ADDITIVES

FOR

HIGH SOLIDS AND WATER-BORNE COATINGS

Werner J. Blank

Rudy Berndlmaier & Dan Miller

King Industries Inc.

OUTLINE

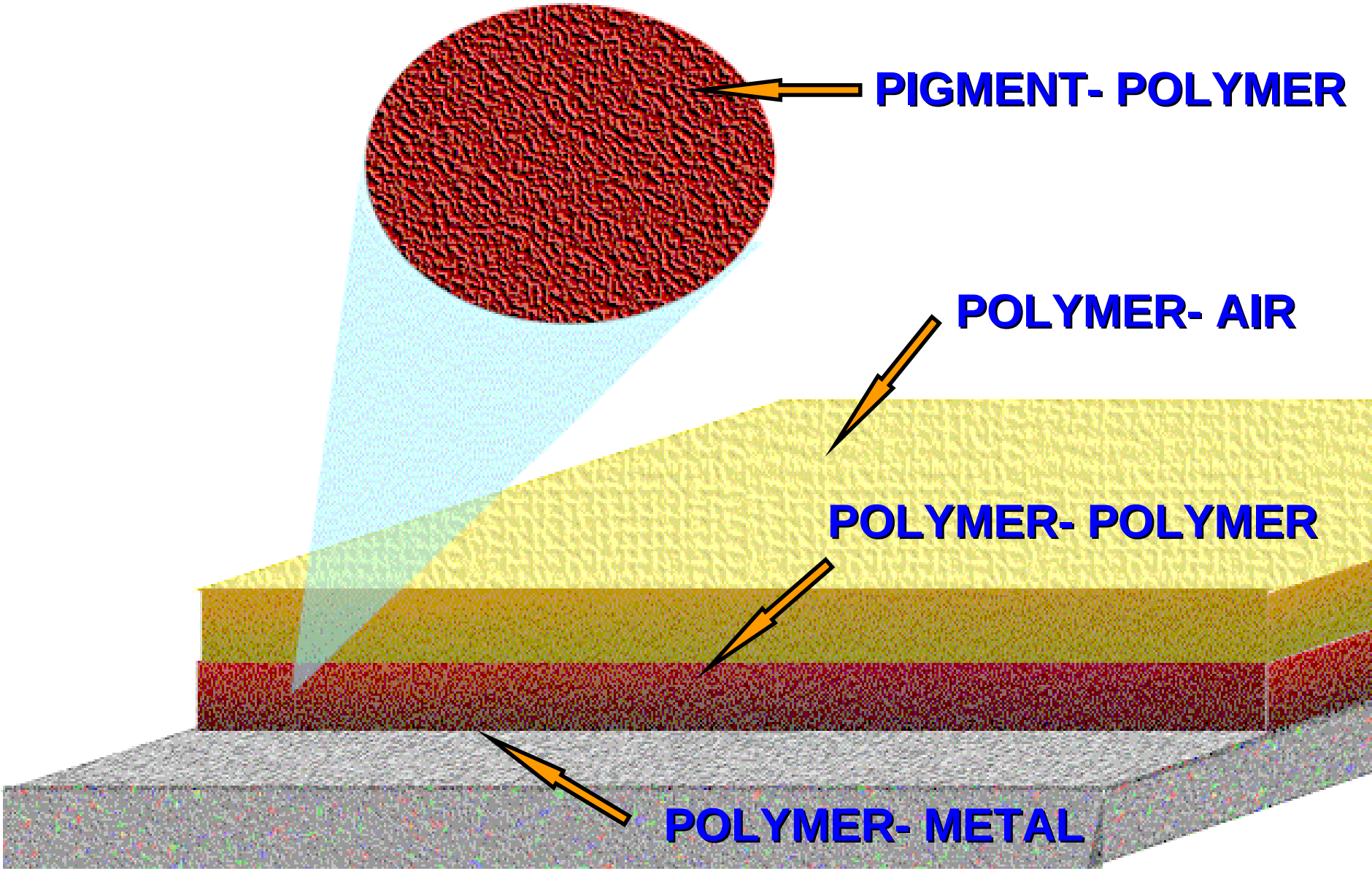
FUNCTION OF ADDITIVES

TYPE OF ADDITIVES

CHEMICAL COMPOSITION

FORMULATION STRATEGIES

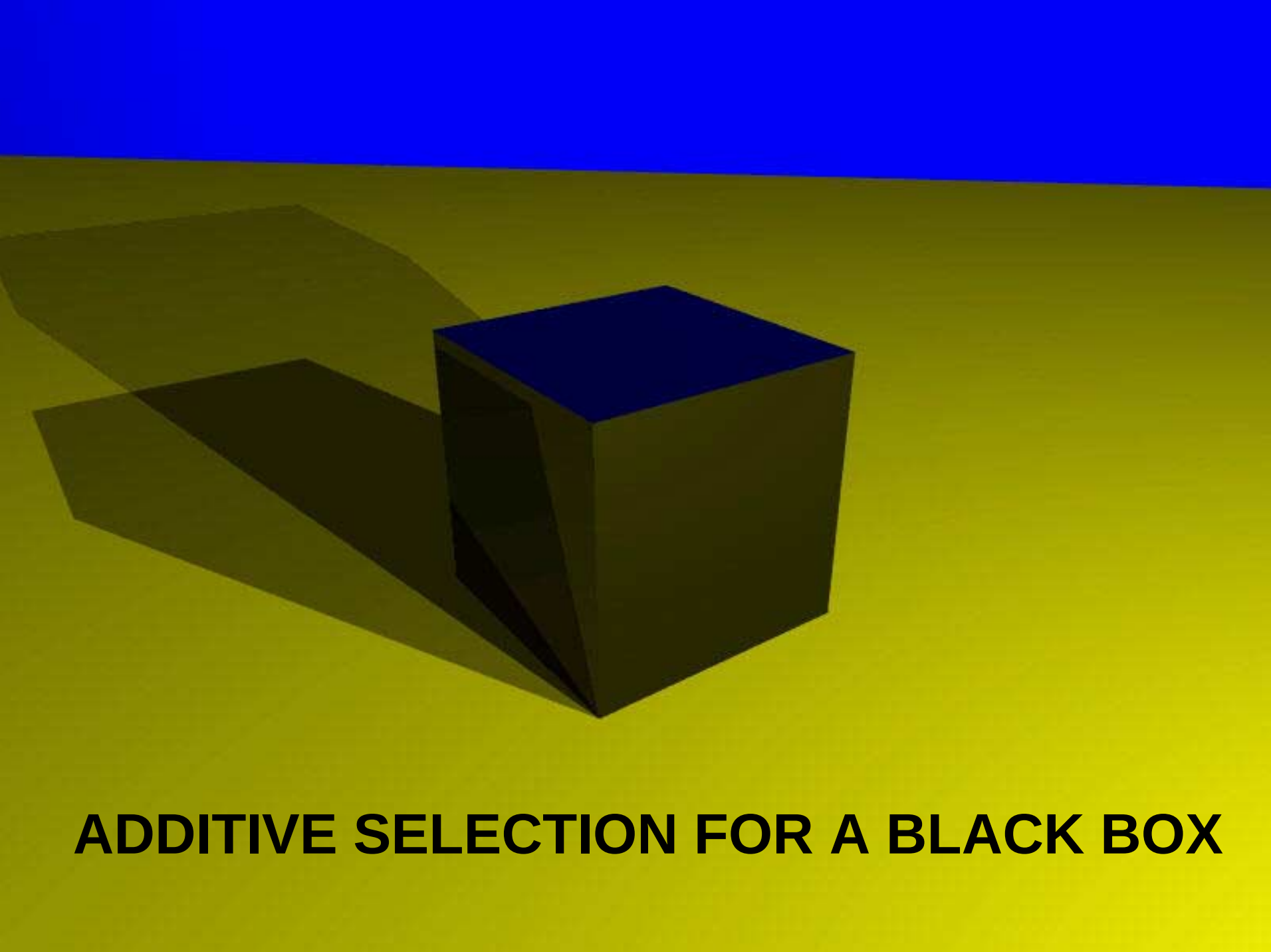
INTERACTION RESIN-ADDITIVES

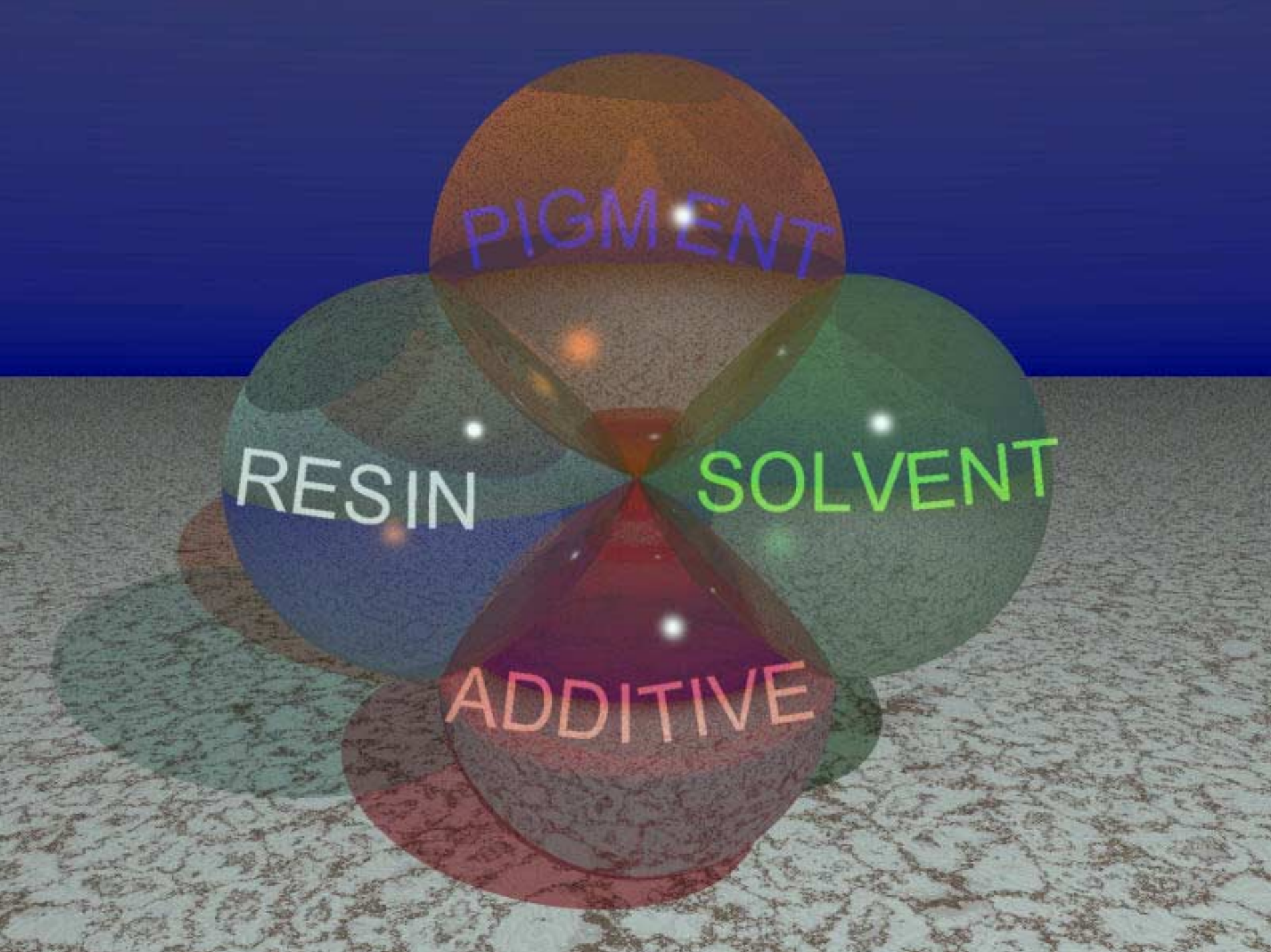


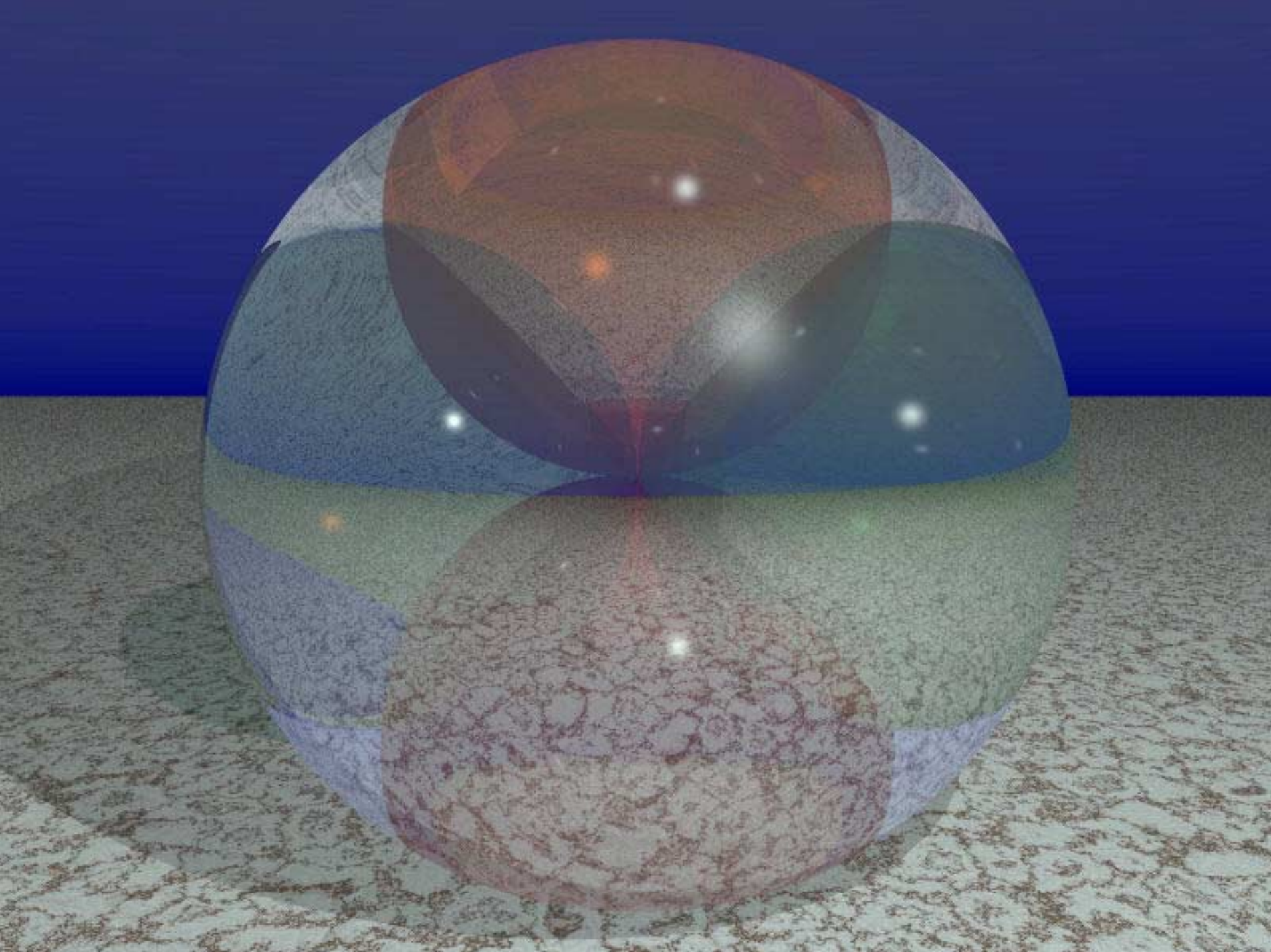
SURFACE COATING INTERFACES

PAINT

FLOW
CATALYST
DEFOAMER
PIGMENT
X-LINKER
MODIFIER
RESIN
AMINE
WATER
SOLVENT


ADDITIVE SELECTION FOR A BLACK BOX


PIGMENT
RESIN
SOLVENT
ADDITIVE

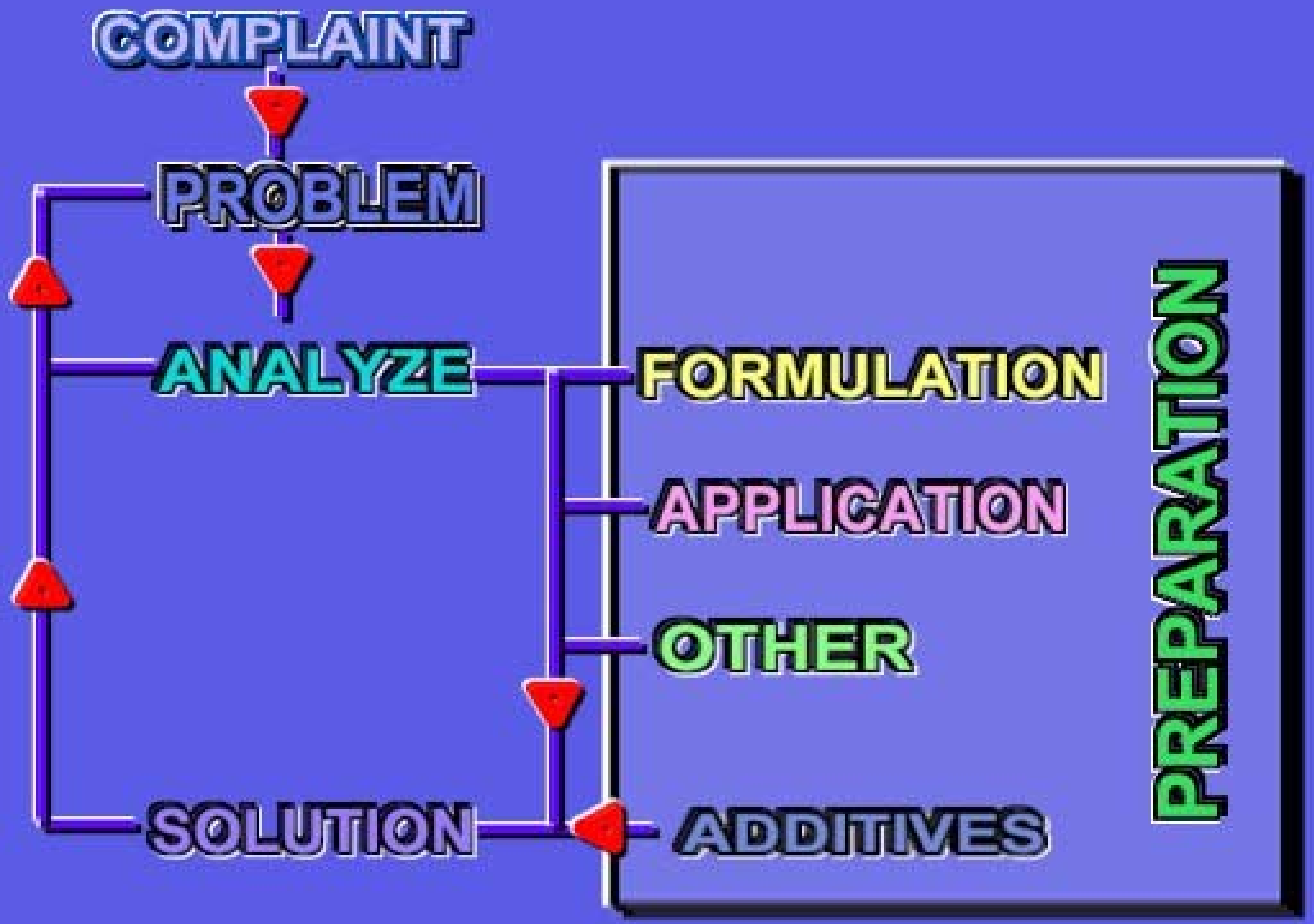


DIFFERENCE

REGULAR-HS-WATER

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

FORMULATION



COATING FORMULATION

PAINT
- **PREPARATION**

APPLICATION

FILM FORMATION

PERFORMANCE
- **MECHANICAL**
- **ENVIRONMENTAL**

RESIN

CROSSLINKER

PIGMENT

SOLVENTS

ADDITIVES

PAINT PREPARATION

Grinding Paste

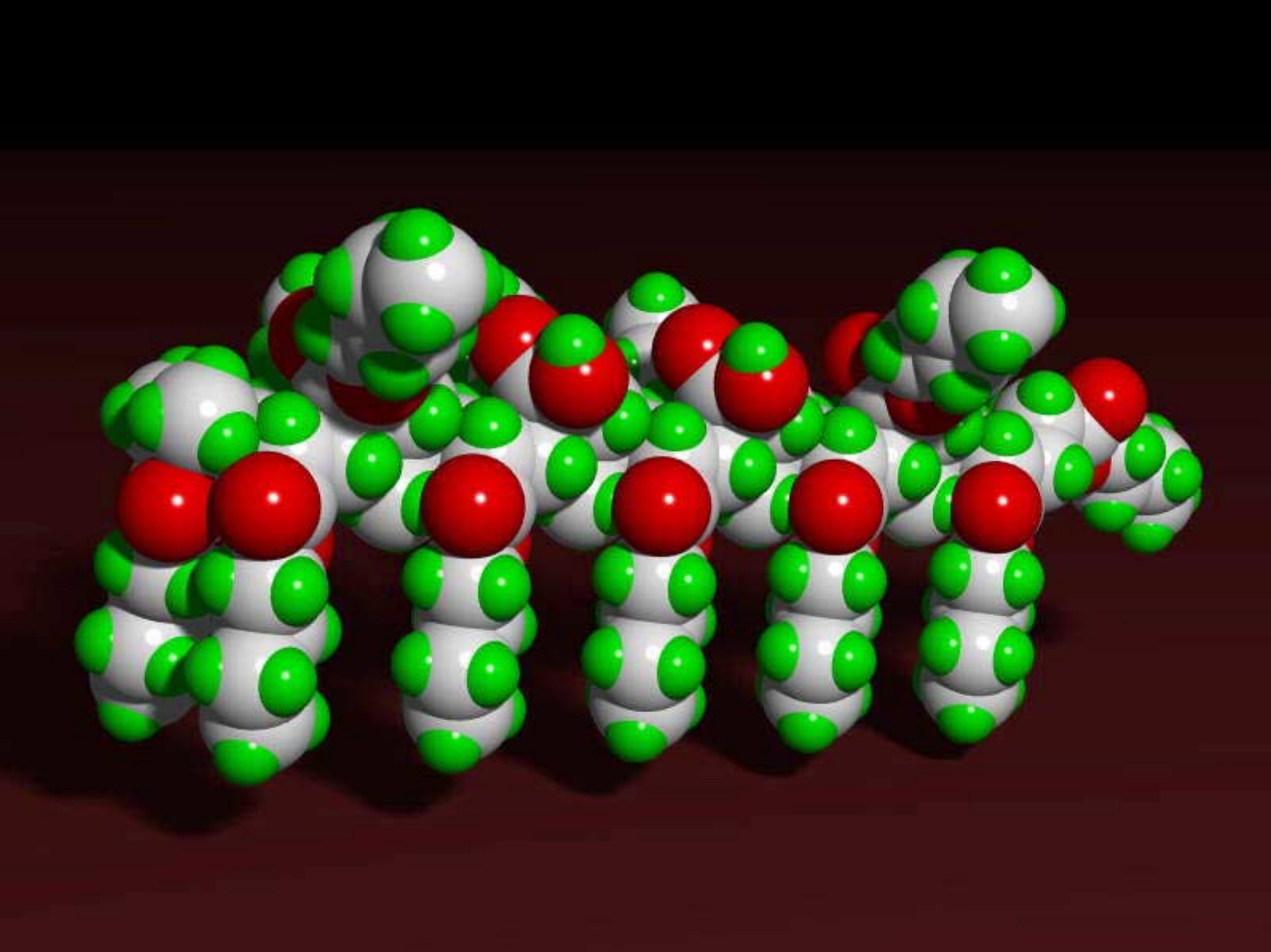
- Antisettling agents
- Binders
- Corrosion inhibitors
- Defoamer
- Extenders, flatting agents
- Lubricants, wax
- Pigments & colorants
- Solvents
- Stabilizers
- Thickeners

Let Down

- Binders
- Catalysts and driers
- Coalescing agents
- Coupling agents
- Crosslinking agents
- Flow control agents
- Plasticizers
- Solvents
- Tints
- UV absorbers & stabilizer

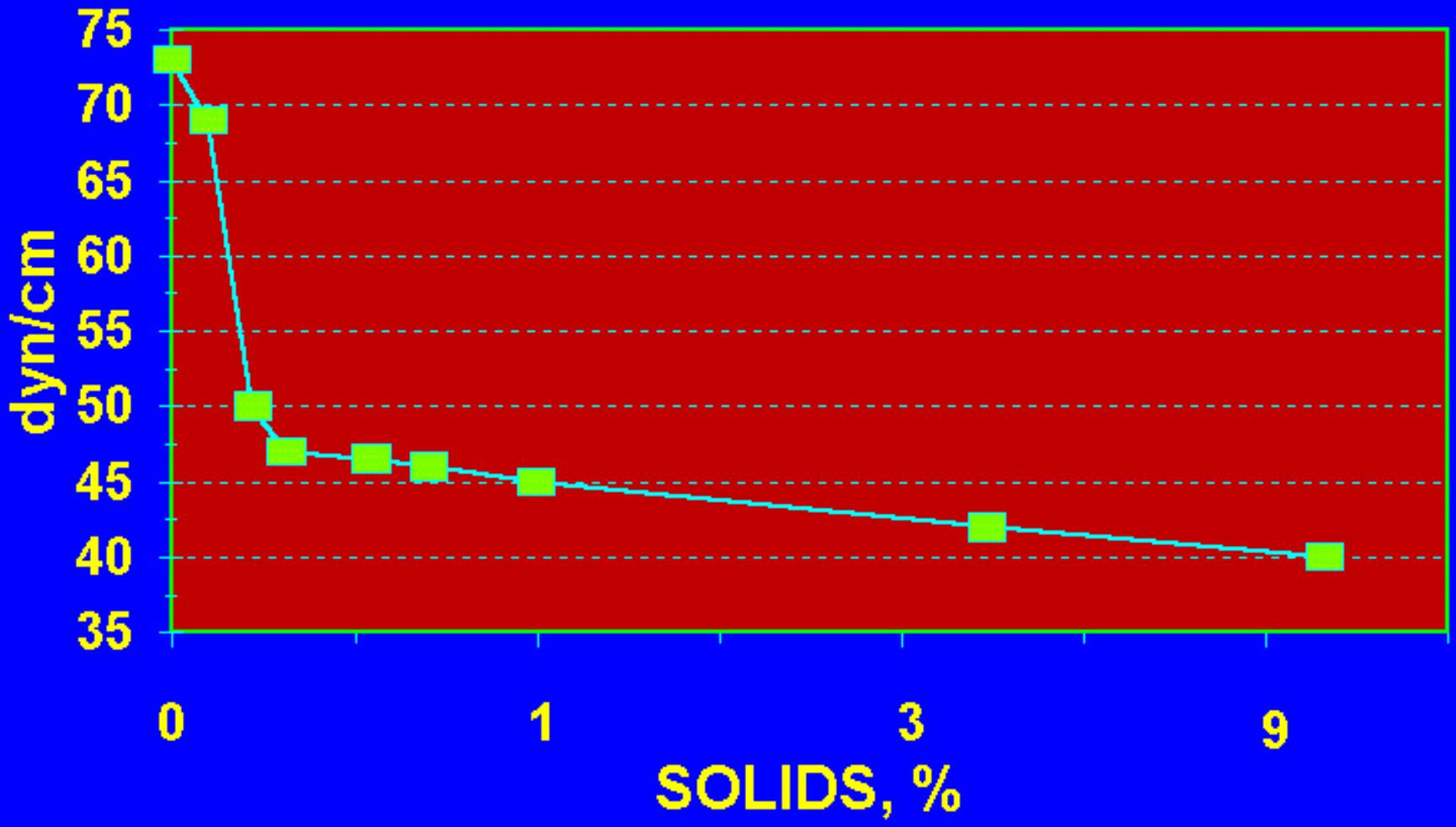
GRIND FORMULATION

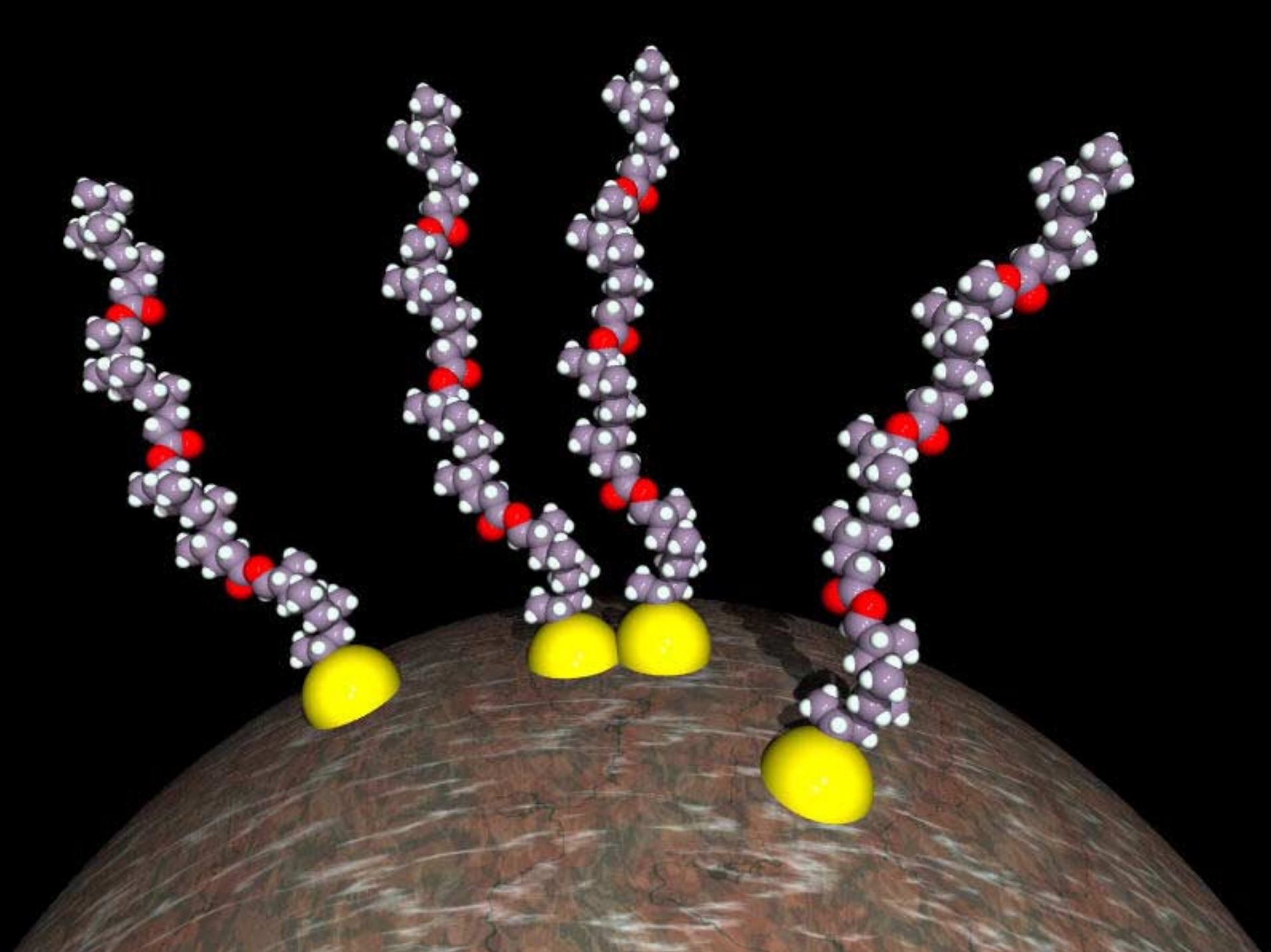
Additives	Function	Chemical Composition
Deaerators Defoamers Antifoams	Removes air entrapped during pigment dispersion	mineral oil, silicones waxes, silica and fatty acids
Dispersants Emulsifiers Surfactants	Lowers surface tension adsorbs on pigment steric stabilization	Nonionic, anionic surfactant block polymer polycarboxylate
Stabilizers	pH control	Amines, base

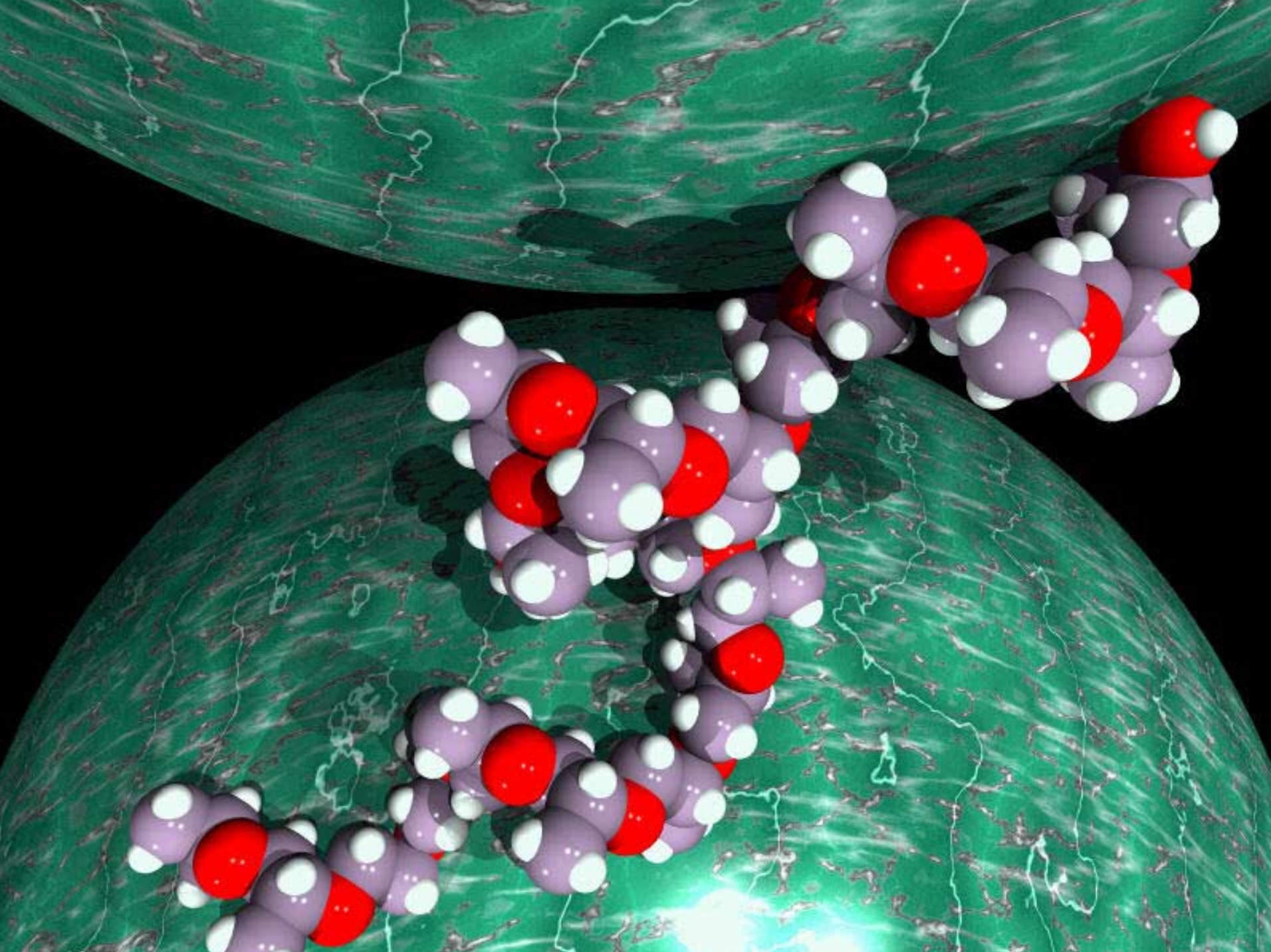


ACRYLIC POLYMER

ACID NUMBER 110





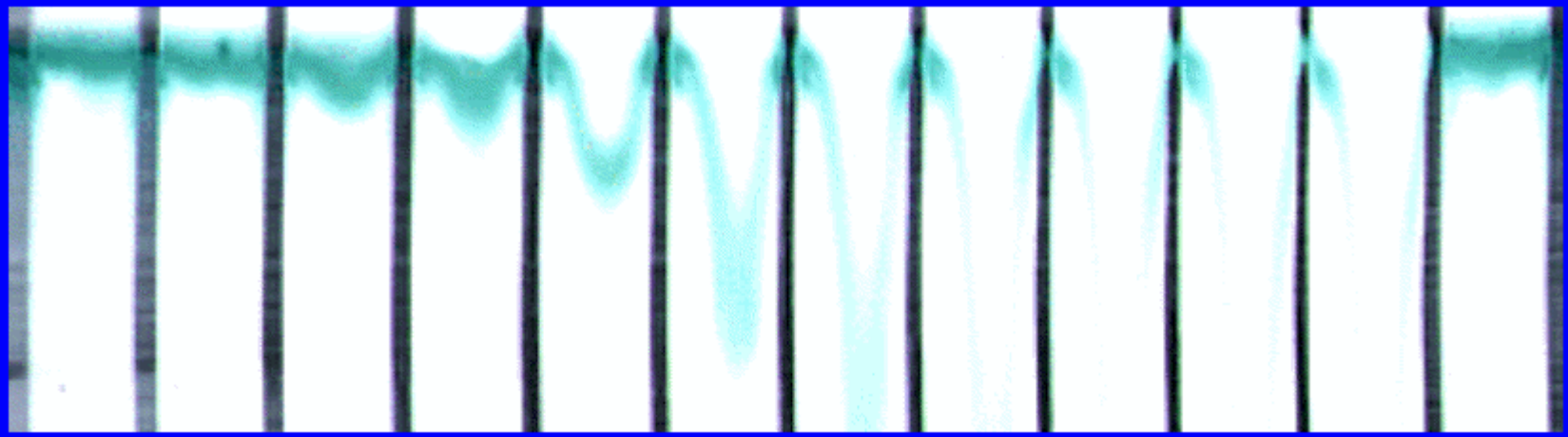


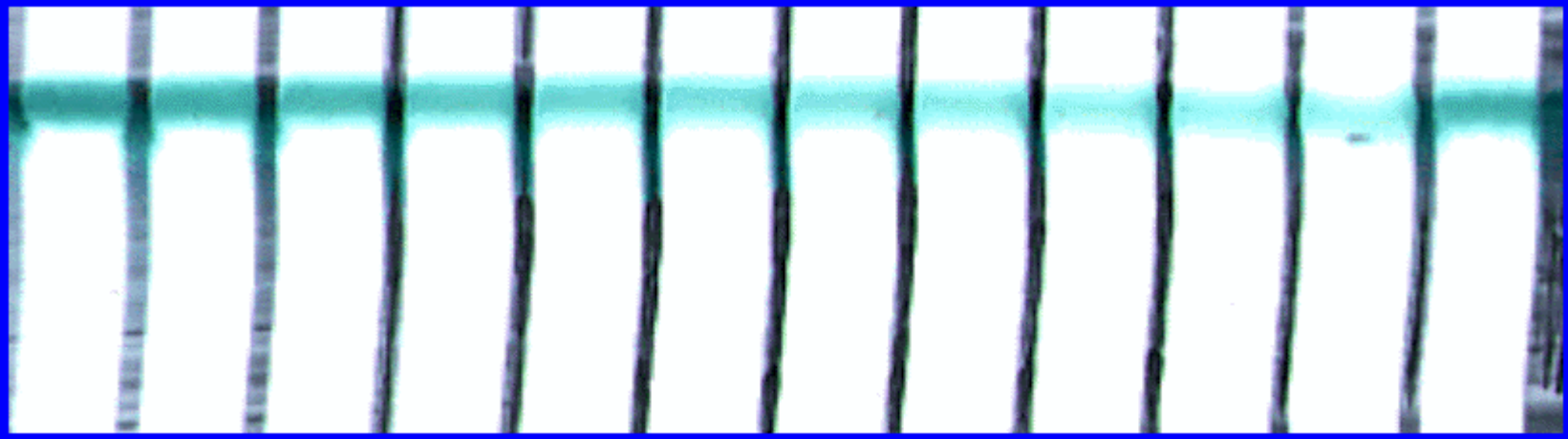
Application Requirement	Solution
Application method	Rheology control
Environmental	Low VOC, toxicity
Stability requirement	Depending on enduse
Humidity	Control required
Substrate	Low surface tension
Contamination	additives to improve
Cure profile	Catalysis

APPLICATION METHODS

SAG TEST

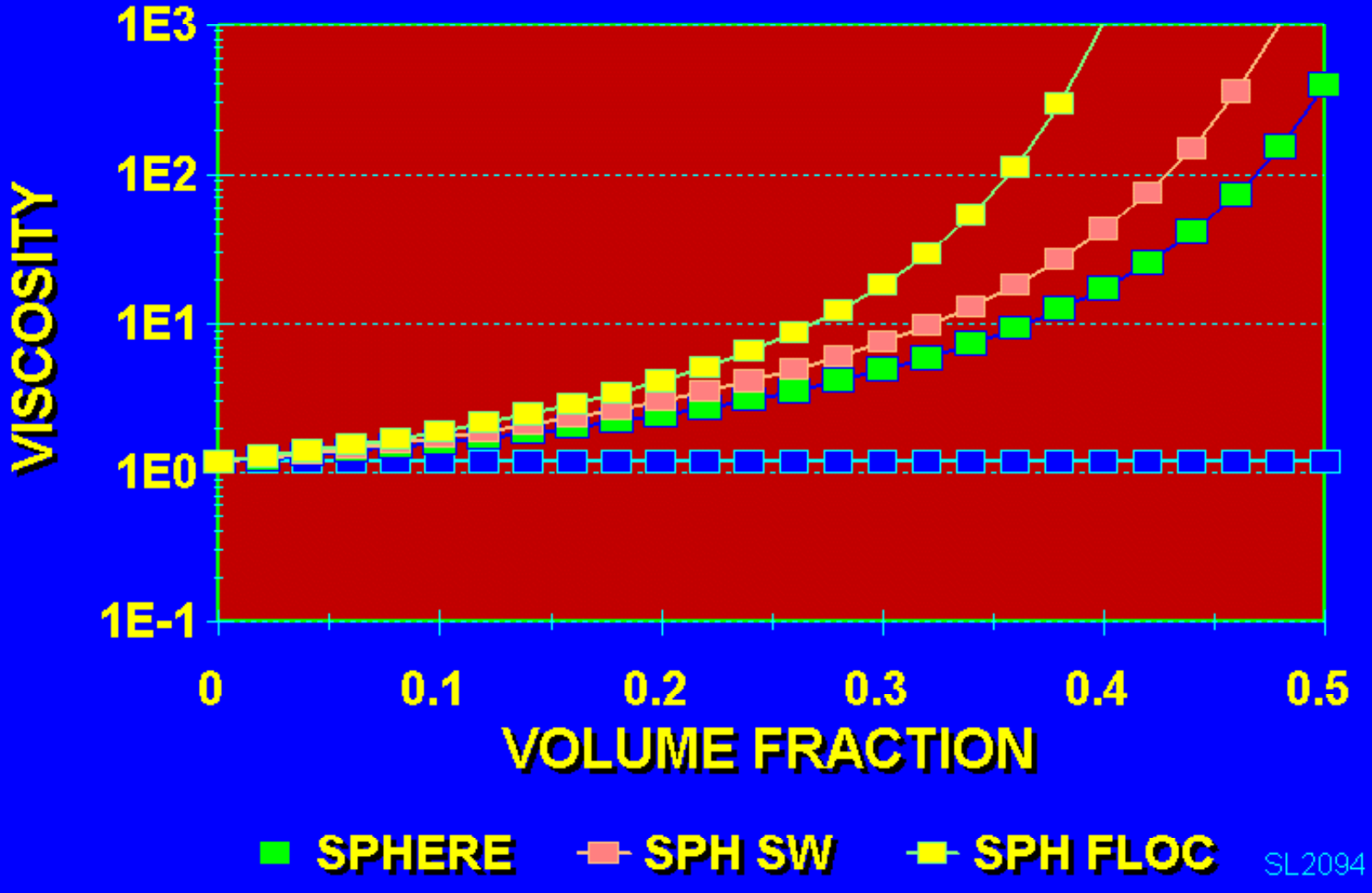
4 6 8 10 11 12 14 16 18 20 22 24





SL2100

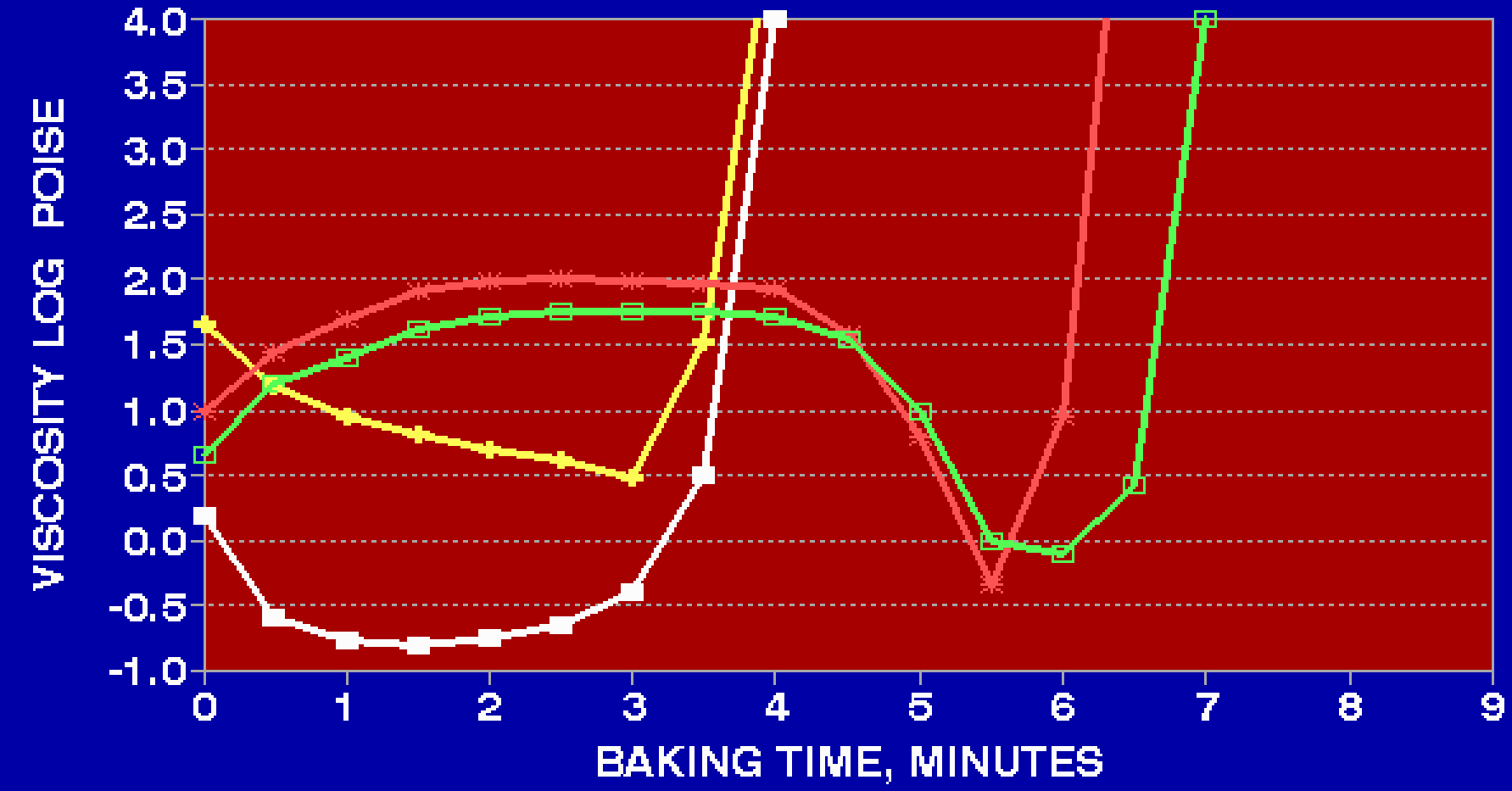
VISCOSITY OF DISPERSION



RHEOLOGY MODIFIER

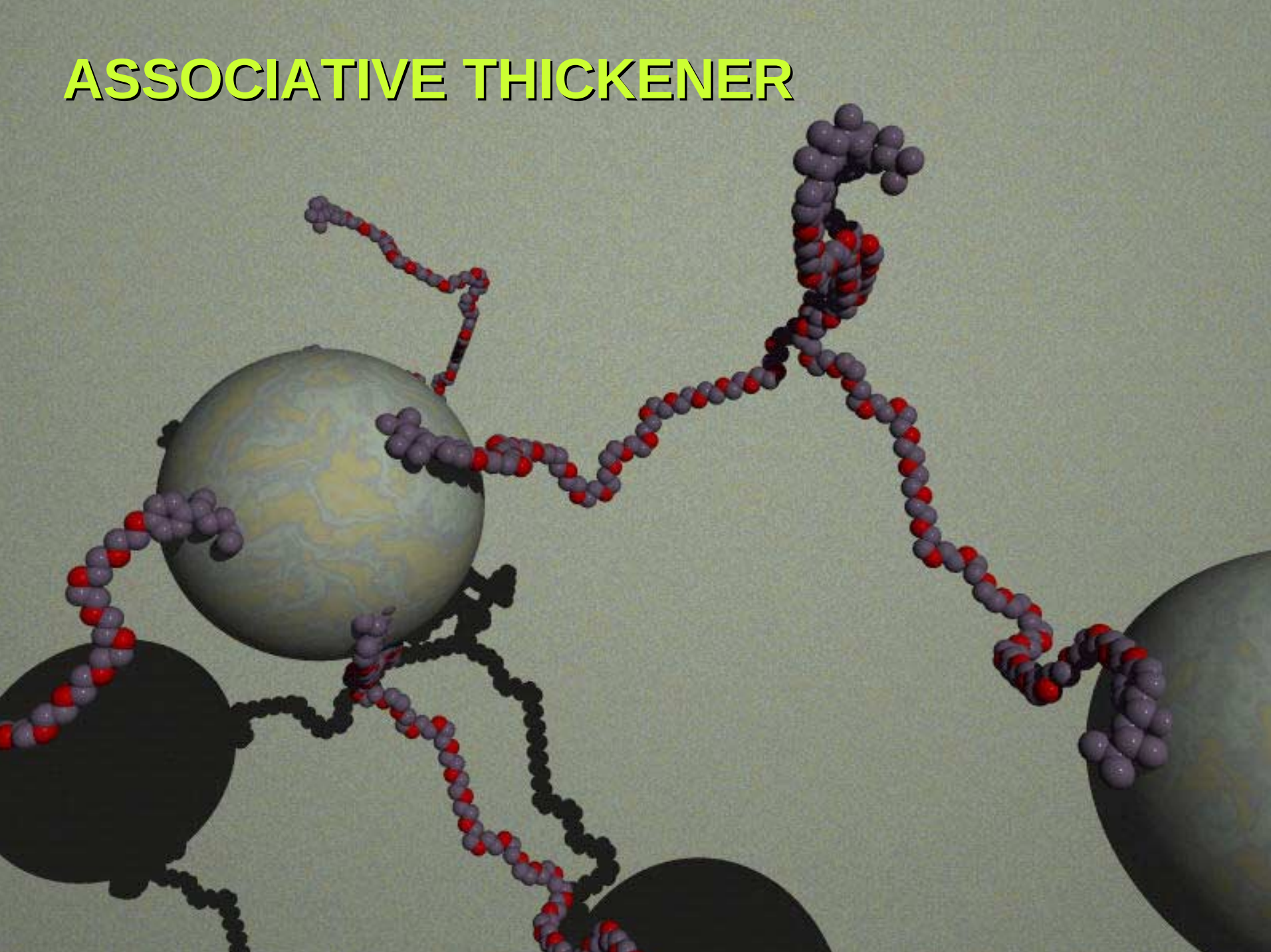
- ATTAPULGITE
- SMECTITE
- ASSOCIATIVE
- SILICA
- TITANATE
- POLYESTER
- POLYACRYLATE
- POLYOLEFIN
- ORGANO CLAY
- ORGANO SULFONATE
- POLYAMIDE
- CASTOR DERIVATIVE
- POLYUREA
- CATIONIC OLIGOMER

VISCOSITY OF HIGH SOLIDS COATING
DURING CURE AND CROSSLINKING



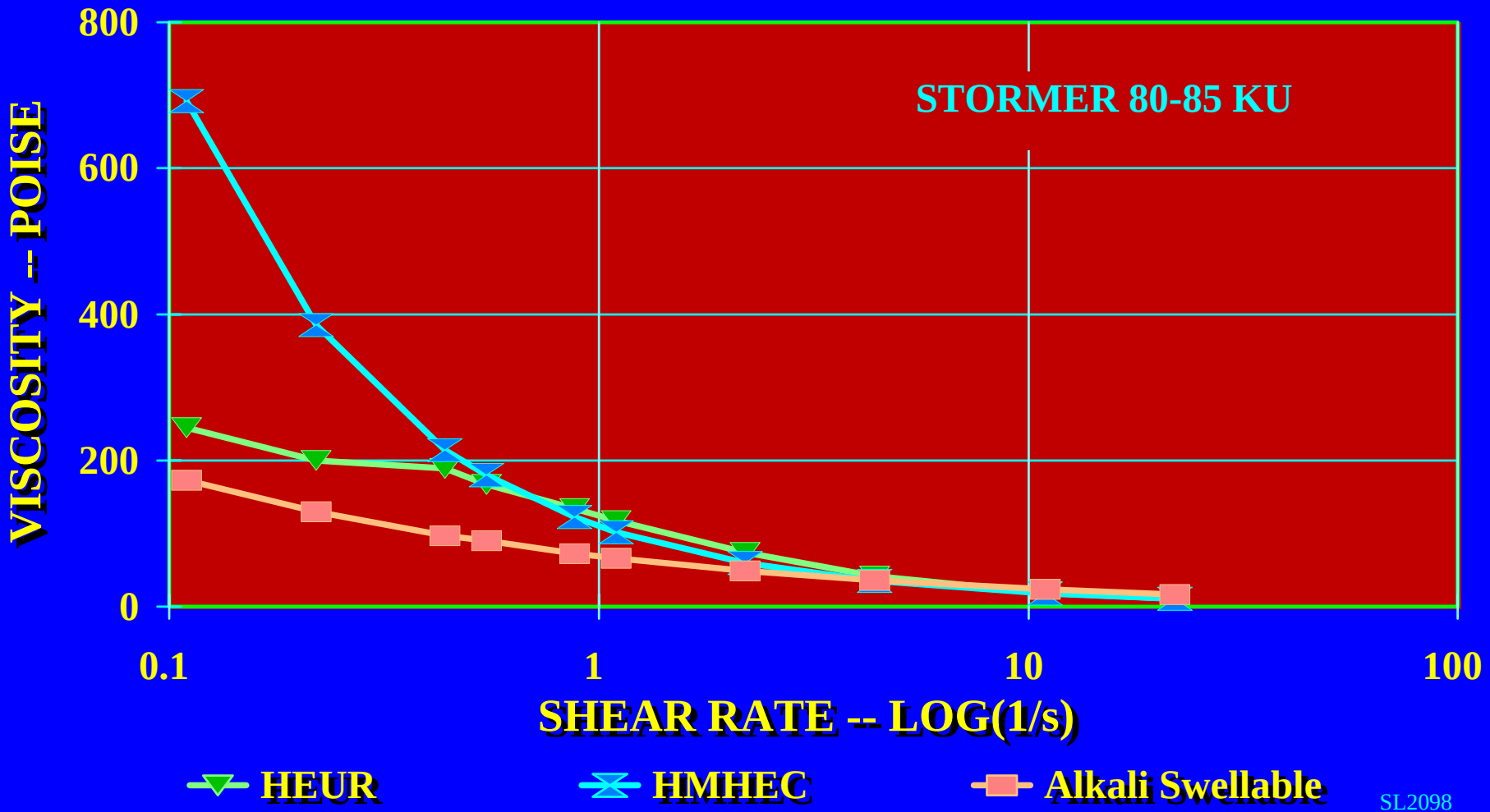
SL1530

ASSOCIATIVE THICKENER



VISCOSITY -- LOW SHEAR RANGE

LATEX MAINTENACE



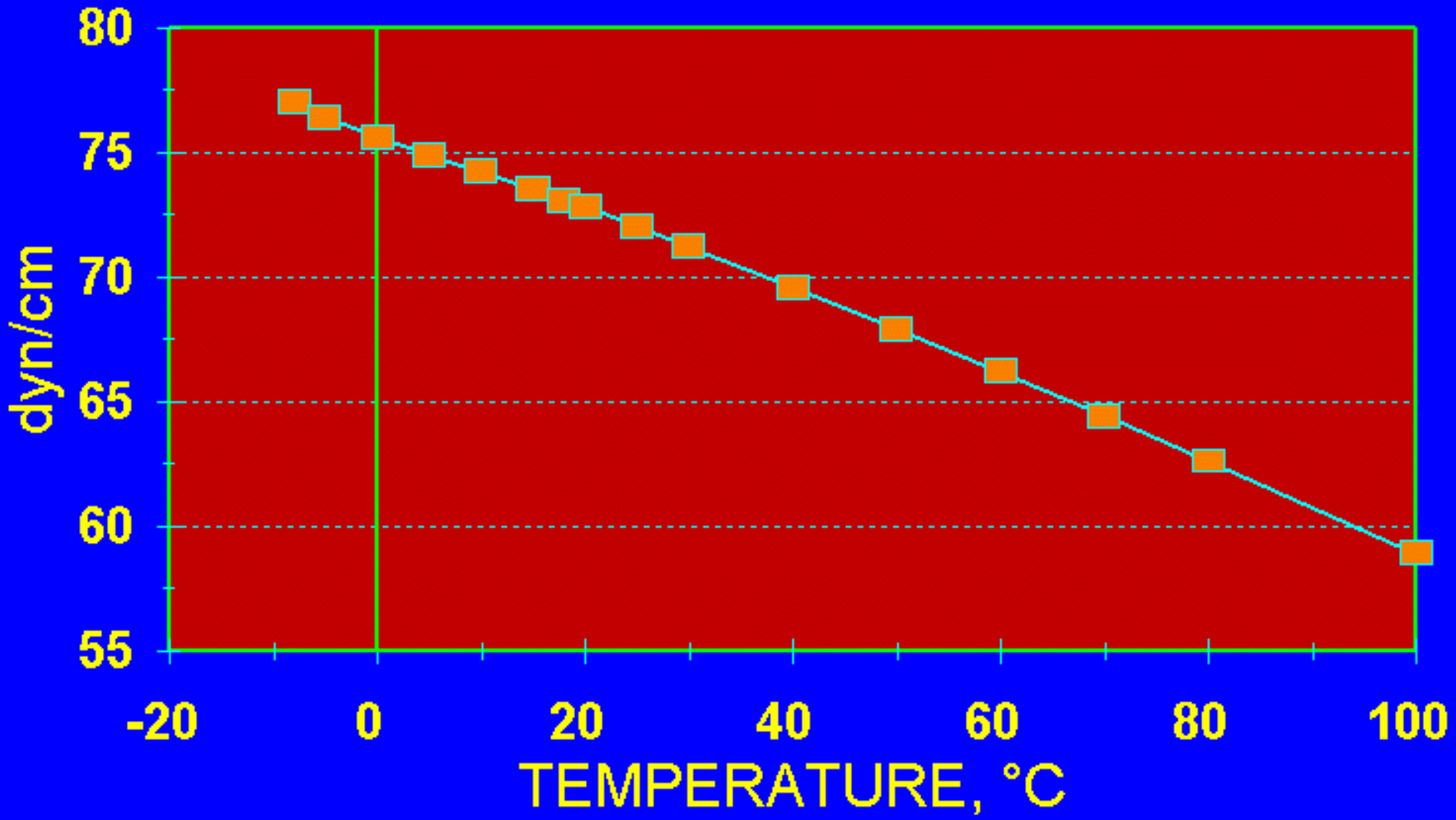
SL2098

FILM FORMATION
PROBLEMS & REMEDIES

Atmosphere, dry, moist, gas heated	Humidity control, catalysis
Coalescence	Controlled of Tg
Flash off time, blistering	Release of solvent
Film thickness	Reaction products
Flow and leveling	Surface tension
	Cure profile

SURFACE TENSION

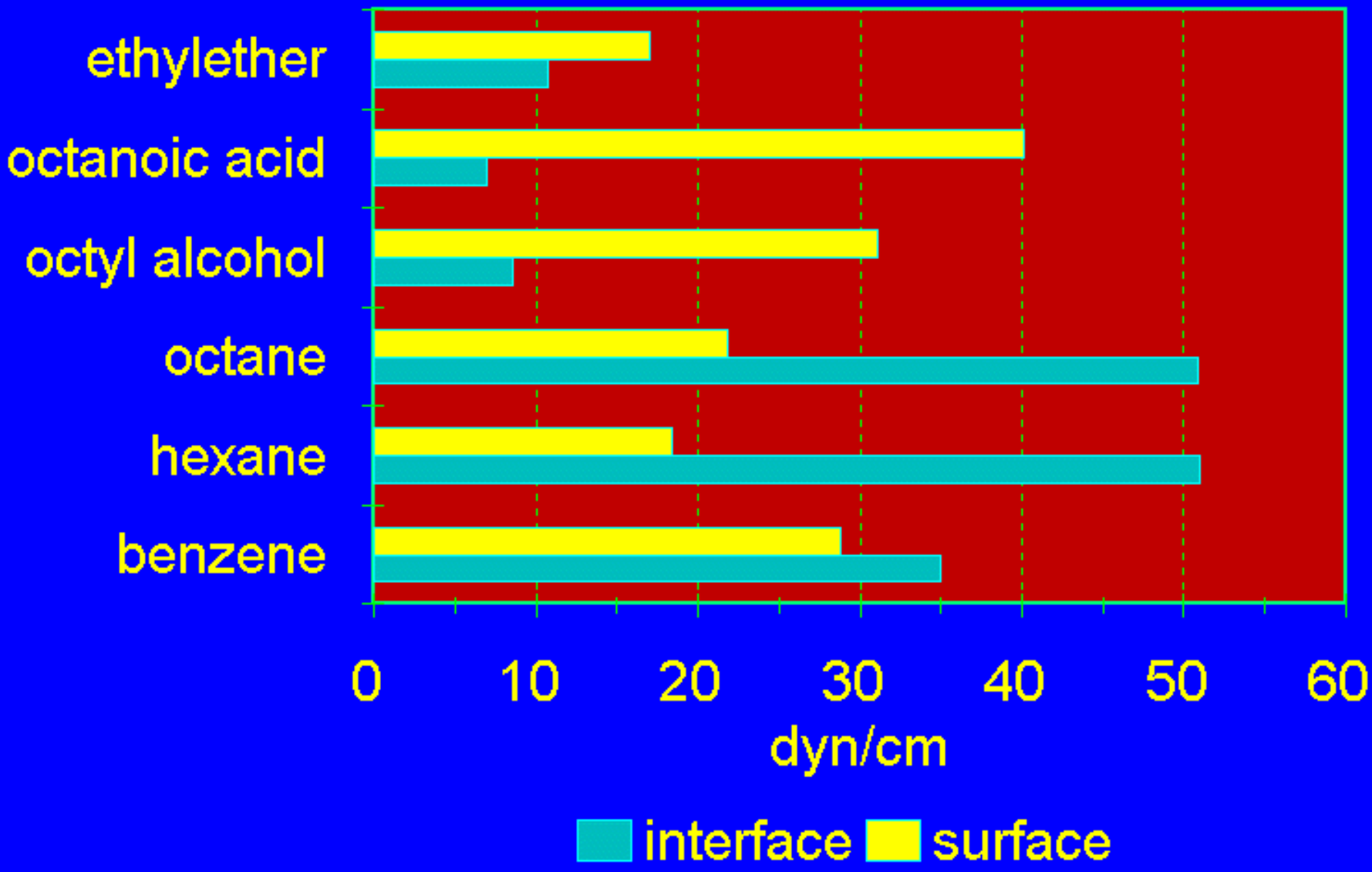
WATER



SL2089

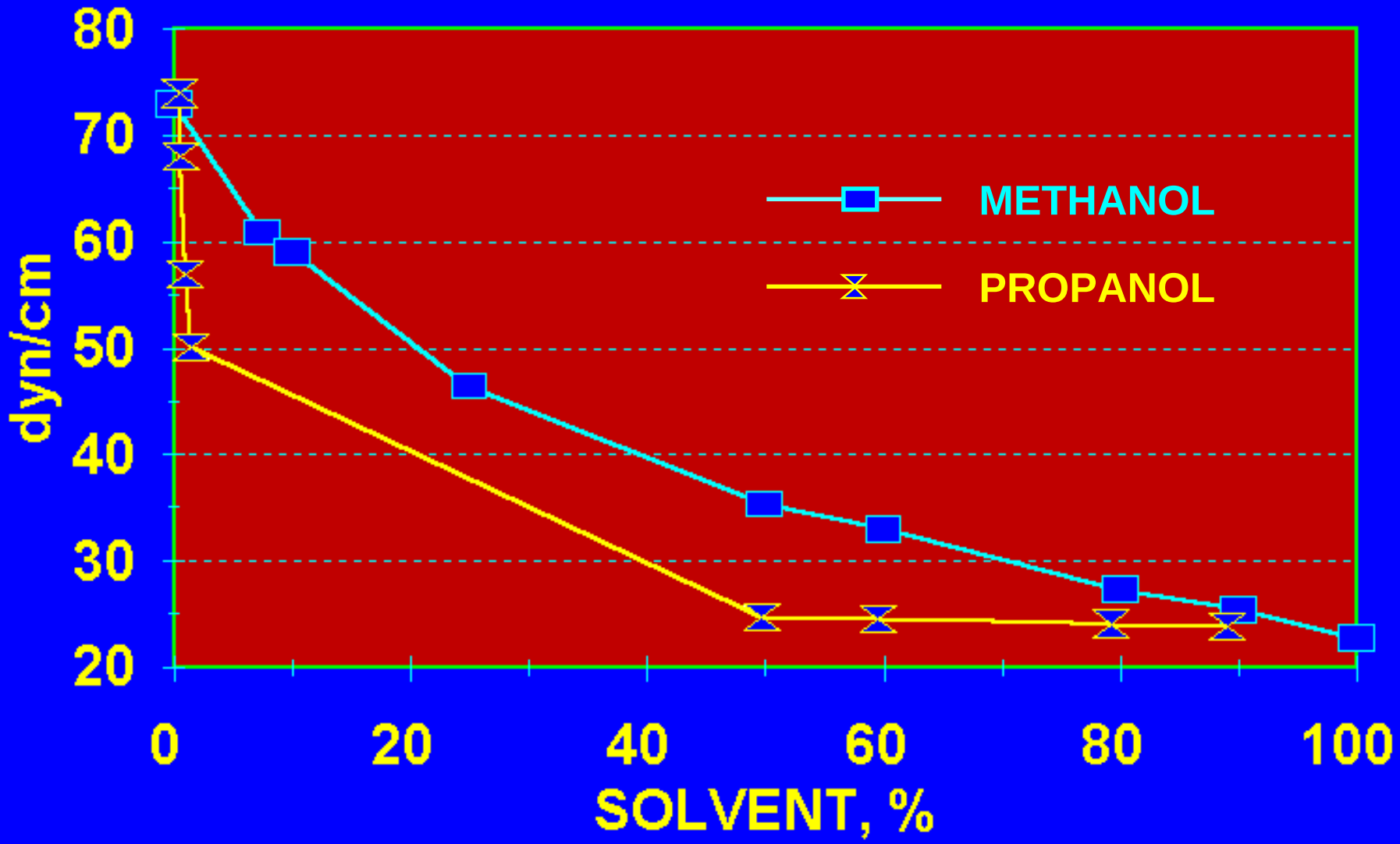
SURFACE AND INTERFACE TENSION

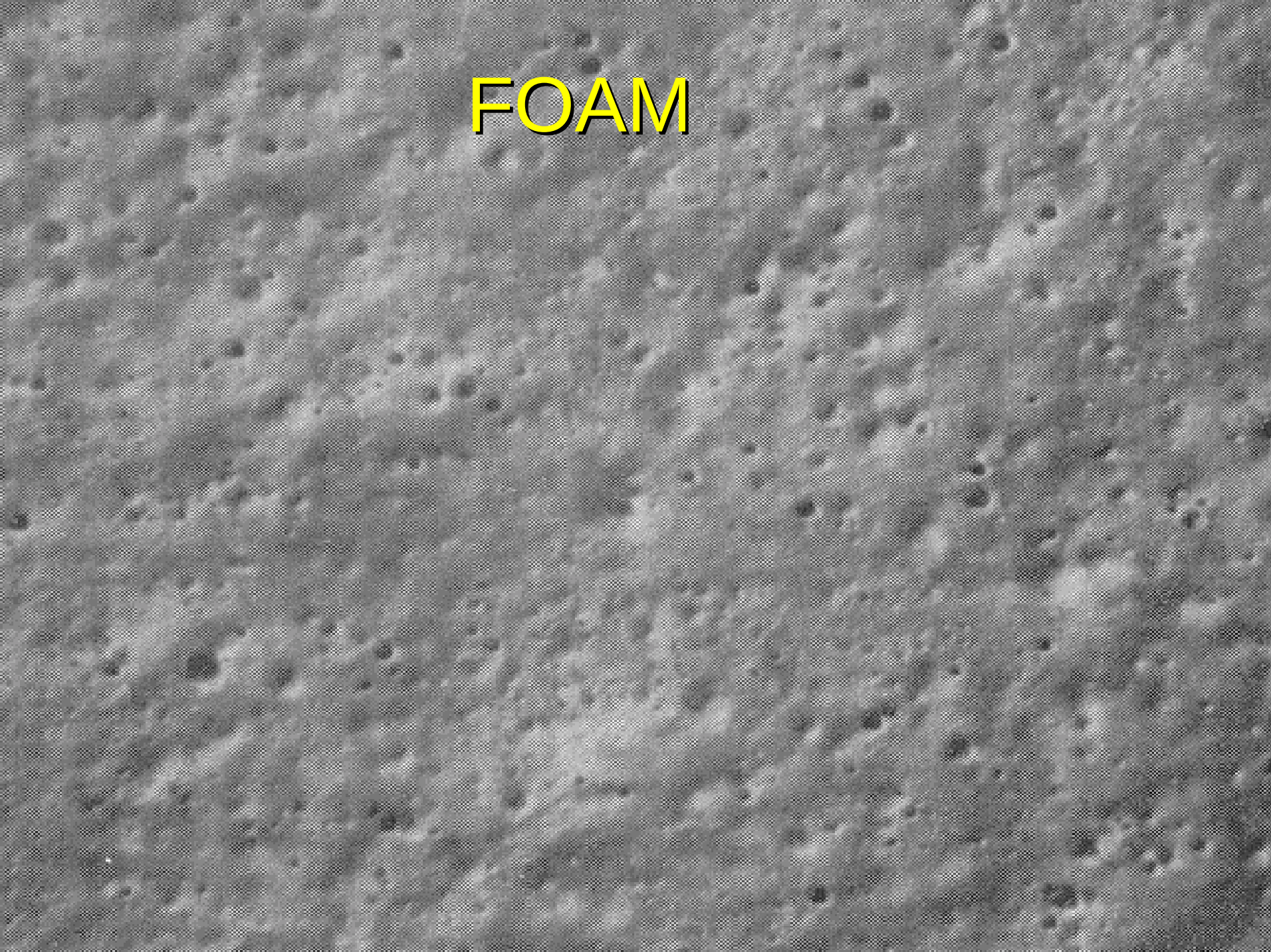
WATER INTERFACE



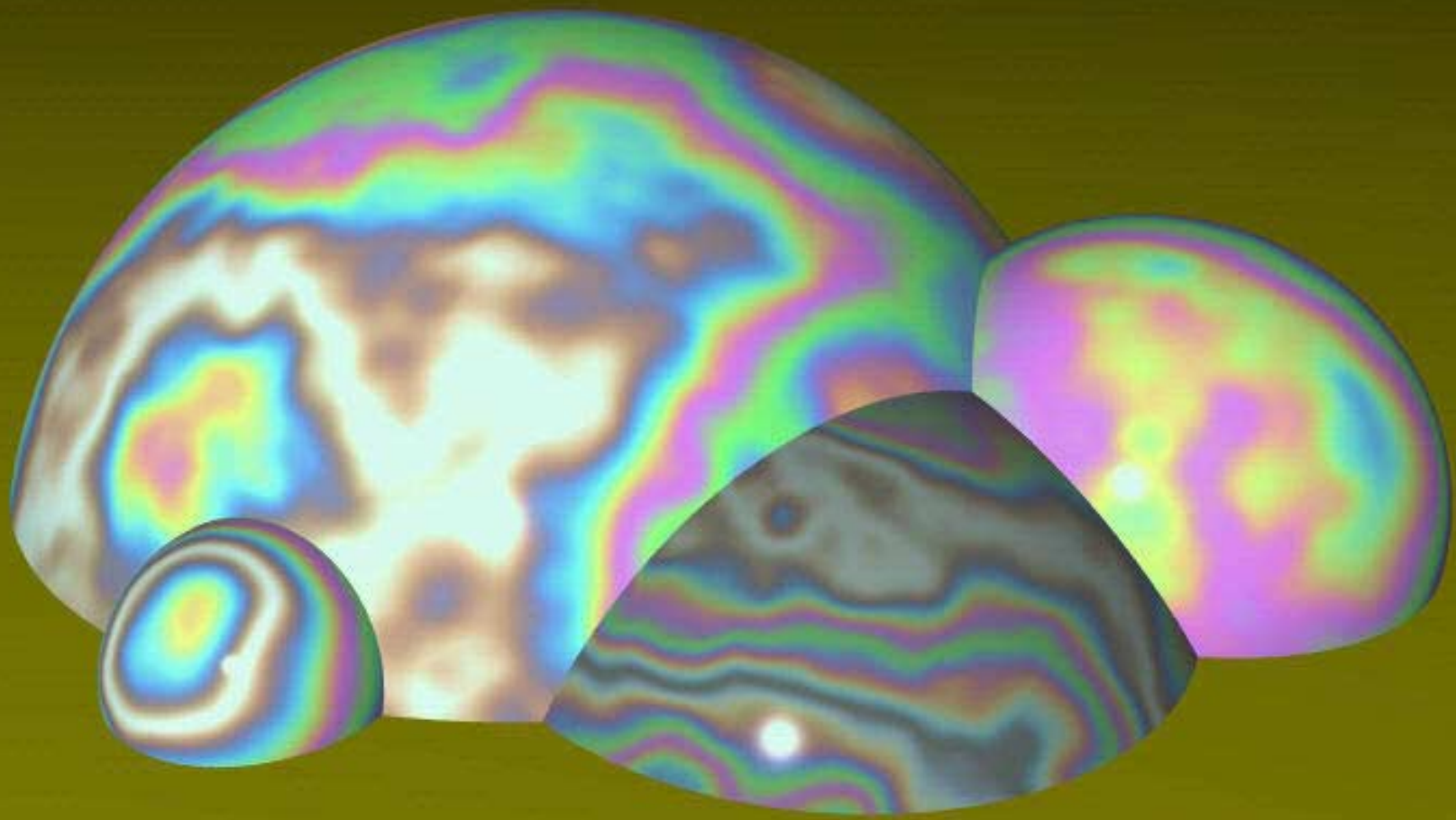
SURFACE TENSION

WATER SOLVENT

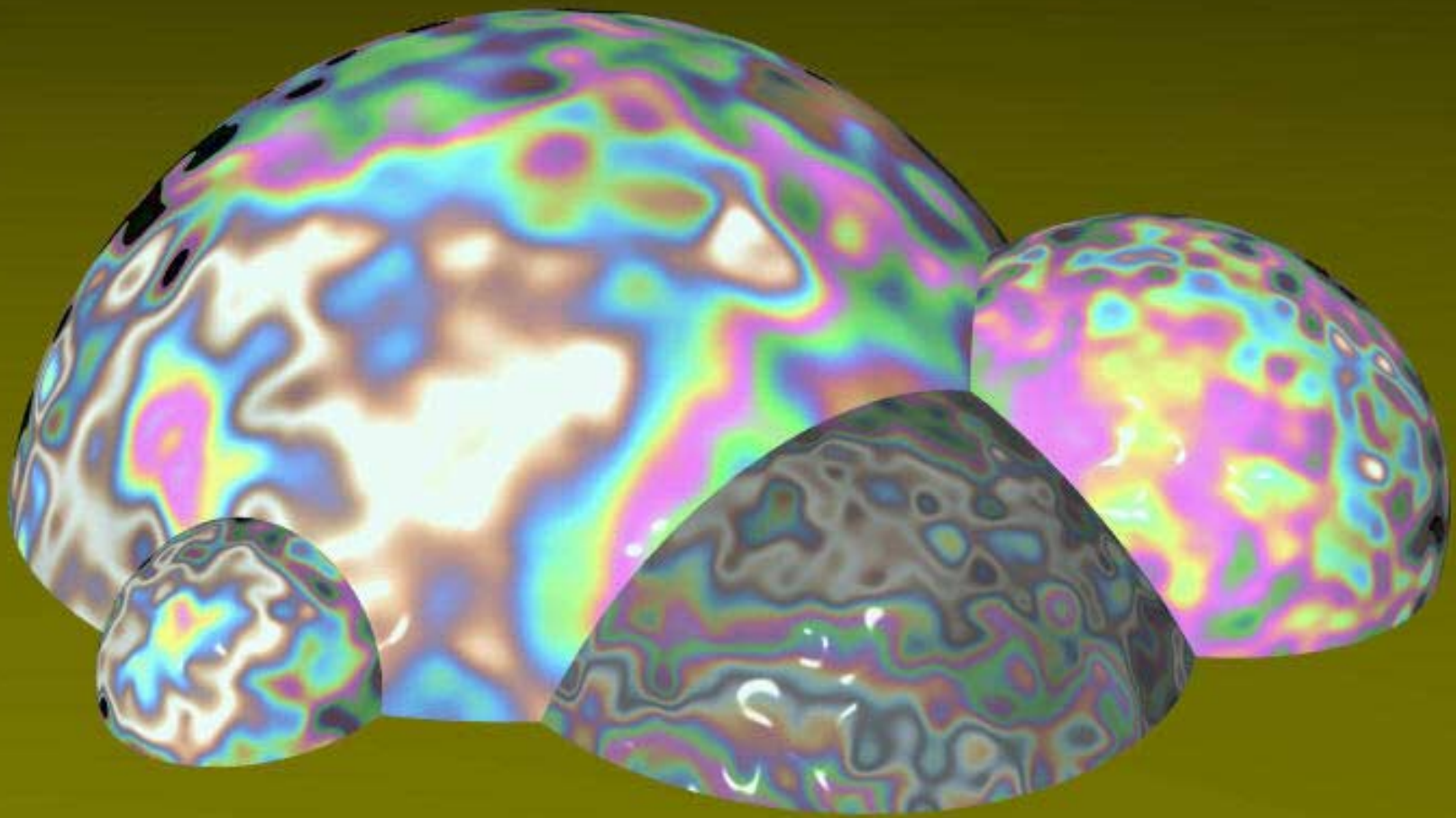



FOAM

FOAM-SURFACE TENSION, VISCOSITY



DE-FOAMER

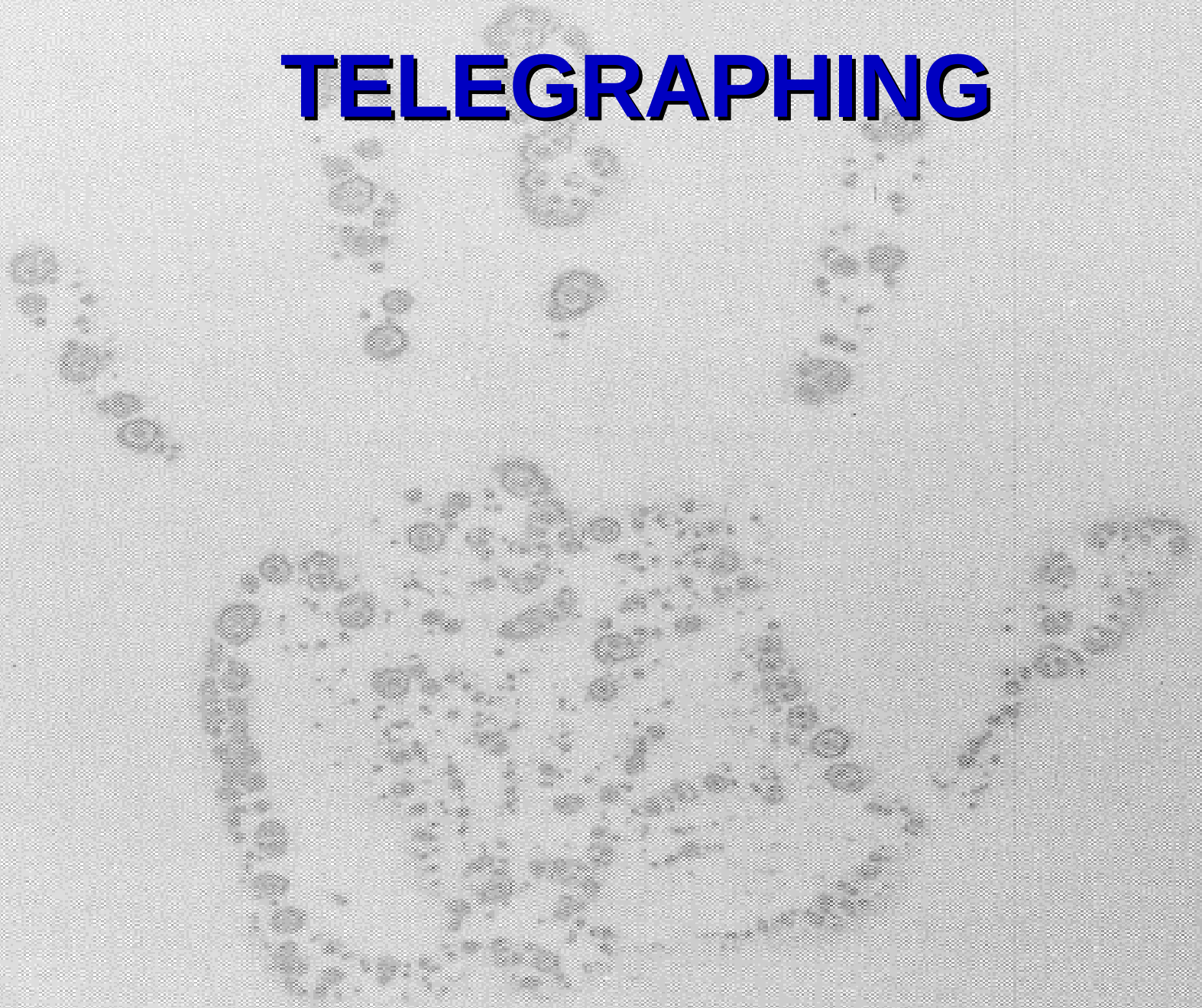


CRAWLING

WETTING

DEWETTING

TELEGRAPHING




FAT EDGE


SOLVENT POP

FILM PROPERTIES

PROPERTY	INFLUENCED BY
Appearance Gloss	Pigment dispersion.
Hiding power, Color	Surface smoothness
Hardness/Flexibility	Polymer & crosslinker degree of cure
Mar-abrasion resistance	Elasticity, slip
Environmental resistance	Adhesion, PVC

ADDITIVES to IMPROVE FILM PROPERTIES

Hardness

Flexibility

Impact resistance

Coefficient of friction

Mar & abrasion resistance

Resin & Crosslinker

Catalyst, stabilizer

Polymer modifier

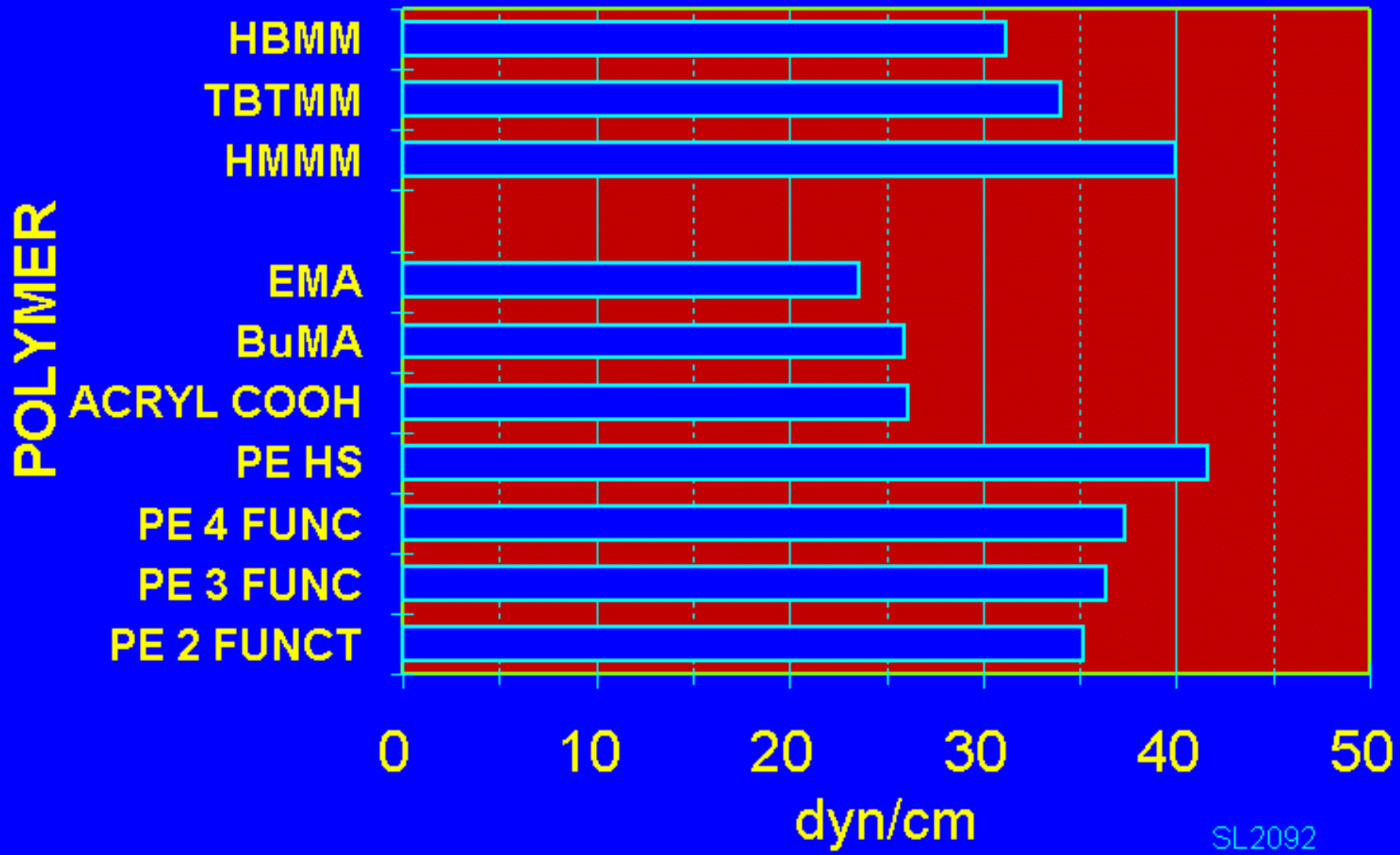
Adhesion promoter

FLOW LEVELING

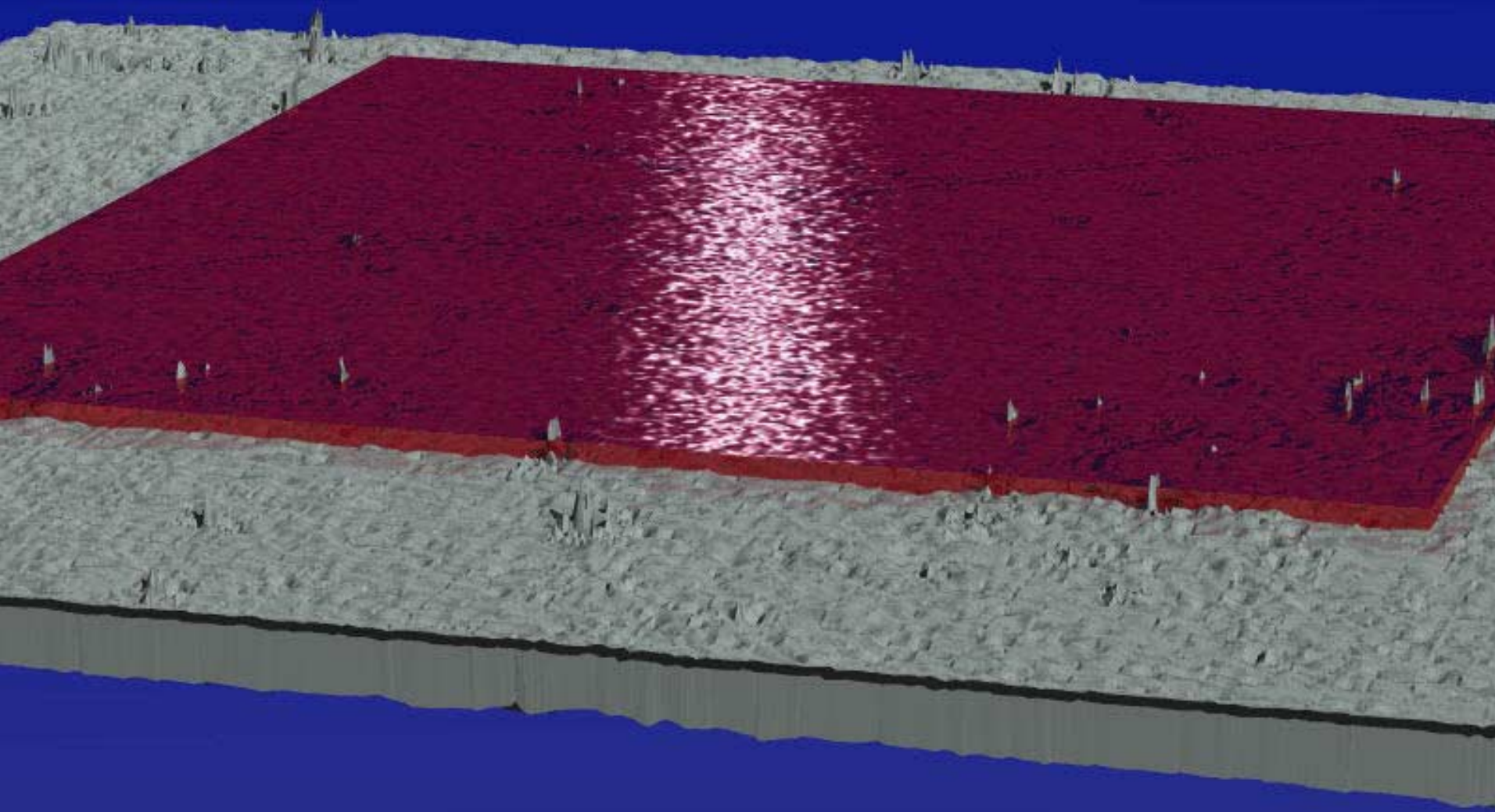
SOLUBILITY PARAMETER → POLAR

SL2093

SURFACE TENSION



FLOW AND LEVELING

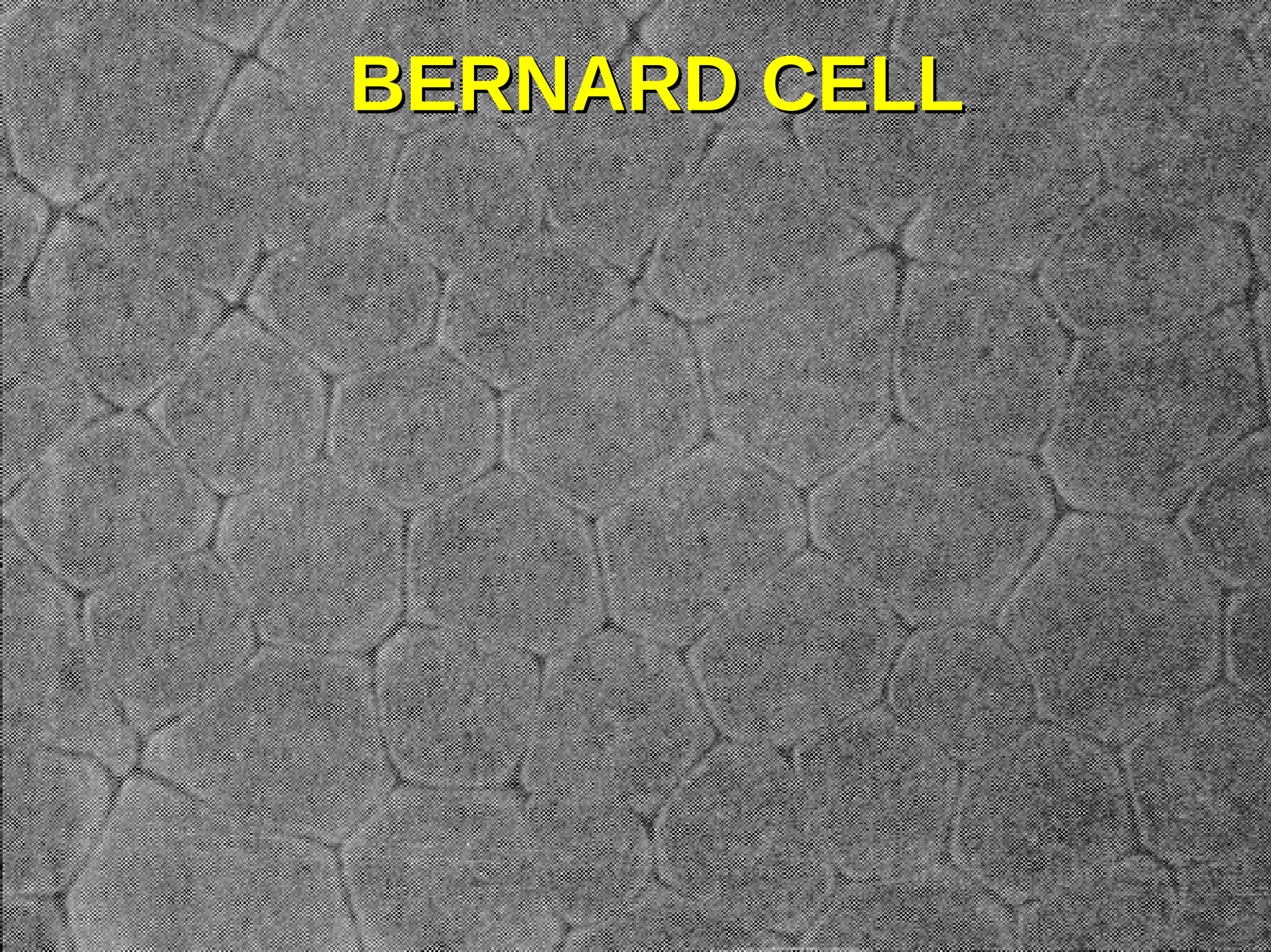



ORANGE PEEL

CRATERS


FISH EYE

BERNARD CELL



ADDITIVES to IMPROVE FILM PROPERTIES

Environmental resistance

Salt spray

Humidity

Exterior durability,

Acid etch resistance

Resin & Crosslinker

Corrosion inhibitor

Catalyst

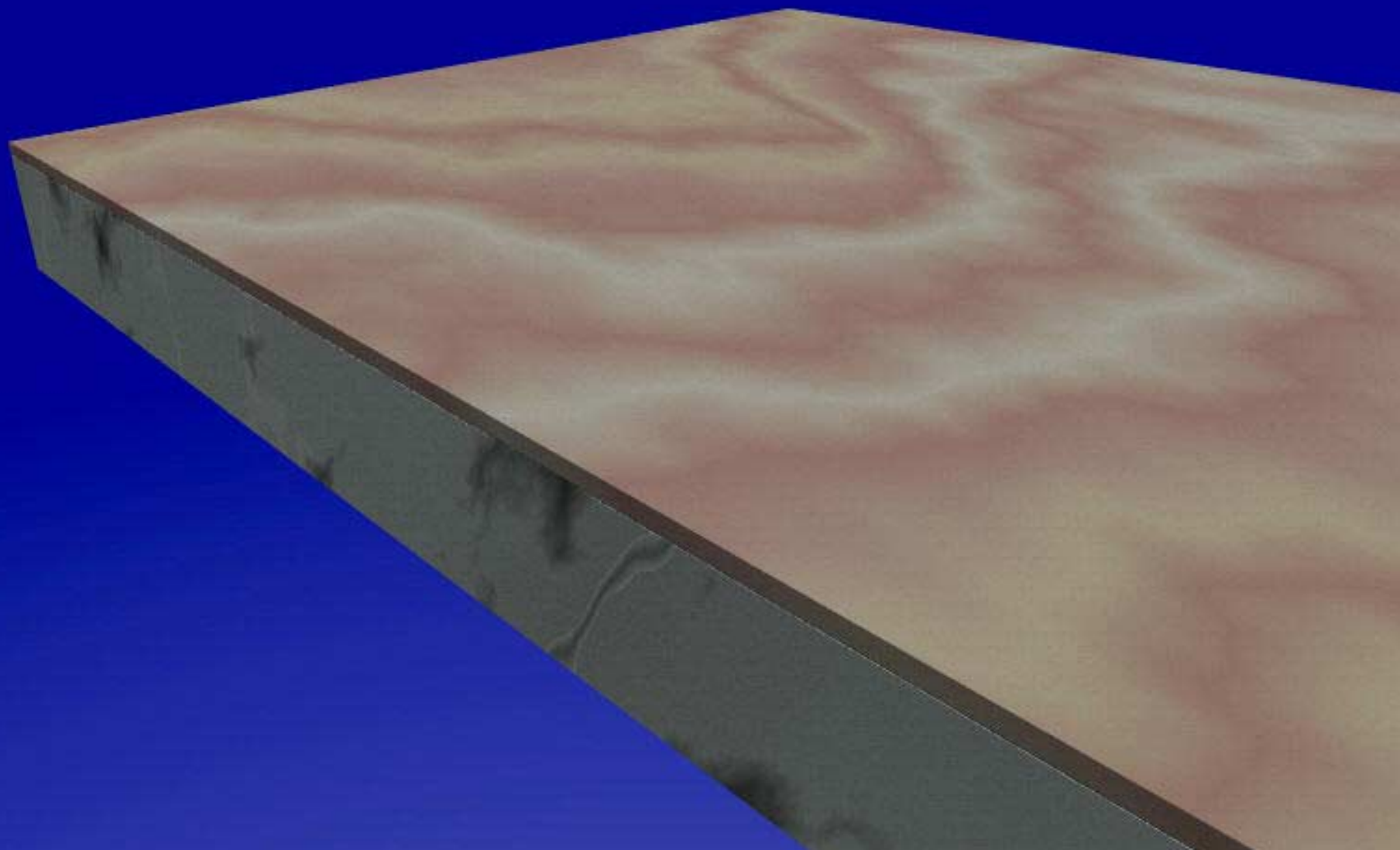
UV absorber

Additives

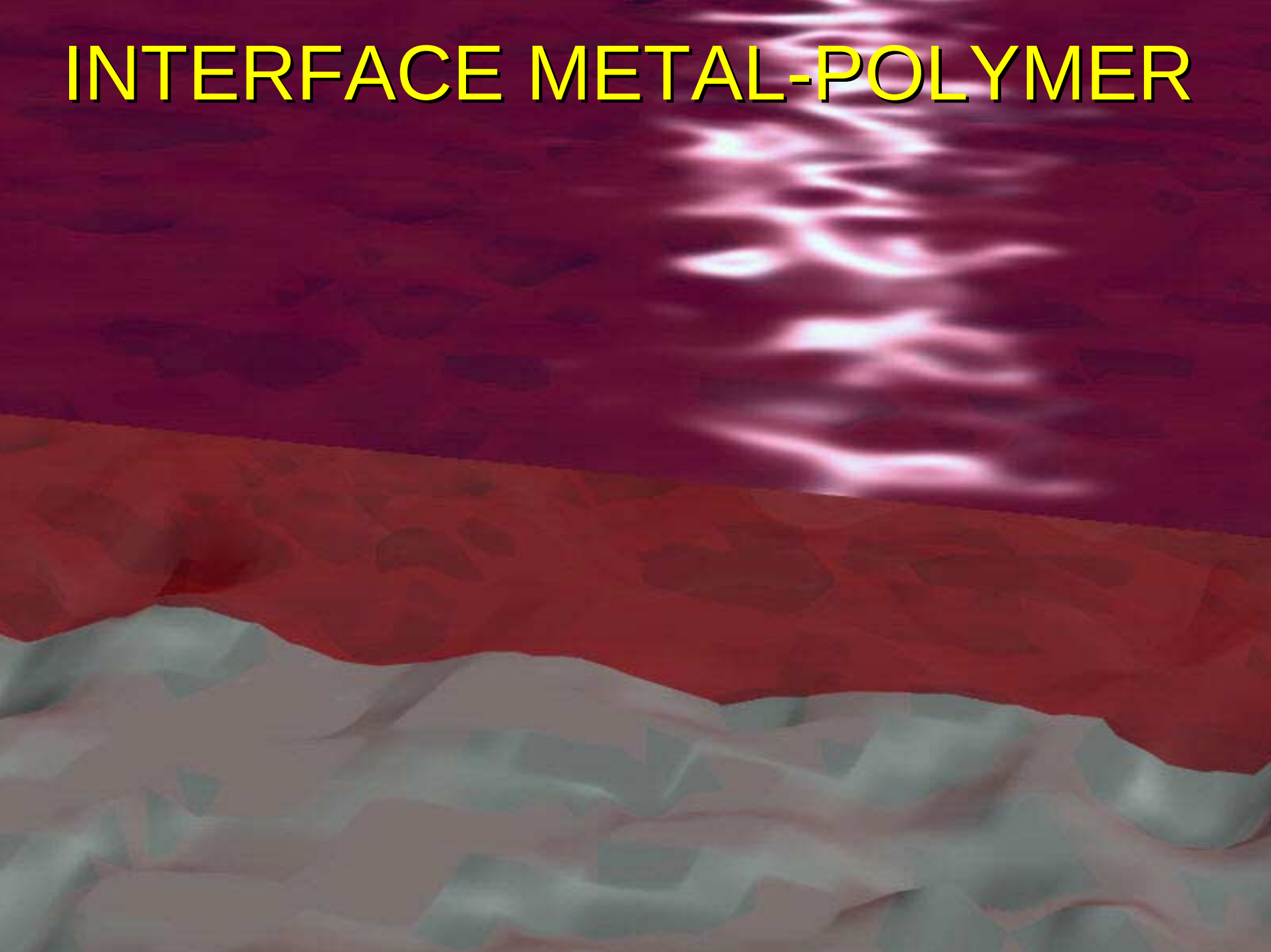
ADDITIVES to IMPROVE FILM PROPERTIES

Hardness	Resin & Crosslinker
Flexibility	
Impact resistance	Catalyst, stabilizer
Coefficient of friction	Polymer modifier
Mar & abrasion resistance	Adhesion promoter

SURFACES ARE DIFFERENT

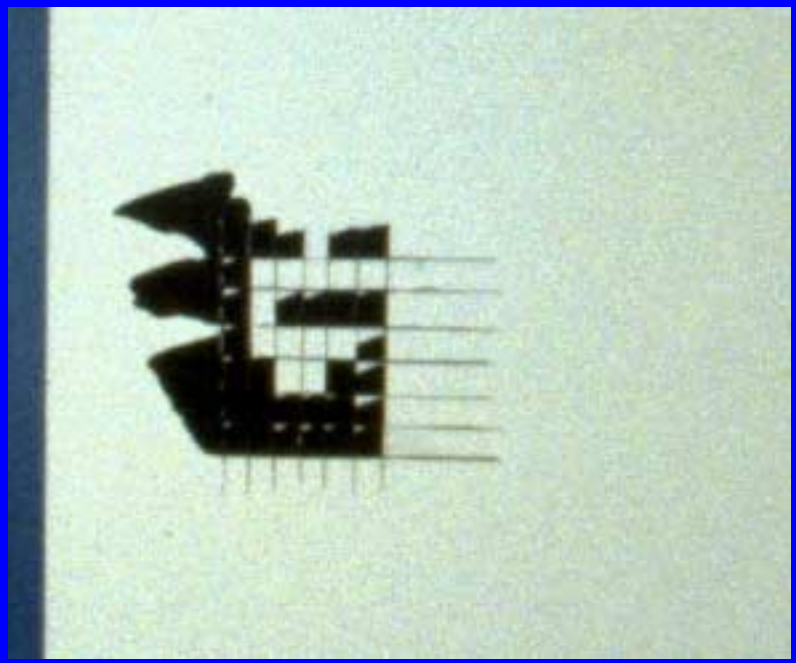


INTERFACE METAL-POLYMER

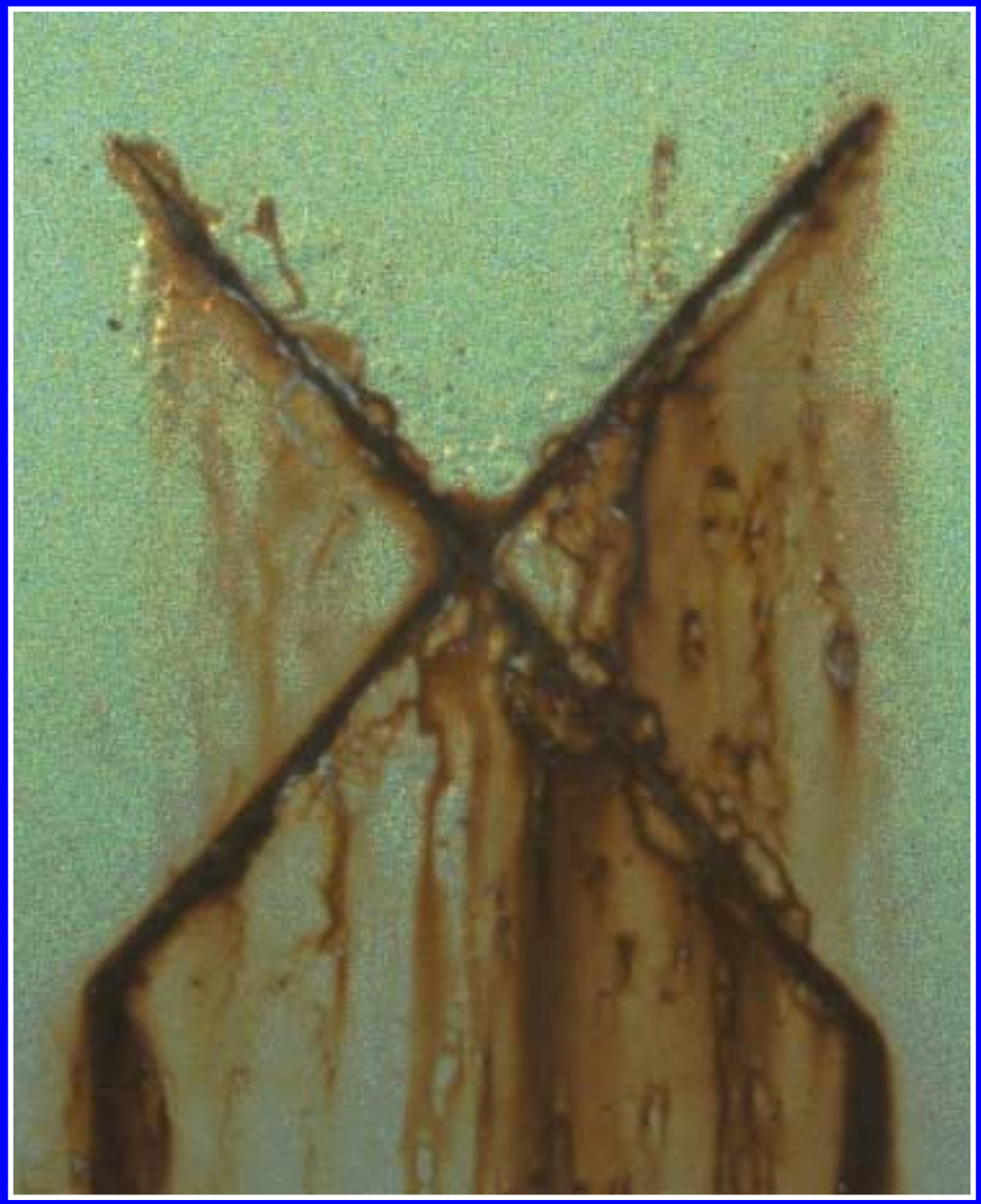


INTERFACIAL ADHESION
WEAK BOUNDARY LAYERS

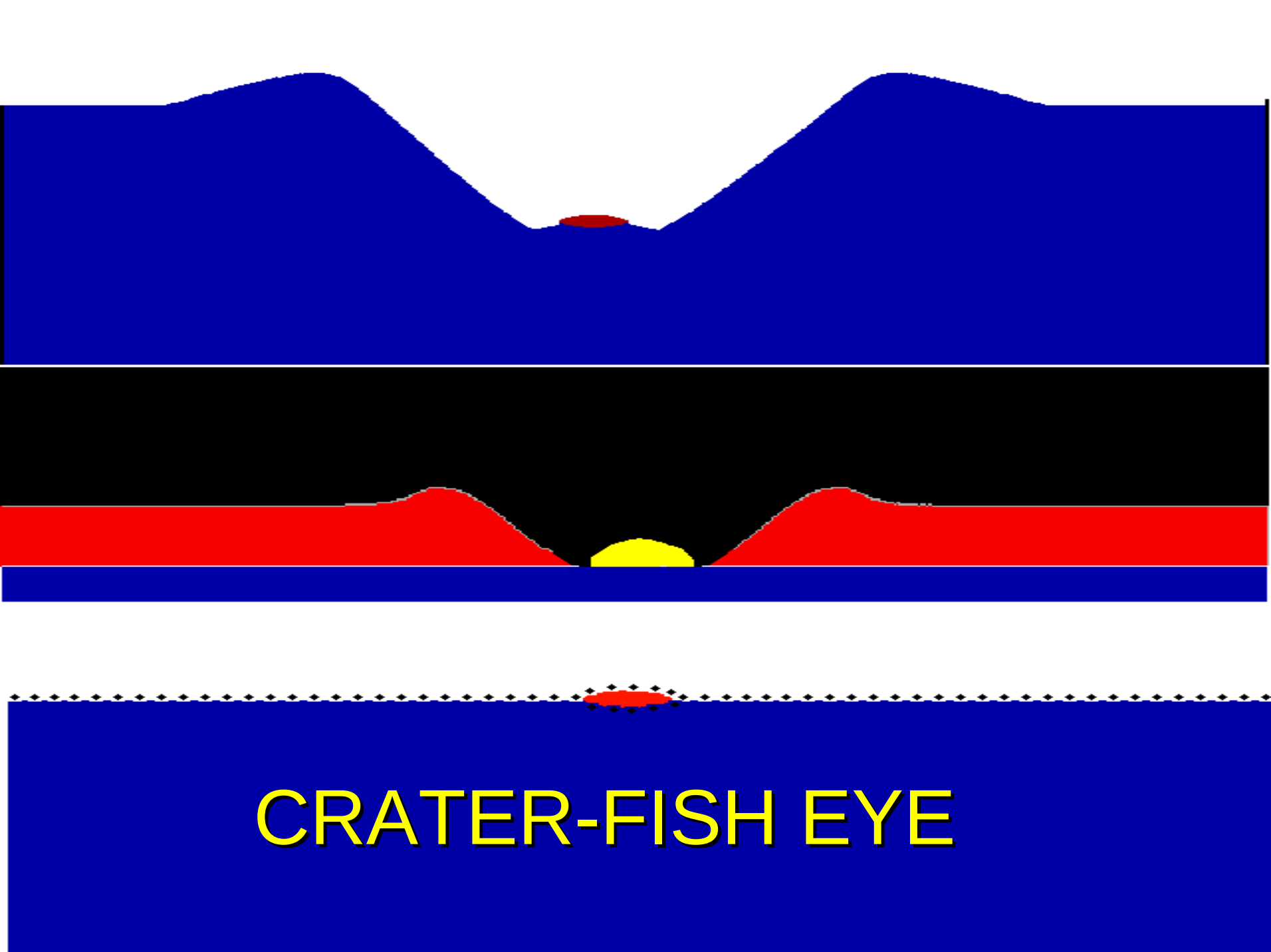
INTERCOAT ADHESION



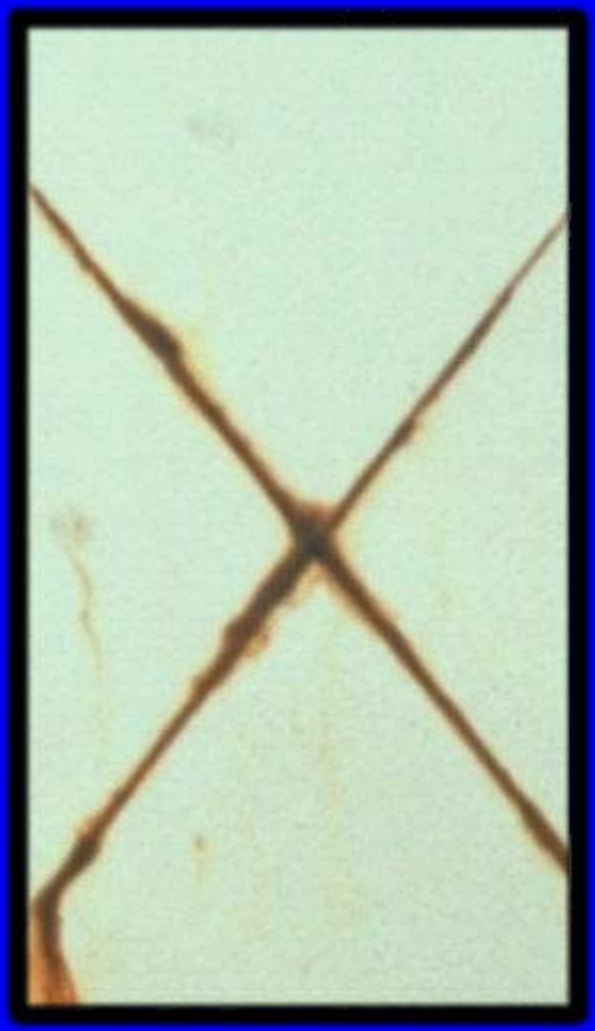
TPO-PE



CORROSION
PE/HMMM


CRATER-FISH EYE

DISPERSANTS EFFECT ON ADHESION



RSO_3 Me

NO DISP.

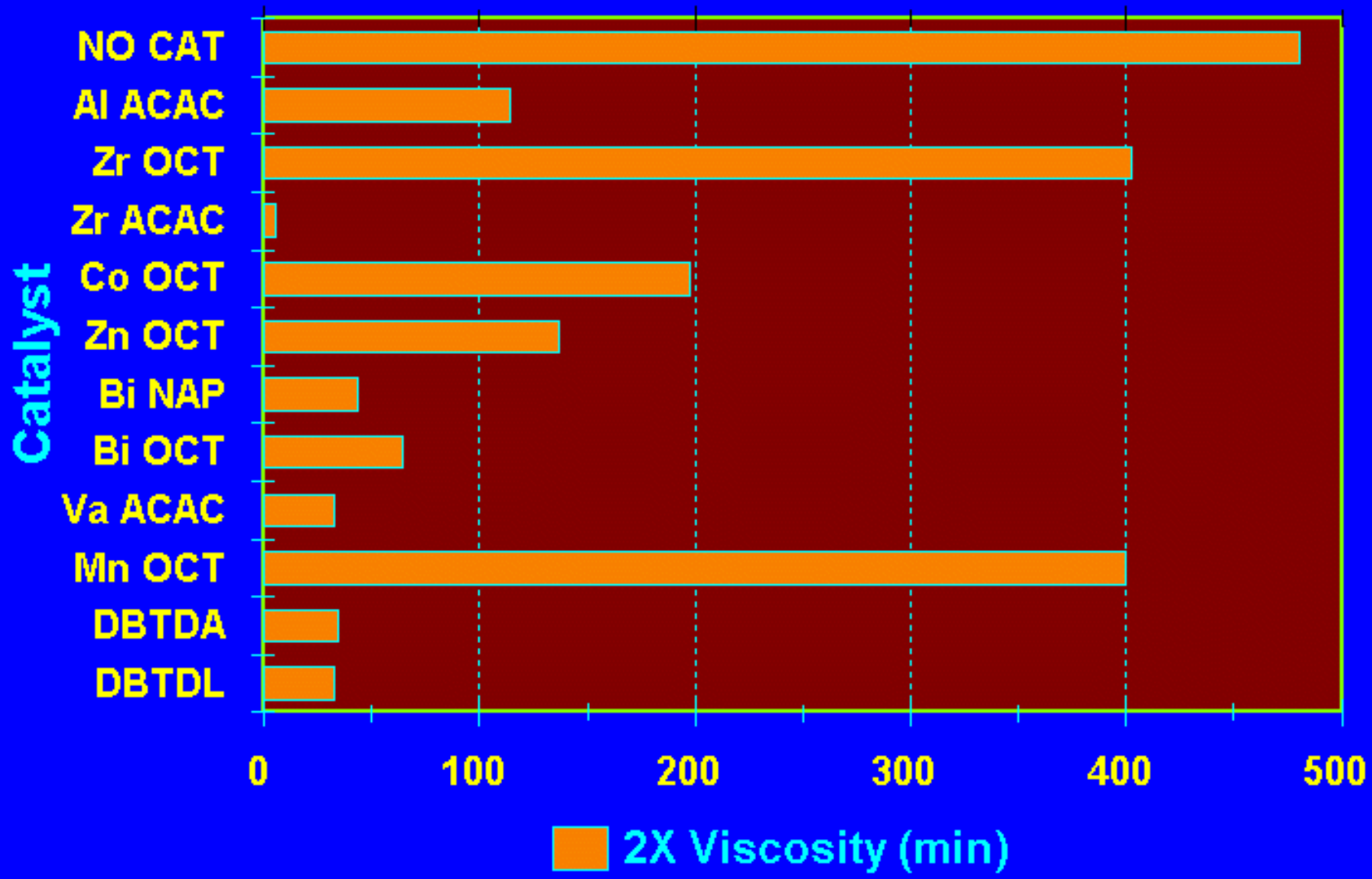
RCOOA

PERFORMANCE PROFILE FOR A CATALYST

Property	Ideal behavior
Potlife	No effect
Reactivity	Highly catalytic
Chemical resistance	Excellent
Exterior durability	No effect
Color	No discoloration
Pigment interaction	No absorption
Compatibility	Wide compatability

2K Catalyst Study (HMDI trimer)

Metal Cat Study (0.0065% on TRS)

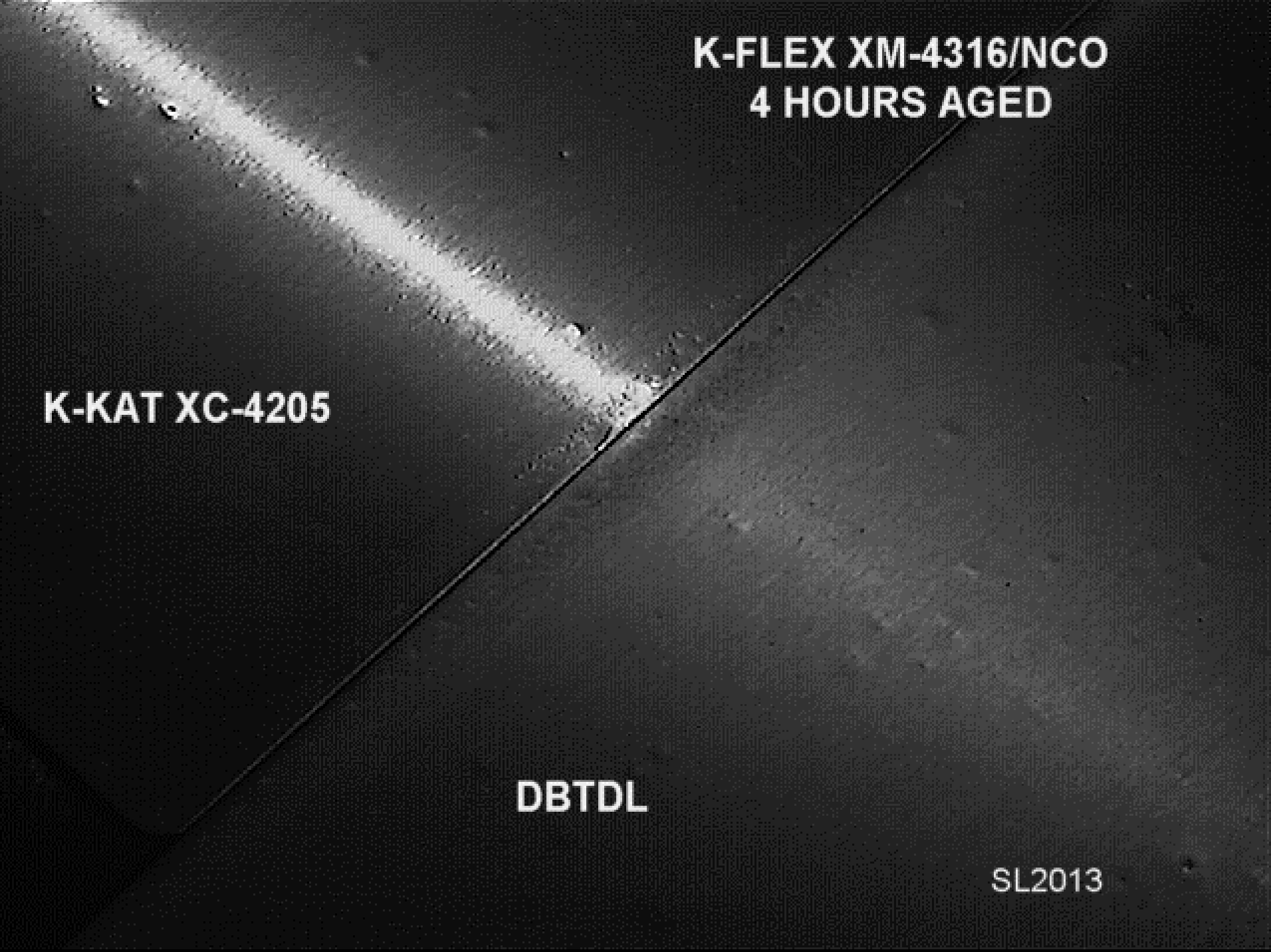


SL2019

HDT-LV ISOCYANATE
WATER (2%) 0.0045 % Me

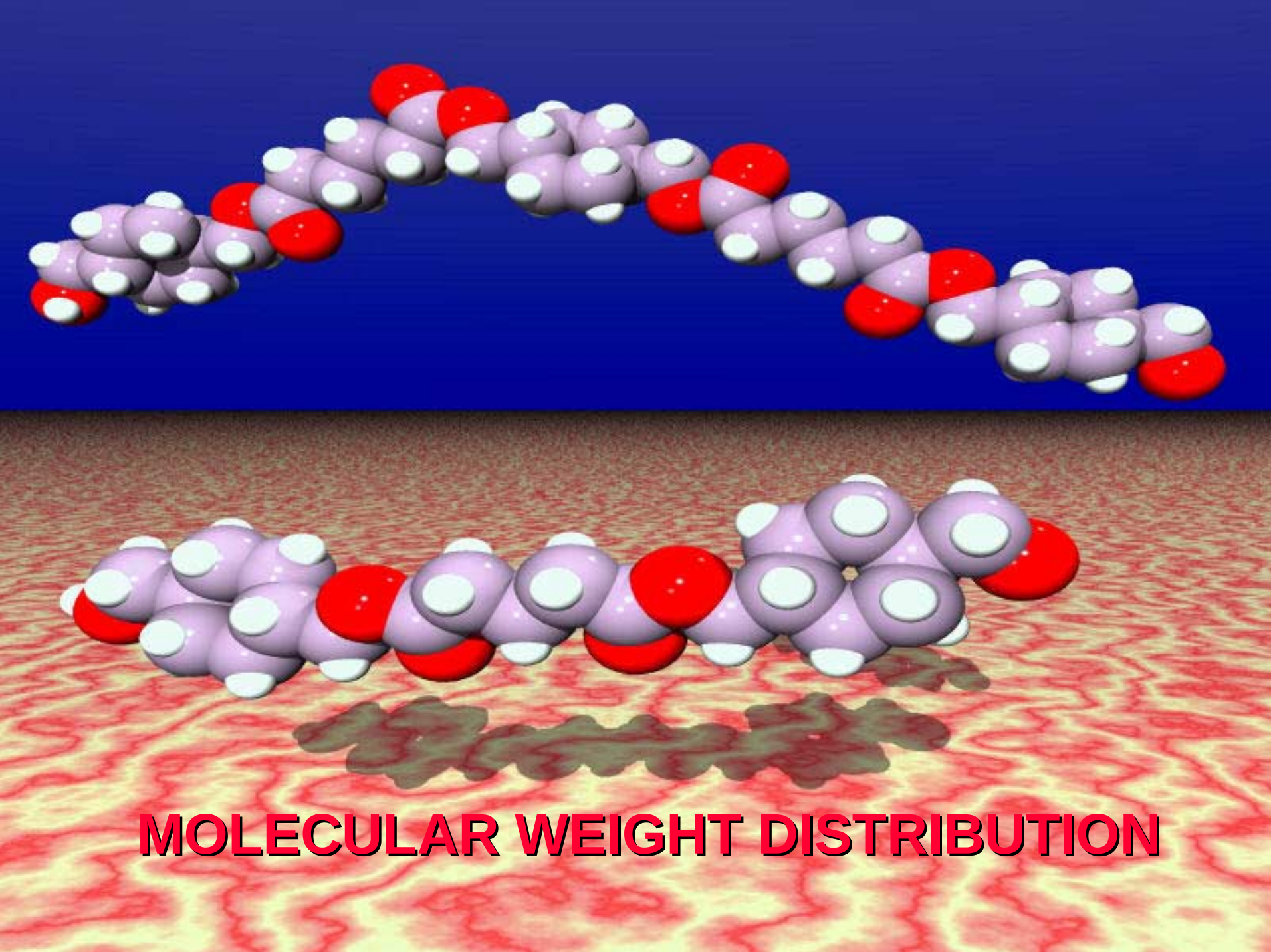
K-KAT XC-4205 DBTDL

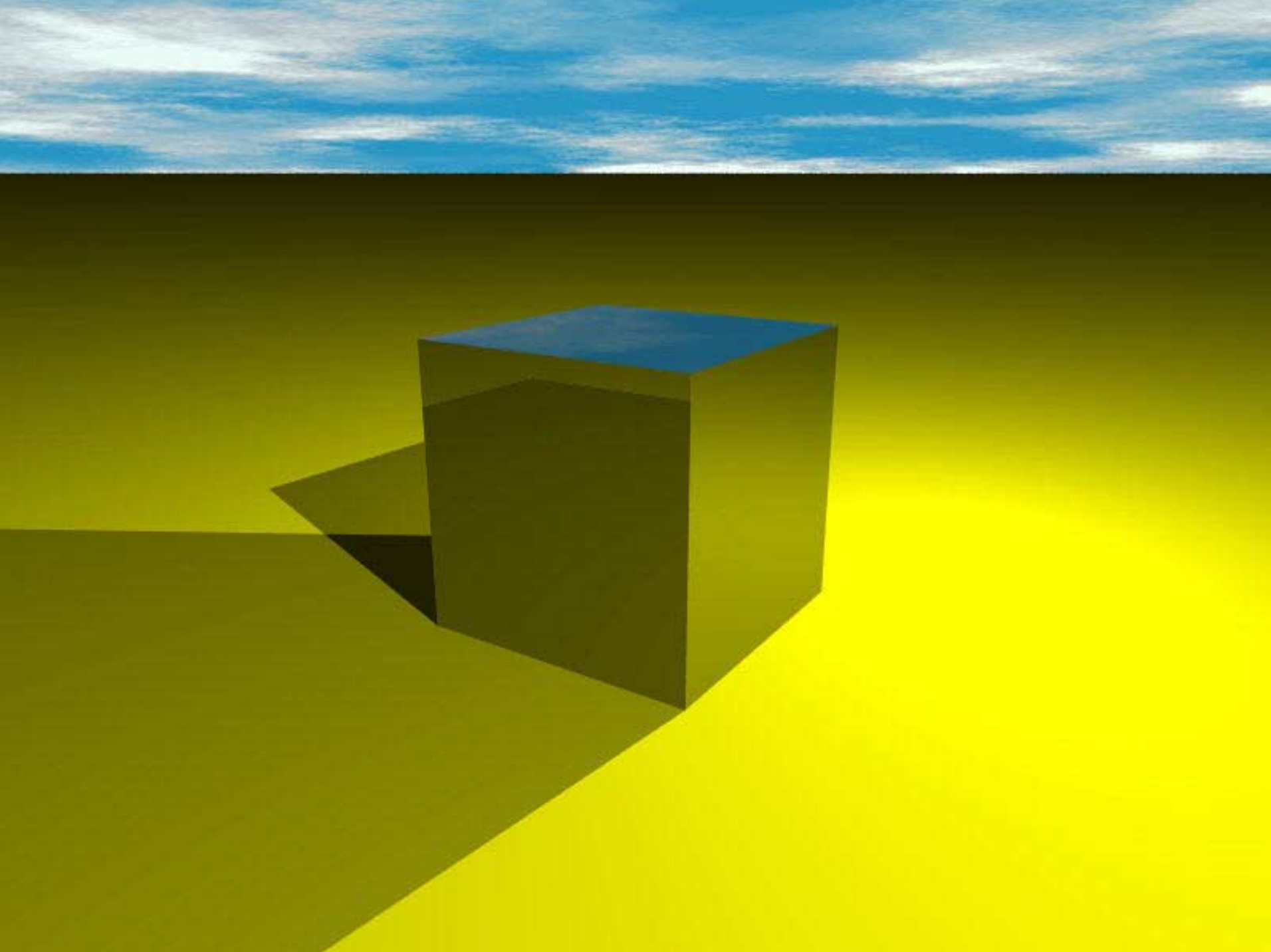
SL2014


K-FLEX XM-4316/NCO
4 HOURS AGED
K-KAT XC-4205
DBTDL
SL2013

PERFORMANCE PROFILE REACTIVE DILUENT

Property	Desired Range
Molecular weight	400-800, narrow MW dist.
Functionality	2-3
Type of functional group	OH, COOH, epoxy
Viscosity, (100 %), cps	500-5000


MOLECULAR WEIGHT DISTRIBUTION



RESIN - CROSSLINKER

VISCOSITY/SOLIDS

FUNCTIONAL GROUPS

HYDROXYL, CARBOXYL

FUNCTIONALITY

MOLECULAR WEIGHT / DISTRIBUTION

SOLUBILITY PARAMETER (HANSEN)

COMPATIBILITY

PERFORMANCE PROFILE

PIGMENTS &FILLER

SURFACE AREA

OIL ABSORPTION

PARTICLE SIZE / DISTRIBUTION

pH IN WATER

SOLUBLE CONTENT /COMPOSITION

DENSITY

SURFACE TREATMENT

SOLVENT

- BOILING POINT
- SOLUBILITY PARAMETER (HANSEN)
- VISCOSITY
- SURFACE TENSION / WATER SOLUTIONS
- AZEOTROP
- WATER SOLUBILITY
- TOXICITY
- BIODEGRADATION
- EVAPORATION RATE

ADDITIVE

CHEMISTRY

FUNCTIONAL GROUPS

MOLECULAR WEIGHT

SOLUBILITY PARAMETER

SURFACE TENSION

MODE OF ACTION

POTENTIAL SIDE REACTIONS

RELATIVE PERFORMANCE TO OTHER ADDITIVES

RECOMMENDATIONS

- KEEP IT SIMPLE
- USE ADDITIVES ONLY IF NECESSARY
- A SIMPLE FORMULATION IS EASIER TO TROUBLESHOOT
- ADDITIVES SOLVE AND CREATE PROBLEMS
- TRY TO UNDERSTAND THE PROBLEM
- KNOW ALL THE COMPONENTS
- KNOW THE PHONE NUMBER OF YOUR ADDITIVE SUPPLIER

ACKNOWLEDGEMENT

LEN CALBO BOB COUGHLIN

KING INDUSTRIES
SPECIALTY CHEMICALS