PATCHAM

Achieving Sustainability and Innovative Targets

with the latest Additive Technologies

CTT 2025

Core Values and Vision

Product Innovation

- Product Innovation – longevity, resource efficiency
- Innovative Business Models
- Closed-loop systems
- Sustainability

Safe Workplace

- Safe working environment
- Health, safety, and environment
- Employee protection

Manufacturing

- Resource Efficiency
- Waste Minimization
- Energy Efficiency
- Social Responsibility

Environment

- Sustainable Technologies
- Emission Reduction
- Environmental Initiatives
- Environmental Stewardship

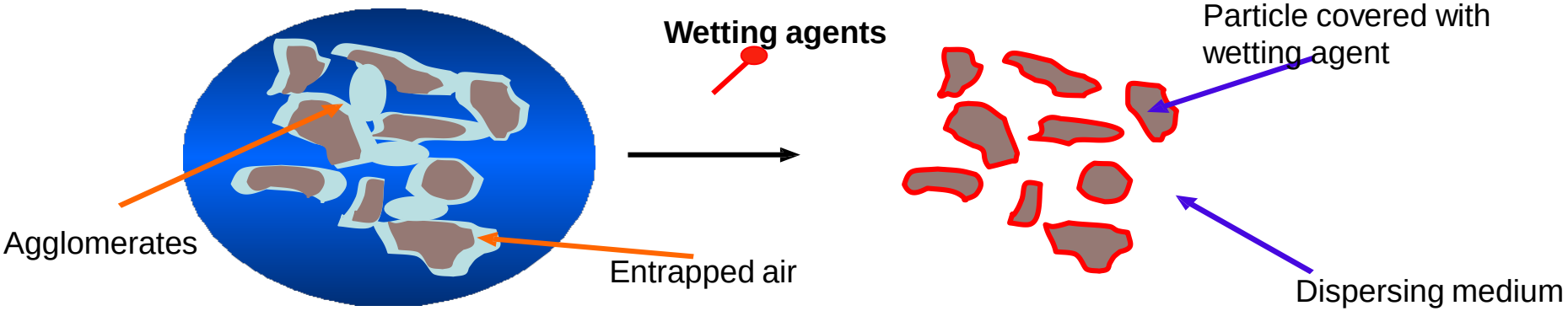
Contributions to Sustainability

- Biobased Raw materials
- Cumene/Aromatic-Free
- PTFE/ PFAs-Free
- Biocide -Free
- Label-Free
- APEO –Free
- Tin-Free
- HAPs-Free
- Solvent/ VOC -Free
- Formaldehyde-Free

The Science behind Pigment Wetting and Dispersion Stabilizing Additives

Pigment Dispersion & Stabilization

1. Pigment wetting: displacement of air and moisture at the pigment surface by the liquid of the mill-base



Good wetting (adjusting Surface Tension liquid phase, through wetting agent):

- ✓enabling high pigment solids
- ✓low mill-base viscosity
- ✓high milling efficiency

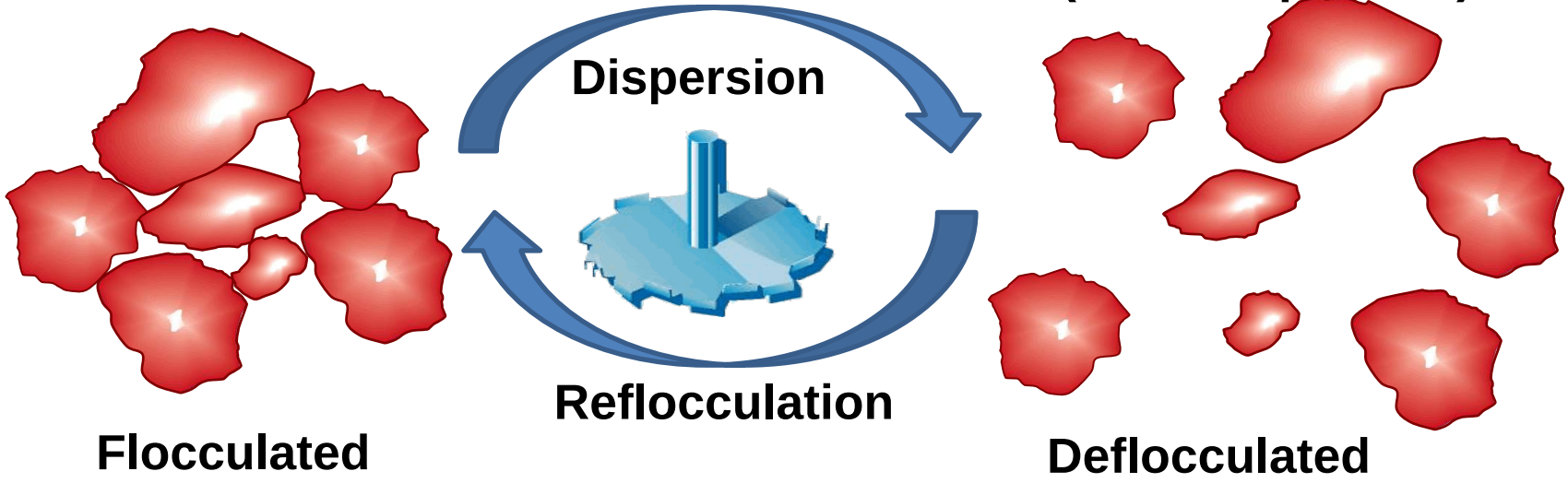
Pigment Dispersion & Stabilization

Pigment dispersion: the application of shear of sufficient energy into the millbase to separate pigment agglomerates into their individual unit particle

Wetting and Dispersing Additives

Agglomerate
Flocculate

Primary Particle
(Ideal Dispersion)



Flocculated

Deflocculated

What's the Difference?

- Wetting additives bring the pigment surface into intimate contact with the continuous phase

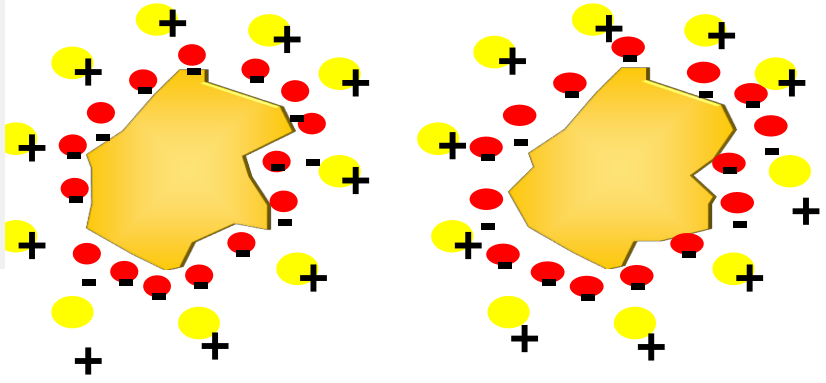
  - displace air, brings pigment into the liquid phase

- Dispersants coat individual pigment particles to minimize particle to particle interactions providing observed lower viscosity

  - stabilize dispersed pigment, prevents flocculation

Pigment Stabilization

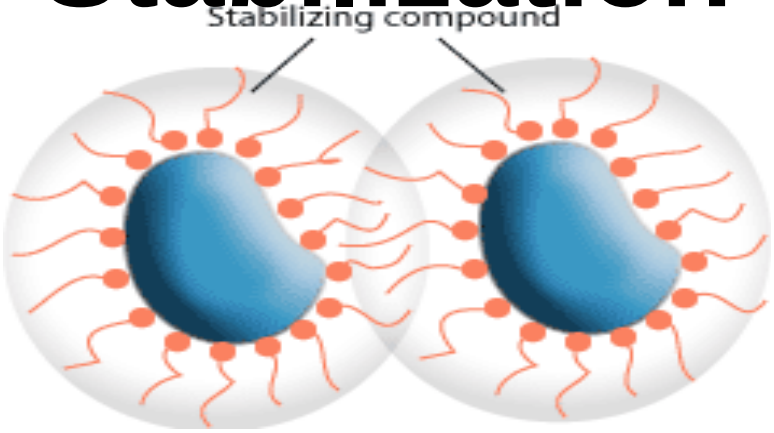
Pigment dispersion:
dispersed particles must be stabilized to prevent flocculation, agglomeration.
Main stabilization mechanism for waterborne systems:



Electrostatic repulsion

- Adsorbed polyelectrolytes
- Stabilization efficiency increases with density of electrical double layer
- Additives used for dispersion in waterborne systems are high molecular weight products containing charged polymeric side chains

Steric or Entropic Stabilization

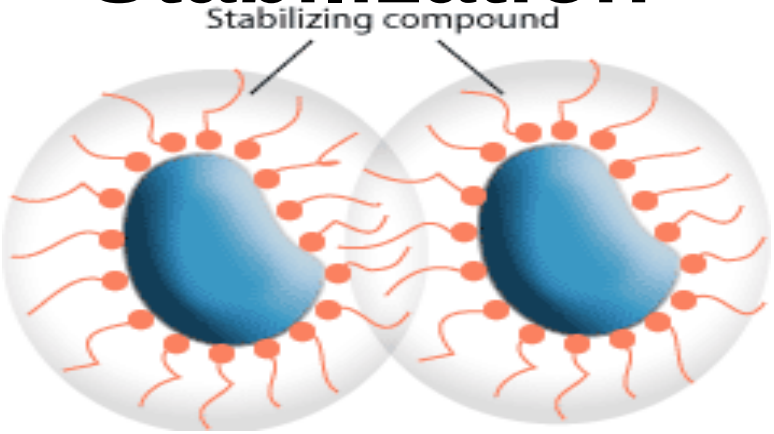


Main stabilization in solvent borne systems

Dispersant Requirements:

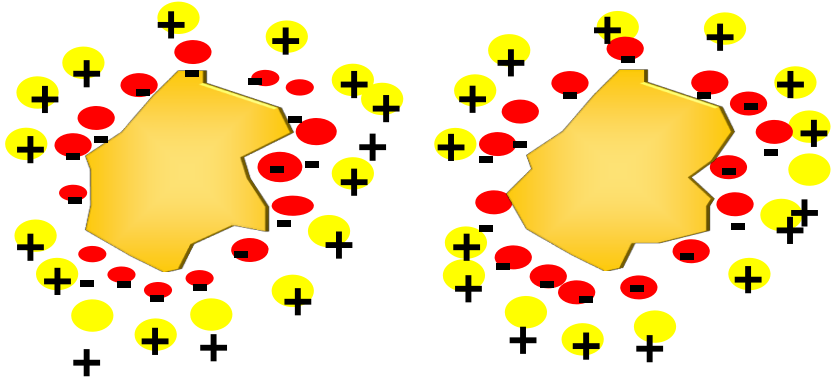
- Contains affinic groups providing strong adsorption on pigment surfaces
- Resin/solvent compatible chains directed into the surrounding vehicle.

Steric or Entropic Stabilization



Main stabilization in solvent systems

Electrostatic Repulsion



Main stabilization in aqueous systems

Dispersant Requirements:

- Contains affinic groups providing strong adsorption on pigment surfaces
- Resin/solvent compatible chains directed into the surrounding vehicle.

Dispersant Requirements

Resin compatibility
Solubility
Pigment dispersion stability
Pigment affinic/anchoring groups
compatible with pigment surface chemistry
No degradation of important film properties
No reduction in application properties

Technology Challenge

A. For waterborne dispersions

a) Wetting hydrophobic pigments, extenders

b) Electrostatical stabilization, for all pigments

c) Additionally: transition to steric stabilization during dry;
the drying film shifts from aqueous to be more organic and hydrophobic due to loss of water and concentration of the resin emulsion particles

Technology Challenge

A. For apolar solvent-borne dispersions
   a) Wetting hydrophobic and hydrophilic pigments fillers, and extenders
   b) Steric – for all pigments, as solvents evaporate causing the system to shrink and particulates to compact, stability must not be compromised by the loss of solvents

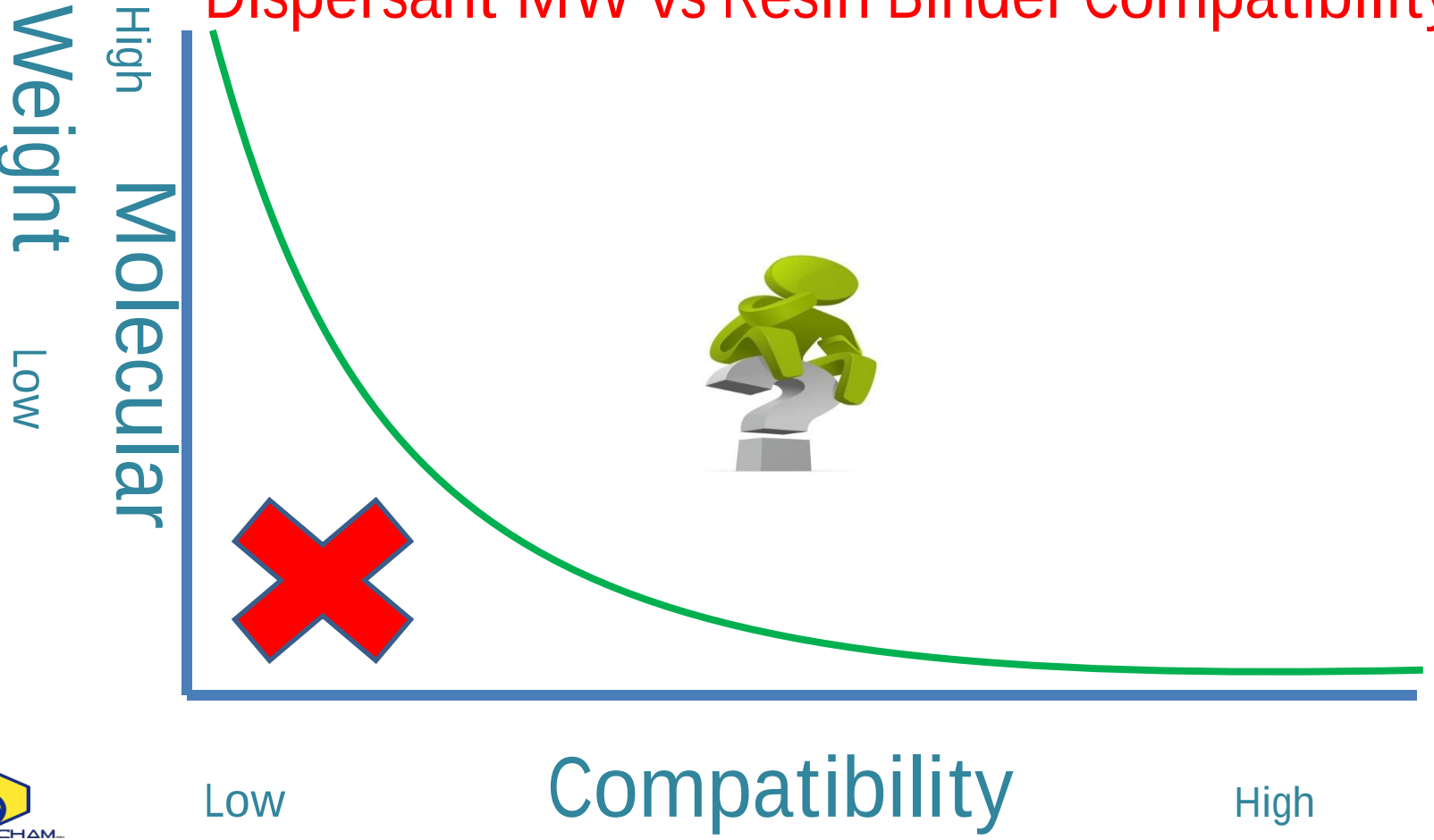
Remarks

Pigment Wetting is a relatively slow process
(Washburn Equation)

Rule 1) the higher the MW of the surfactant, the slower the wetting

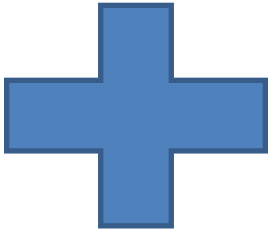
Rule 2) the higher the MW of the dispersant, the stronger the steric stabilization

Dispersant MW vs Resin Binder Compatibility



Patcham New Technology

Dispersion Stability of Higher Molecular Weight Additives



Broad Compatibility of Lower Molecular Weight Additives

H M V

High Molar Volume

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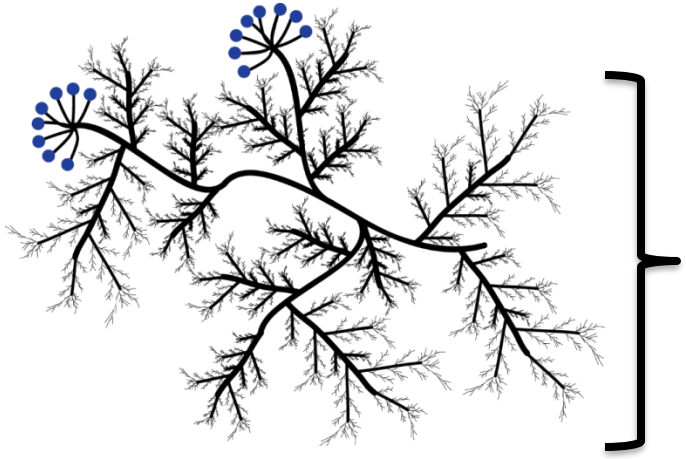
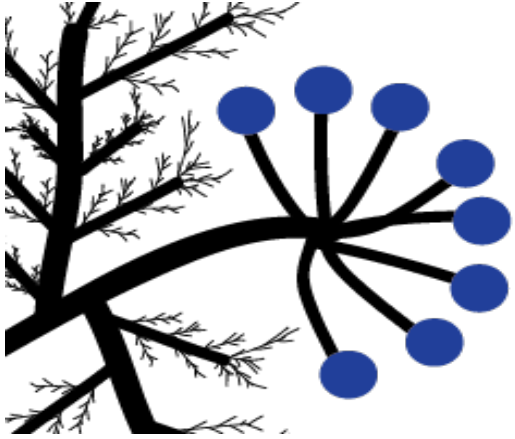
High Molar Volume Technology



Higher volume for a given mass of polymer

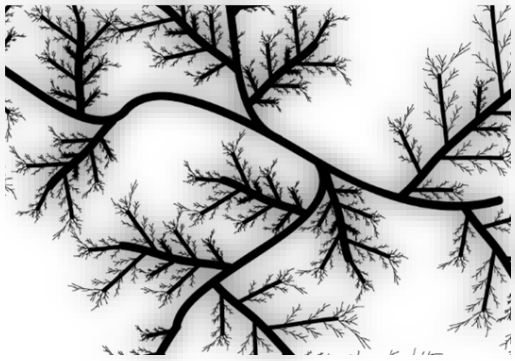
Branched polymeric structures between the pigment particles creates greater steric repulsion

High Molar Volume Technology



Multiple anchoring groups
Faster wetting rate and lower mill base viscosity
Stronger Stabilization

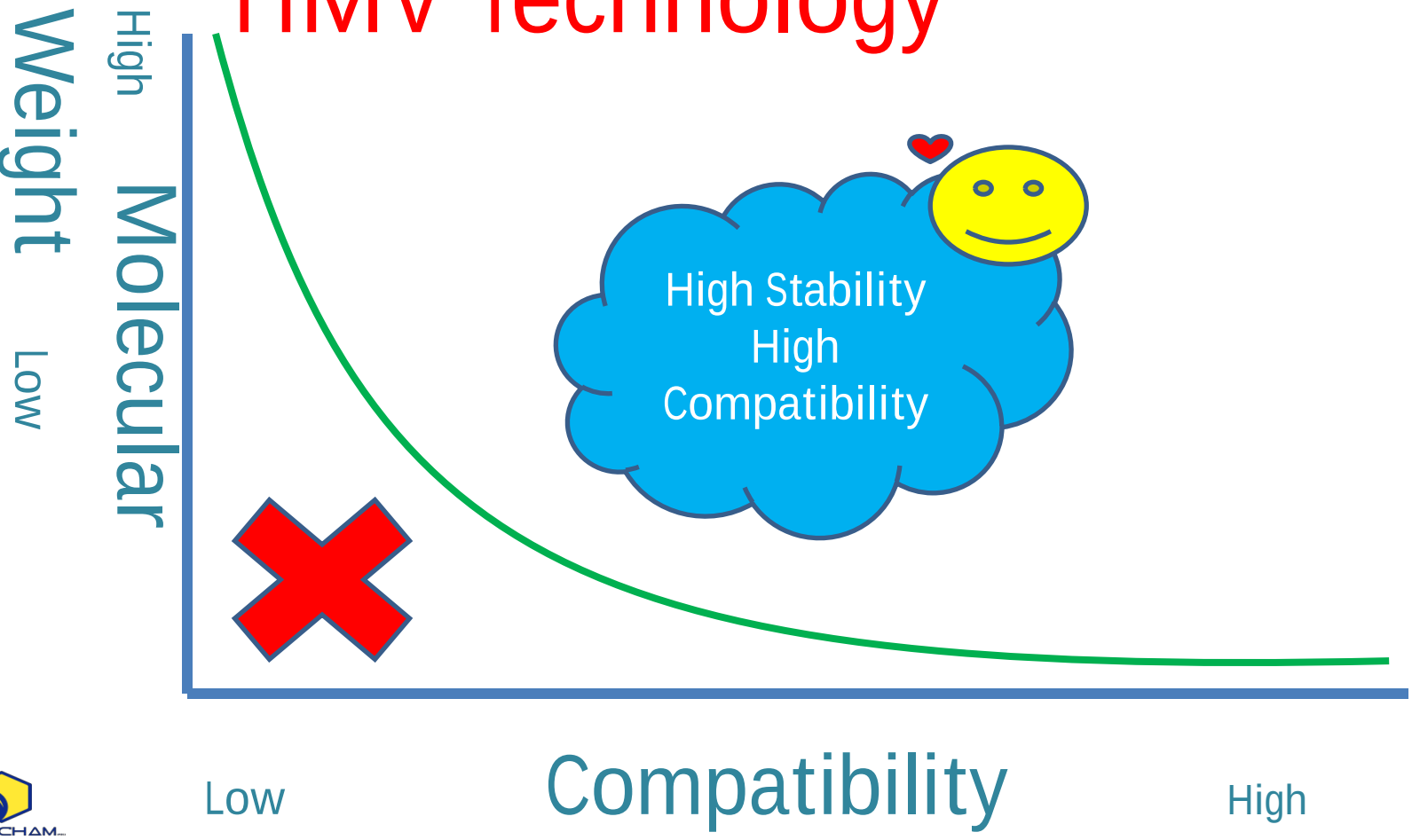
High Molar Volume Technology

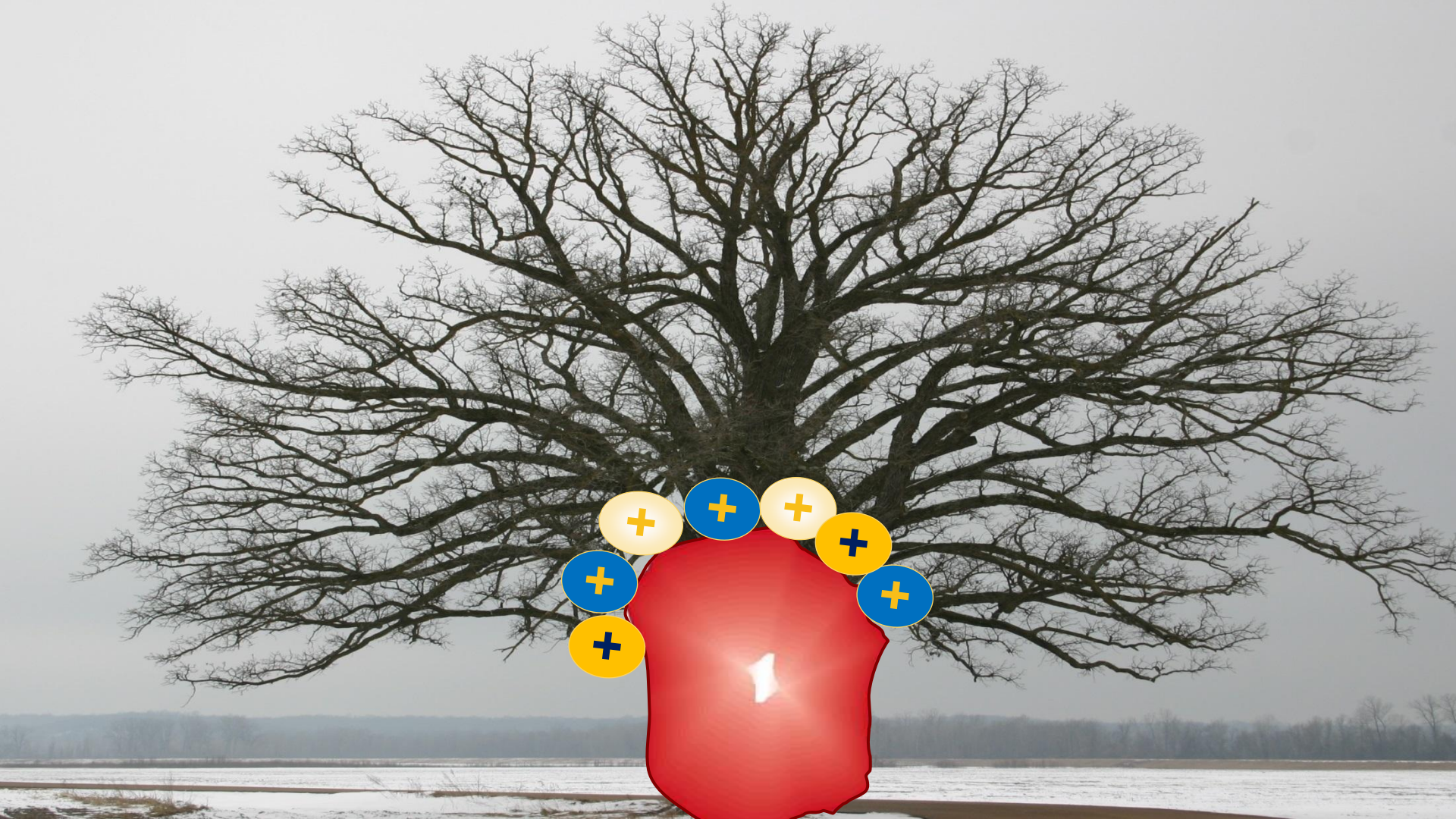


Lower MW Branched Polymeric Segments

Allows it to be used in a wider range of resin systems without incompatibility issues of similar MW linear or unbranched structures

HMV Technology

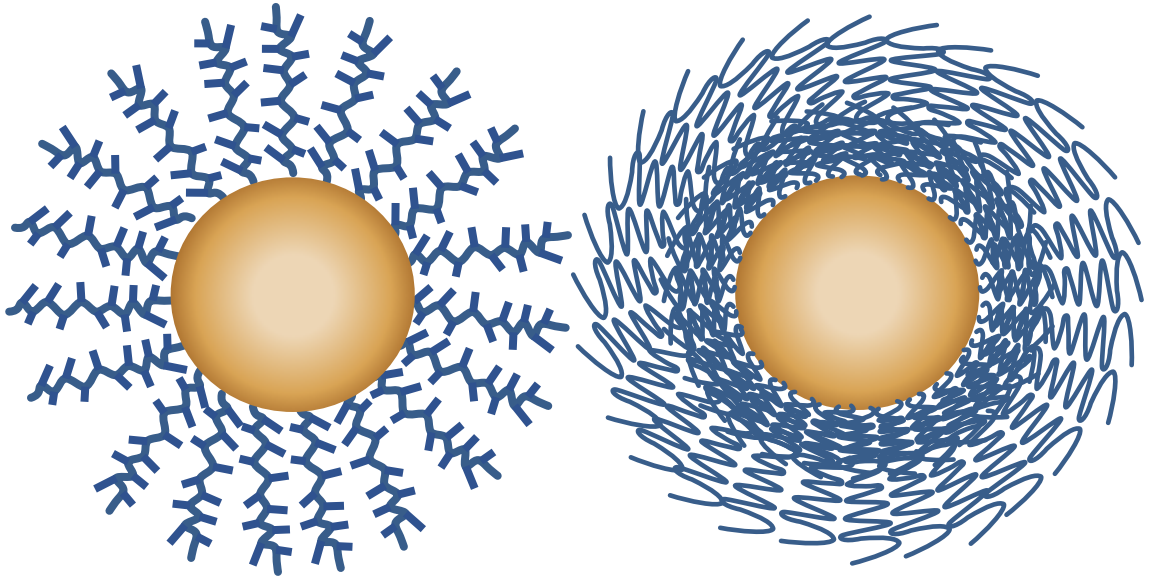




Advantages of HMV Technology

- Faster Wetting/Dispersion > Productivity
- Optimize grinding times, better performance
- Increased stabilization improves stability
- Compatible in wide range of resins and solvents
- Development of resin minimal and resin free pigment concentrates easily achieved

HMV compared to HIA



HMV HIA

Hyper Intermolecular Association

- Concept describing the potential of dispersant polymers for forming multi-layer molecular structures with neighboring components: non-adsorbed dispersant molecules, binders, including solvents
- HIA refers to the capacity of adsorbed dispersant to immobilize neighboring components, thus increasing the thickness of the adsorbed protective layer
- HIA is essential in increasing stabilization efficacy of low molar mass dispersants, as the individual molecule is too small for the formation of a stable protective layer

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Novel HIA Polymeric Dispersant for Solvent borne Systems

Pat-Add DA 3054

Compatible Resin Systems	
Resin Systems	Description
2K PU	Acrylic Polyol
Epoxy	Bisphenol A type cured with Amine or Amide
TPA	Acrylic Resins
Acid Cure	Short Oil Alkyd and UF cured with PTSA
Alkyd-Melamine	Short Oil Alkyd with MMF
Polyester-Melamine	Saturated Polyester with MMF
Universal Grinding Resin	Aldehyde based
Long Oil Alkyd	Vegetable oil and fatty acid based
Medium Oil Alkyd	Vegetable oil and fatty acid based
Short Oil Alkyd	COFA-based
CAB Solution	CAB 381
	CAB 531
	CAB 551

Solubility	
Solvents	
MPA	●
Xylene	●
Toluene	●
MIBK	◍
EEP	●
Acetone	●
Di-Acetone alcohol	●
n-Butyl Acetate	◍
Ethyl glycol acetate	●
IPA	○
N-Butanol	○
Solvesso 100	●
Solvesso 150	●
Oxsol 100	◍
Propylene carbonate	●
MTO	○

Soluble ● Insoluble ○ Partially soluble ◍

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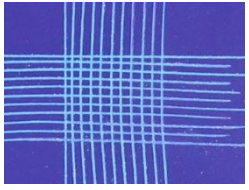
Novel HIA Polymeric Dispersant for Solvent borne Systems

Pat-Add DA 3054

Direct Grinding Systems using PB 15:3			
	SB 2K PU	SB Epoxy	Polyester Melamine
Pigment Loading	4.5%		
%SOP of **New Dispersing Agent**	35%		
Paint Properties			
Fineness of Gauge	7+	7+	7+
Visosity, KU	68	88	63
Gloss @20°	93	99	68
Gloss @60°	95	100	87
Adhesion test	Pass	Pass	Pass
Conical Mandrel Bend test	Pass	Pass	Pass
MIBK Rub (100 rub)	Pass	Pass	Pass
MEK Rub (100 rub)	Pass	Pass	Pass

Adhesion, 2mm crosshatch

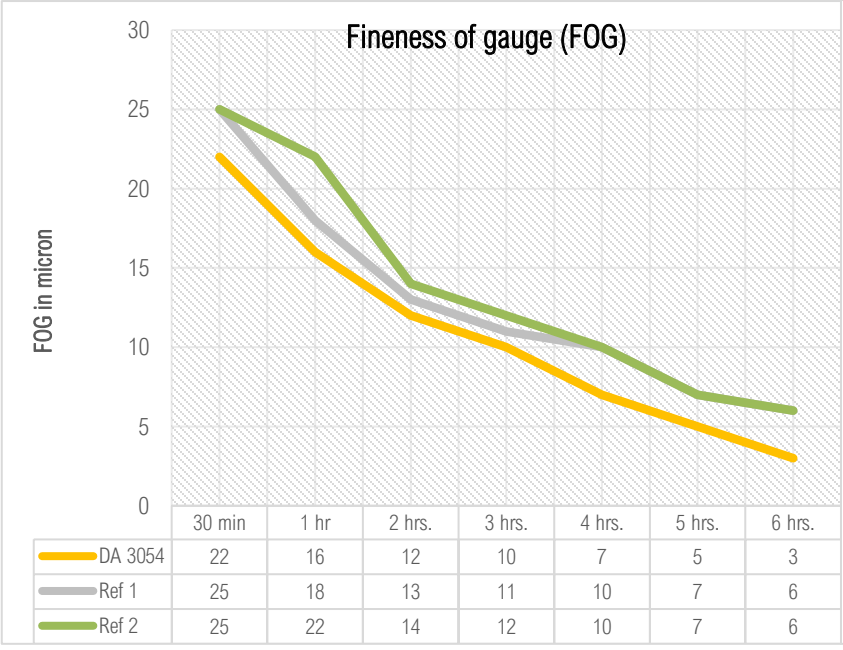


Conical Mandrel Bend test

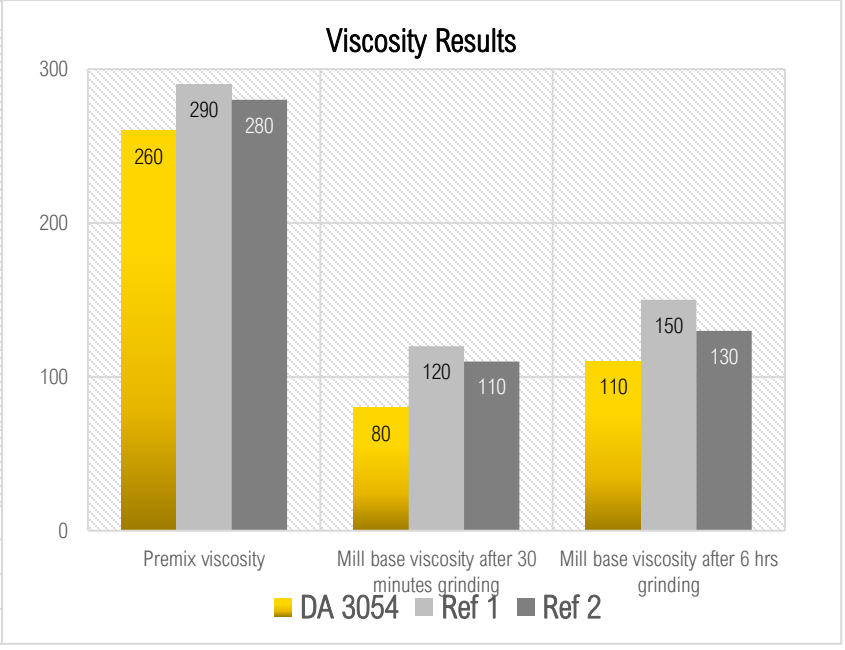
Novel HIA Polymeric Dispersant for Solvent borne Systems

Pat-Add DA 3054

2K PU Topcoat Black



	30 min	1 hr	2 hrs.	3 hrs.	4 hrs.	5 hrs.	6 hrs.
DA 3054	22	16	12	10	7	5	3
Ref 1	25	18	13	11	10	7	6
Ref 2	25	22	14	12	10	7	6

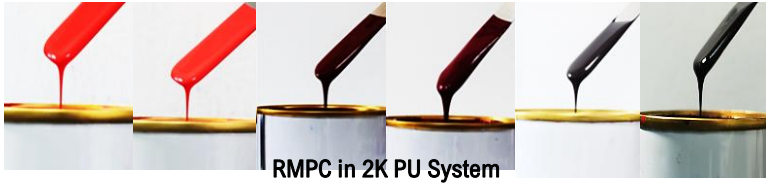


Novel HIA Polymeric Dispersant for Solvent borne Systems

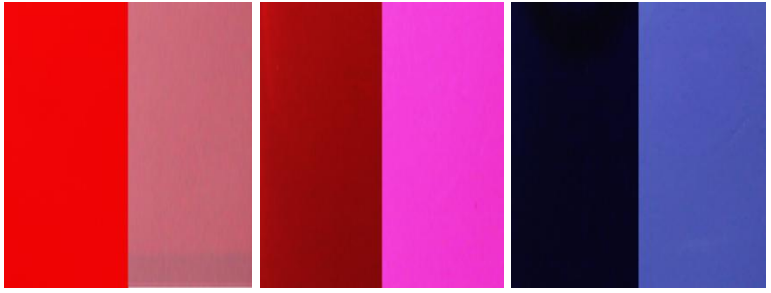
Pat-Add DA 3054

Pigment Concentrates with Organic Pigments

Sudaperm Red 2957		Hostaperm Red E5B02		Hostaperm RL spec	
PR 254		PV 19		PV 23	
Initial	After Stability	Initial	After Stability	Initial	After Stability



RMPC in 2K PU System



	Sudaperm Red 2957		Hostaperm Red E5B02		Hostaperm RL spec	
	PR 254		PV 19		PV 23	
Properties	**Initial**	**After Stability**	**Initial**	**After Stability**	**Initial**	**After Stability**
Viscosity, KU	65	66	66	83	75	77
Masstone						
L*	41.34	41.50	35.78	36.02	27.03	27.30
a*	45.55	45.96	34.45	34.80	2.00	-3.09
b*	25.00	25.68	12.56	12.66	-1.94	-2.60
Gloss @ 20	98	91	92	91	89	84
Gloss @ 60	101	95	95	95	94	92
dE, Rub out Tint Tone	0.54	0.29	0.68	0.43	0.80	0.90

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Latest Dispersant Technology

Opportunities and Applications

Solventborne Systems:
Automotive Coatings
Wood Coatings
Industrial Coatings
Protective and Marine Coatings
Coil Coatings
Inks
SB Pigment Dispersions

Now, Commercially Available Dispersant Technologies for

- Solvent Borne Systems
- Water Borne Systems
- Solvent Free Systems

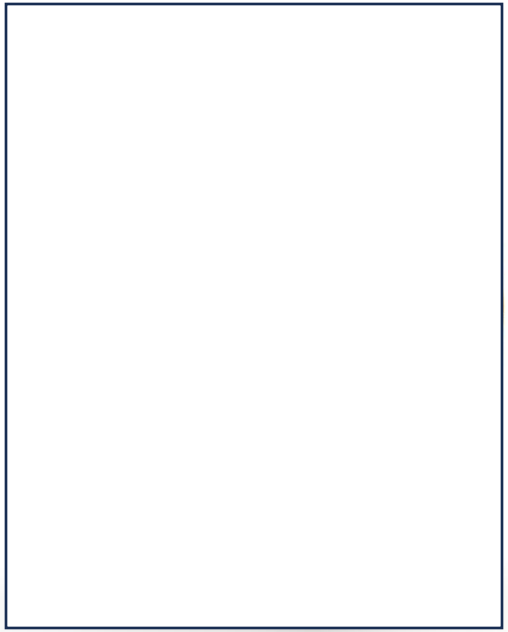
- These technologies can each be used to make a complete Colorant System
- Can be used to make co grinds in traditional paint manufacturing methods
- Can be used with traditional grinding resins

Dispersant Selection

- Determine solubility
- Determine compatibility
- Establish surface chemistry suitability
- Optimize order of addition (laboratory vs production)
- Confirm pigment dispersion stability and compatibility
  - From liquid to solidification following application
- Optimize use level
- Evaluate color stability
- Test film properties

Aknowledgement of Headquarters Development Team

- Bhavesh Patel
- Johan Bieleman



Thank You!

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