

Irganox[®] 1010-DW ECO - Novel Antioxidant Preparation for the Thermal Stabilization of Waterborne Adhesive Formulations

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Agenda



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An introduction to Sterically Hindered Phenol Antioxidants

2

Theory: Why Antioxidants – Mode of Action

3

Chemistry: NEAT Technology

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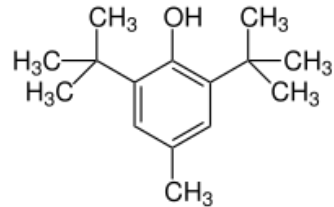
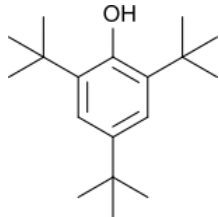
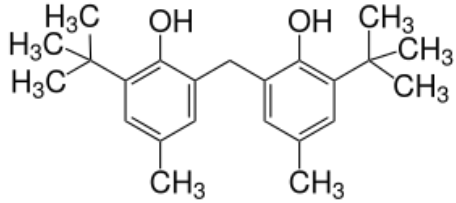
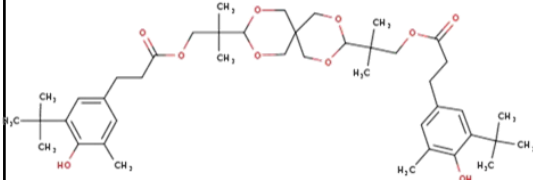
Irganox[®] 1010-DW ECO: Product Highlights

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Summary

The regulatory landscape for antioxidants is evolving

Classical stabilizers used in water-based systems are now facing tremendous regulatory pressure

Butylhydroxytoluene (CAS# 128-37-0) commonly known as BHT has been classified H: 410		
Proposal to place 2,4,6-tri-tert-butylphenol (CAS# 732-26-3) commonly known as 2,4,6 TTPB is toxic for reproduction (Article 57c) persistent, bio accumulative and toxic (PBT) (Article 57d)		
Classification of AO 2246 2,2'-methylenebis-(4-methyl-6-tertiary-butylphenol (CAS# 119-47-1) as SVHC, this stabilizer is now classified Reprotoxic category 1B (H360F)		
AO 80 (CAS# 90498-90-1) this substance is harmful in contact with skin, GHS 07		

About Irganox® 1010

Leading antioxidant with excellent performance



Application:

- All purpose stabilizer for the broadest selection of polymer classes, Including: PO, PB, EVA, polyacetals, PA, PU, polyesters, PVC, styrene homo- and co-polymers, Synthetic and natural rubbers
- Irganox 1010 is recommended for applications such as: SB coatings, adhesives, sealants, elastomers and fiber bonding

Sustainability Highlights:

- Indirect food contact
- Odorless
- Low volatility
- Tin-free
- High extraction resistance

Performance Highlights:

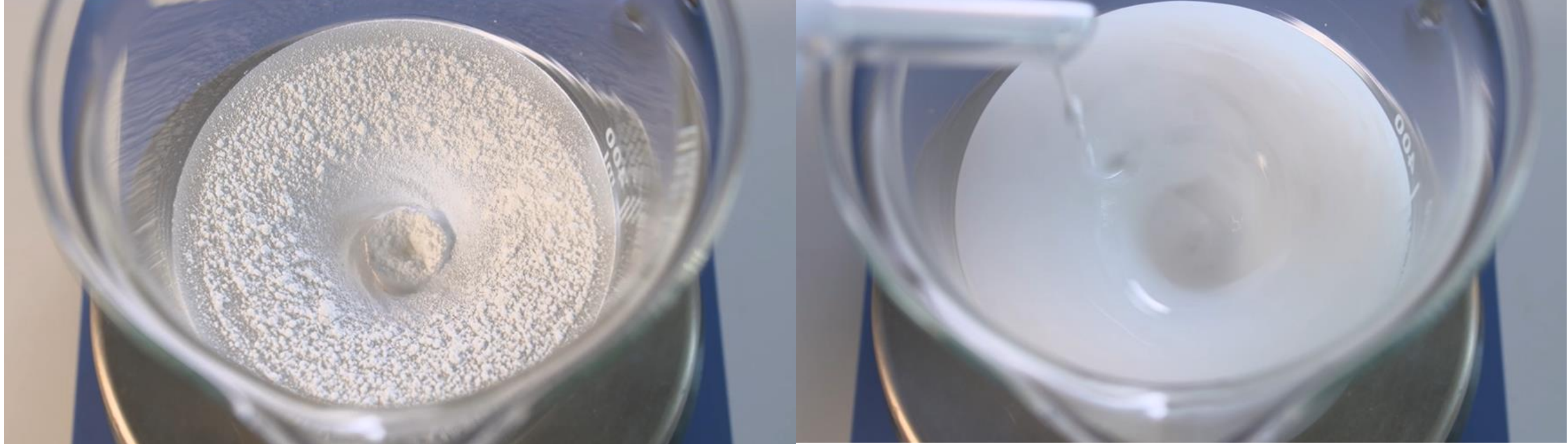
- Excellent retention/stabilization of
 - Viscosity
 - Color
 - Mechanical properties
- Excellent extraction resistance
- Low volatility
- Is made in a tin free process

Characteristic Values:

	Irganox 1010
Appearance:	White powder
Molecular weight	1178 g/mol
Melting range	110-125° C
Bulk Density [g/cm ³]:	530-630 g/l
Vapor pressure at 20° C	7e-10 Pa (extrapolated)

Introducing Irganox® 1010-DW ECO

NEAT – technology makes Irganox 1010 easily dispersible in waterborne adhesive formulations



- In its original form, Irganox 1010 is a relatively coarse powder, which is water insoluble and not easy to disperse (Irganox 1010 DISP)
- Irganox 1010 can be transferred into a stable Dispersion in Water (DW) using Novel Encapsulation Additives Technology (Irganox 1010-DW ECO)
 - ▶ Three ways to evaluate Irganox 1010 in waterborne (WB) adhesive formulations
 - Irganox 1010
 - Irganox 1010 DISP = pre-disperse Irganox 1010 into water with emulsifiers followed by addition to WB adhesive formulation
 - Irganox 1010-DW ECO (AO1 NEAT) = prepare colloidal antioxidant aqueous dispersion followed by addition to WB adhesive formulation

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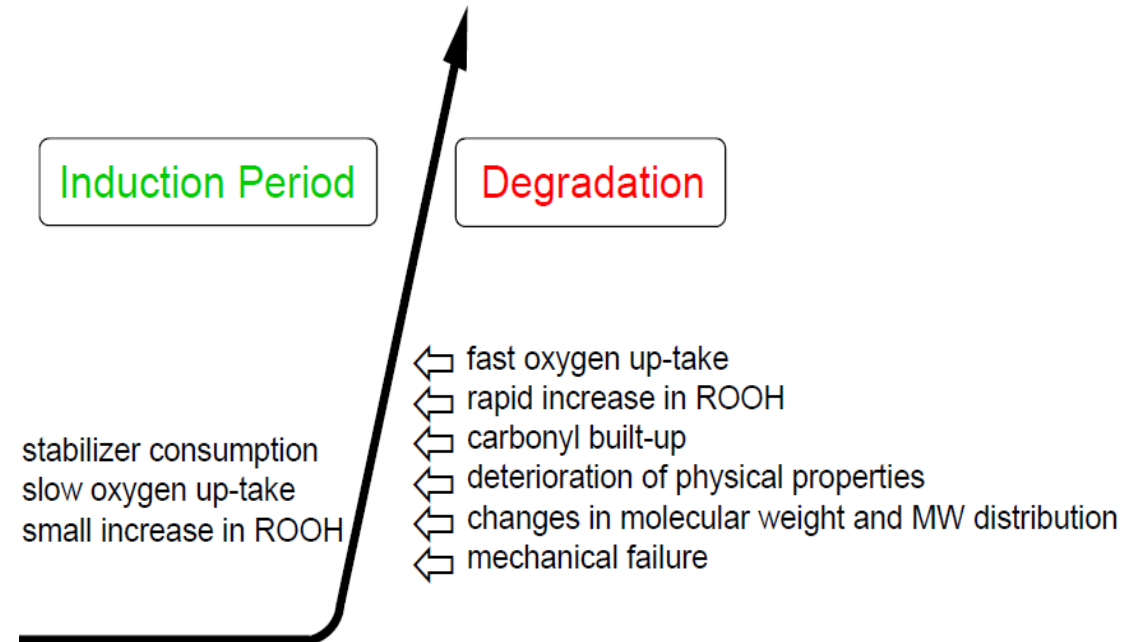
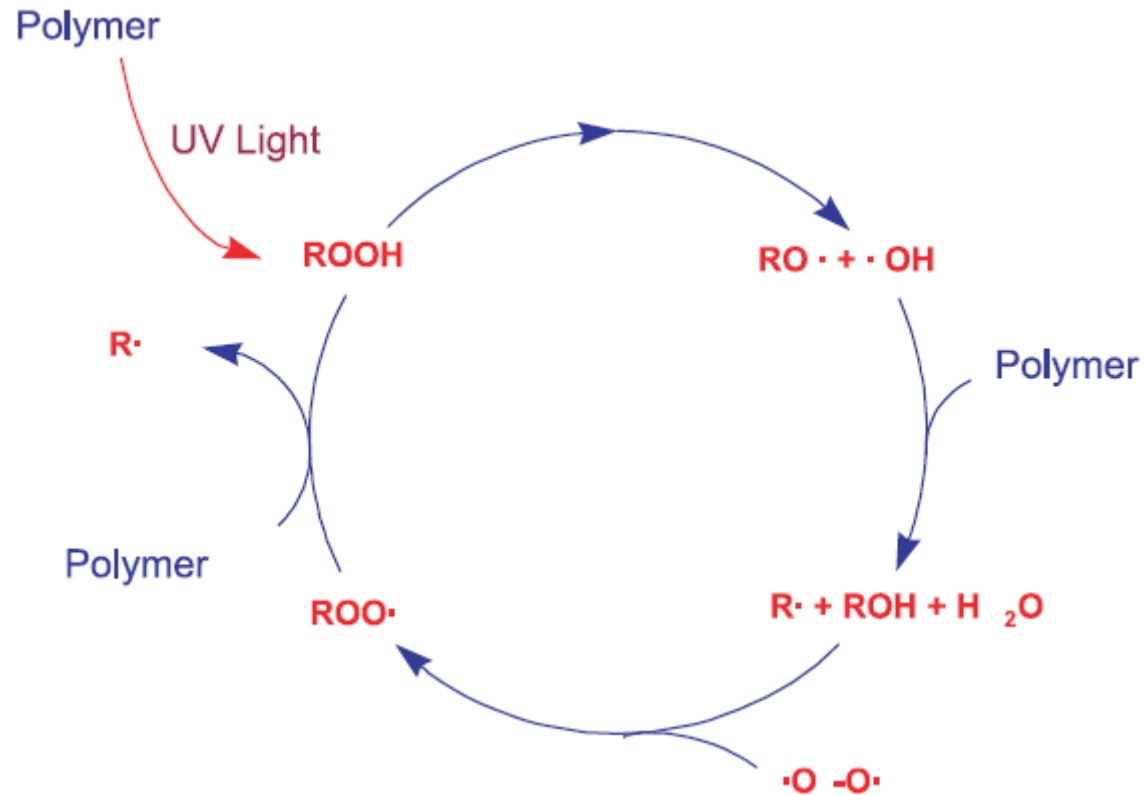
3 Chemistry: NEAT Technology

4 Irganox[®] 1010-DW ECO: Product Highlights

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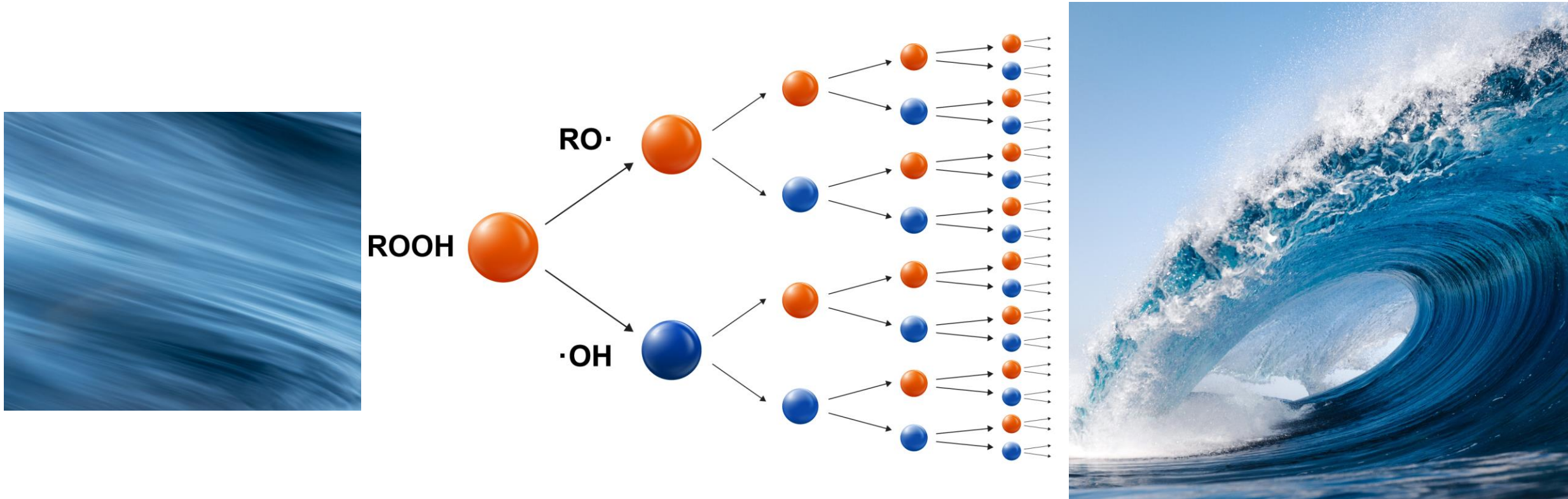
Why Antioxidants? – Mode of Action

Interrupting the radical chain interaction which leads to stabilization



Why Antioxidants – Mode of Action

Autocatalytic process – the best time to intervene is as early as possible



Formation of a reactive species during process caused by: **Heat, catalyst, mechanical shearing**

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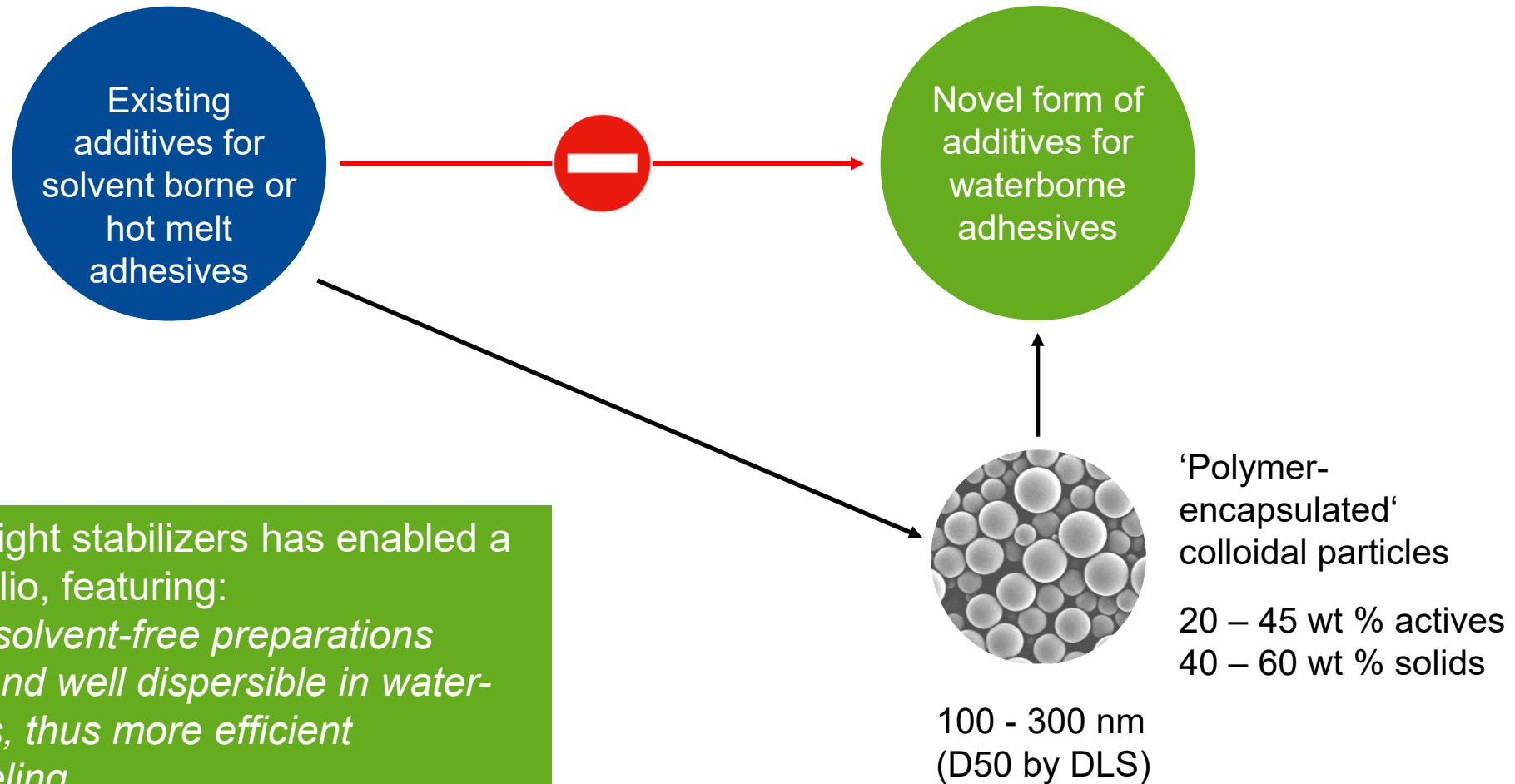
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How can hydrophobic antioxidants become dispersible in water?

With NEAT (Novel Encapsulation of Additive Technology) to ensure water-compatibility



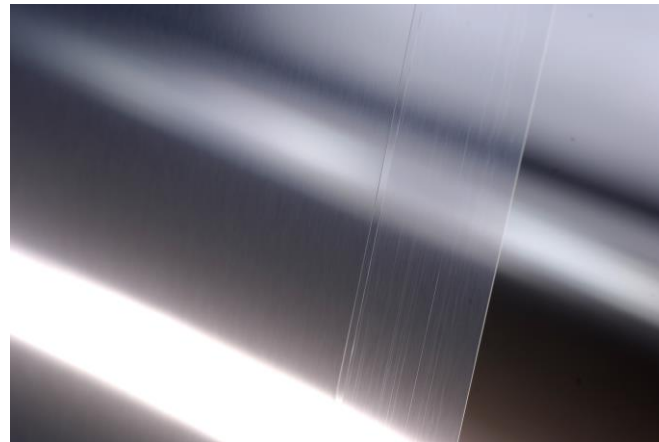
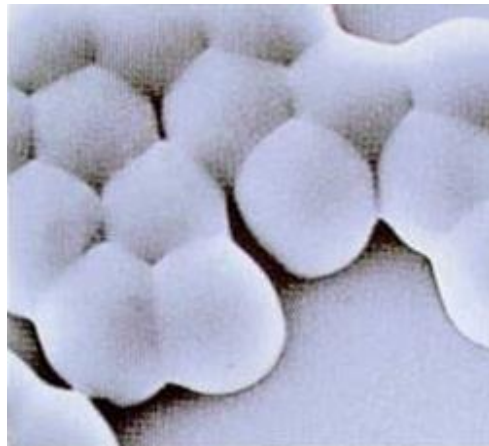
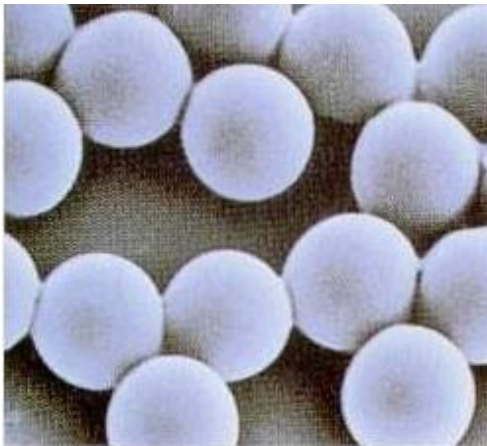
NEAT applied to light stabilizers has enabled a waterborne portfolio, featuring:

- *Low viscosity, solvent-free preparations*
- *Easy dosage and well dispersible in water-based systems, thus more efficient*
- *No severe labeling*

Characteristics of Irganox® 1010-DW ECO

Irganox 1010-DW ECO is easy to use

- Can be mixed with any other dispersion in a simple stir-in step
- Very mild agitation will result in a perfectly homogeneous mixture
- No high-speed dispersion necessary avoiding foam formation
- The antioxidant is dissolved & encapsulated in the individual polymer particle
- Film formation is opening the capsule and thus releasing the stabilizer
- Distributes homogenously throughout the film, resulting in a clear adhesive layer



NEAT process – applicable for antioxidants

NEAT process makes hydrophobic antioxidants easily dispersible in waterborne formulations

► Performance Highlights

- ❑ Excellent compatibility
- ❑ Easy to use
- ❑ Long-term durability

► Sustainability Highlights

- ❑ Free from hazard labeling
- ❑ VOC-free
- ❑ Tin-free



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The challenge

- Solve the conflict between water resistance and water compatibility
- As water solubility is increased, water resistance is decreased
- Superior extraction resistance (the ability to withstand leaching/removal in water)
- This is particularly important in roof coatings and sealants because they are constantly exposed to harsh weather conditions, including rain, snow, and UV radiation



...the solution

Irganox® 1010-DW ECO: Power Up your water-based formulations with a leading antioxidant...

...now enhanced with encapsulation technology

Performance Highlights

- Water-solubility during application
- Superior extraction resistance vs. wash water
- Excellence thermal stabilization

Sustainability Highlights

- Label-free
- Tin-free
- Solvent-free



Irganox® 1010-DW ECO

Power Up your water-based formulations with the leading AO, enhanced with encapsulation technology



Application:

- Next generation antioxidant for water-based adhesives and coatings
- All purpose stabilizer for a variety of polymer classes
- Original properties of the polymer are maintained
- Can be combined with other type of WB stabilizers e.g. hindered amine light stabilizers

Sustainability Highlights:

- Enables water-based technology
- Indirect food contact
- Label-free / Tin-free
- Low volatility
- High extraction resistance

Performance Highlights:

- Easy stir in water-based formulations
- Excellent stabilization of:
 - Viscosity
 - Color
 - Mechanical Properties
- Excellent extraction resistance also against continuous water wash



Characteristic Values:

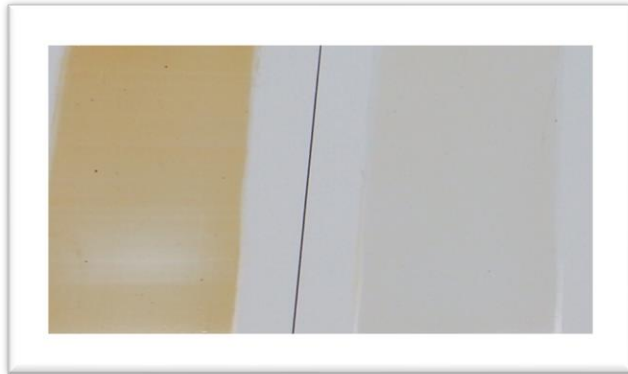
	Irganox 1010-DW ECO
Appearance:	White, liquid dispersion
Active ingredients [%]:	~ 20 %
Solid content [%]:	~ 40 %
Density at 23° C (73° F) [g/cm³]:	~ 1.05
Viscosity at 23° C dynamic	~ 50 mPas



Why Irganox® 1010 needs the NEAT process?

Irganox 1010 without NEAT process is incompatible with water-based dispersions

WB Adhesive 1 Irganox 1010-DW ECO



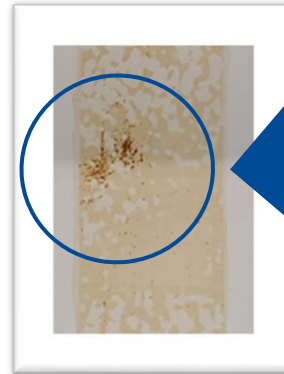
12 hr / 177°C

WB Adhesive 2 Irganox 1010-DW ECO



24 hr / 177°C

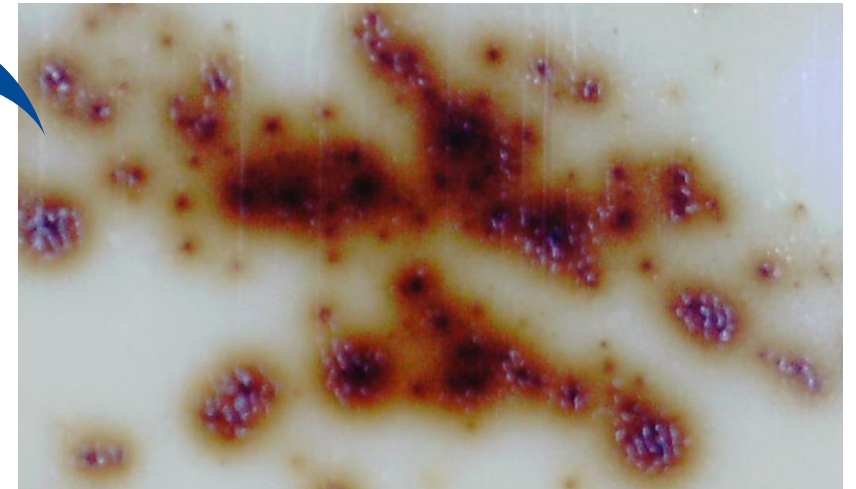
Irganox 1010 DISP



Irganox 1010 DISP



Stabilization of WB Adhesive 1 and WB Adhesive 2 with 1 wt% Irganox 1010-DW ECO vs. 1 wt% Irganox 1010 DISP



Individual Irganox 1010 particles can be observed under polarized light

Magnification: 3X

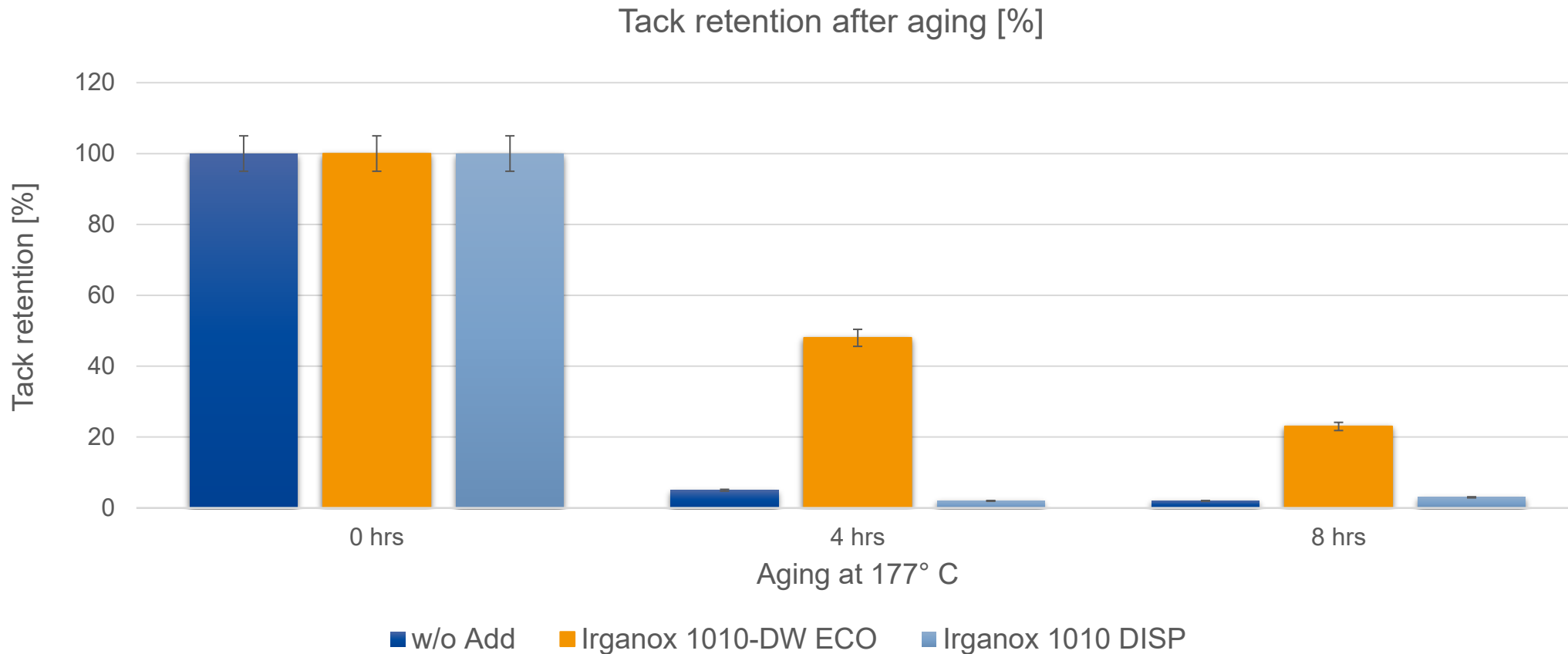
- Violet is crystalline phase
- Brown is amorphous phase

WB Adhesive 1 = Acrylate copolymer dispersion
WB Adhesive 2 = Styrene-Butadiene copolymer dispersion

Irganox® 1010-DW ECO – Adhesion

Only Irganox 1010-DW ECO is stabilizing and retaining adhesion values, leading to longer service life

Development of adhesion values WB Adhesive 1 aged hrs / 177° C

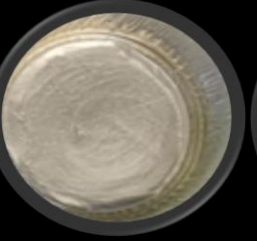
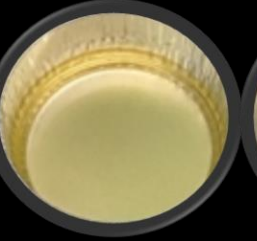
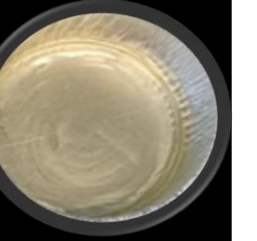
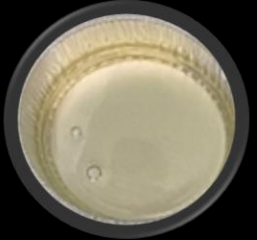
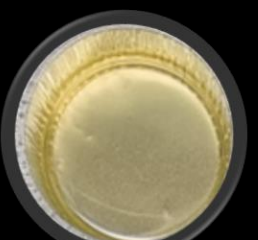


WB Adhesive 1 = Acrylate copolymer dispersion



Irganox[®] 1010-DW ECO – Yellowing

Irganox 1010-DW ECO can be used in a variety of Polyurethane Dispersions (PUDs) to reduce thermally induced yellowing

	0 week / RT		1 week / 120° C		2 weeks / 120° C		3 weeks / 120° C	
PUD 1	 No AO	 AO1 NEAT						
PUD 2	 No AO	 AO1 NEAT						
PUD 3	 No AO	 AO1 NEAT						

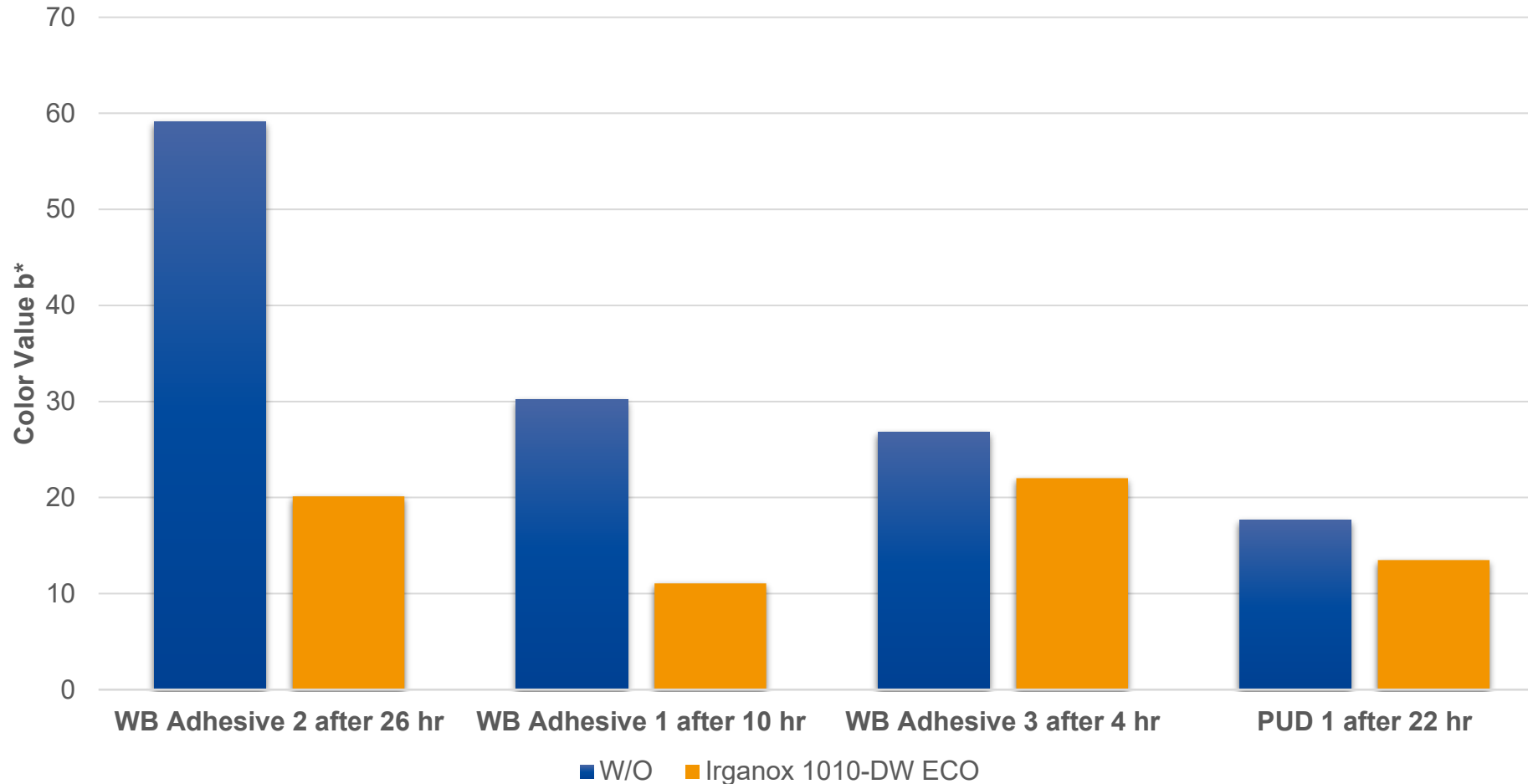
Irganox 1010-DW ECO (AO1 NEAT)
used at 1wt% s/s

PUD 1 = Aqueous dispersion of a polyester-polyurethane elastomer
PUD 2 = Aqueous dispersion of a polyester-polyurethane elastomer
PUD 3 = Aqueous dispersion of an aliphatic polyester-polyurethane

Irganox® 1010-DW ECO – Color values after aging

Irganox 1010-DW ECO has broad application fields across polymer classes, exceeding Irganox 1010

b* values after thermal aging



WB Adhesive 1 = Acrylate copolymer dispersion

WB Adhesive 2 = Styrene-Butadiene copolymer dispersion

WB Adhesive 3 = Styrene-Butadiene copolymer dispersion

PUD 1 = Aqueous dispersion of a polyester-polyurethane elastomer



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Irganox® 1010-DW ECO - Summary

Water-based adhesive formulations using leading antioxidant can now be enhanced with encapsulation technology

Performance Improvement Highlights

- Less thermally induced yellowing in following water adhesive classes:
 - ✓ Polyurethane dispersions
 - ✓ Styrene-Butadiene dispersions
 - ✓ Acrylate copolymer dispersions
- Superior extraction resistance vs. wash water
- Excellence in thermal stabilization
- Retention of adhesion values after thermal aging



Thank you for your attention!

Are there any questions?



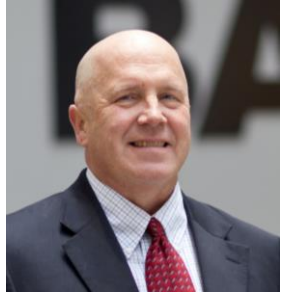
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