

You are now at [www.wernerblank.com](http://www.wernerblank.com)

[HOME](#)

[NEWS](#)

[PUBLICATIONS](#)

[LECTURES](#)

[PATENTS](#)

[DOWNLOADS](#)

# **ADDITIVES**

**FOR**

# **HIGH SOLIDS AND WATER- BORNE COATINGS**

**Werner J. Blank**

**Rudy Berndlmaier & Dan Miller**

**King Industries Inc.**

# OUTLINE

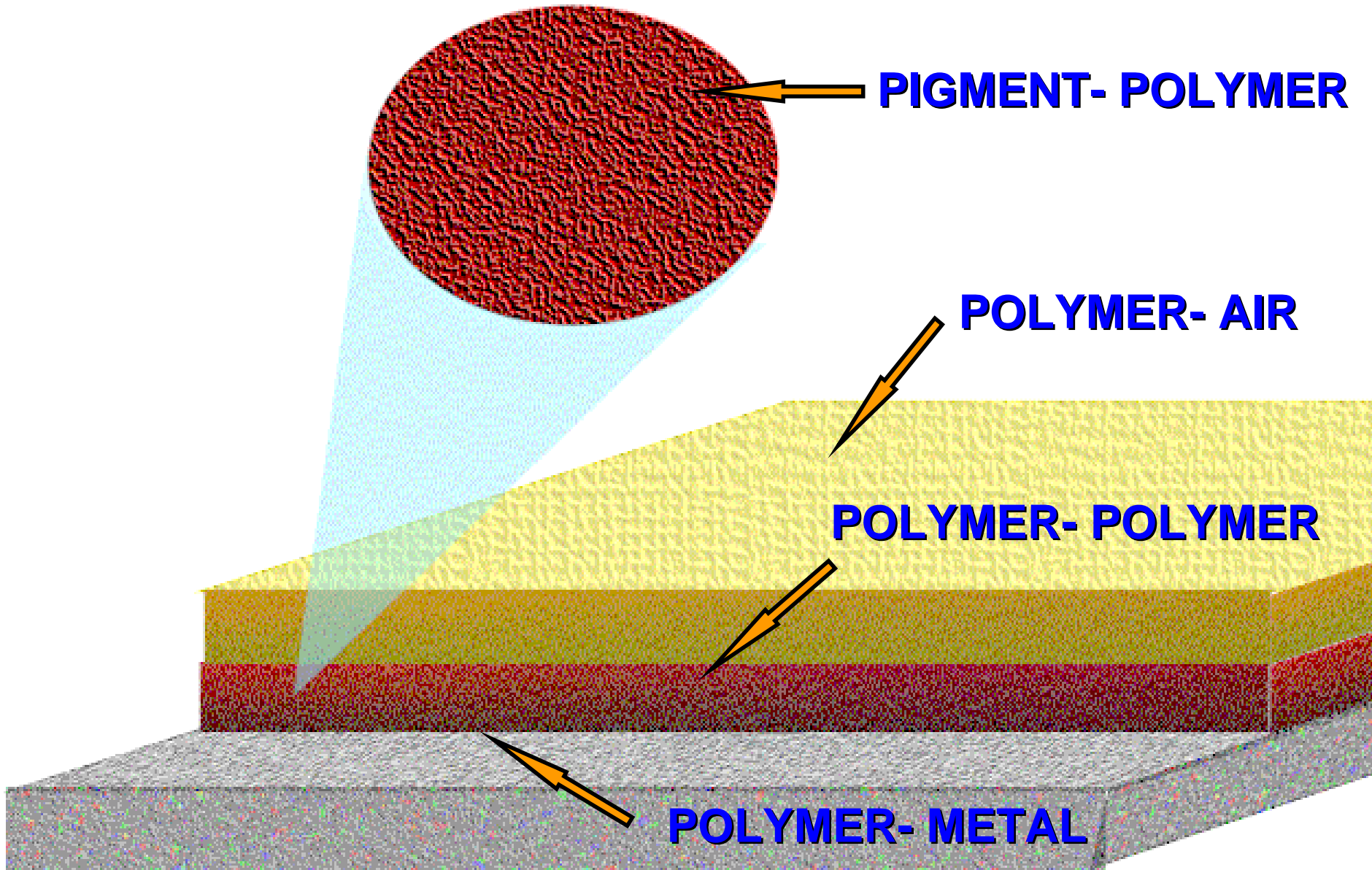
**FUNCTION OF ADDITIVES**

**TYPE OF ADDITIVES**

**CHEMICAL COMPOSITION**

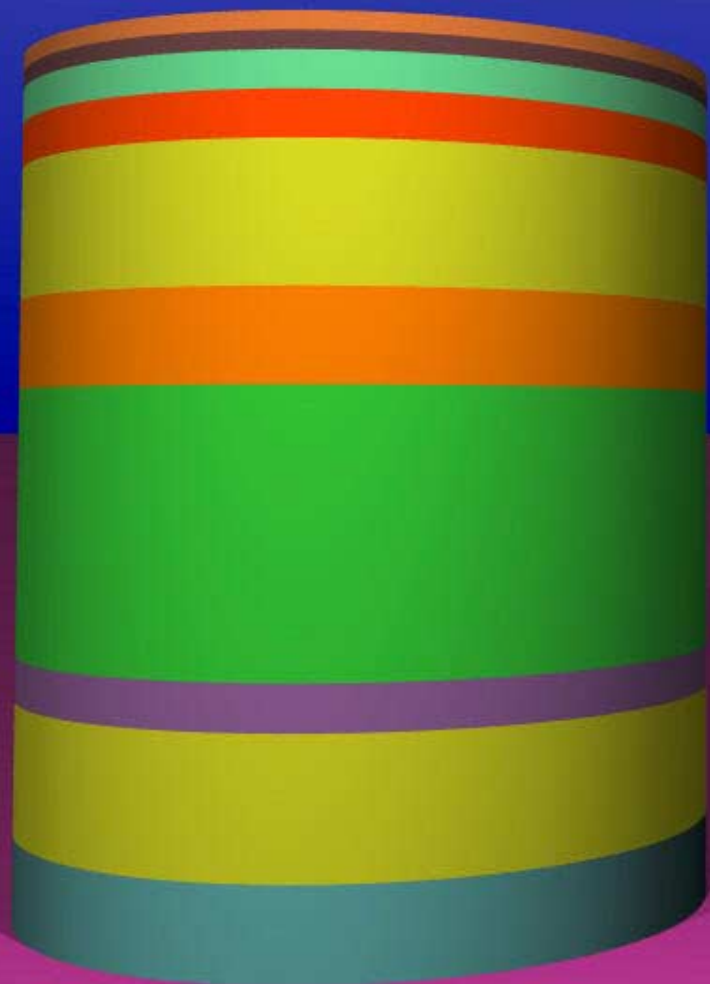
**FORMULATION STRATEGIES**

**INTERACTION RESIN-ADDITIVES**

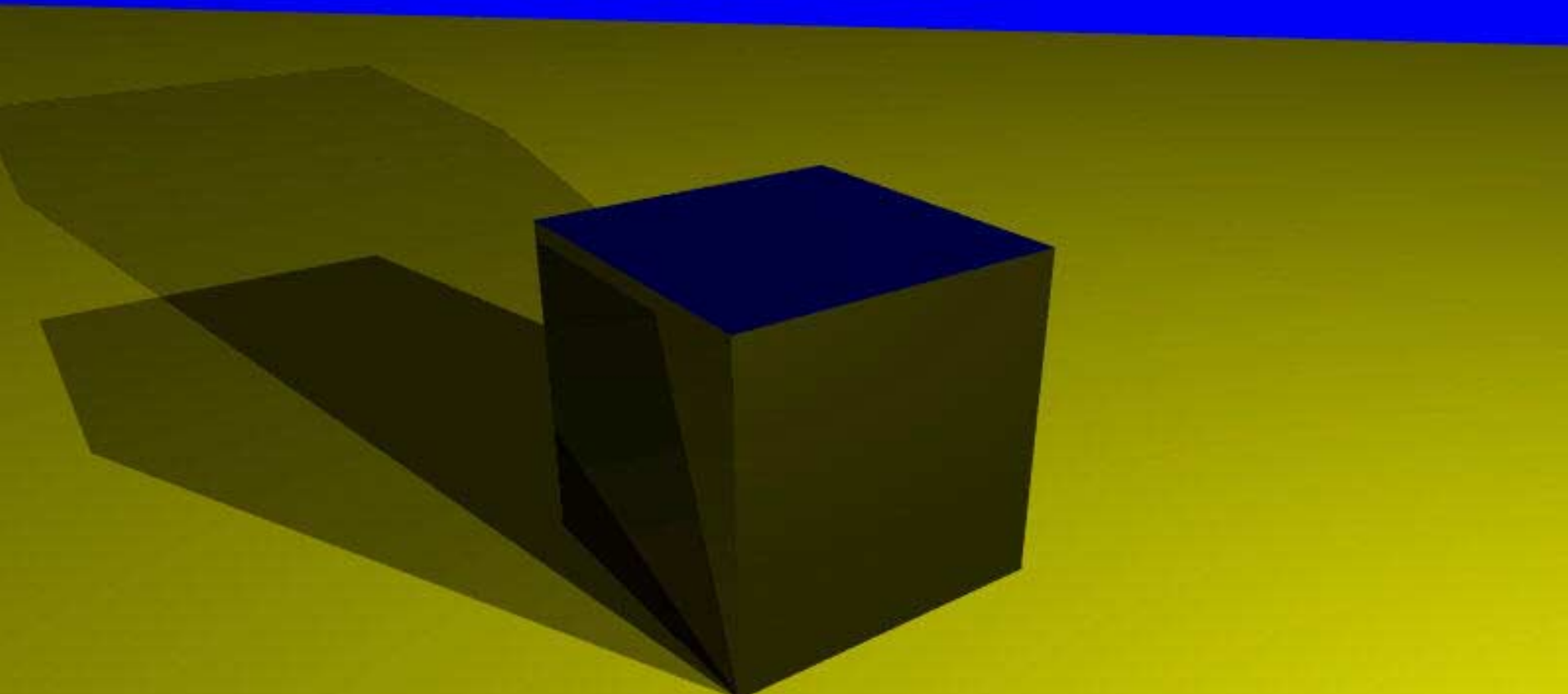


# **SURFACE COATING INTERFACES**

# PAIN T



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



**ADDITIVE SELECTION FOR A BLACK BOX**

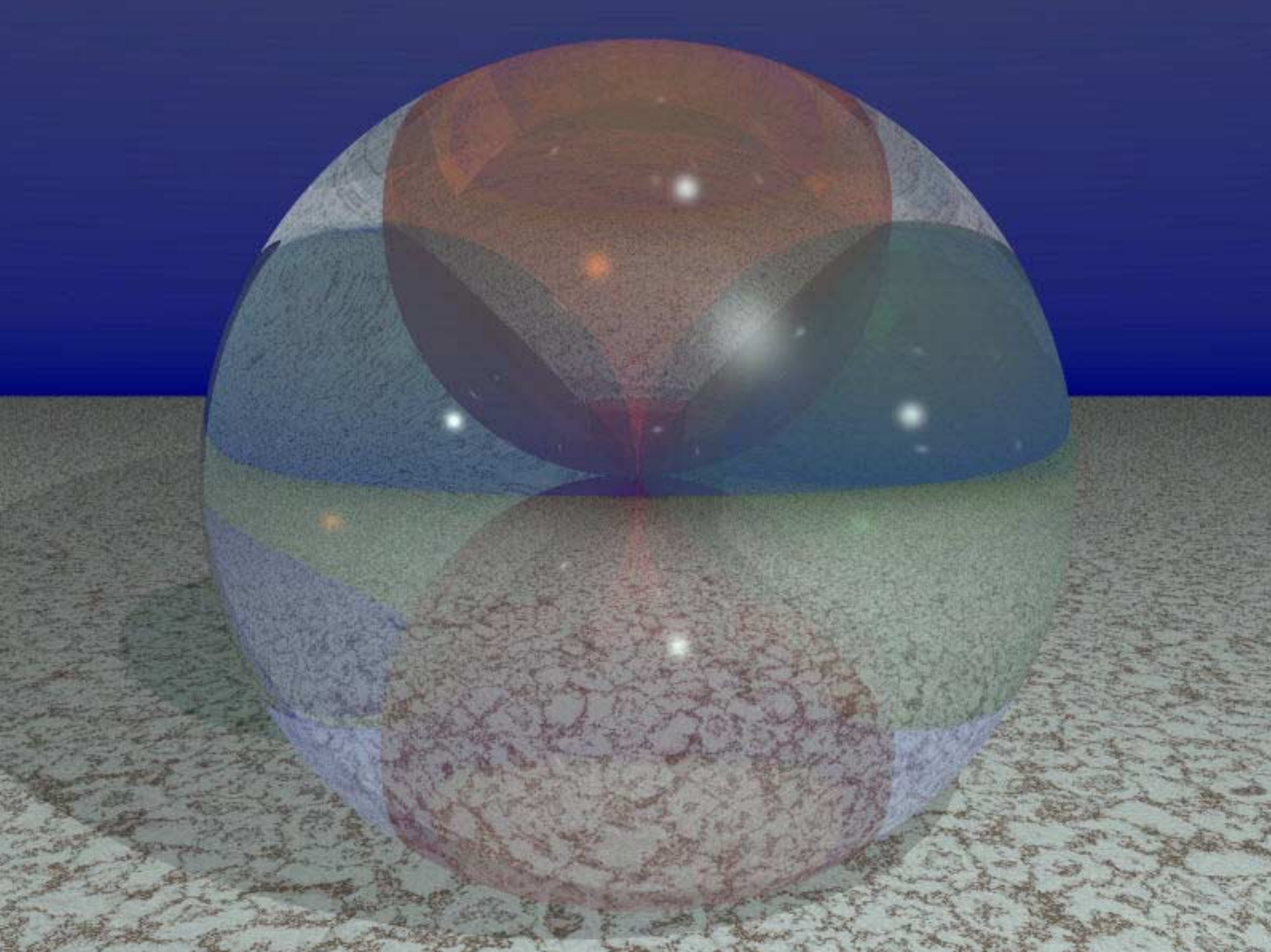


PIGMENT

RESIN

SOLVENT

ADDITIVE

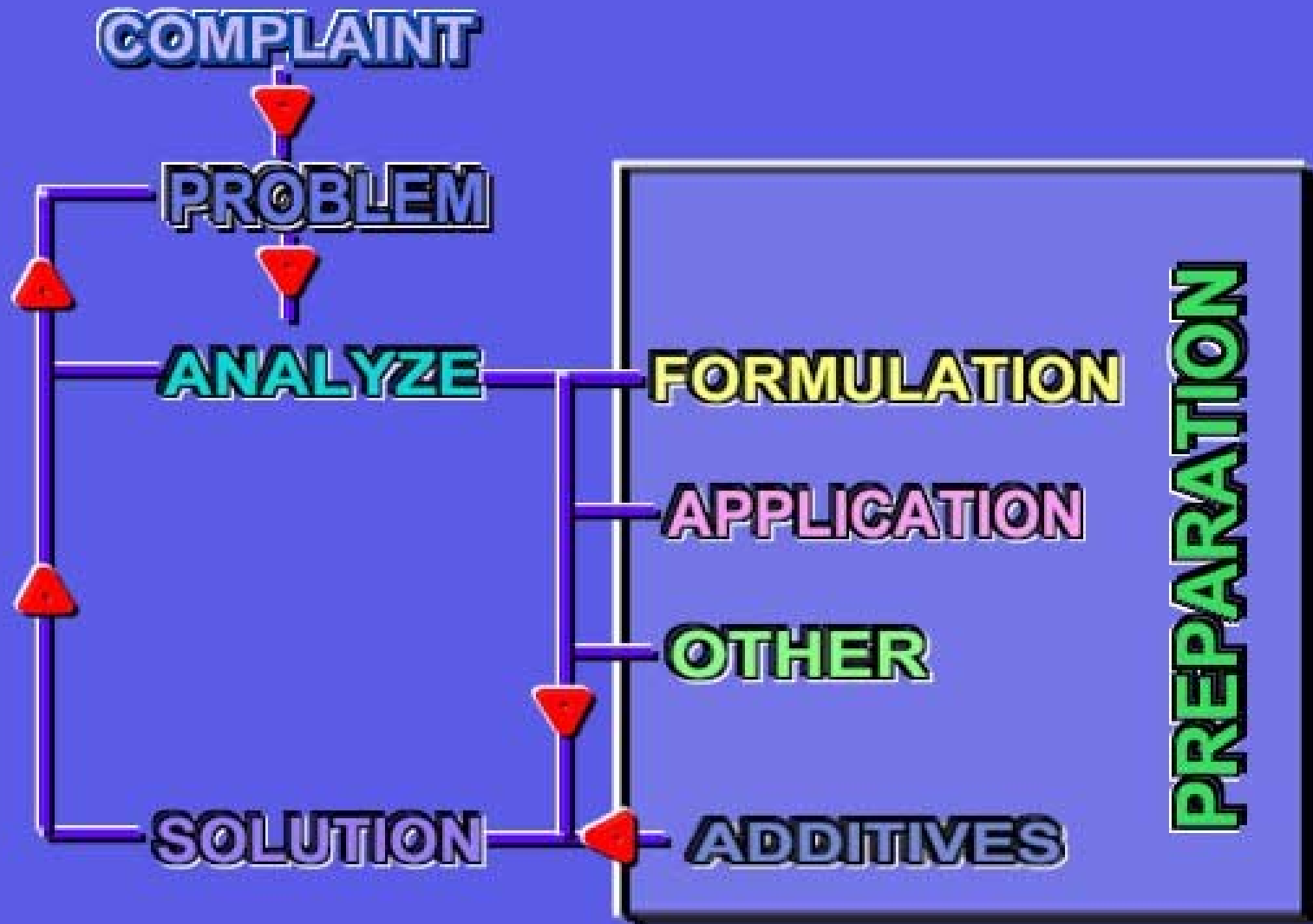


# DIFFERENCE

## REGULAR-HS-WATER

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

# 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

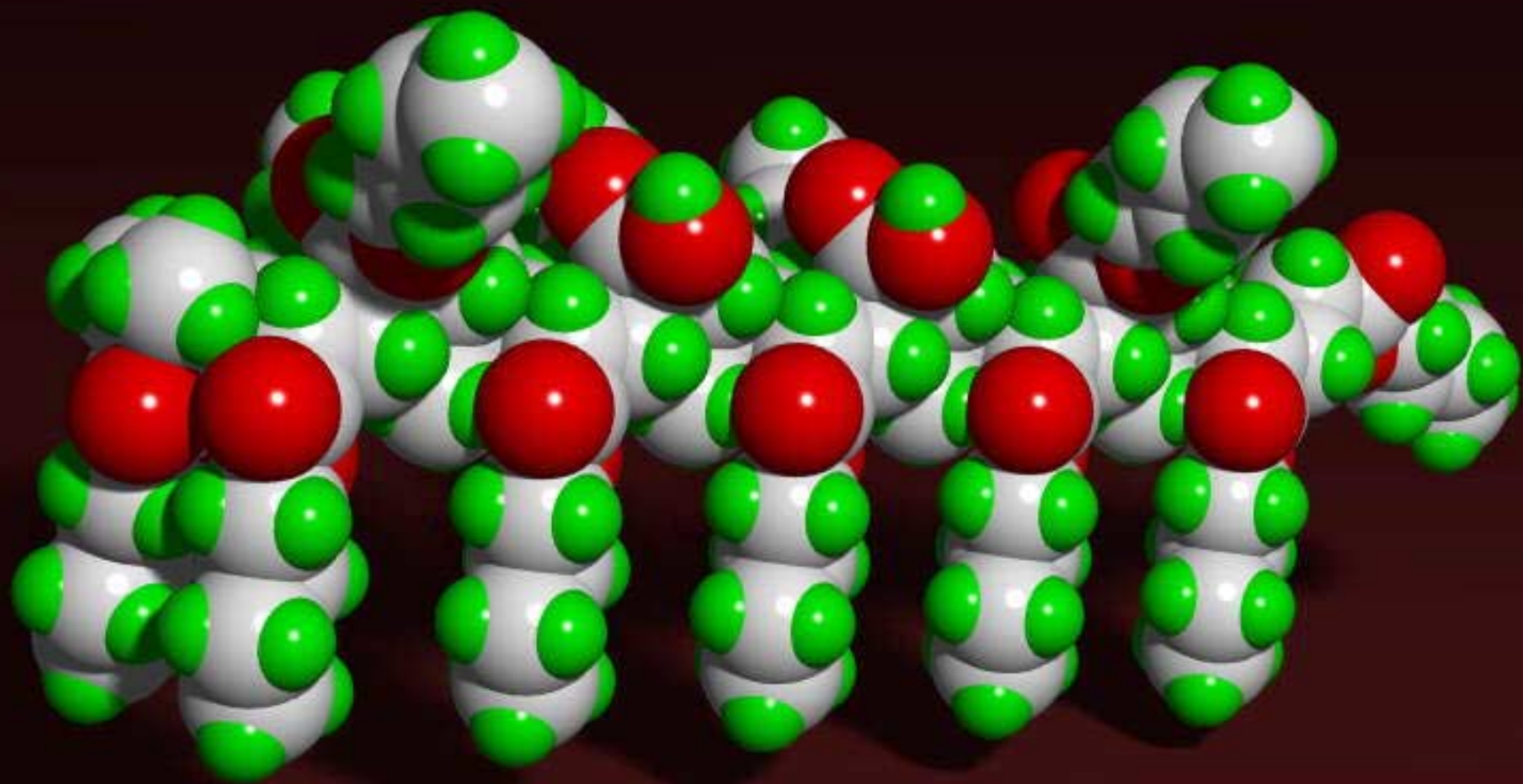
Solvents

Tints

UV absorbers & stabilizer

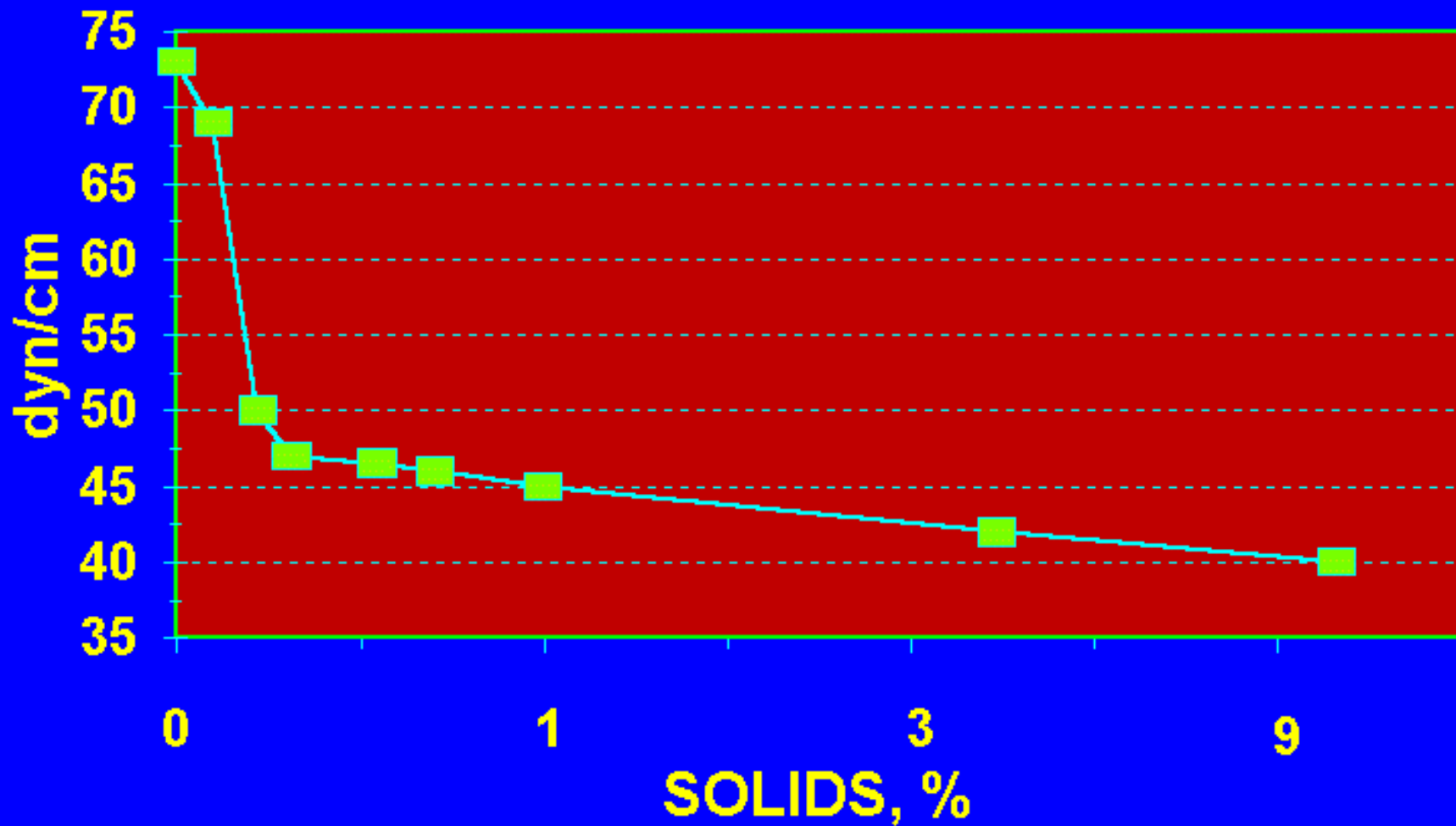
# GRIND FORMULATION

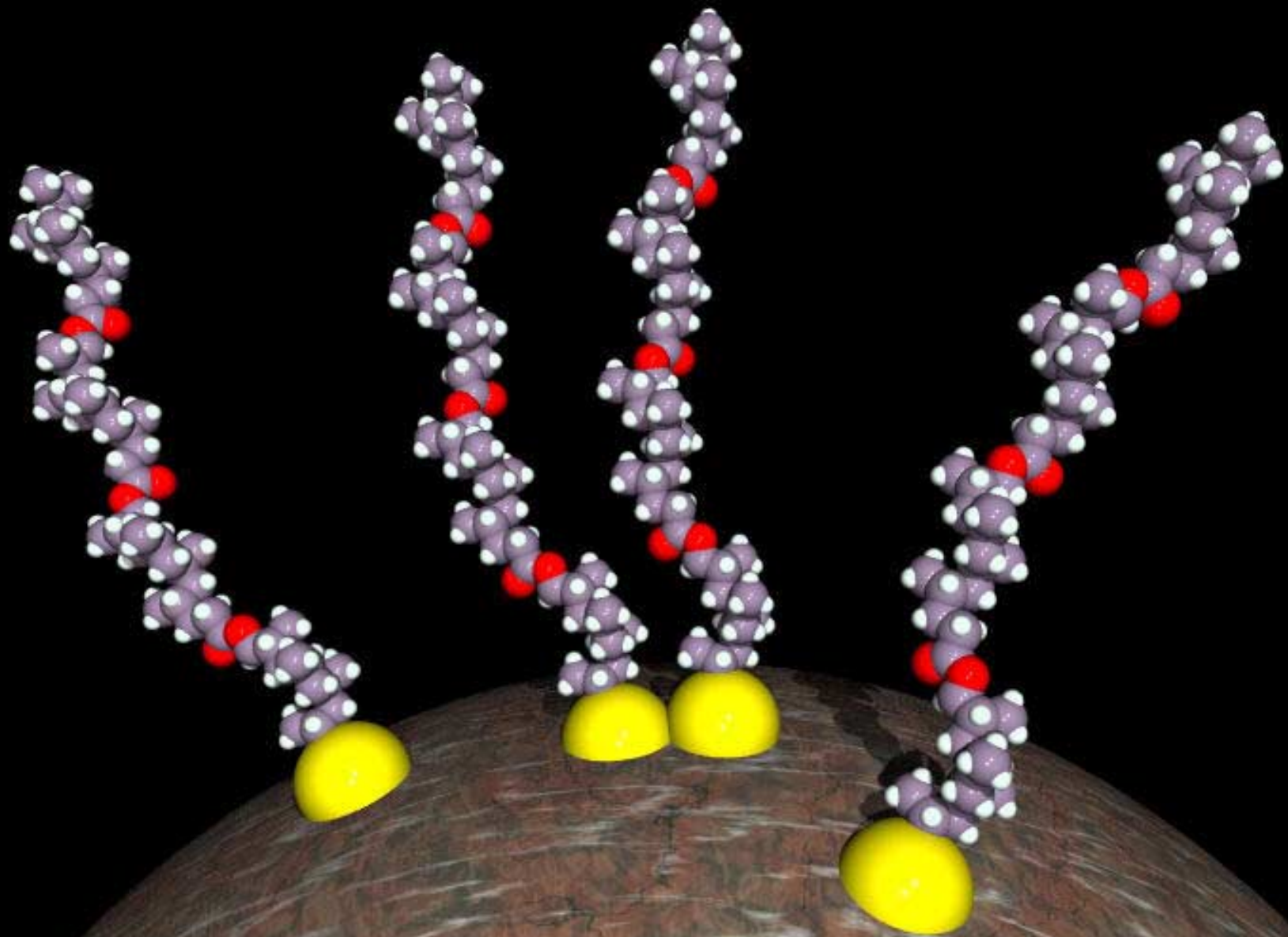
<b>Additives</b>	<b>Function</b>	<b>Chemical Composition</b>
<b>Deaerators</b>	<b>Removes air</b>	<b>mineral oil, silicones</b>
<b>Defoamers</b>	<b>entrapped during</b>	<b>waxes, silica</b>
<b>Antifoams</b>	<b>pigment dispersion</b>	<b>and fatty acids</b>
<b>Dispersants</b>	<b>Lowers surface</b>	<b>Nonionic,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

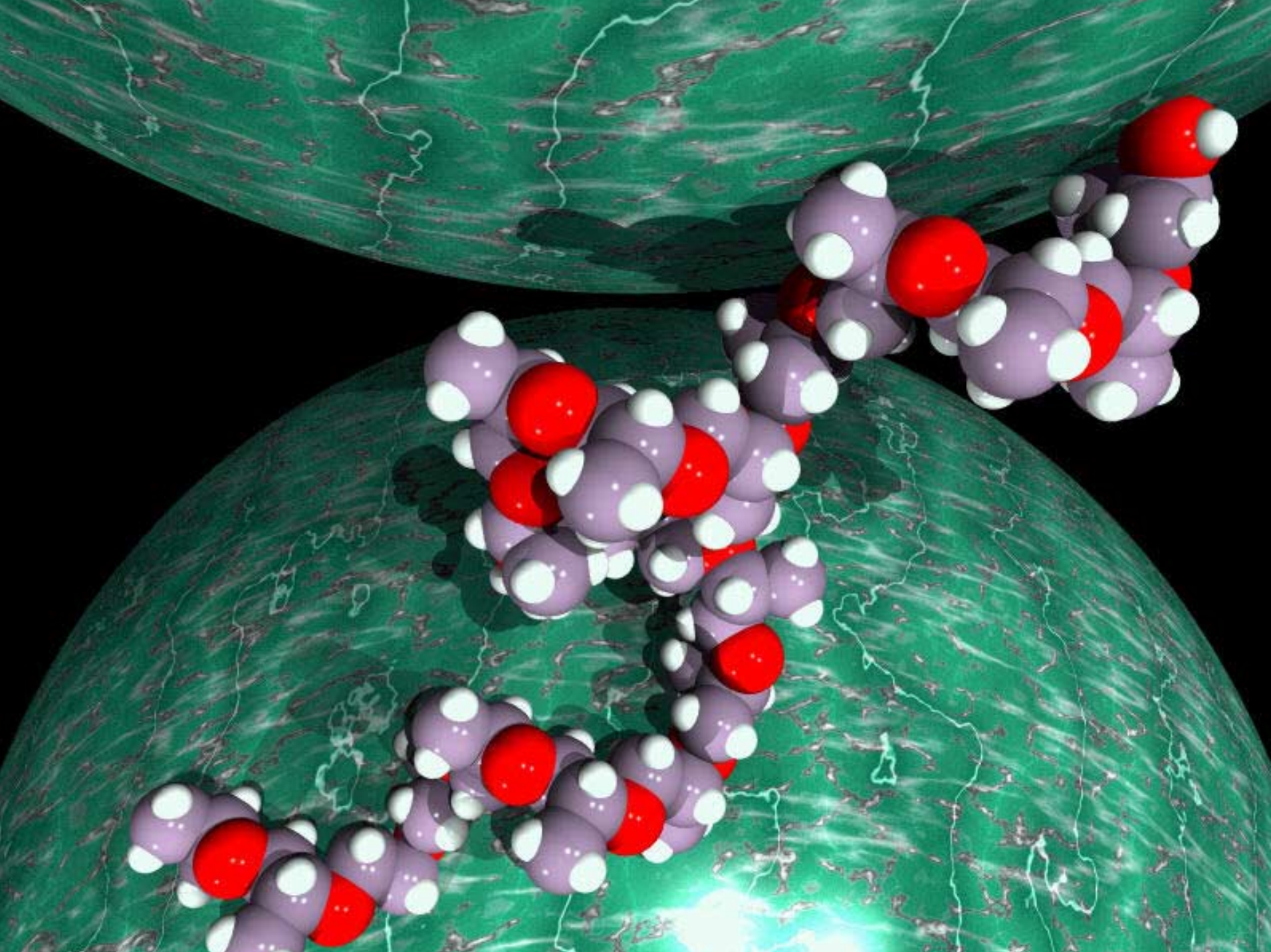


# ACRYLIC POLYMER

## 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

COLLIER

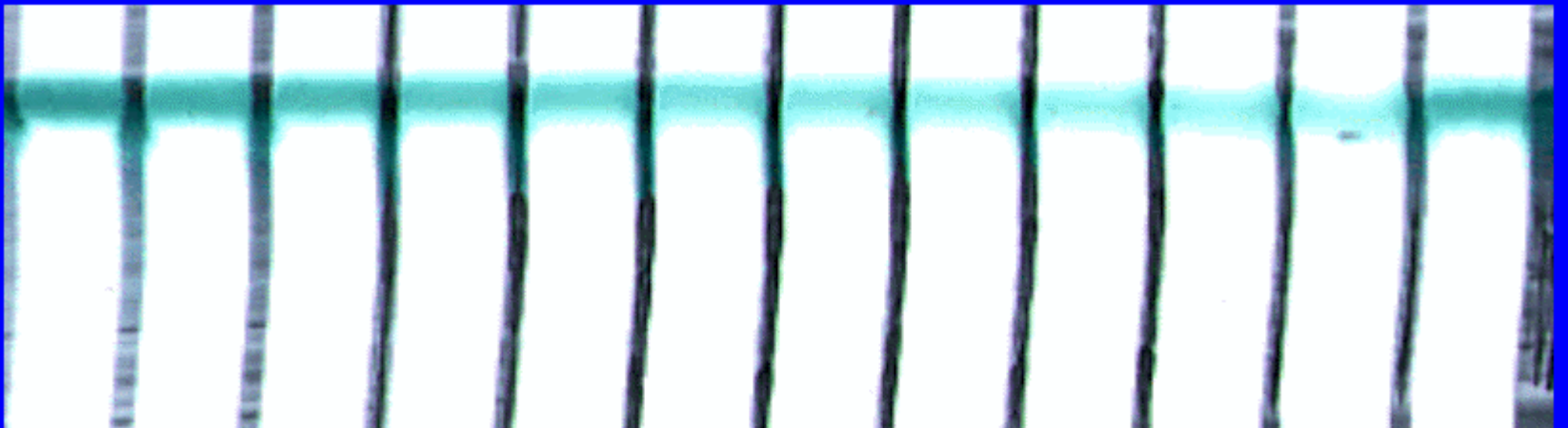
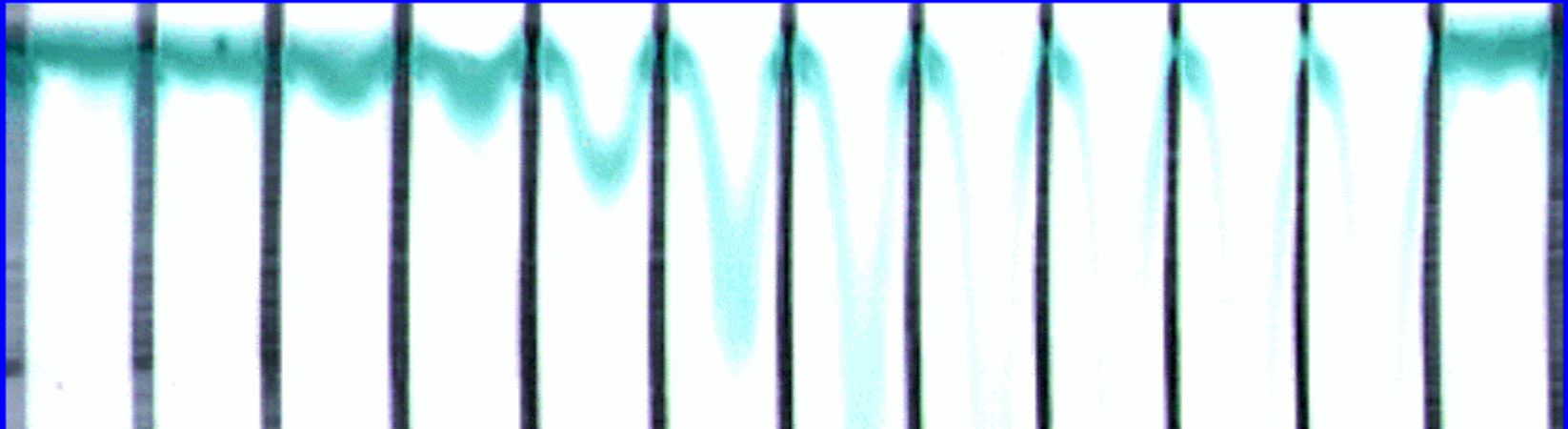
SPRAY

FLOW

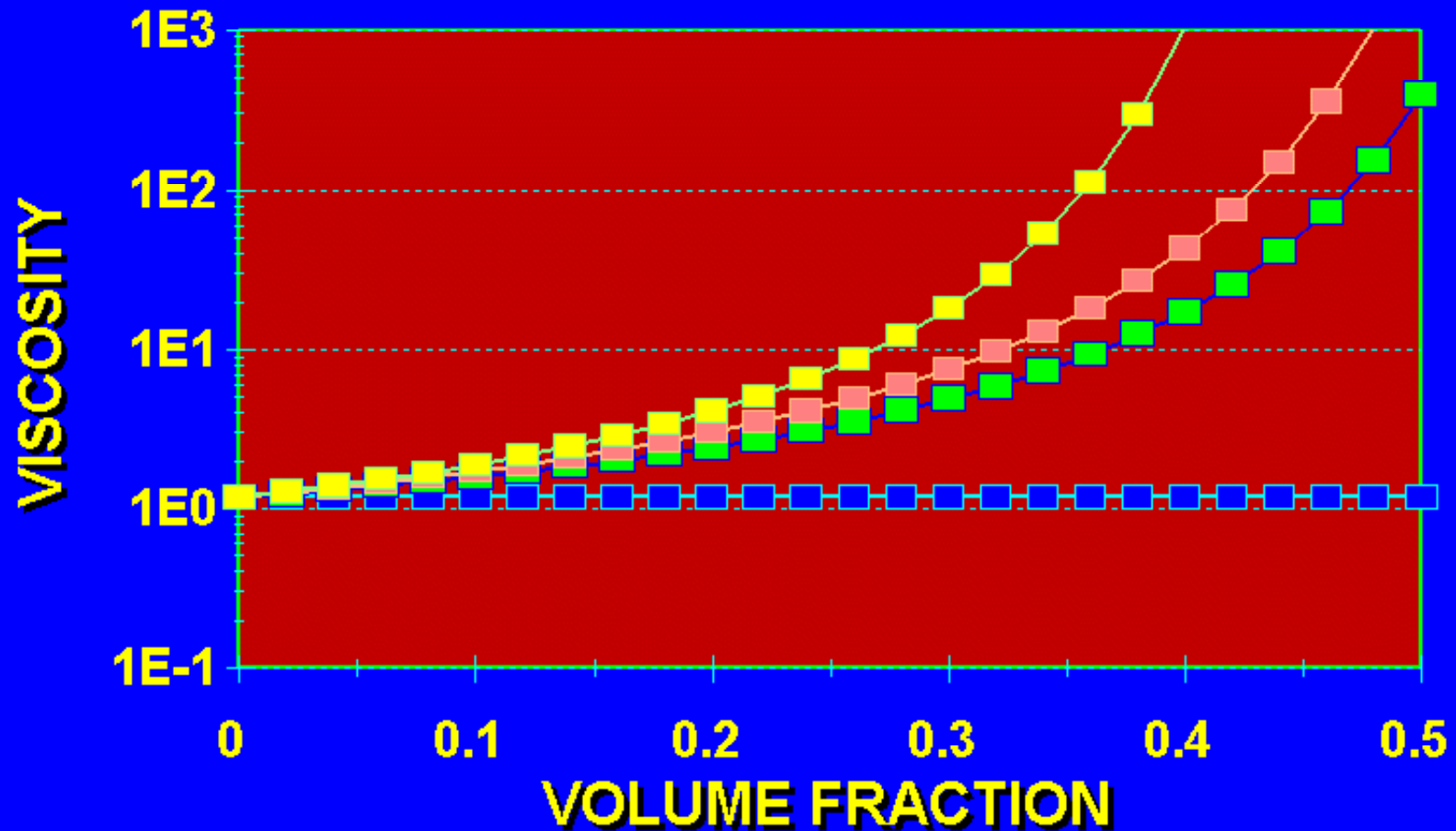
WATER

# SAG TEST

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



# VISCOSITY OF DISPERSION

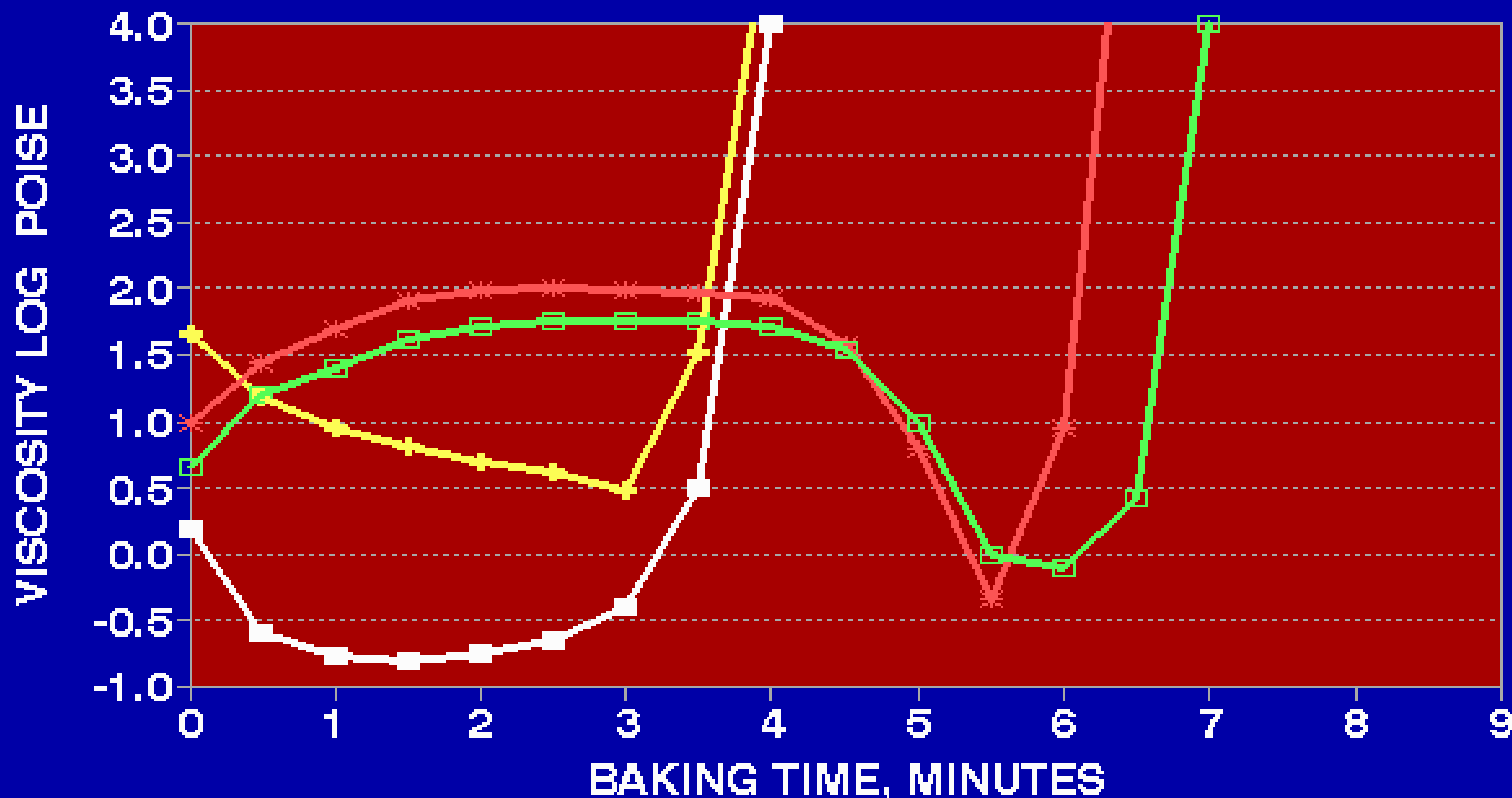


■ SPHERE    ■ SPH SW    ■ SPH FLOC

# RHEOLOGY MODIFIER

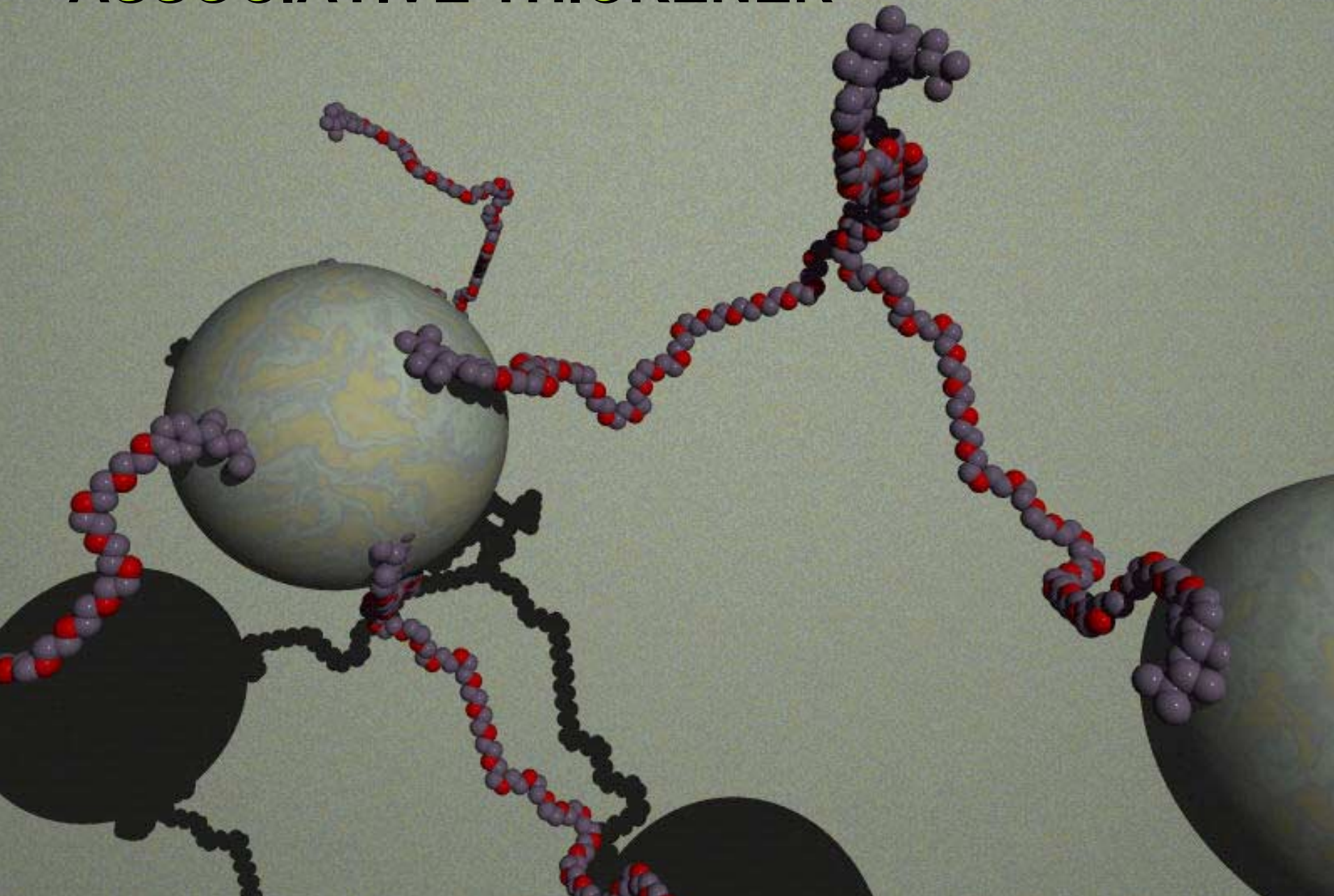
- ATTAPULGITE
- SMECTITE
- ASSOCIATIVE
- SILICA
- TITANATE
- POLYESTER
- POLYACRYLATE
- POLYOLEFIN
- ORGANO CLAY
- ORGANO SULFONATE
- POLYAMIDE
- CASTOR DERIVATIVE
- POLYUREA
- CATIONIC OLIGOMER

# VISCOSITY OF HIGH SOLIDS COATING DURING CURE AND CROSSLINKING



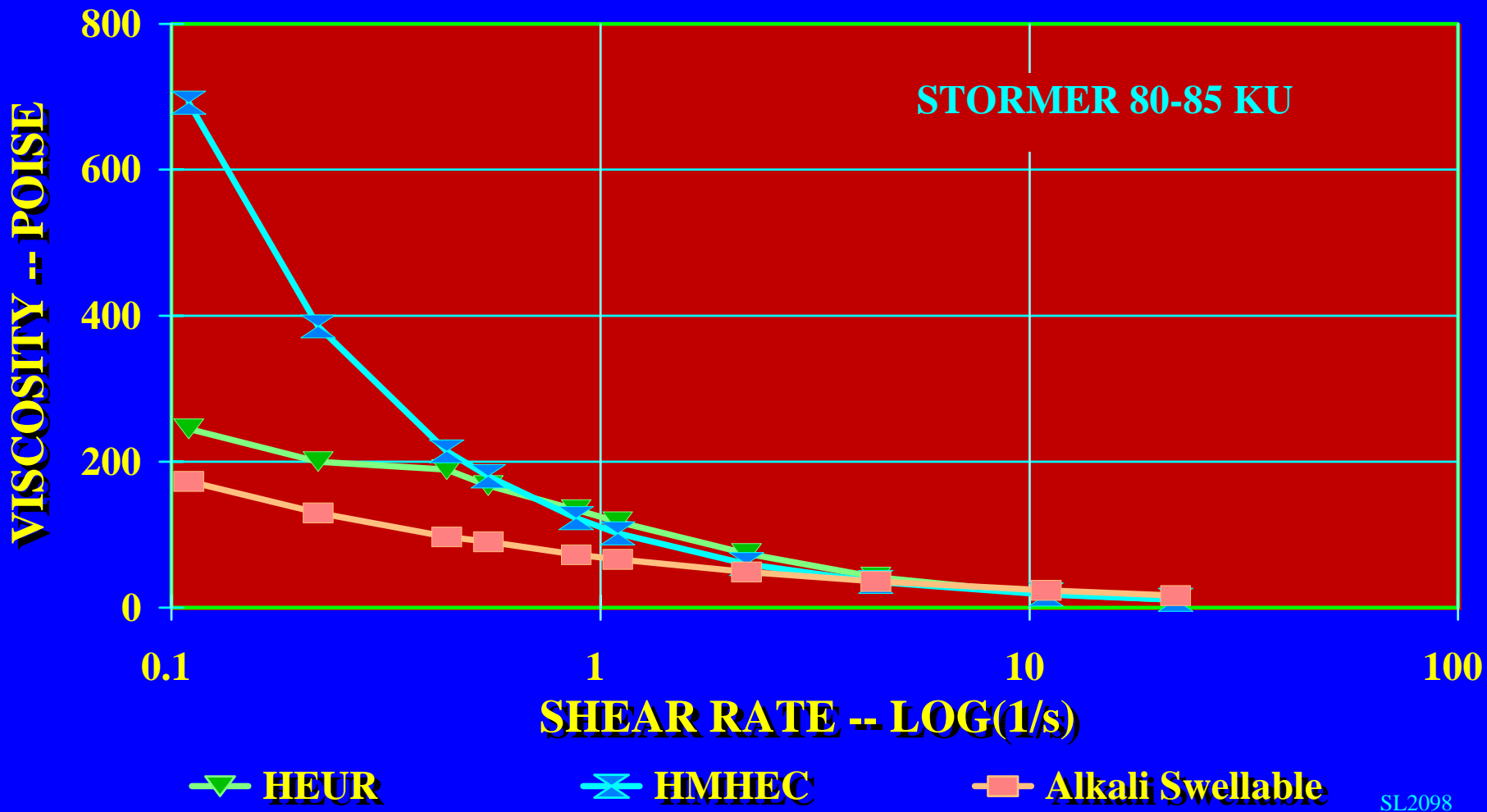
■ PTSA      ▲ PTSA SCA      \* PTSA BL1      □ PTSA BL2

# ASSOCIATIVE THICKENER



# VISCOSITY -- LOW SHEAR RANGE

## LATEX MAINTENANCE



# FILM FORMATION

## PROBLEMS & REMEDIES

Atmosphere, dry,  
moist, gas heated

Coalescence

Flash off time,  
blistering

Film thickness

Flow and leveling

Humidity control,  
catalysis

Controlled of Tg

Release of solvent

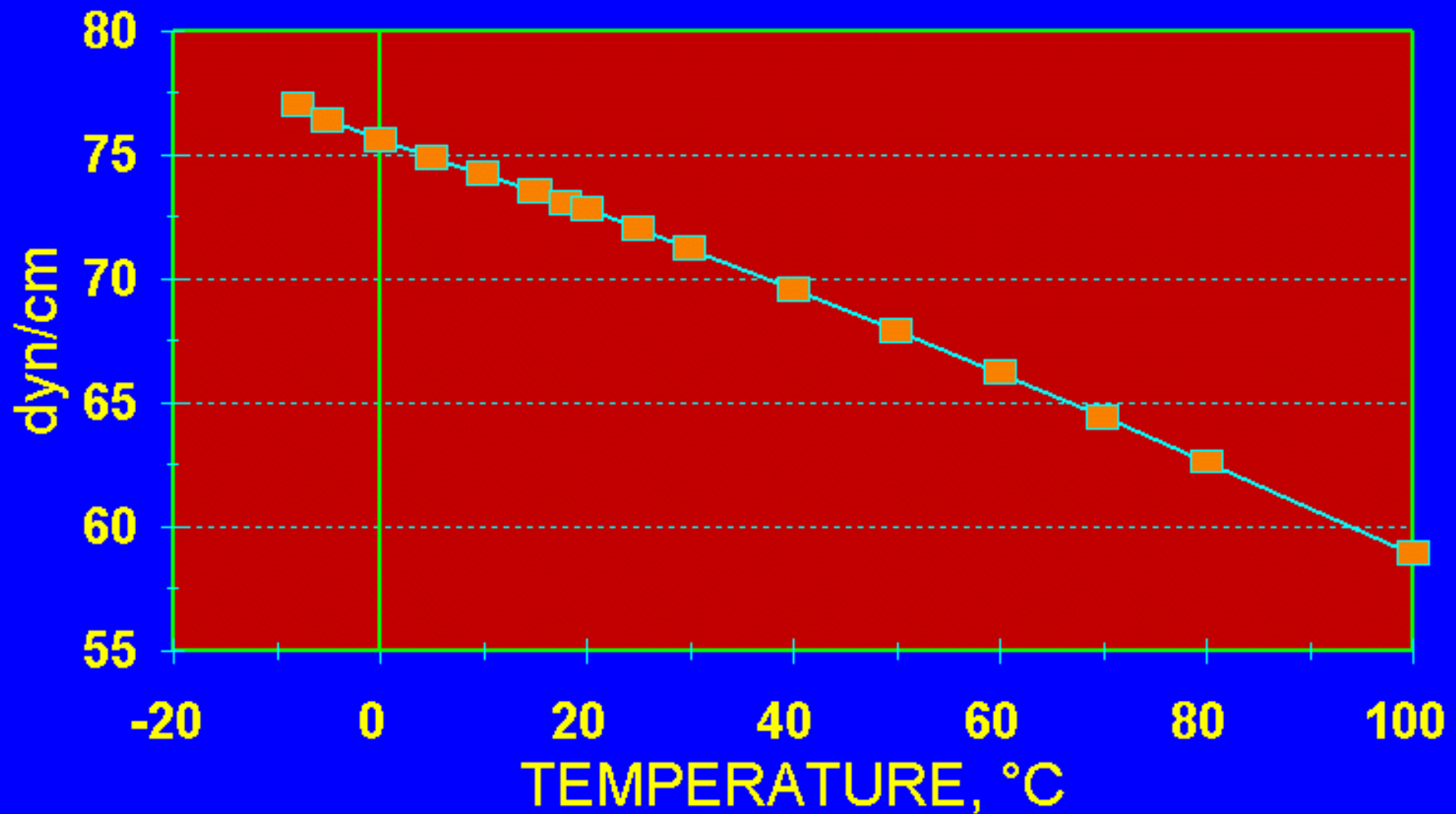
Reaction products

Surface tension

Cure profile

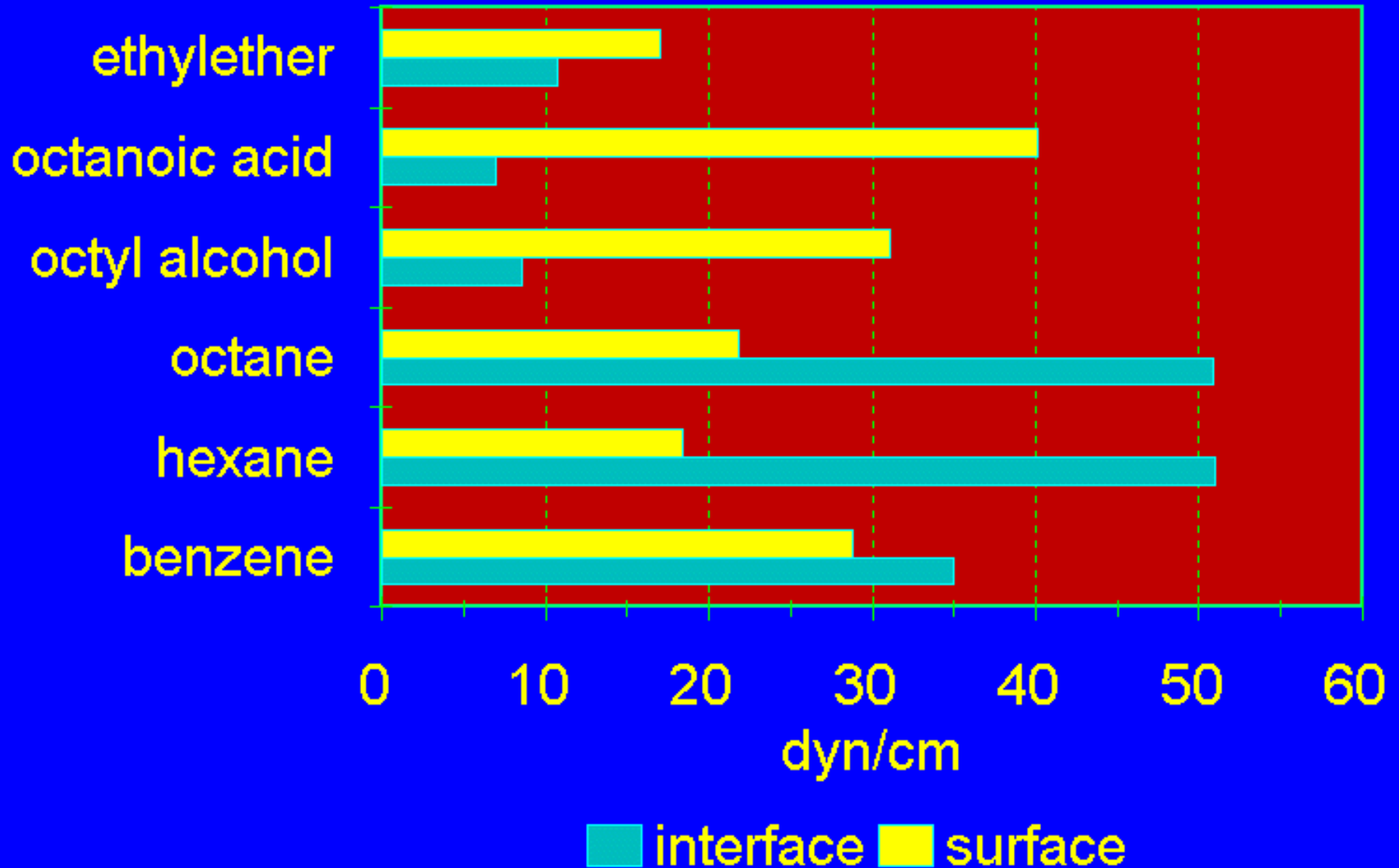
# SURFACE TENSION

## WATER



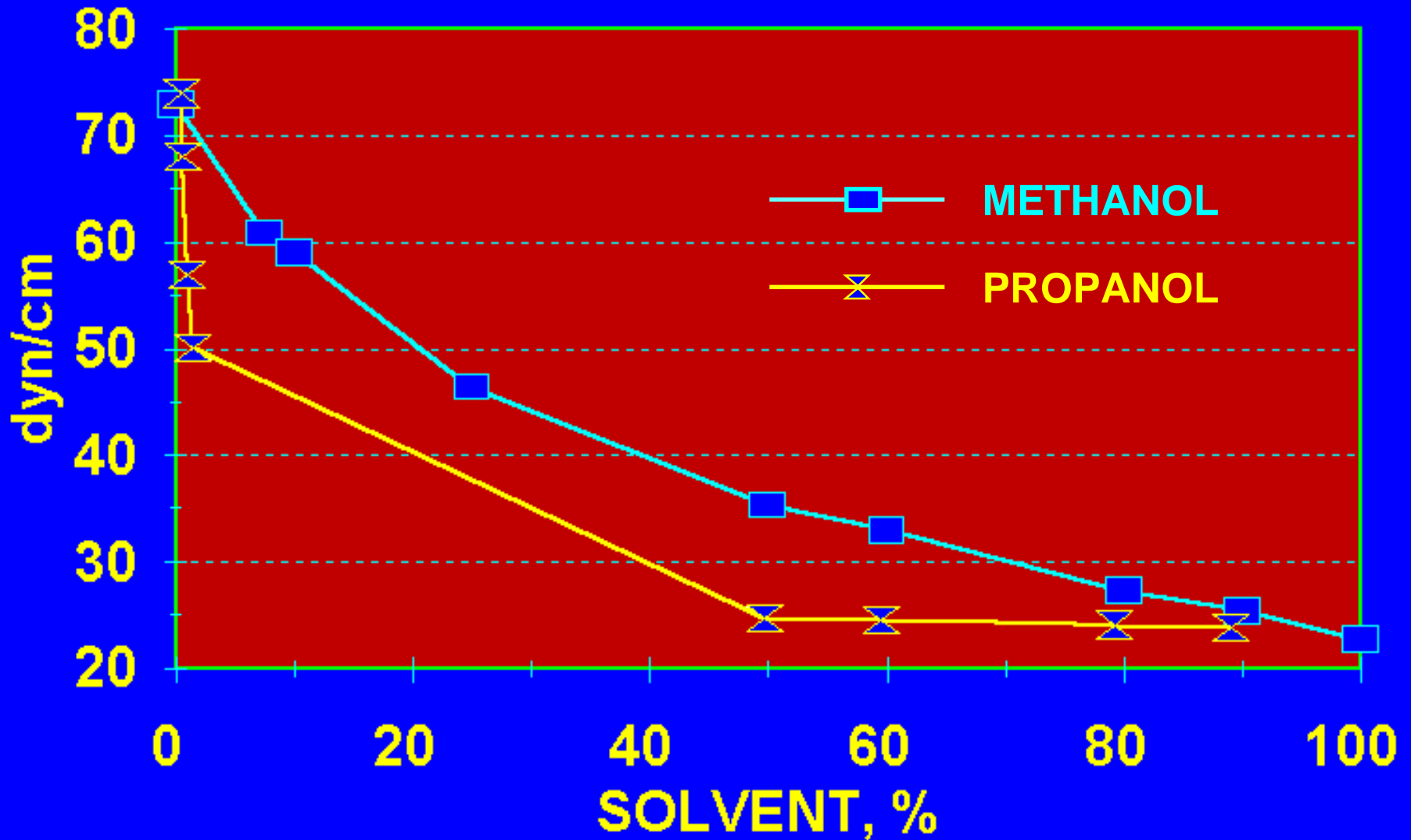
# SURFACE AND INTERFACE TENSION

## WATER INTERFACE

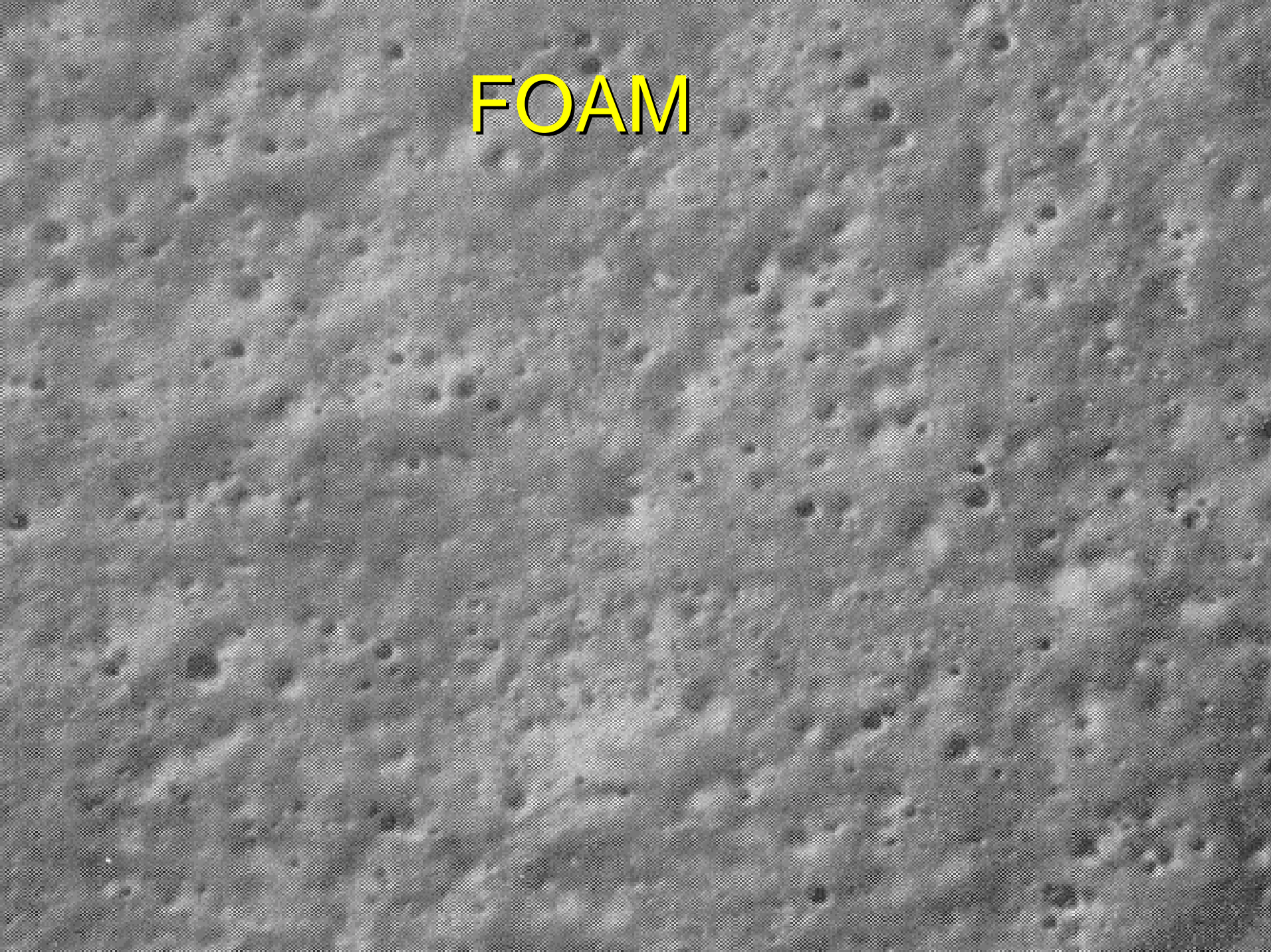


# SURFACE TENSION

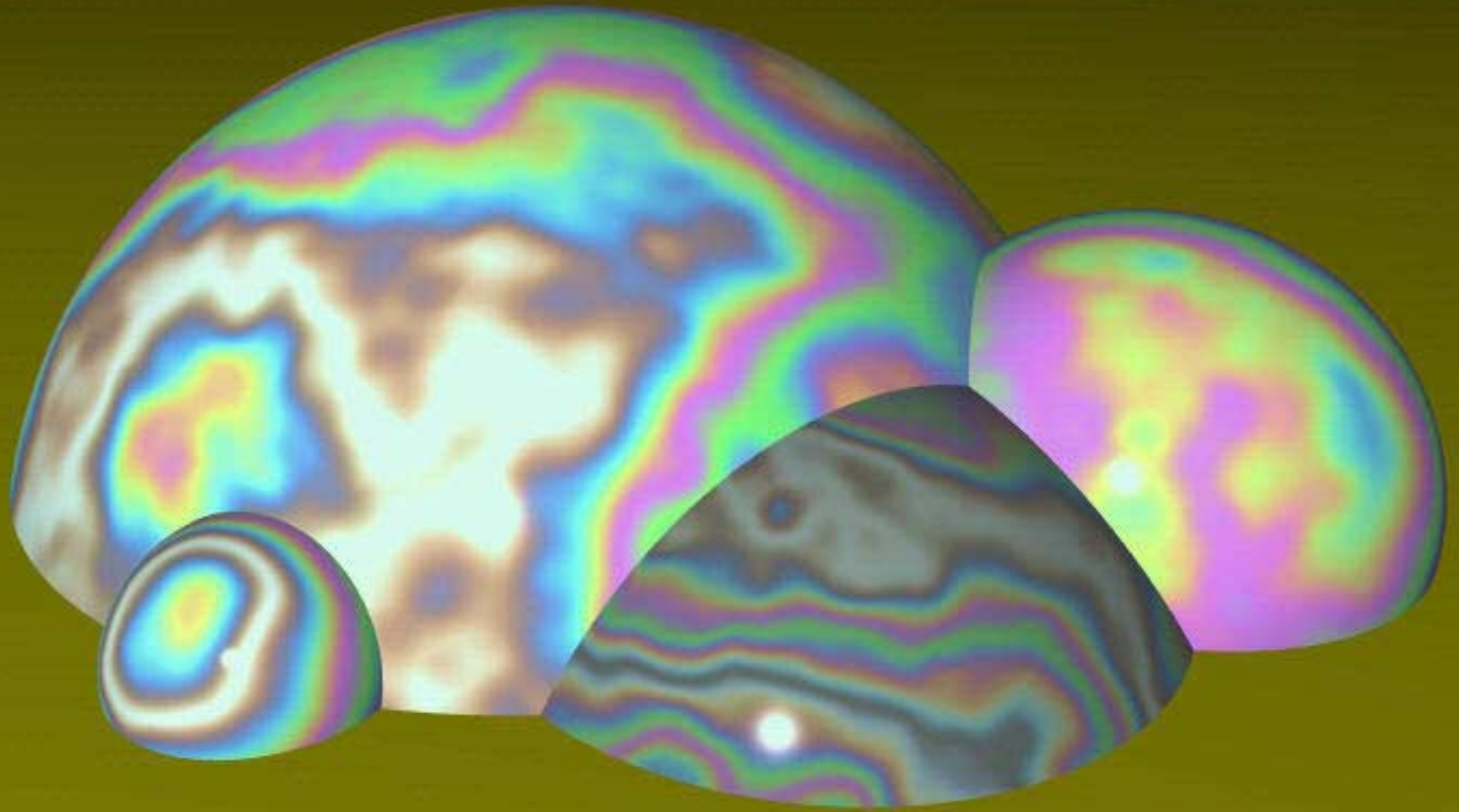
## WATER SOLVENT



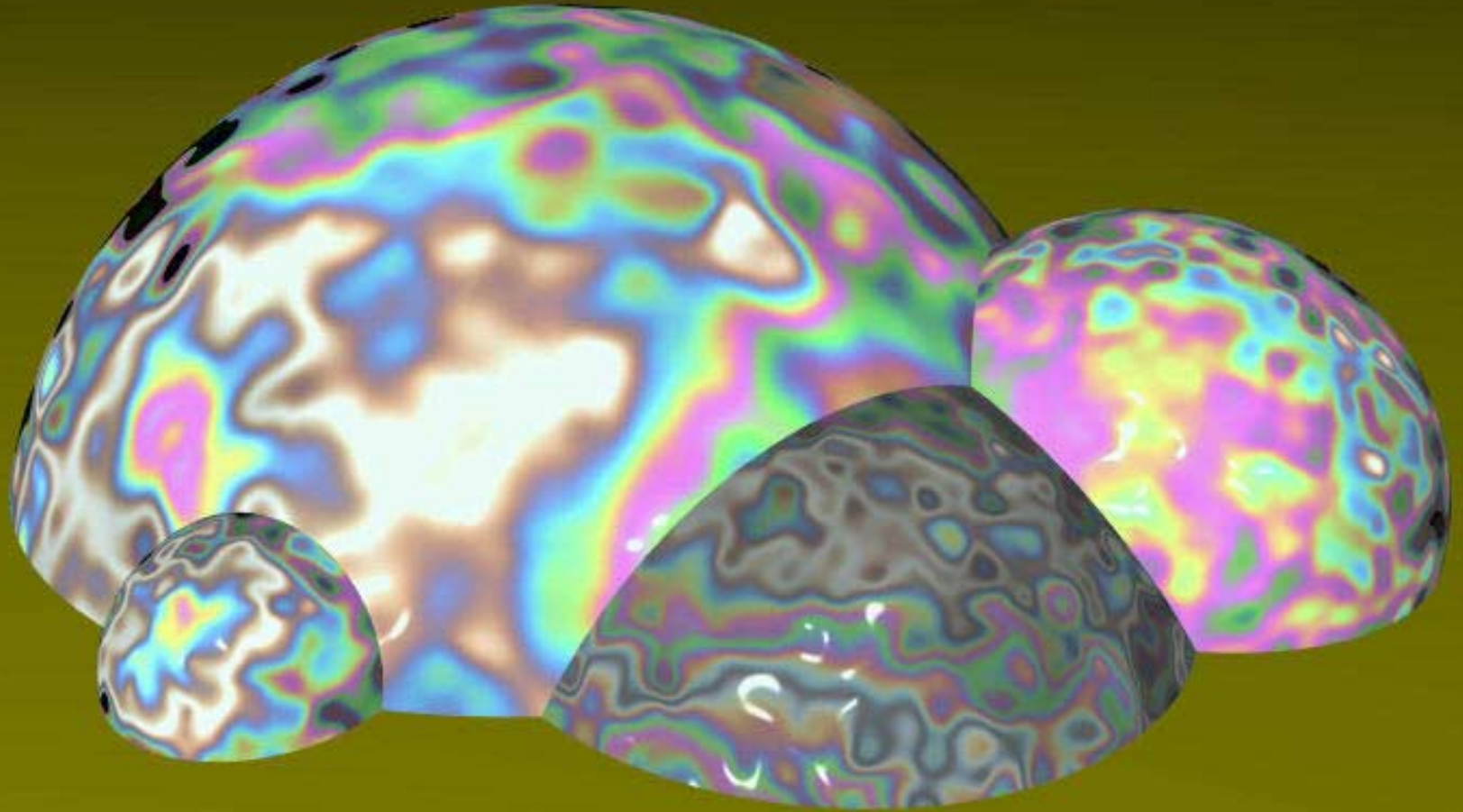
FOAM



# FOAM-SURFACE TENSION, VISCOSITY



# DE-FOAMER



# CRAWLING



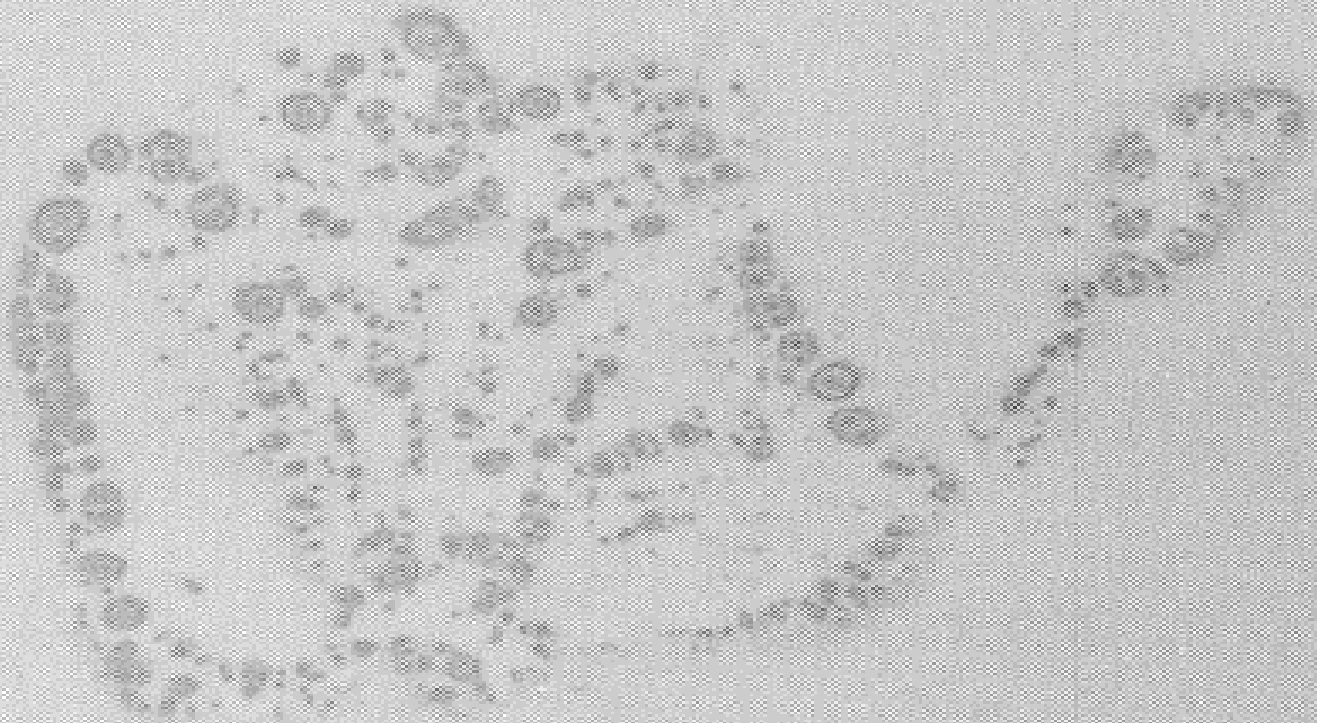
# WETTING

The background of the slide is a close-up photograph of a surface covered with numerous small, spherical water droplets. The droplets are densely packed and vary slightly in size, creating a textured, shimmering effect. The lighting is bright, highlighting the curvature of the droplets and the way they reflect light.

# DEWETTING

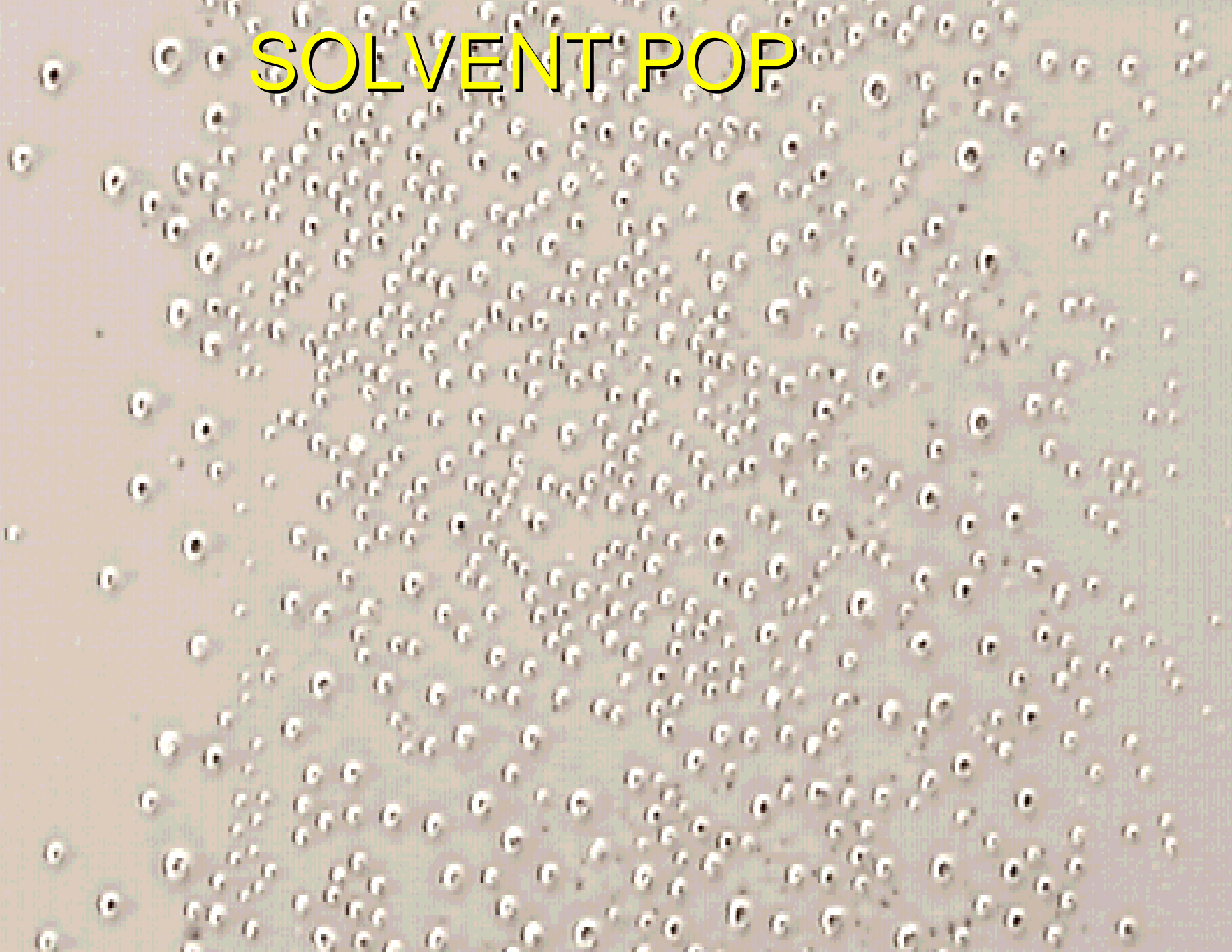


# TELEGRAPHING



**FAT EDGE**

# SOLVENT POP



# FILM PROPERTIES

## PROPERTY

Appearance Gloss

Hiding power, Color

Hardness/Flexibility

Mar-abrasion  
resistance

Environmental  
resistance

## INFLUENCED BY

Pigment dispersion.

Surface smoothness

Polymer & crosslinker  
degree of cure

Elasticity, slip

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



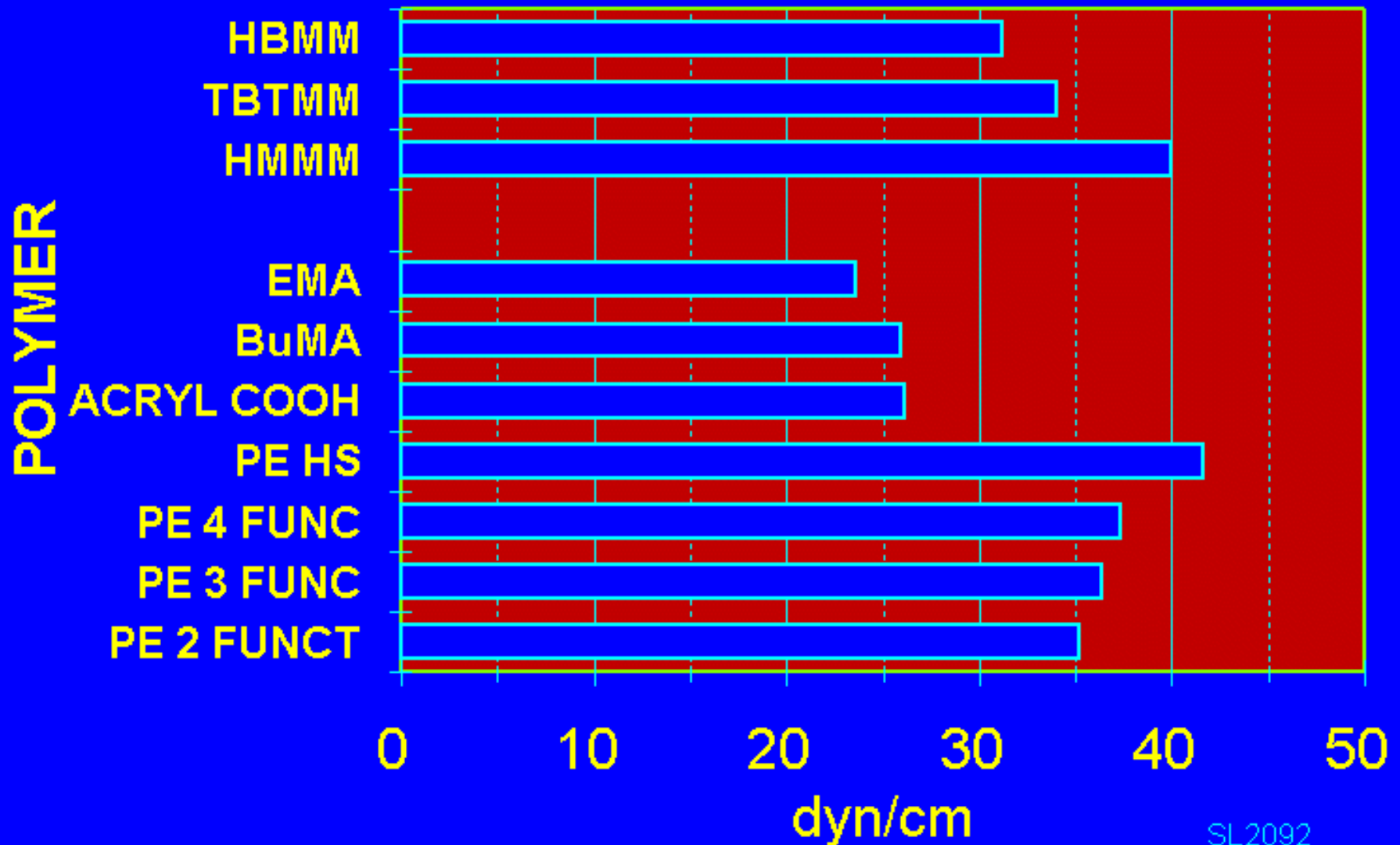
**LEVELING**

**SOLUBILITY PARAMETER**  $\longrightarrow$  **POLAR**

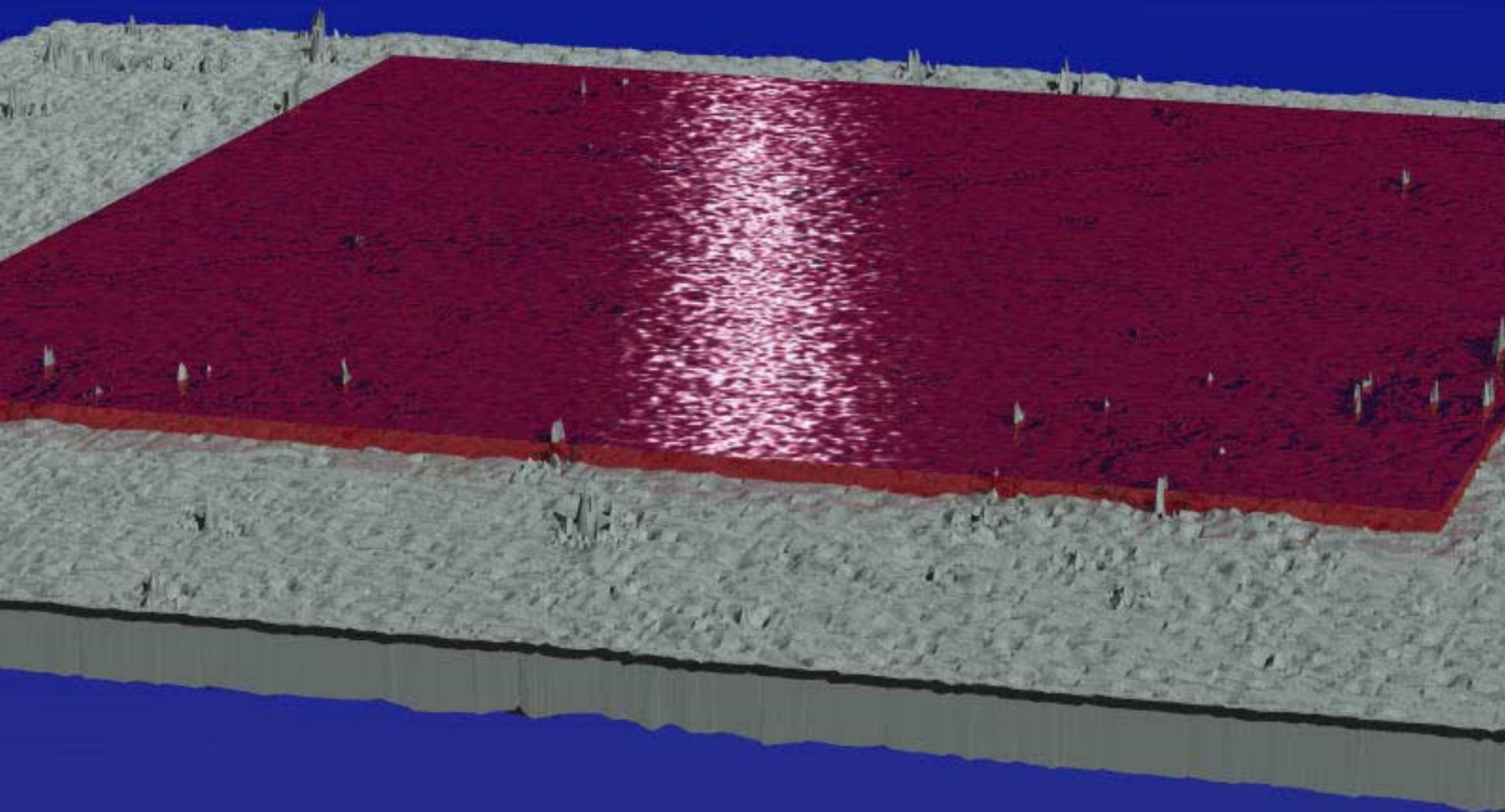


**DEFOAMING**

# SURFACE TENSION



# FLOW AND LEVELING



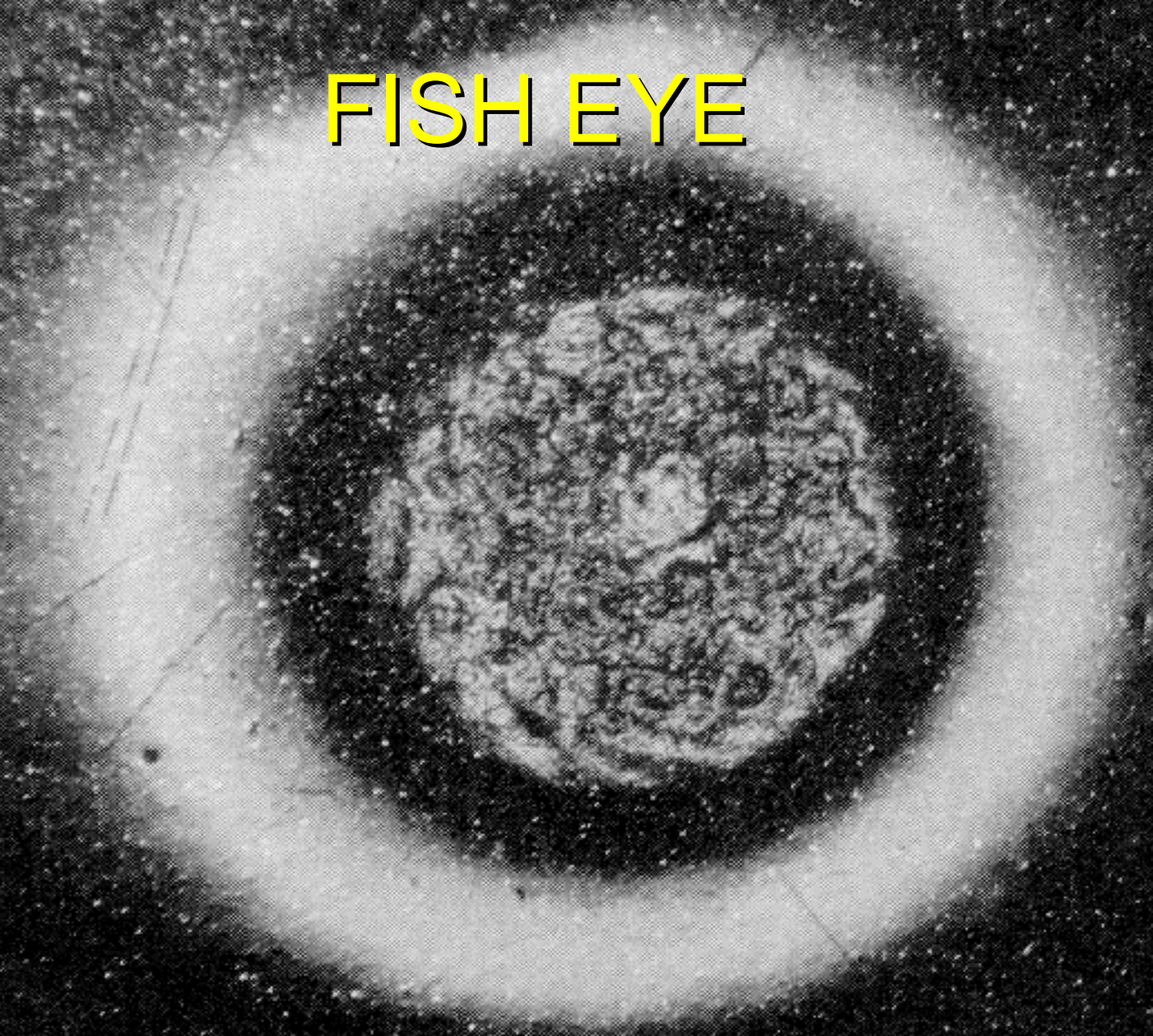
ORANGE PEEL



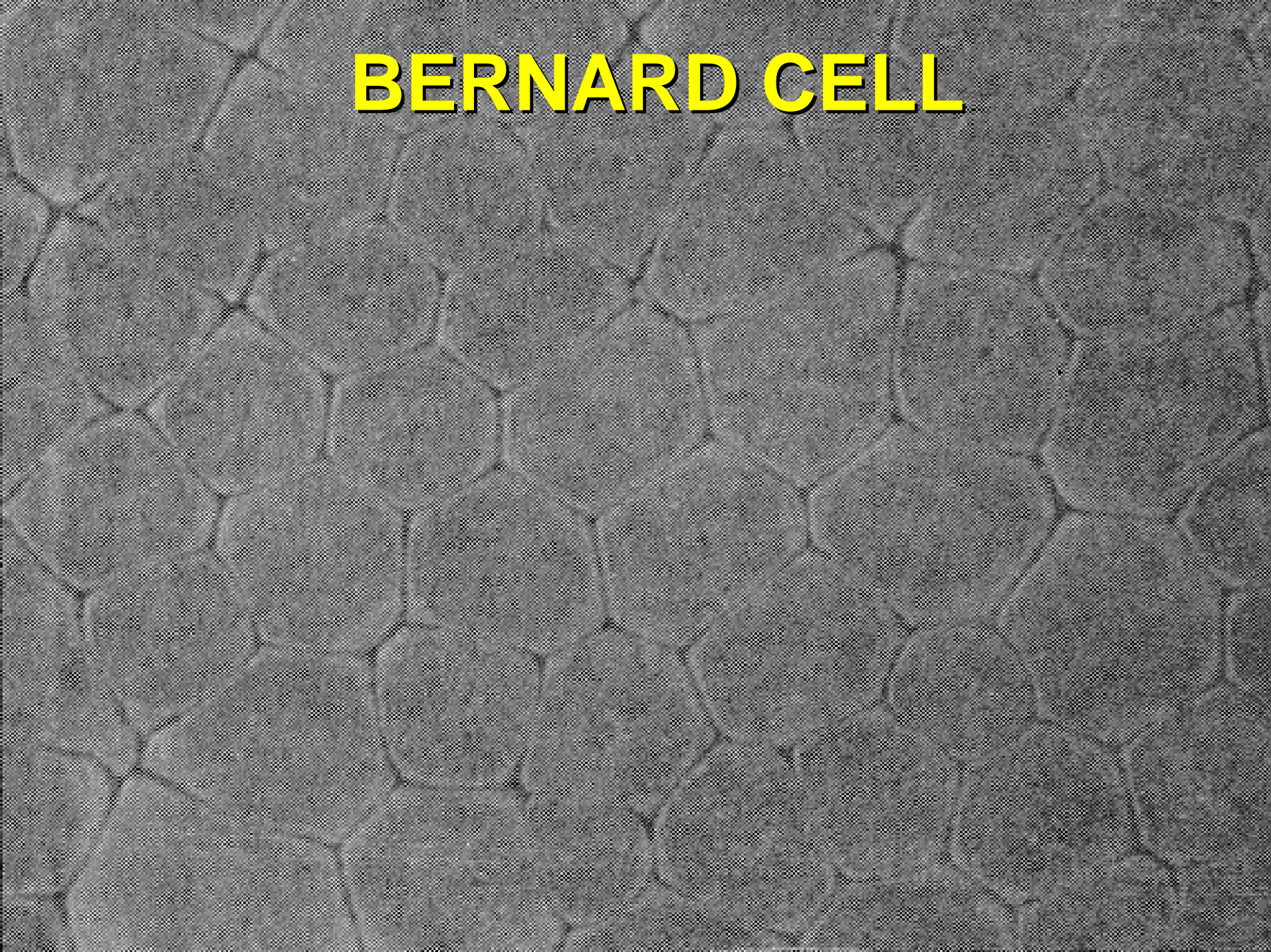
# CRATERS



FISH EYE



# BERNARD CELL



# **ADDITIVES to IMPROVE FILM PROPERTIES**

**Environmental  
resistance**

**Resin &  
Crosslinker**

**Salt spray**

**Corrosion inhibitor**

**Humidity**

**Catalyst**

**Exterior durability,**

**UV absorber**

**Acid etch resistance**

**Additives**

# **ADDITIVES to IMPROVE FILM PROPERTIES**

**Hardness**

**Flexibility**

**Impact resistance**

**Coefficient of friction**

**Mar & abrasion  
resistance**

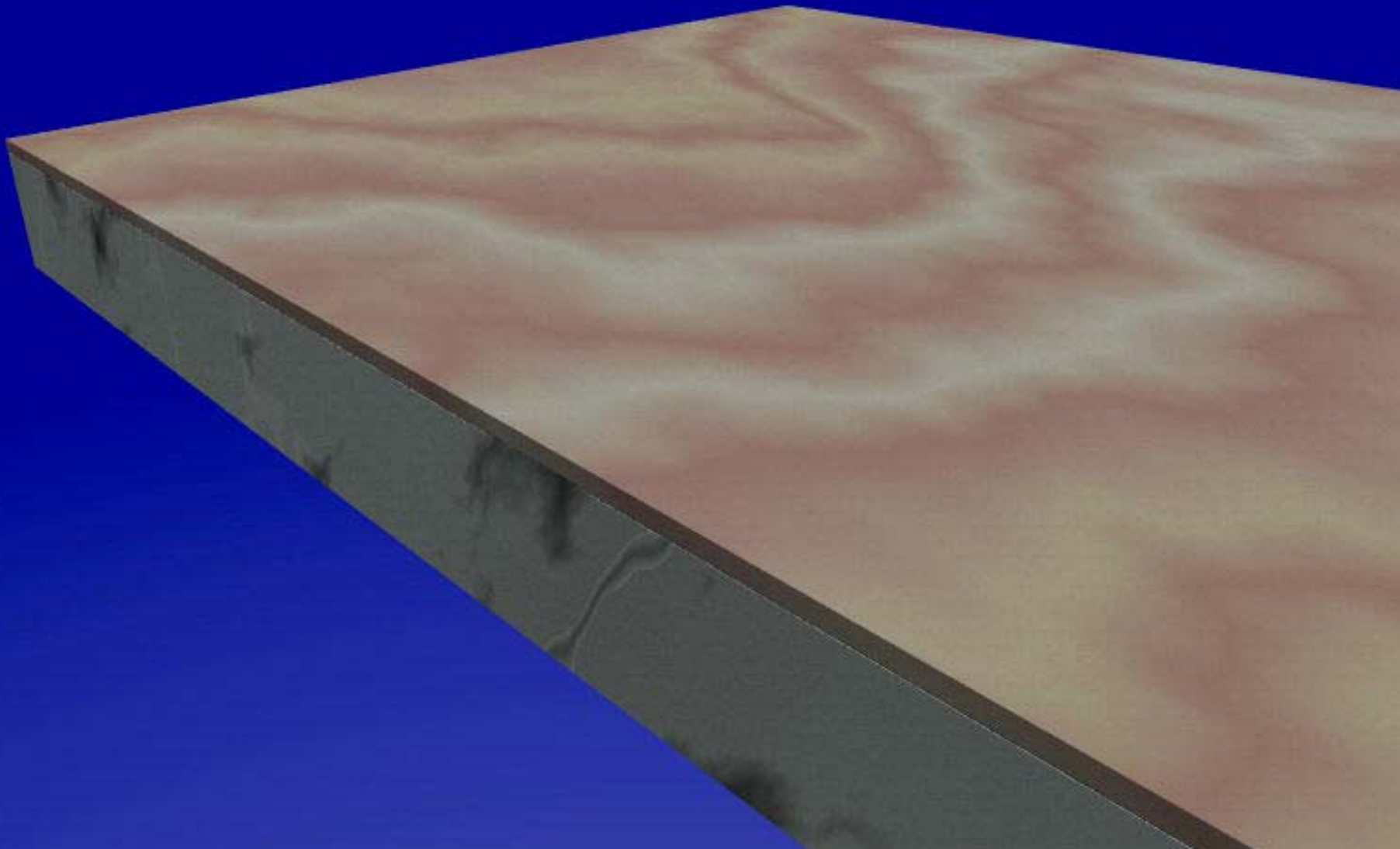
**Resin & Crosslinker**

**Catalyst, stabilizer**

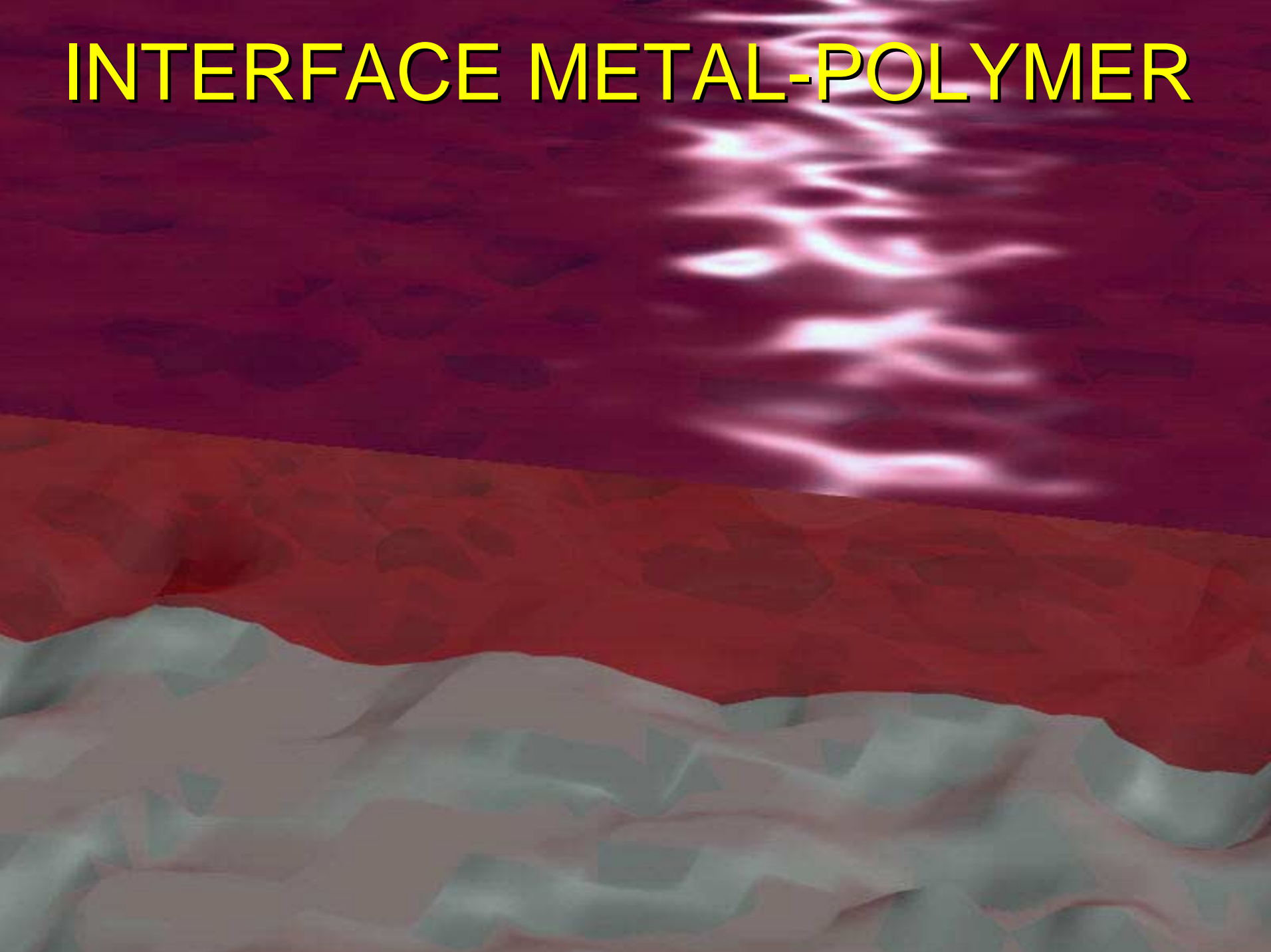
**Polymer modifier**

**Adhesion promoter**

**SURFACES ARE DIFFERENT**



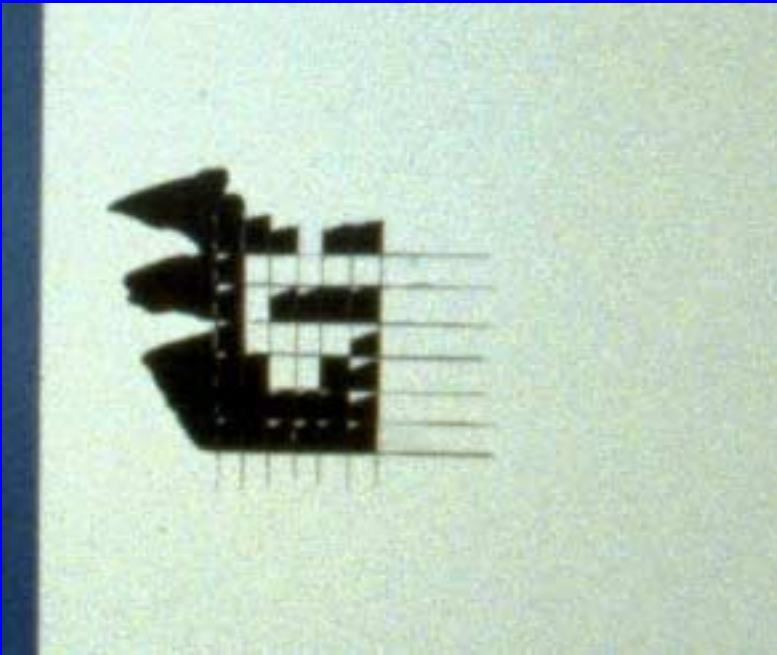
# INTERFACE METAL-POLYMER



# INTERFACIAL ADHESION WEAK BOUNDARY LAYERS

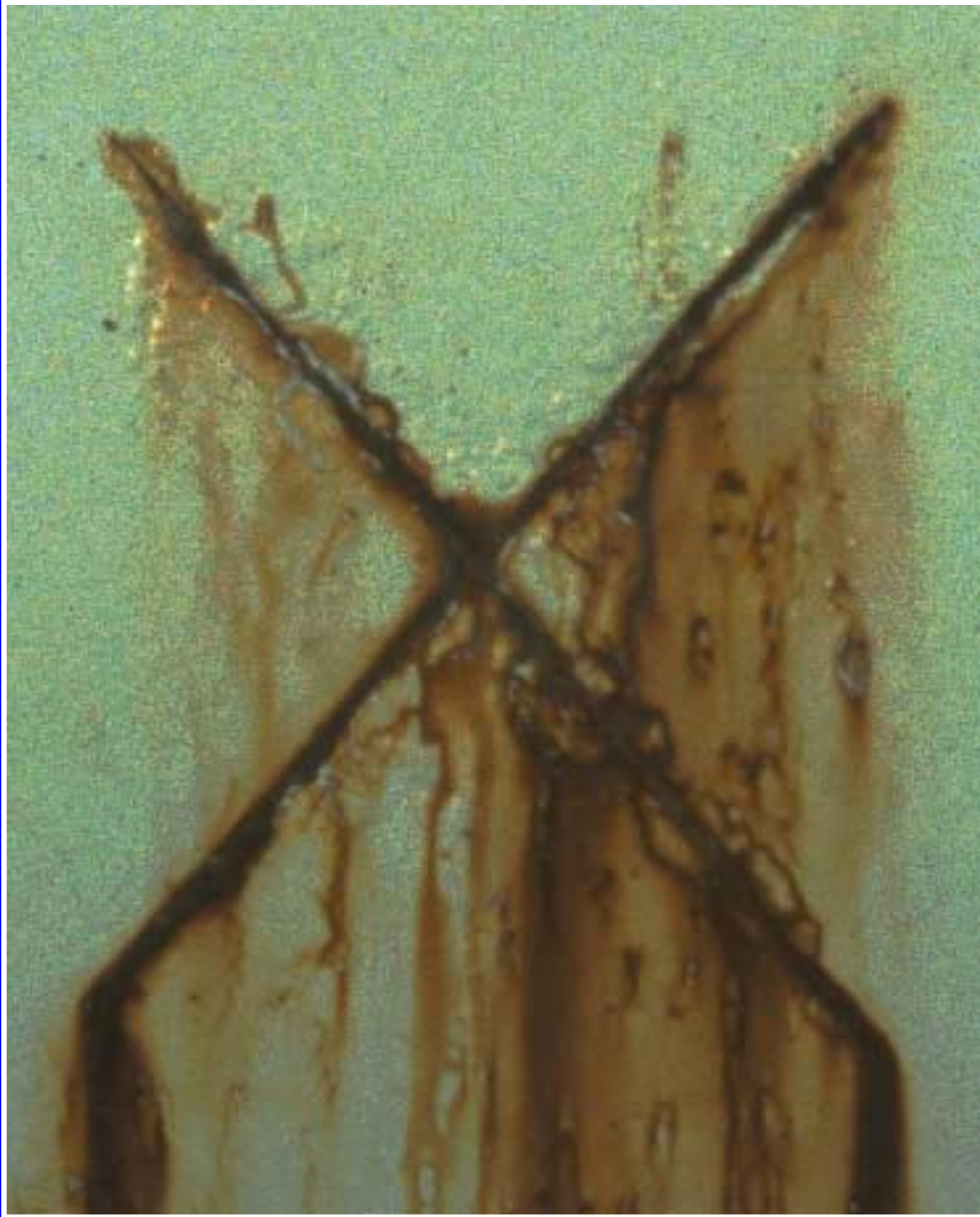


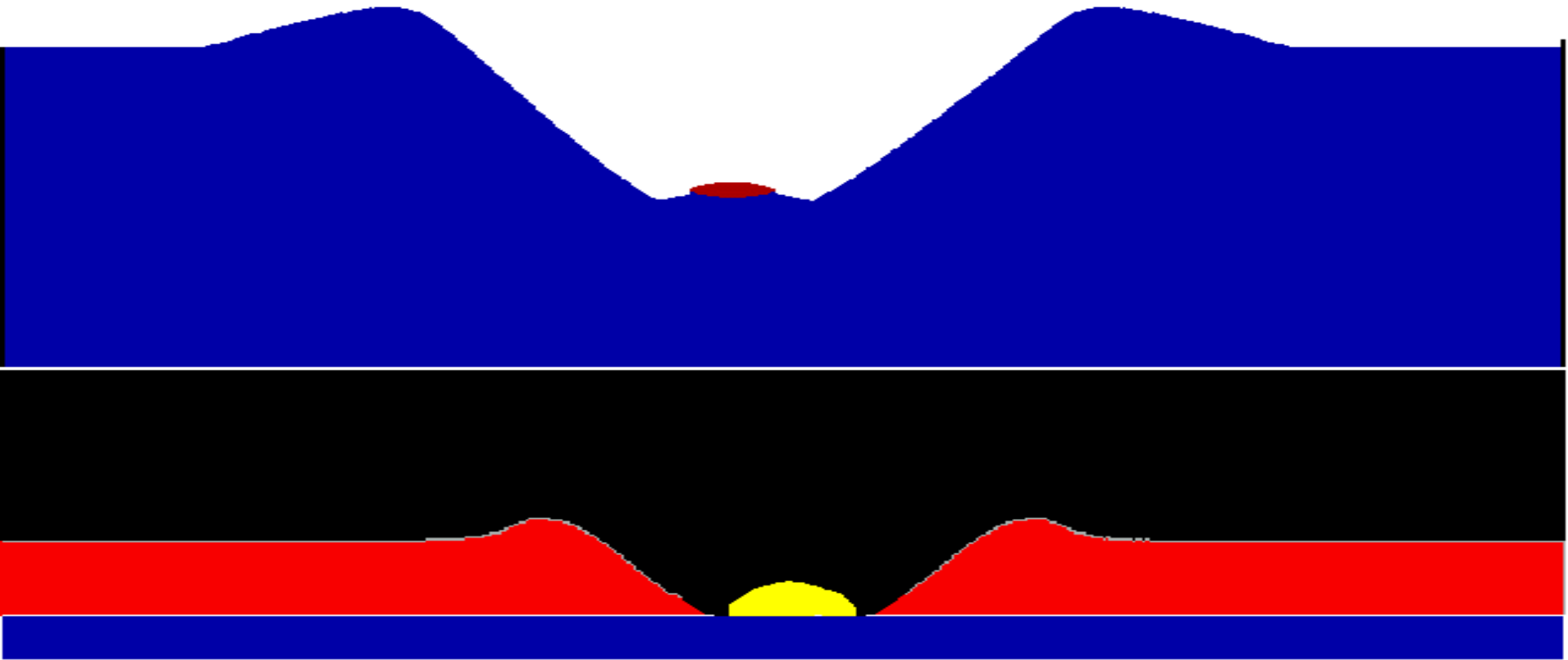
# INTERCOAT ADHESION



TPO-PE

# CORROSION PE/HMMM





CRATER-FISH EYE

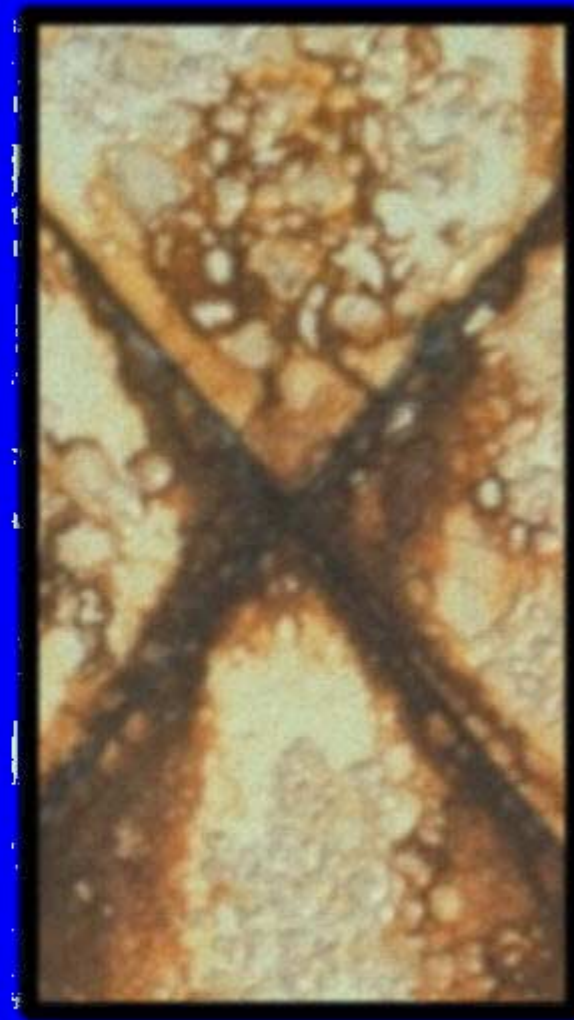
# DISPERSANTS EFFECT ON ADHESION



$\text{RSO}_3 \text{ Me}$



NO DISP.



$\text{RCOOA}$

# 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

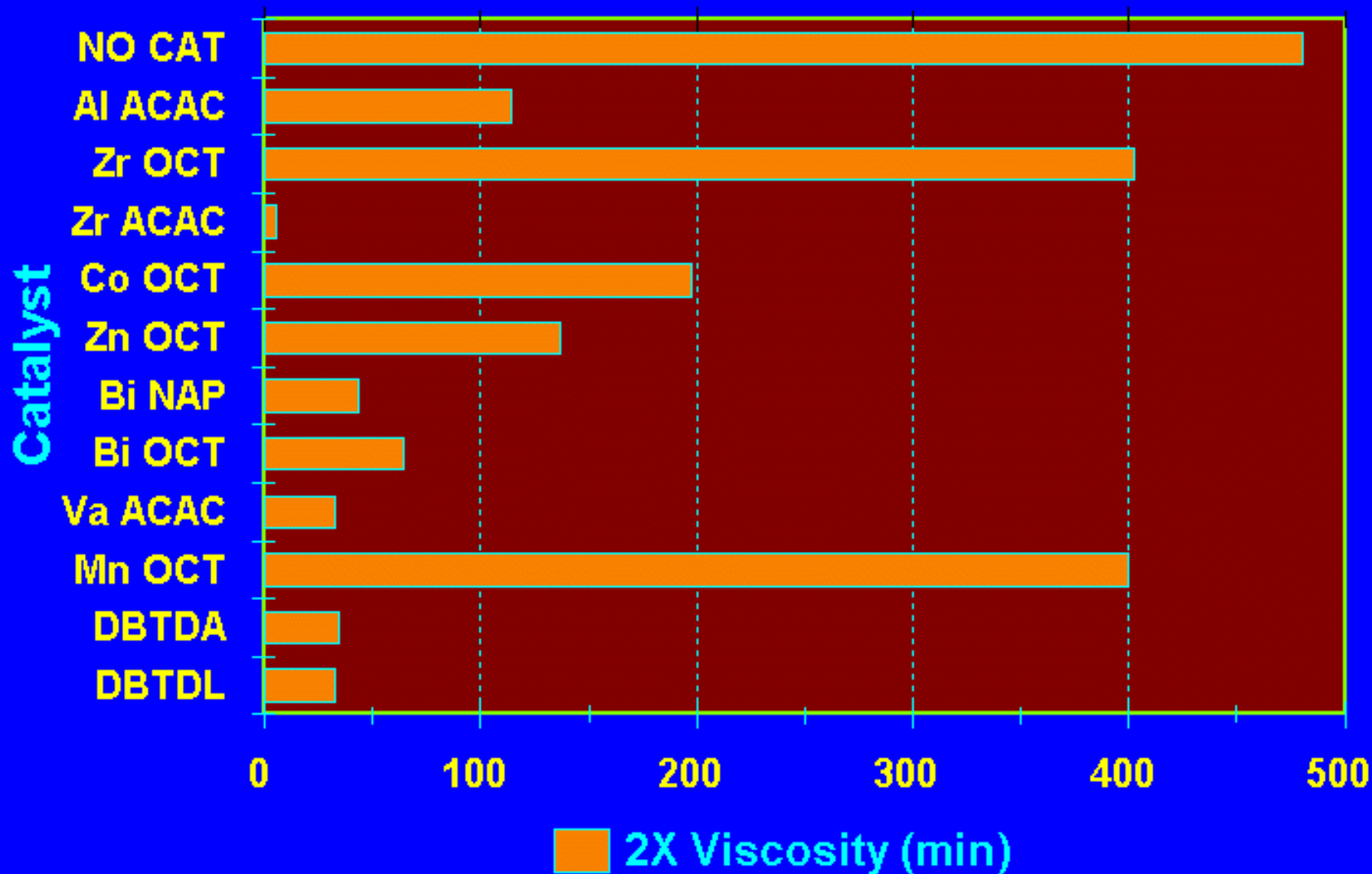
No absorption

Compatibility

Wide compatability

# 2K Catalyst Study (HMDI trimer)

## Metal Cat Study (0.0065% on TRS)



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



**K-KAT XC-4205**

**DBTDL**

**K-FLEX XM-4316/NCO  
4 HOURS AGED**

**K-KAT XC-4205**

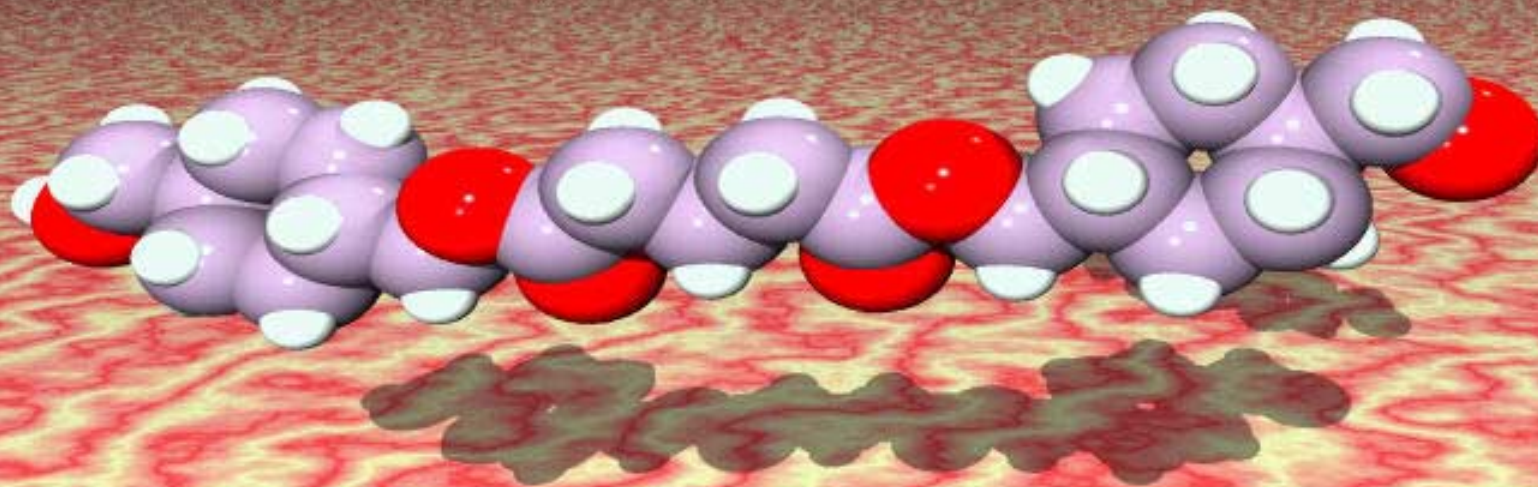
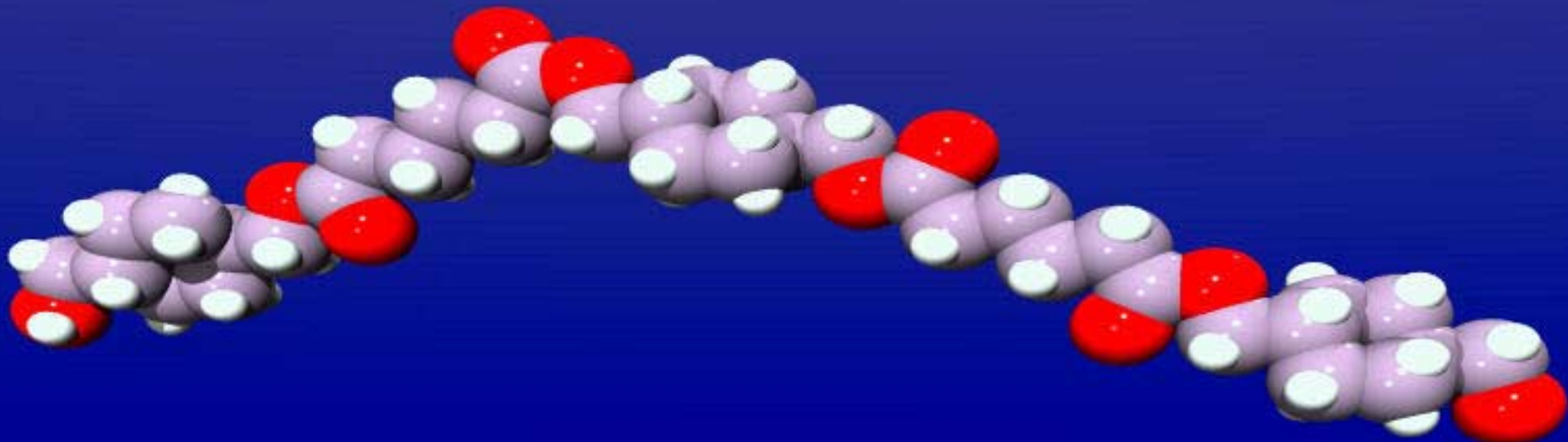
**DBTDL**

**SL2013**

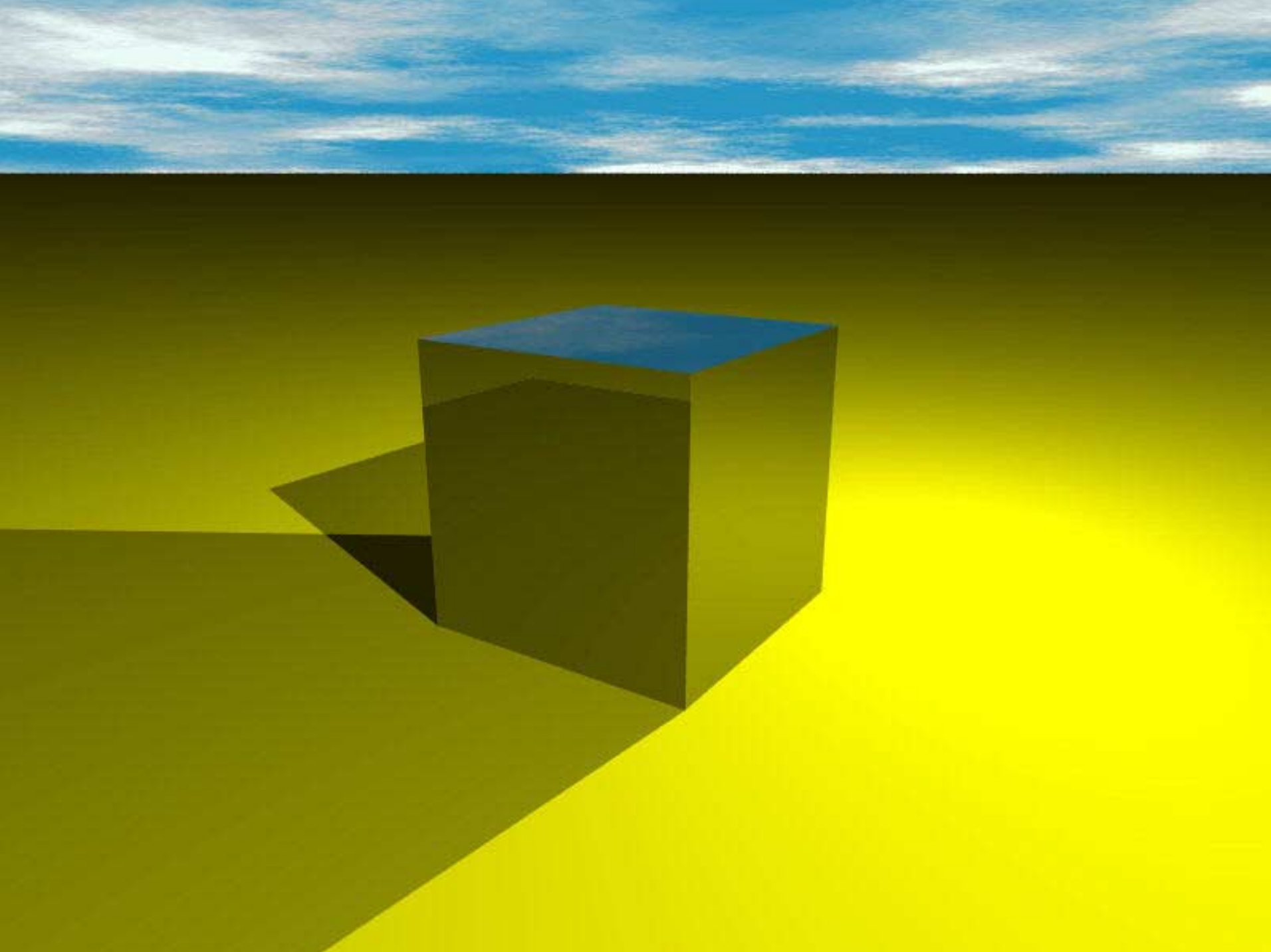
# PERFORMANCE PROFILE

## 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 GALBO BOB COUGHLIN



The conditions of your use and application of our products, technical assistance and information (whether verbal, written or by the way of product evaluations), including any suggested formulations and recommendations, are beyond our control. Therefore, it is imperative that you test our products, technical assistance and information to determine to your own satisfaction whether they are suitable for your intended uses and applications. Such testing has not necessarily been done by King Industries, Inc. ("King"). The facts, recommendations and suggestions herein stated are believed to be reliable, however, no guarantee or warranty of their accuracy is made. EXCEPT AS STATED, THERE ARE NO WARRANTIES, EXPRESSED OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE. KING SHALL NOT BE HELD LIABLE FOR SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES. Any statement inconsistent herewith is not authorized and shall not bind King. Nothing herein shall be construed as a recommendation use any product(s) in conflict with patents covering any material or its use. No license is implied or granted under the claims of any patent. Sales or use of all products are pursuant to Standard Terms and Conditions stated in King sales documents.