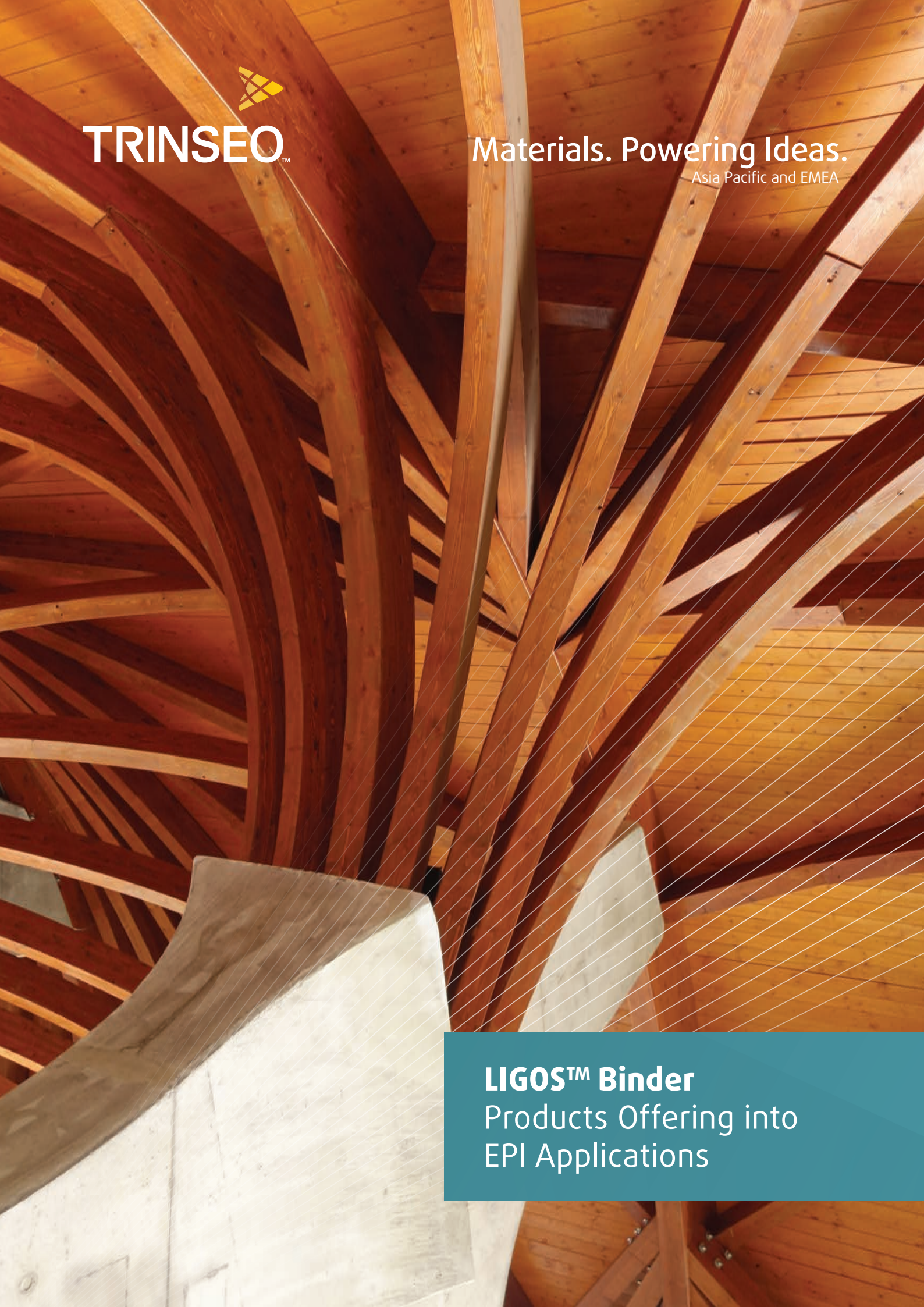

TRINSEO™

Materials. Powering Ideas.

Asia Pacific and EMEA

LIGOS™ Binder
Products Offering into EPI Applications

Trinseo LIGOS™ Binders
Product Offering into EPI Applications

Introduction

Emulsion Polymer Isocyanate (EPI) adhesives formulated with Styrene/Butadiene (SB) latex provide high performance, formaldehyde free adhesive for the lamination of high quality wood, which cures at room temperature. Such a system is particularly useful in humid and/or wet environments. EPI's are typically used as wood adhesives in those areas where the specific performance advantage of room temperature cure in humid and/or wet environments are beneficial.

SB Latex provides only a portion of the overall performance of the system. It is used in combination with polyvinyl alcohol (PVOH), polymeric isocyanates and other minor additives. SB latex improves high temperature adhesive creep resistance and water resistance. SB latex products are in direct competition from vinyl acetate-ethylene copolymer latex (VAE). In those cases where water resistance is required, SB latexes outperform their VAE counterparts.

Trinseo provides three products for EPI adhesive systems: LIGOS™ A3003, LIGOS™ A3620 and LIGOS™ A3014. These products are made globally in several manufacturing locations. LIGOS™ A3003 and LIGOS™ A3620 both show superior wet adhesion strength and all three latex binders provide acceptable dry adhesion performance.

Table 1: Product Overview

Grade	Polymer Type	Tg (°C)	Solids	PH
LIGOS™ A3003	Functionalized SB	10	50.5	6.5
LIGOS™ A3620	Functionalized SB	9	50.0	6.0
LIGOS™ A3014	SB	6	46.0	10.0

EPI Formulation

A representative formulation is provided in Table 2. EPI is a two component adhesive system. Component A contains an emulsion formulation which is reactive at room temperature with Component B, a polymeric diisocyanate such as methylene diphenyl diisocyanate (Huntsman/Bayer polymeric MDI).

The emulsion formulation of Component A has been adapted by Trinseo to fit SB latexes developed for this application. Toluene is often used in traditional EPI formulations to assist with regulation of pot life. The formulation in Table 2 reflects the work by Trinseo to remove the solvent and minimize surfactants while still providing acceptable pot life. Surfactants/ dispersants can be added in one step or multiple steps to assist with dispersing or stabilizing of Component A elements.

Care should always be taken when handling isocyanates. As with all isocyanates, polymeric MDI can behave as an allergen and sensitizer. Always use the appropriate engineering control and personal protective equipment (PPE) as prescribed by the material supplier when handling any isocyanate.

Table 2: Representative Formulation

Component A	Range (pts)
Water	5-15
Dispersant	0.1-0.5
Filler ($CaCO_3$)	20-30
SB Latex	20-30
PVOH (solution)	30-40
Defoamer	0.1-0.5
Preservative	0.1-0.5
Total	**100**

Component B	Range (pts)
Polymeric MDI	15*

*15 pts based on 100 pts Component A

Performance Tests

There are several critical performance tests for an EPI wood adhesive. These include:

Lap Shear Tests

- ***Dry Adhesion:*** measured after the adhesive is used to marry two overlapping wooden items of known geometry. Adhesion is generated by using a constant marriage force for a brief time followed by room temperature cure (overnight for early strength, 3 days for full cure). The wooden article is then pulled using appropriate equipment (for example: an Instron) to measure the shear force necessary to break the adhesive bond.
- ***Wet Adhesion:*** similar to the dry strength test with the added step that after cure the article is soaked in room temperature tap water overnight and tested wet.
- ***Boiling Water Adhesion:*** similar to the dry strength test with the added steps that after cure the article is submerged in boiling water for 4 hours, then soaked in 60°C water overnight and submerged in boiling water again for an additional 4 hours, run under cold tap water for 1 hour and tested wet.
- ***Hot Adhesion:*** similar to the dry strength test with the added limitation that the Instron pull is done in a thermal chamber at an elevated temperature.

Thermal Creep Resistance Tests

- Dynamic Mechanical Analysis (DMA) Creep Test. Using a dynamic mechanical spectrometer (DMS), a cured film of the full adhesive system is placed under 0.02MPa of stress at either 100°C or 230°C for 5 minutes and then allowed to recover for 5 minutes. Lower strain (displacement) during the initial stress period and a recover closer to the original unstrained position is considered good. This test is done as a proxy for creep under thermal stress.

Formulation Stability

- ***Shelf Life Stability:*** Component A, (the PVOH/Latex/Additives elements) must have adequate stability to be formulated and shipped to work site locations. The full Component A formulation is combined, but no Component B isocyanate is added. Viscosity is measured every 12 or 24 hours over a 2-day period. There should be minimal viscosity build during the 2 days - no more than 10-20%.
- ***Pot Life:*** The full formulation (Component A and Component B) must have sufficient open time to allow for its use before cure. For the full formulation, viscosity is measured every 15 or 30 minutes for around 2.5 hours. Viscosity will build but in a moderate and controlled manner with minimal or no foaming.

Trinseo's LIGOS™ A3003, LIGOS™ A3620 and LIGOS™ A3014 have been tailored to provide the benefits of an SB latex and minimize any adverse impact on stability.

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