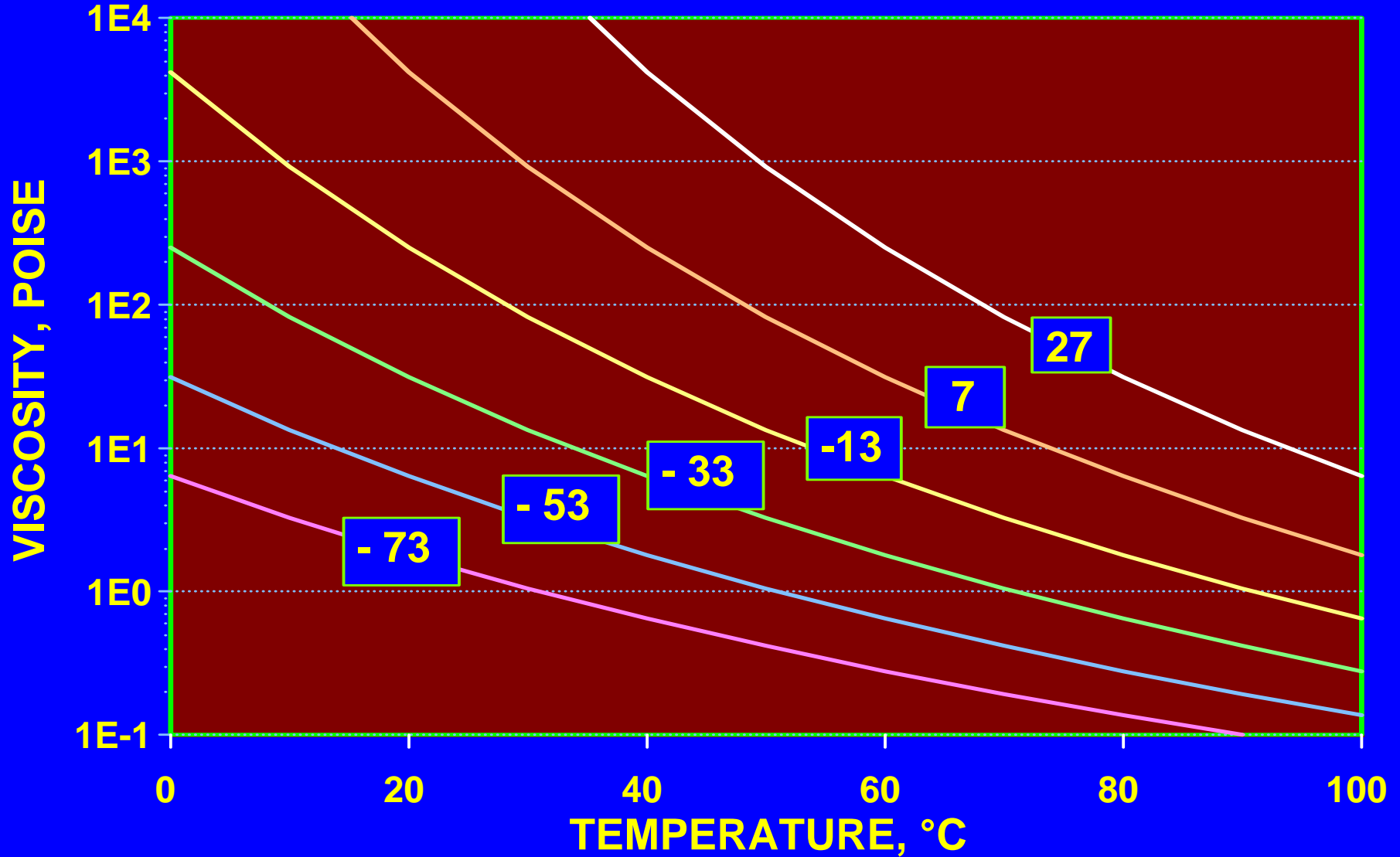
VISCOSITY vs. CHAIN LENGTH

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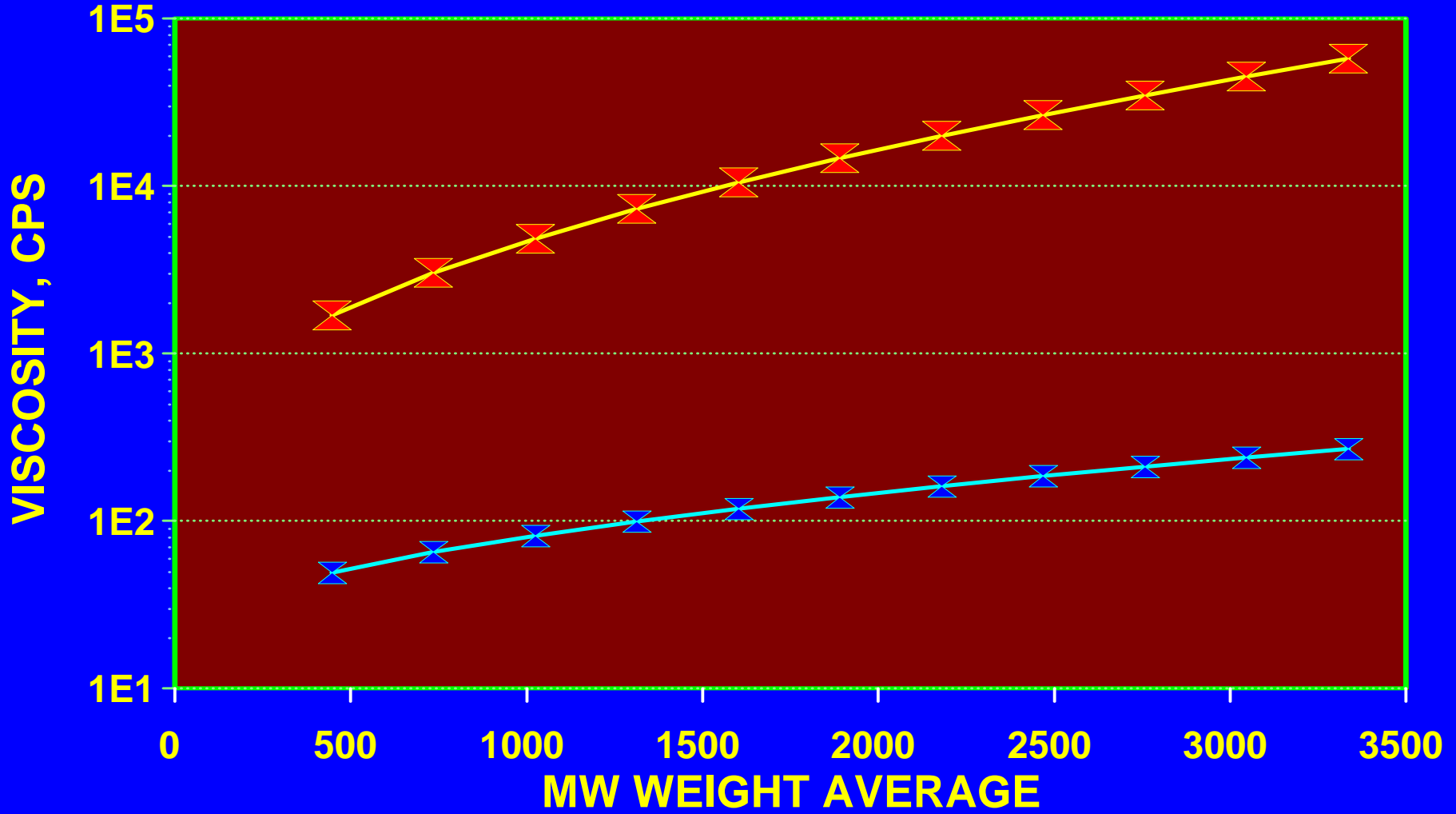
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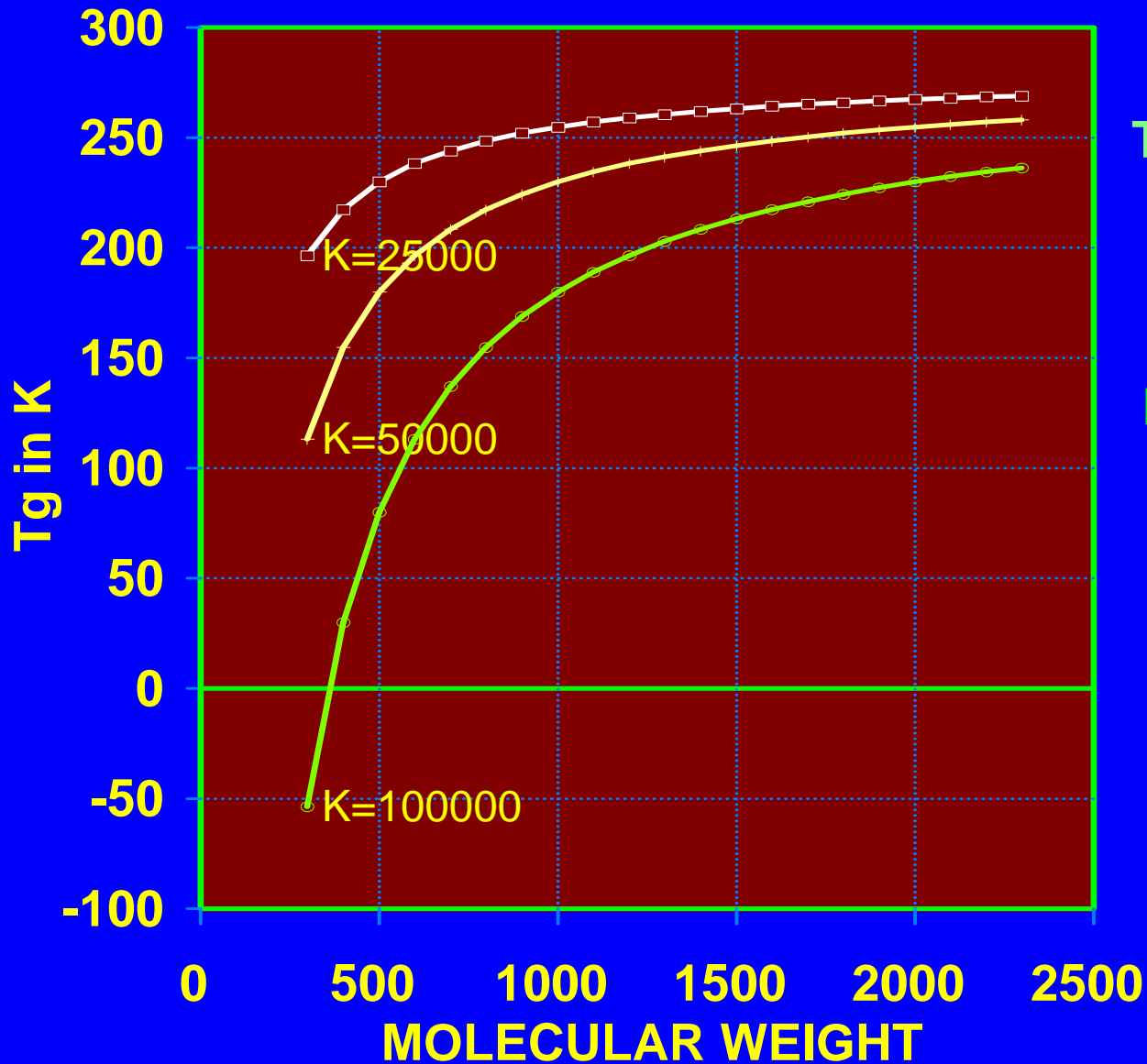
VISCOSITY-MOLECULAR WEIGHT 65°C

$$\text{LOG}(\text{VISC}) = A + C \cdot \text{SQRT}(Z)$$



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T_g vs MOLECULAR WEIGHT OF OLIGOMERS

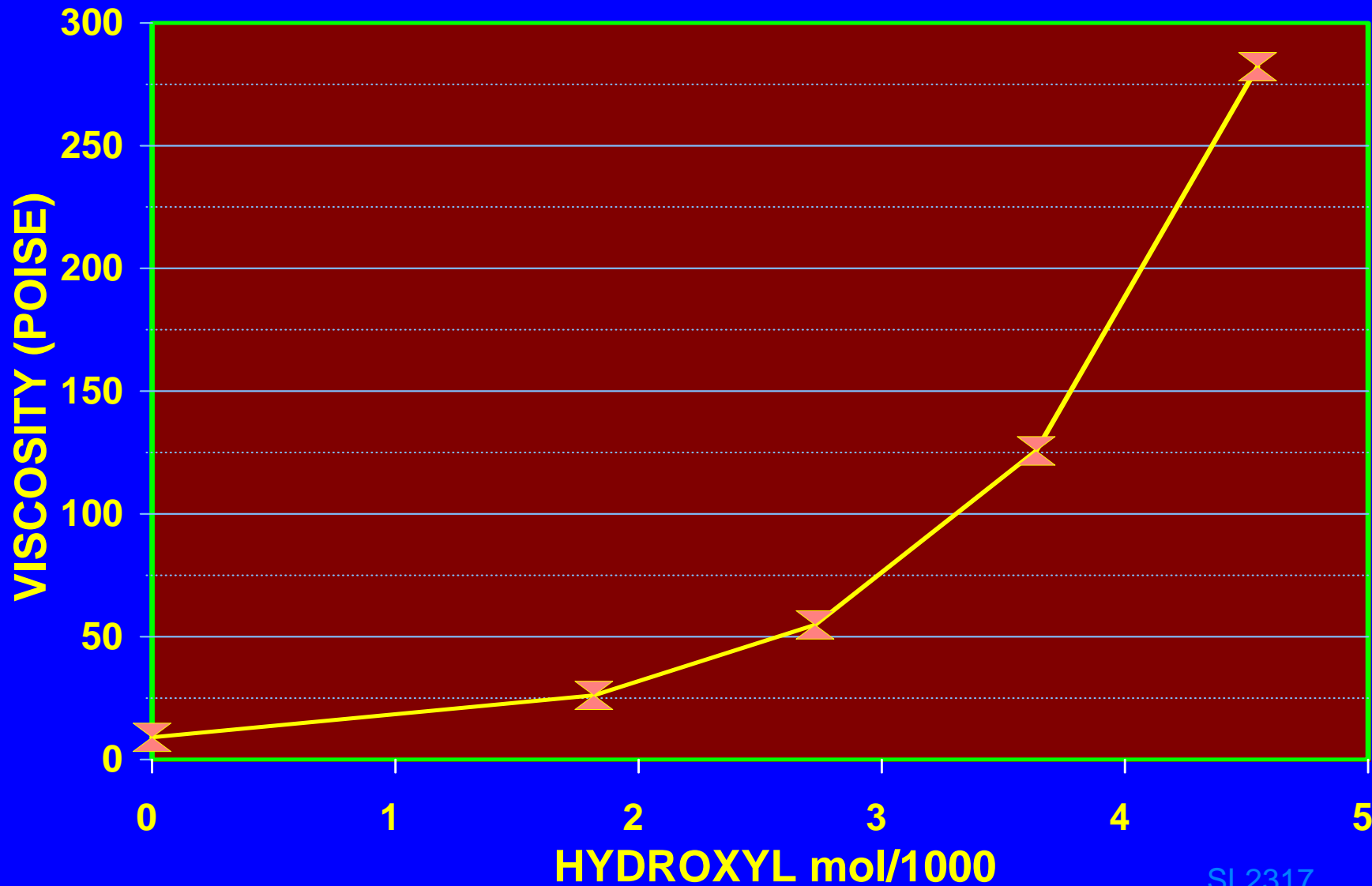


$$T_{g0} = T_g - \frac{K}{M_n}$$

K IS A CONSTANTS .

VISCOSITY vs. HYDROXYL CONTENT

NPA/NPG/TMP/DIBASIC ACID



SL2317