Coatings Trends & Technologies SUMMIT

Improving Water Resistance of Pure Acrylic Emulsions with Nonionic Reactive Surfactants

INDORAMA VENTURES

1

Introduction

2

Case

3

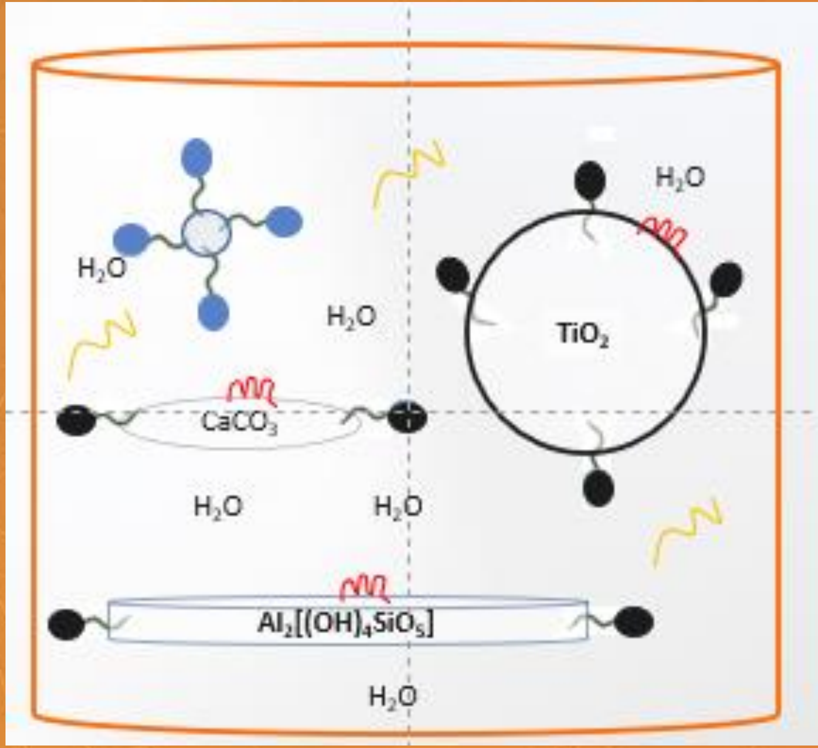
Wrap up

COATINGS SUSTAINABILITY

I. Reduce **environmental impacts.**

II. Efficient use of **resources**

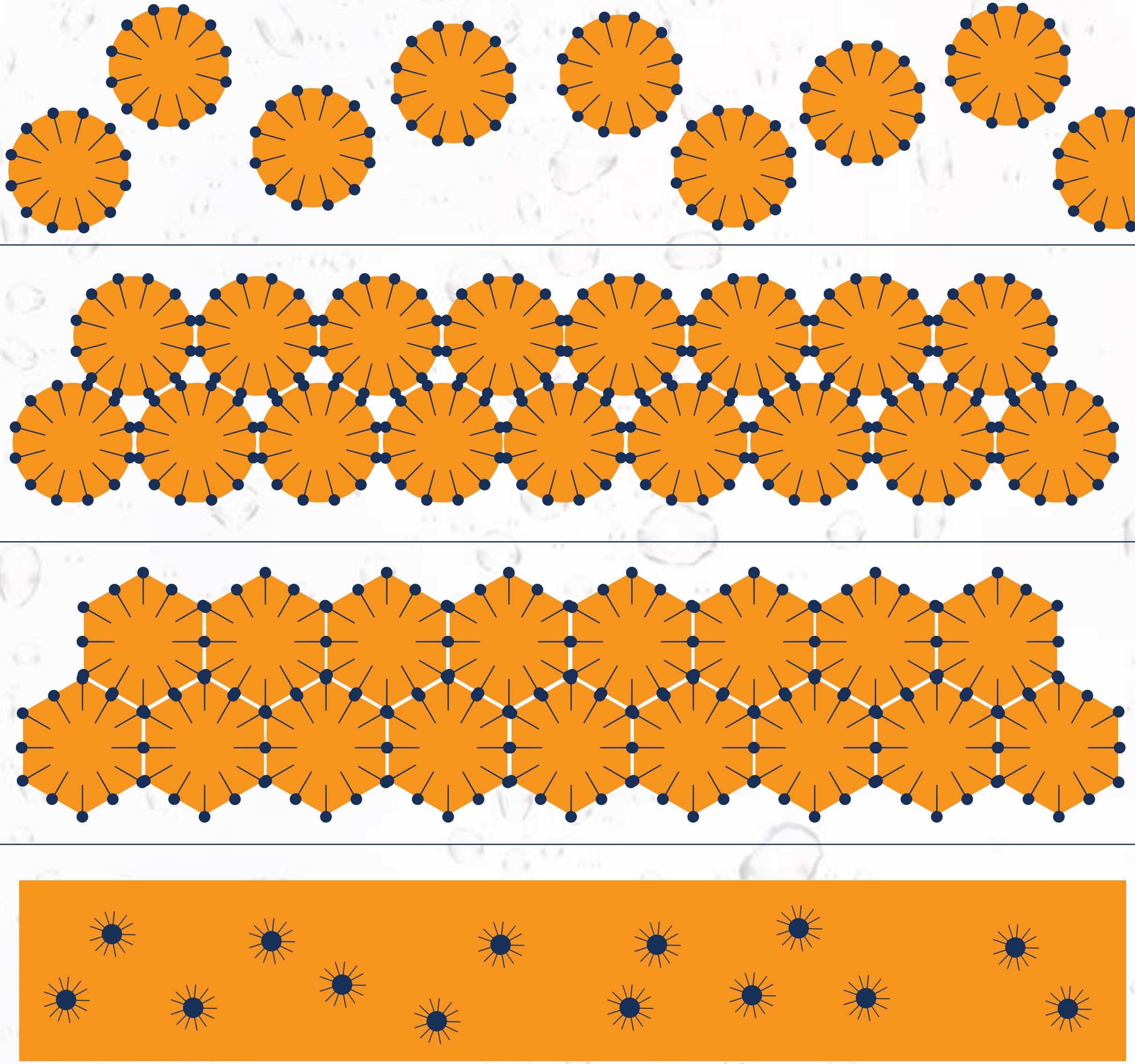
III. Increased **durability of materials**



Waterborne Coatings

EFFECT OF WATER-SOLUBLE SPECIES ON PERFORMANCE OF WATERBORNE PAINT

WHY DOES IT HAPPEN?



Emulsion Polymer

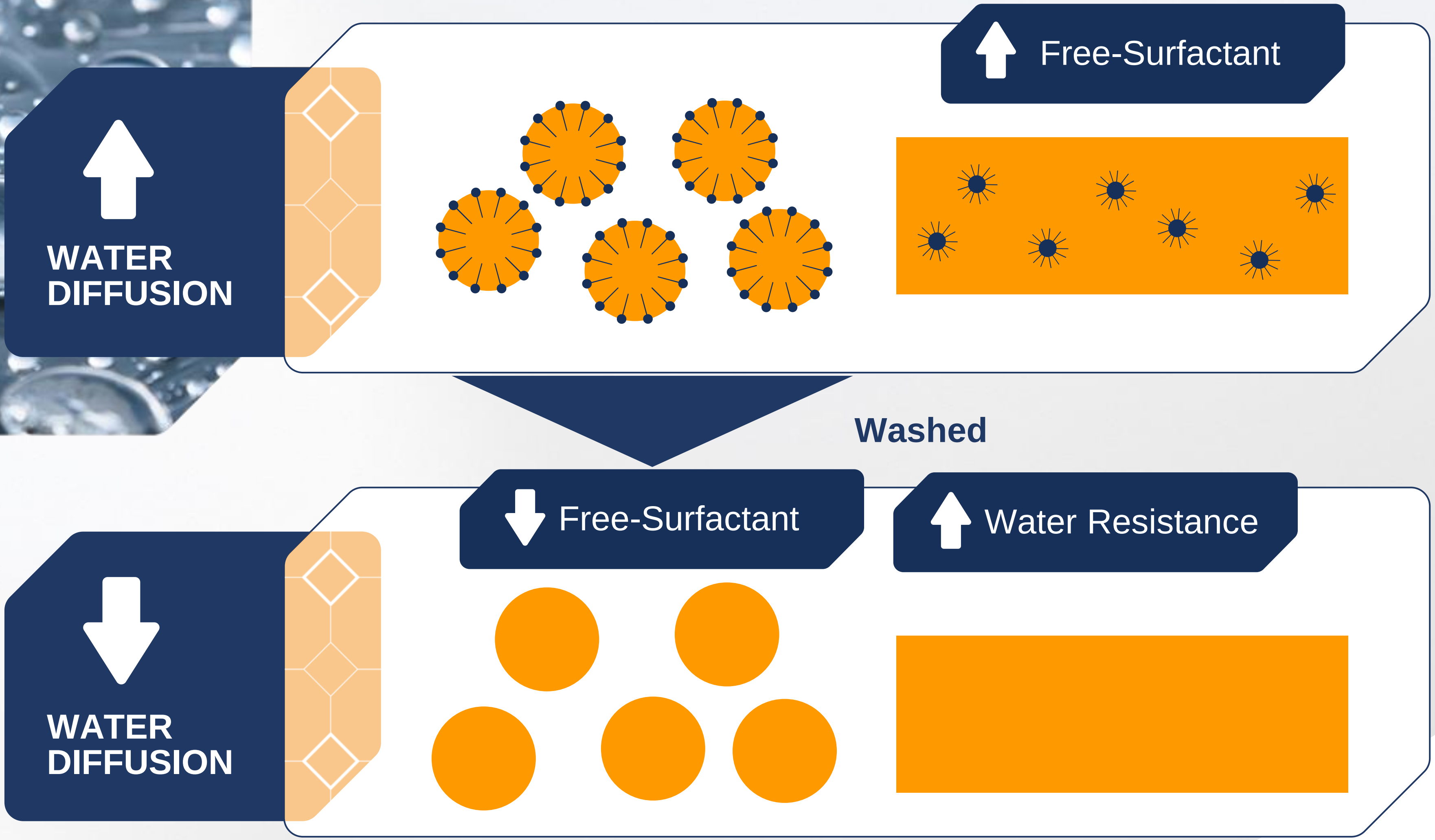
STAGE I — Fragile Film

T>MFFT

STAGE II — Continuous and Transparent Film

T>Tg

STAGE III — Coalesced Film



HOW TO IMPROVE WATER RESISTANCE?

Vanderhoff et. Al., J. Pol. Sci. **1973**, 41, 155-174.

STRATEGY

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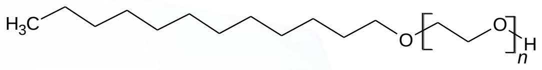
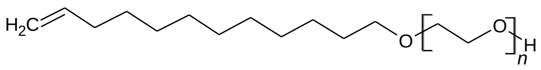
Surfactant migration ↓ ▶ **Water resistance** ↑

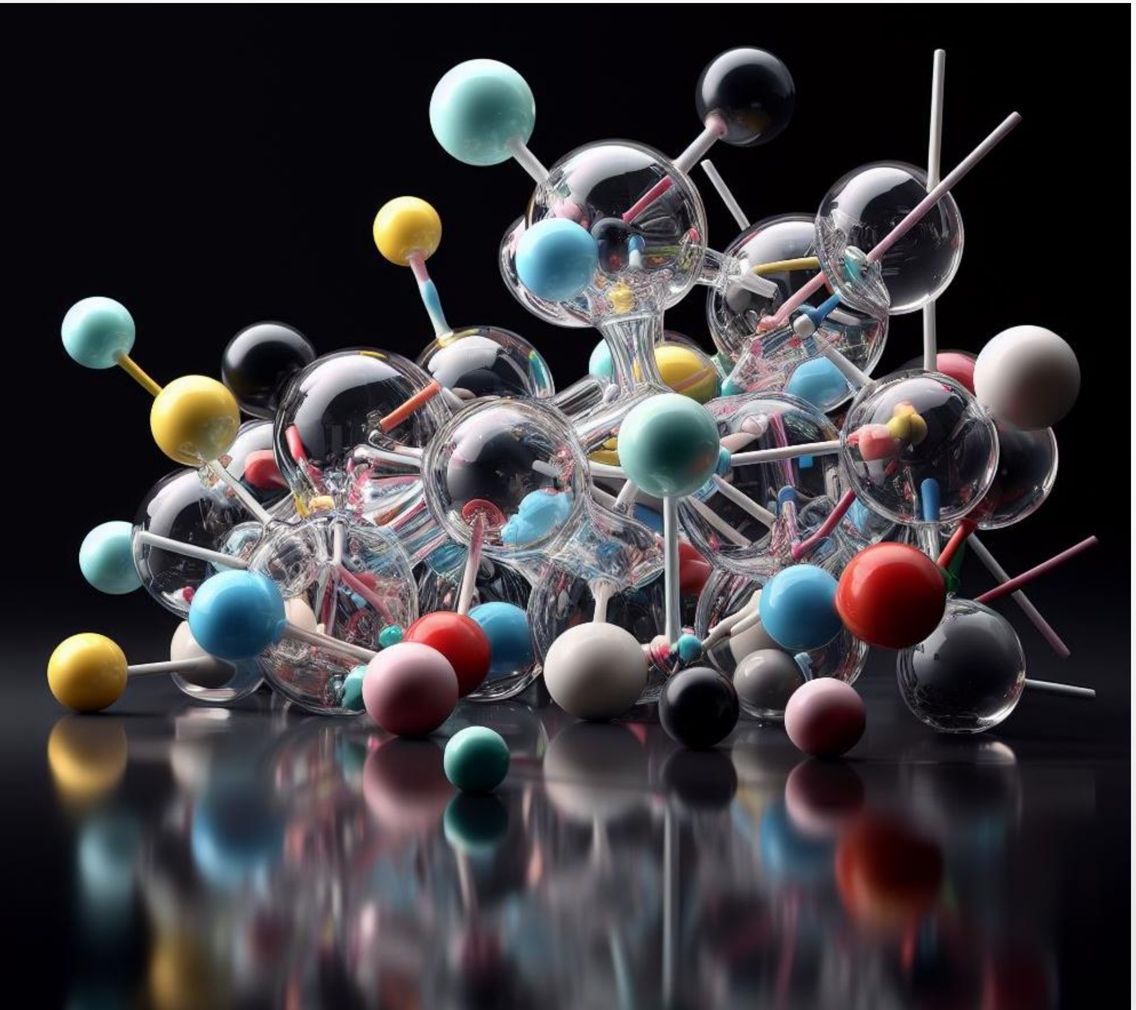
Conventional surfactants ▶ Reactive surfactants



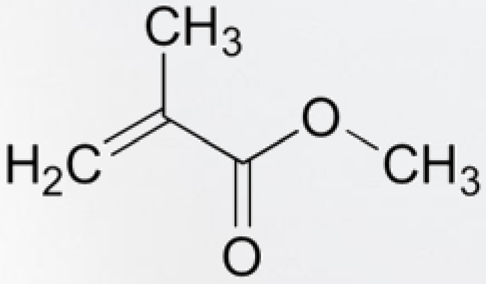


INDORAMA VENTURES

ALL-ACRYLIC LATEX ADVANTAGES

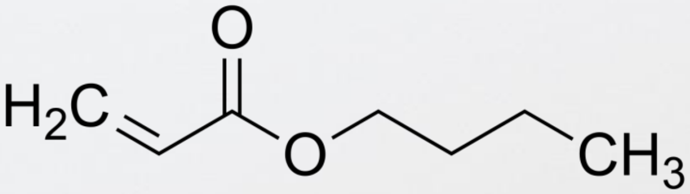


MMA



Tg ~ 105°C

BA



Tg ~ -54°C

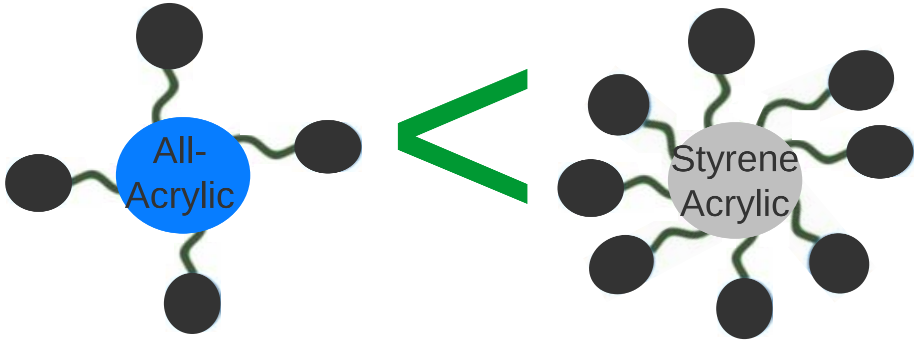
- ✓ Tg
- ✓ Mechanical Properties

- ✓ UV-resistance
- ✓ Hydrolytic resistance
- ✓ Oil resistance

- ✓ Interior
- ✓ Exterior paints

ALL-ACRYLIC LATEX DISADVANTAGE

Colloidal Stability



Source: M. El-Aasser and P. Lovell, Emulsion Polymerization and Emulsion Polymers, Wiley, West Sussex, **1997.**

OBJECTIVES

1

Develop reactive surfactant

2

Apply in EP

All-acrylic latex

3

Optimize EP process

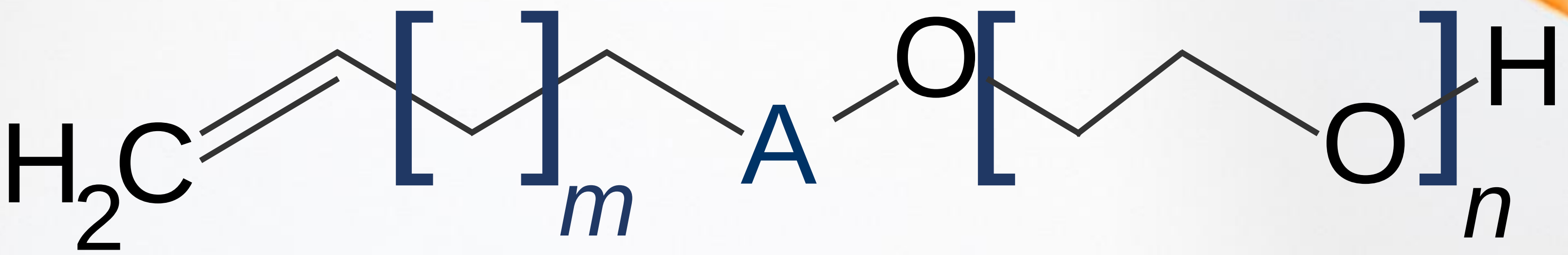
Stability x Incorporation

4

MAXIMIZE

WATER RESISTANCE

REACT N1



APEO-free

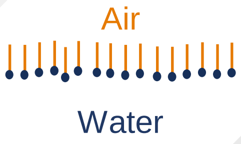
Partially Bio-based

VOC ≤ 5 g/L

Concentrated Product
Solid content >99 wt.%

Liquid

HLB of **15**



Behave as **conventional** surfactants

Compatible with all latexes

TWO STEP PROCESS

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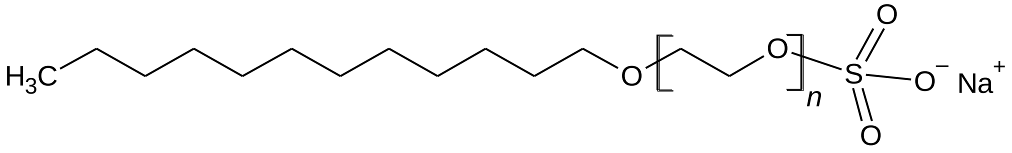
1° STEP: Generation of seeds

MONOMERS

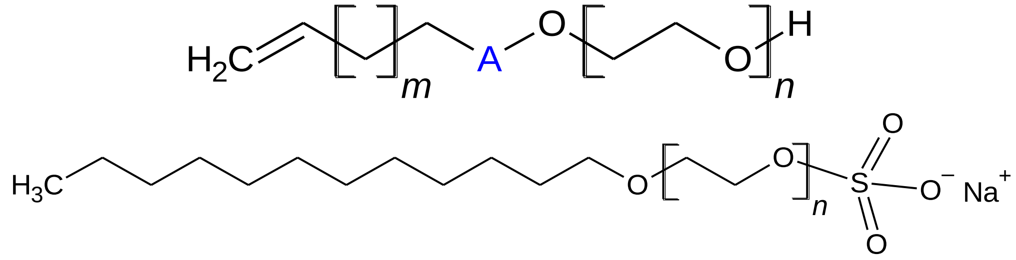


SC ~ 10 wt%
40 - 50 nm

2° STEP: Growth of seeds

MONOMERS

10^{18} seeds/L



SC ~ 45 - 50 wt%
~ 100 nm

Asua et. *Al.*, *Langmuir* **2003**, 19, 3212 - 3221.

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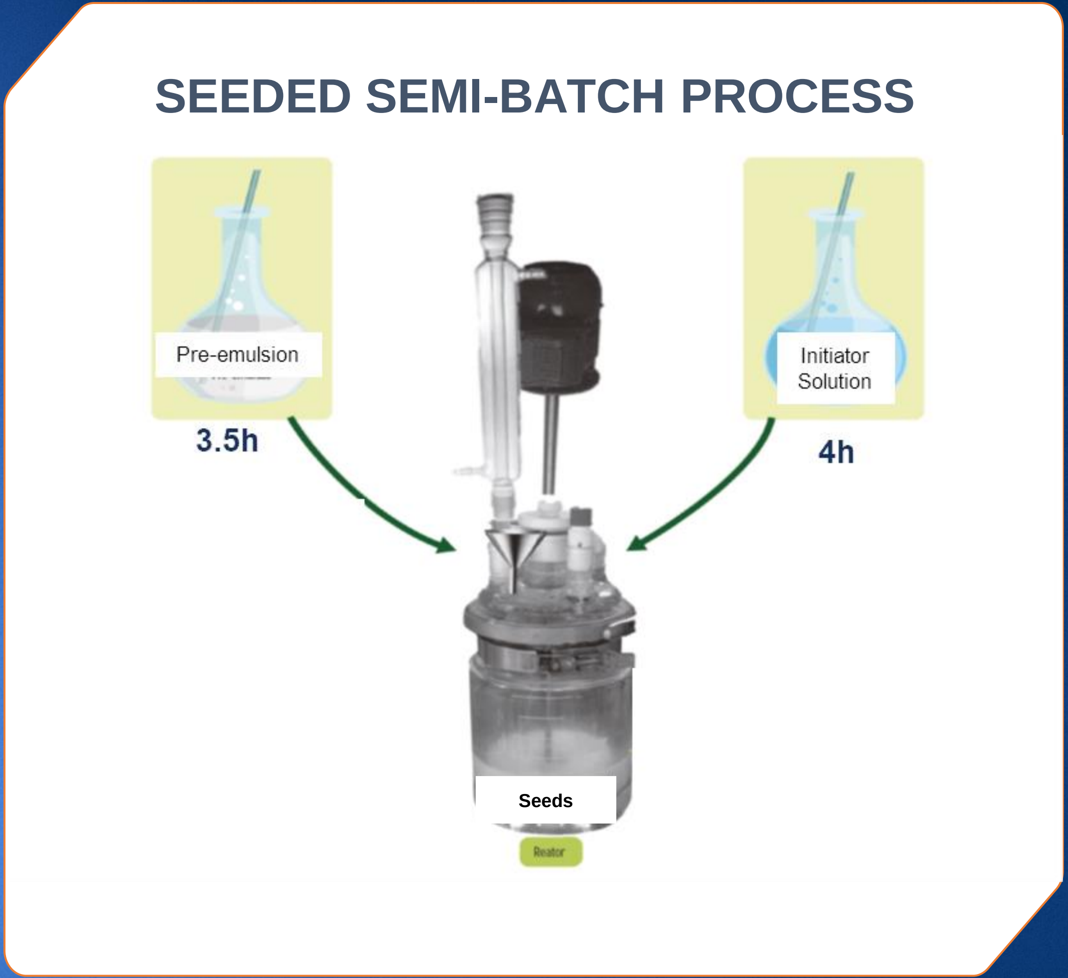
Emulsion Polymerization



Starting Formulations

	Components	w/w
Emulsion Polymer seed (Previously prepared)	Methyl Methacrylate (MMA)	0.75
	Butyl acrylate (BA)	0.72
	Methacrylic acid	0.03
	Anionic surfactant*	0.38
	Ammonium persulfate	0.004
Pre-emulsion	Methyl Methacrylate (MMA)	23
	Butyl acrylate (BA)	22
	Methacrylic acid	1
	Anionic surfactant*	TBD
	REACT N1	TBD
Thermal Initiator	Ammonium persulfate	0.15
Ox-redox Initiator	Oxidizing Agent	0.02
	Reducing Agent	0.02

* Sodium salt of lauryl ether sulfate

EFFECT OF SURFACTANT COMPOSITION ON COAGULUM FORMATION IN EP

Coagulum in reactor
Thermocouple
Impeller

Dispersed coagulum in latex

75 wt% REACT N1
25 wt% Anionic Surfactant

800 ppm

67 wt% REACT N1
33 wt% Anionic Surfactant

834 ppm

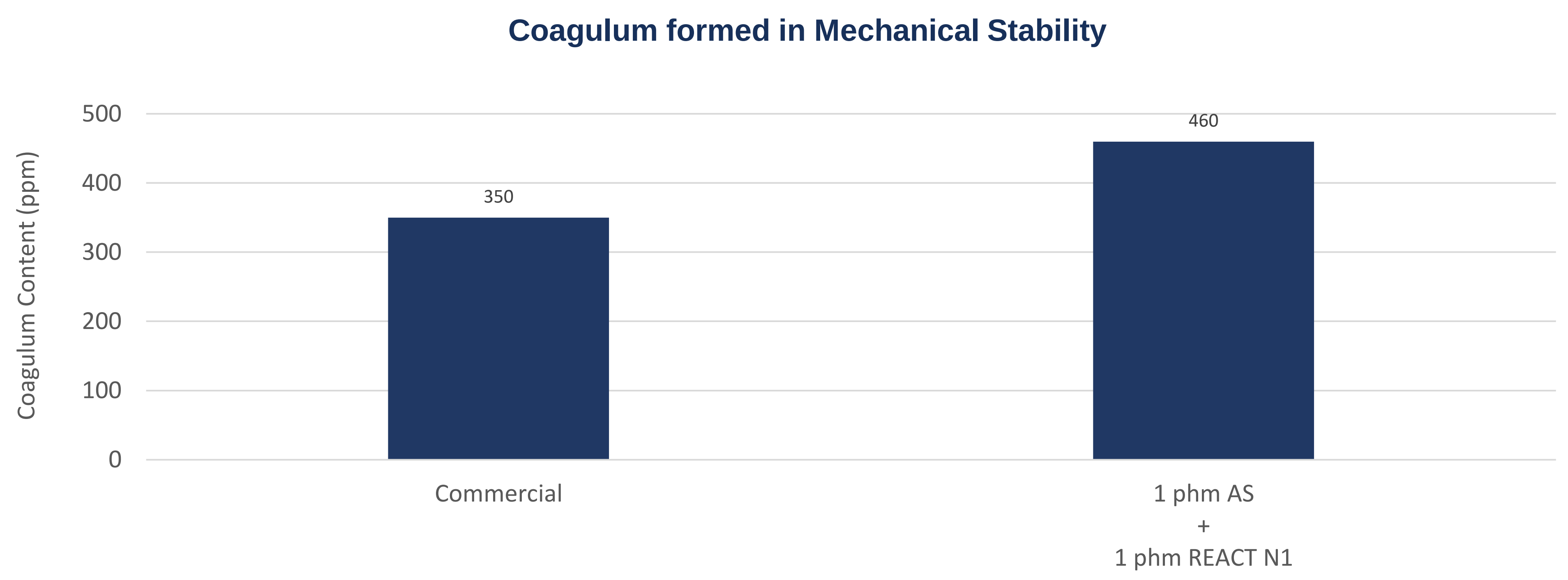
50 wt% REACT N1
50 wt% Anionic Surfactant

805 ppm

GENERAL PROPERTIES OF LATEXES

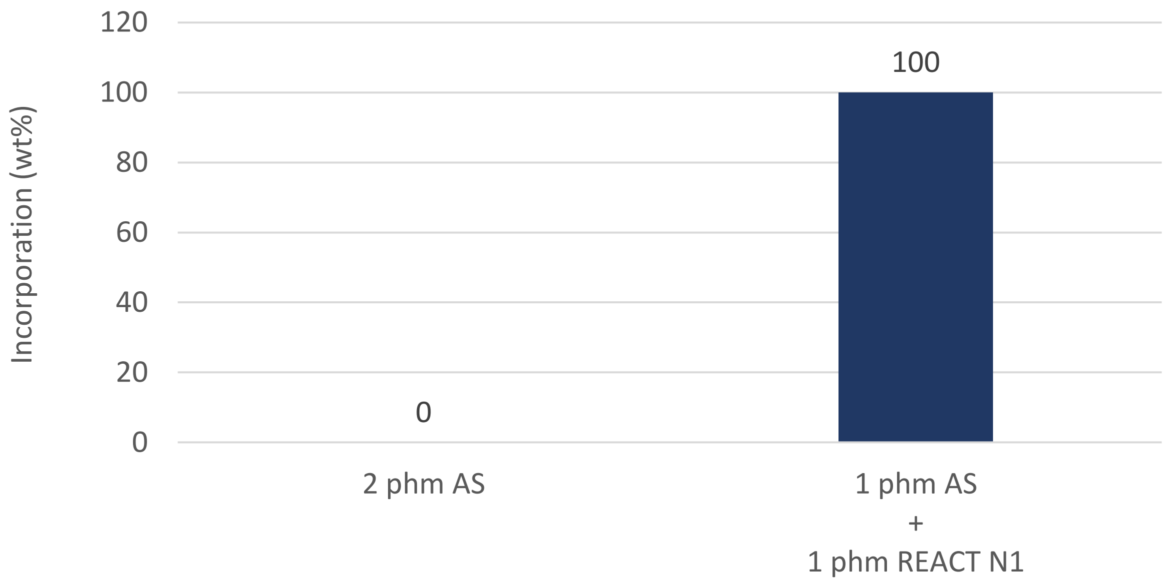
Properties	Final latex 2 phm AS	Final latex 1 phm REACT N1 1 phm AS
pH	**8**	**8**
Solid Content (wt%)	**47**	**46**
Particle Size (nm)	**92**	**101**
Viscosity (cP, 25 °C)	**1025**	**618**
Surface Tension (mN/m, 25 °C)	**40**	**39**

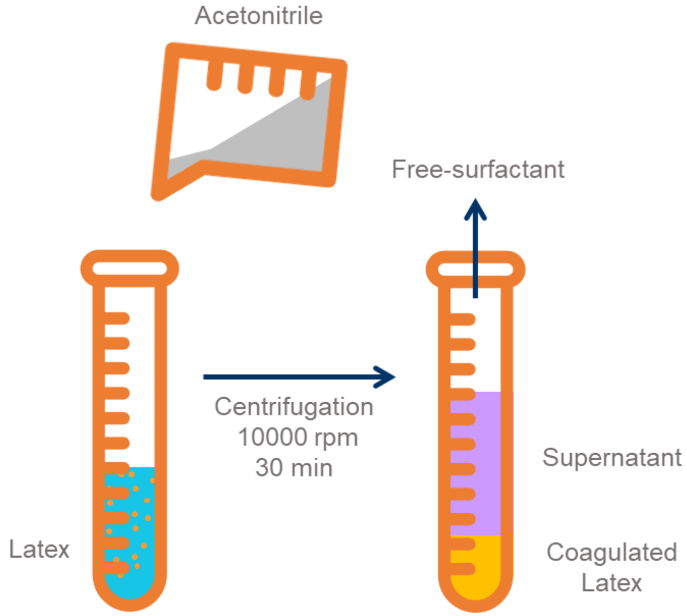
EFFECT OF REACT N1 ON STABILITY



INCORPORATION OF REACTIVE NONIONIC SURFACTANT

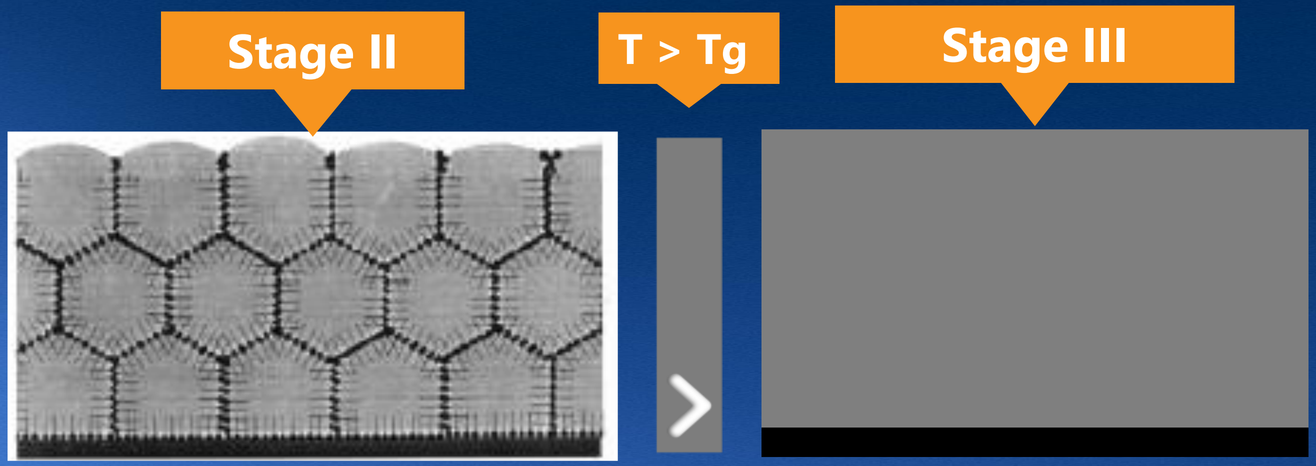
Surfactant Incorporation = Total Surfactant - Free Surfactant





FILM FORMATION

↑ Coalescence → ↓ Rate of Water Diffusion
↑ Water Resistance



Continuous and Transparent Film

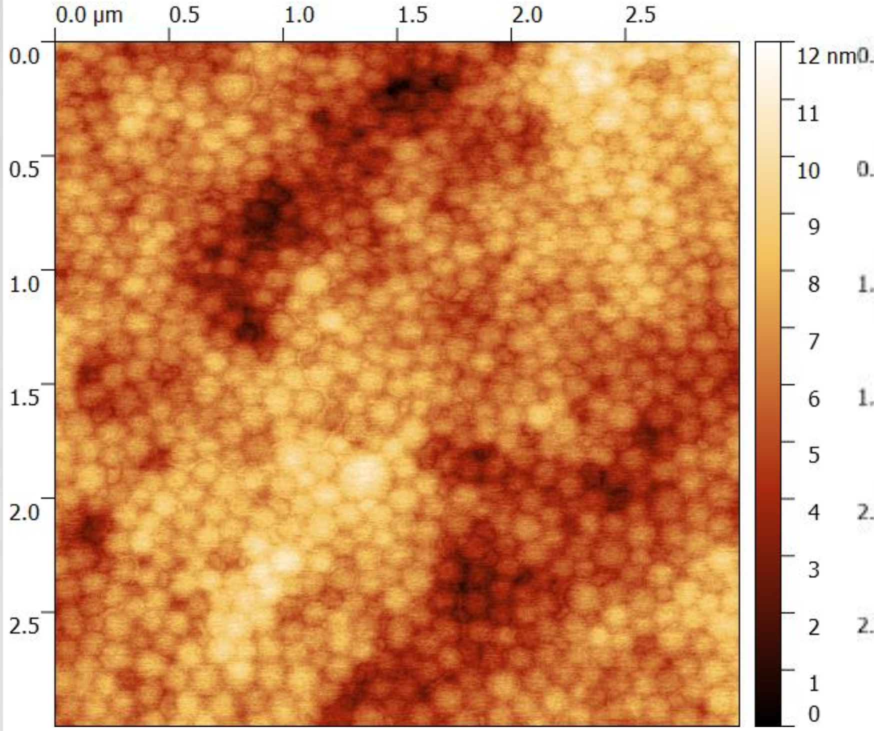
Coalesced Film

Vanderhoff et. Al., J. Pol. Sci. **1973**, 41, 155-174.

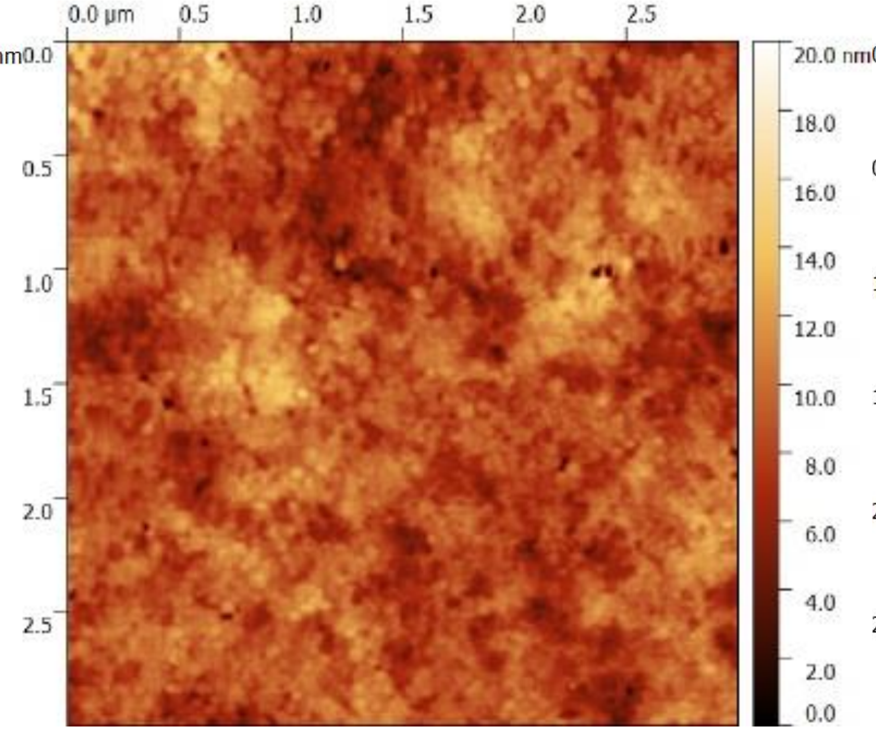
AFM

Latex Films with 2 phm of ULTRAFILM® 5000 cast on Leneta, dried at 25 °C, 60 % RH, 7 days

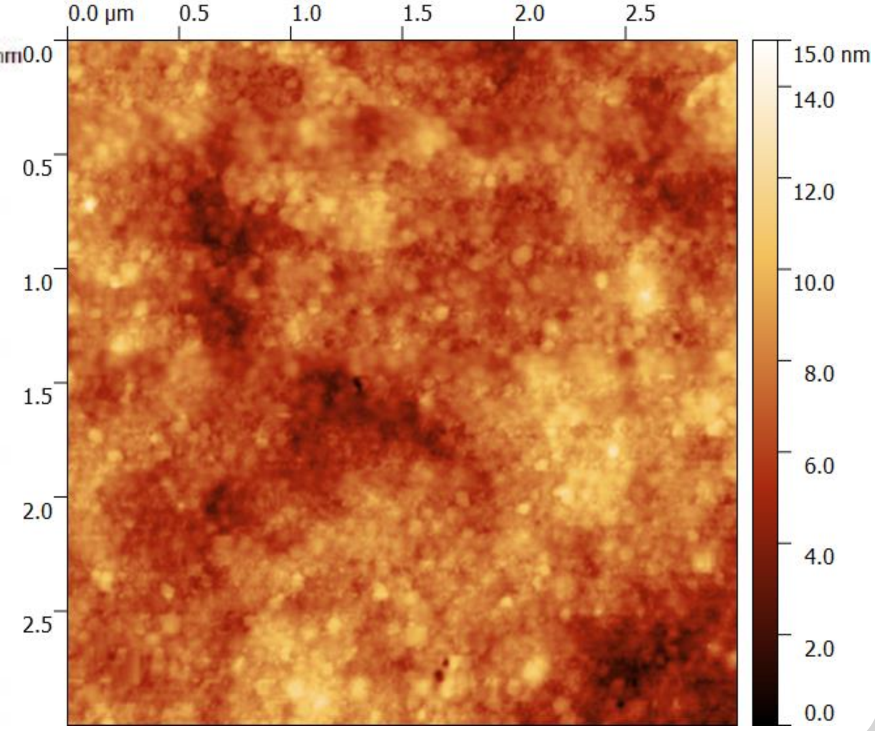
Commercial



AS



AS / REACT N1 (1:1)



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WHITENING

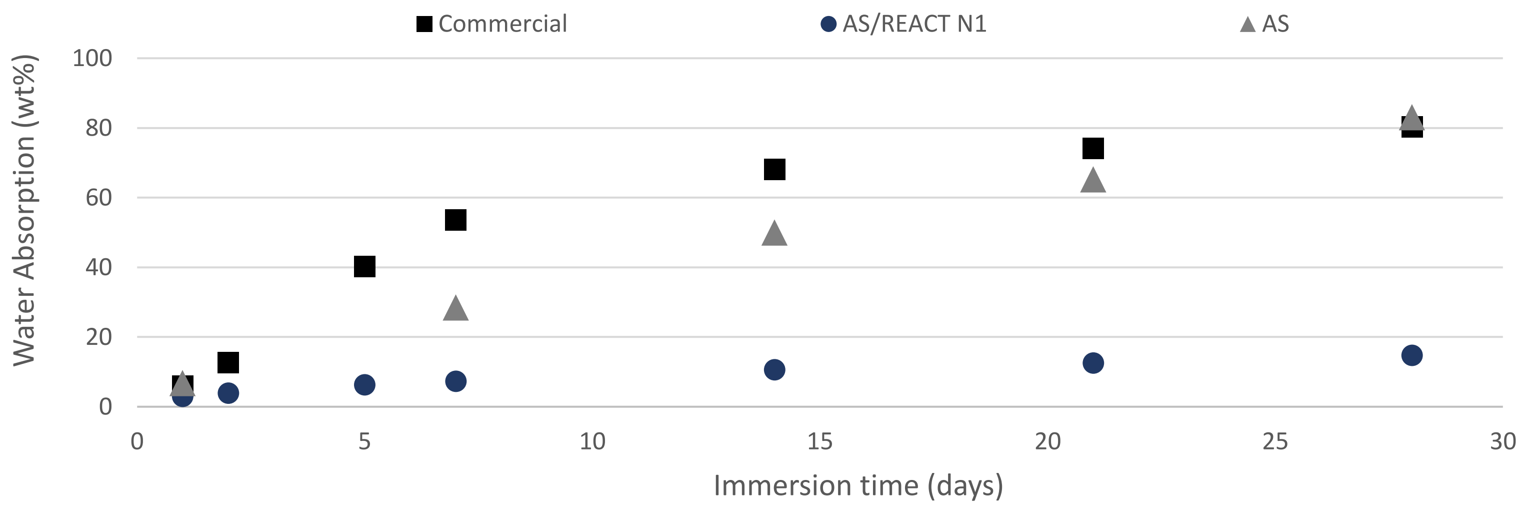
Latex films with 2 phm of ULTRAFILM® 5000
Immersed in water at 25°C after 4 days

Commercial

AS / REACT N1 (1:1)

WATER ABSORPTION

Latex films with 2 phm of ULTRAFILM® 5000
Immersed in water at 25°C



SUSTAINABILITY ACHIEVEMENTS

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Environmental and social performance	Efficient use of resources	Durability of materials
Biobased alternatives	High **performance** in the **application**	**Enhance** short & long-term performance
HSE friendly formulations	**Excellent** control of **stability** and **particle size**	Water resistance ↑ **80%**
Free of GHS hazard pictograms	High level of **incorporation**	
	Coalesced films	

INDORAMA VENTURES

Thank you!!!

Please visit us at Table #46.

Contact

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