

*ENGINEERED FILLERS/EXTENDERS
FOR WOOD COMPOSITES: EXTEND
AND ENHANCE PHENOLIC AND PMDI
ADHESIVES*



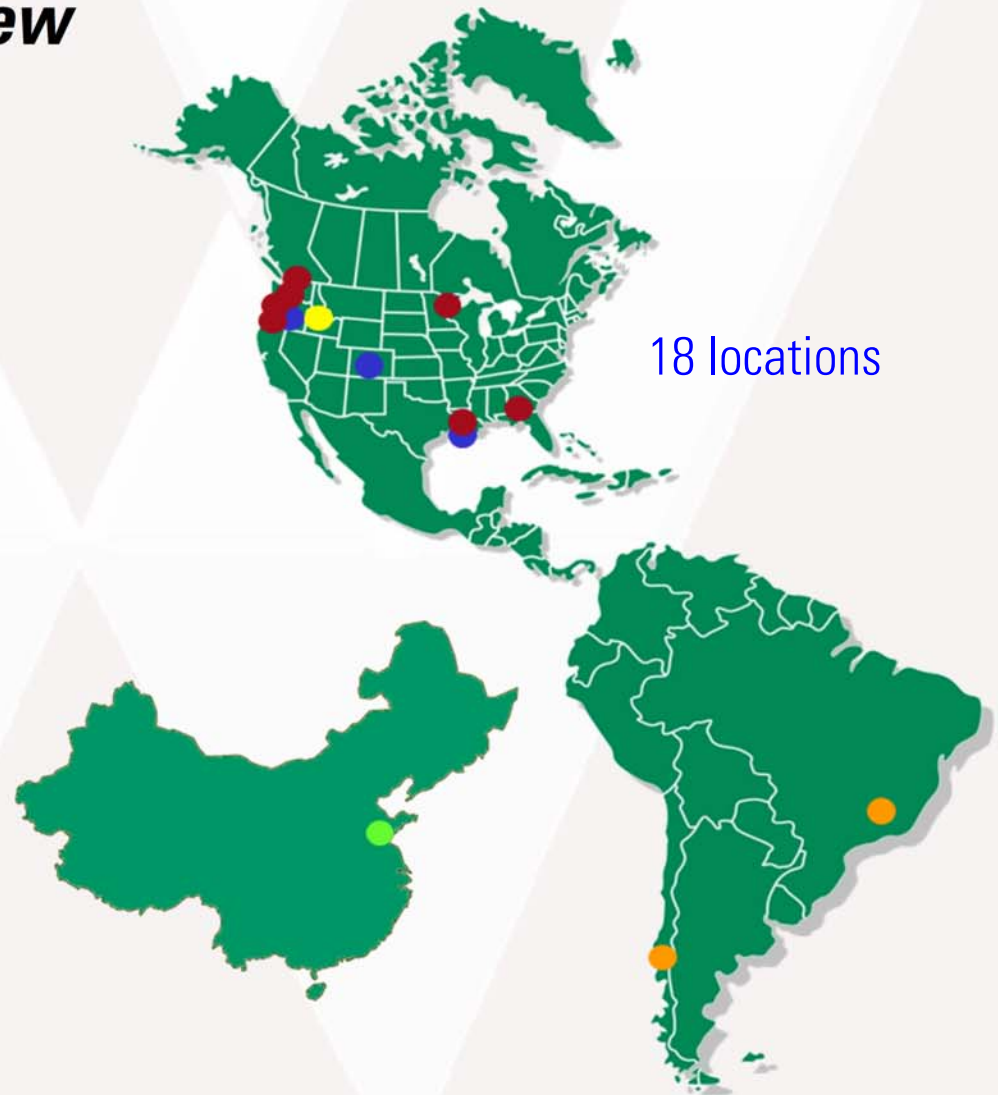
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*PELICE 2016, Atlanta, GA
Date: April 7 2016*

Company Overview

- Founded in 1952
- Privately owned multinational
- Markets served:
 - Wood Products Industry
 - Railroad (SpikeFast®)
 - Specialty Coatings (PolyQuick®)
 - Equipment & Robotics (PreTec)
 - Do-It-Yourself products (Eclectic Products)
 - Industrial Adhesives





Our Core Technology Competencies

Wood Products Industry

Fillers and Extenders

North America over 80% of the Fillers/Extender business

Modal®

CCR

Walnut Shell

Wheat flour

Q-bond®

Patch for Plywood Repair

Water-based Putty

Polyurethane

Epoxy

Edge-sealers and primers

Sealers and Paints for OSB, particleboard and plywood

Railroad Industry

Wood Tie Plugging

Non-foaming Polyurethane

SpikeFast®

ES-50

High Performance Coating

to coat/seal/waterproof concrete, wood or metal.

Polyurea coatings

PolyQuick® P – 480

PolyQuick® P – 690

Erosion/Dust Control

Soil stabilization/fugitive dust control

Hydrobind, DustPly Plus®

PreTec

Precision metering and dispensing equipment

Robotics, automation, sensors

Eclectic Products

Do-it-yourself products

E6000®

Goop®

Famowood®

Analytical Capabilities in WVCo R&D

Extensive wood and polymer science background



FTIR; chemical analysis

Spectroscopy

Formulation

Rheology



Flow behavior,
cure analysis,
gel time

Product
Development

Mechanical
Testing

Thermal
Analysis



Cure analysis, polymer viscoelasticity &
structure-property analysis

Instron® Universal Tester
MTS Hydraulic dynamic tester

Panel
Manufacture

Fillers and Extenders in Wood Composites

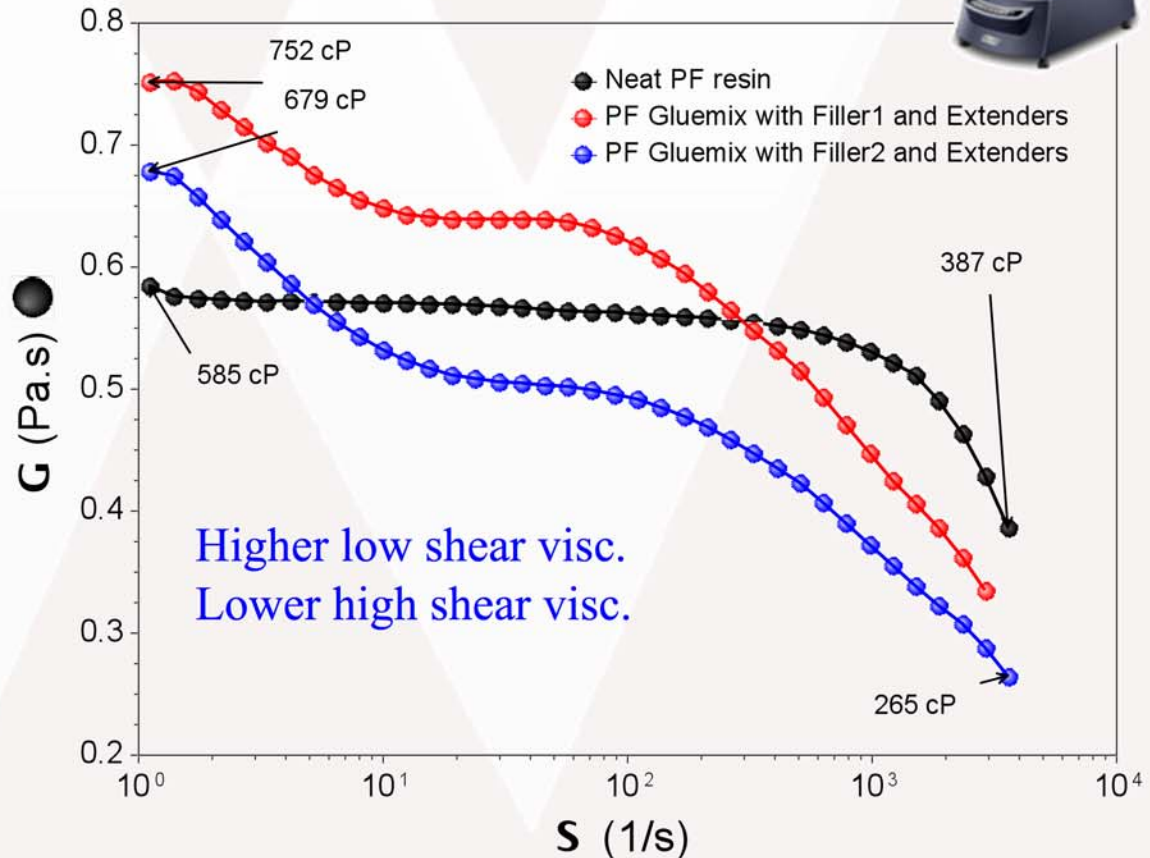
How do Fillers-extenders enhance glue efficiency?



1. Enhancing flow behavior (rheology)
2. Improved distribution

Benefits of fillers/extendors

- Improve glue-mix distribution
- Reduce over penetration
- Improve tack
- Improves glue-mix stability
- Overall resin reduction





Present and Future of Fillers/Extenders

Present:

Conventional fillers/extenders can provide performance.
Decades long data and experience in conventional applications

Future:

- Engineered fillers/extenders which can provide specific rheology required for specific customer needs.
- Extending the technology beyond phenolic adhesive chemistry
 - Understanding physical and chemical properties of individual components and their contribution in glue properties.
 - Engineered filler blend formulation for required glue-mix performance.
 - Process improvement to produce products in tight spec range.

REZ-FLEX



(patent pending)

Engineered pMDI Additive
for wood composites



Engineered pMDI Additive

REZ-FLEX
(patent pending)

REZ-FLEXTM

*Proven
Success-15-30%
pMDI reductions*



What is the REZ-FLEX System?

Two main parts

1. Chemical: REZ-FLEX suspension

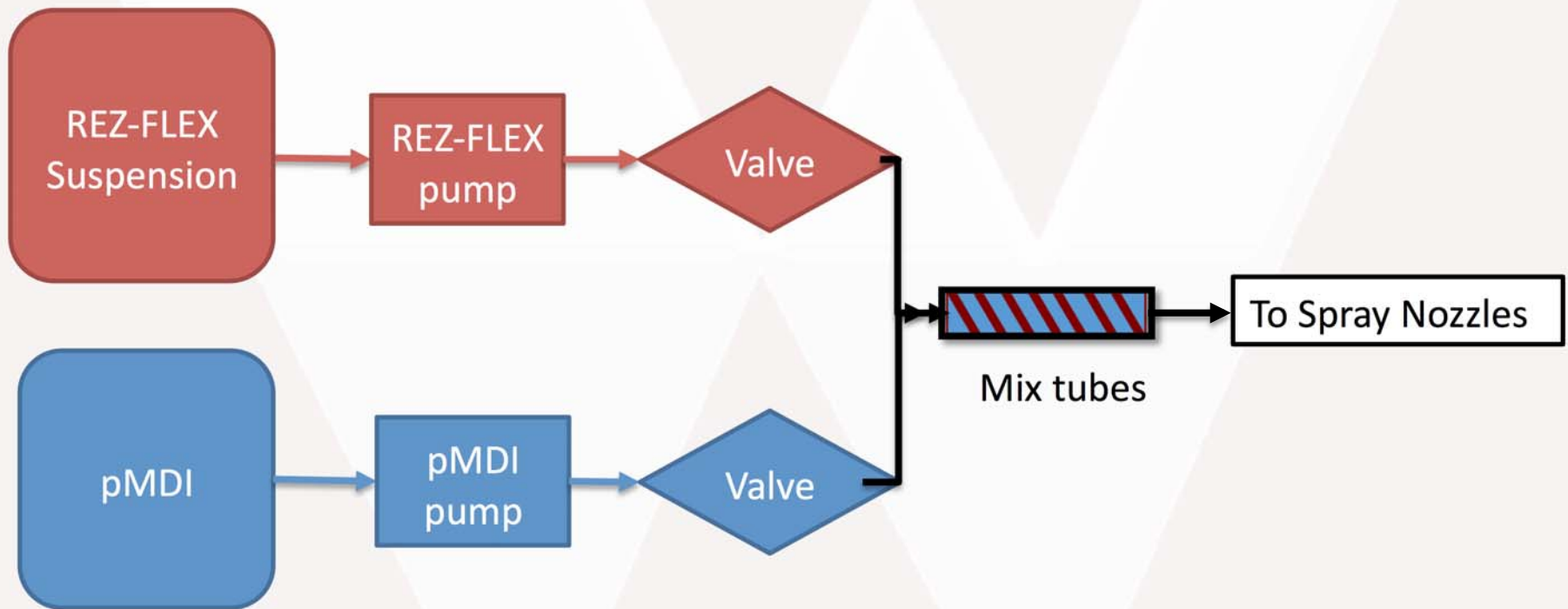
- water + interactive engineered extender



2. Equipment: metering and mixing

- a) Accurately mixes pMDI and REZ-FLEX seconds before application
- b) Accurately follows wood flow rates to apply constant %pMDI

Schematic representation of REZ-FLEX application



The system is precisely operated by a computerized control panel



Engineered pMDI Additive

REZ-FLEX

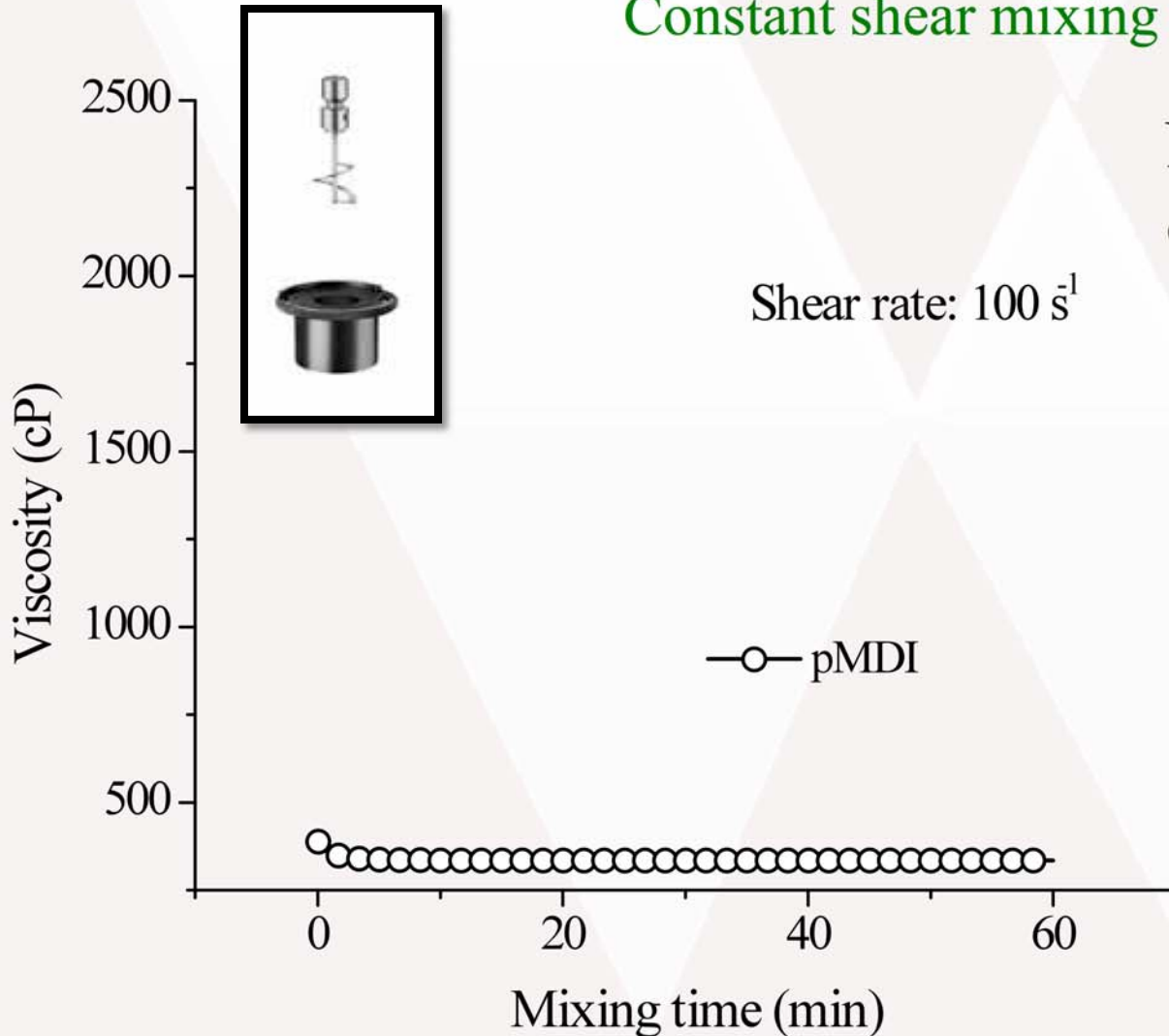
(patent pending)

REZ-FLEX/pMDI Rheology

Constant shear mixing at 77 °F

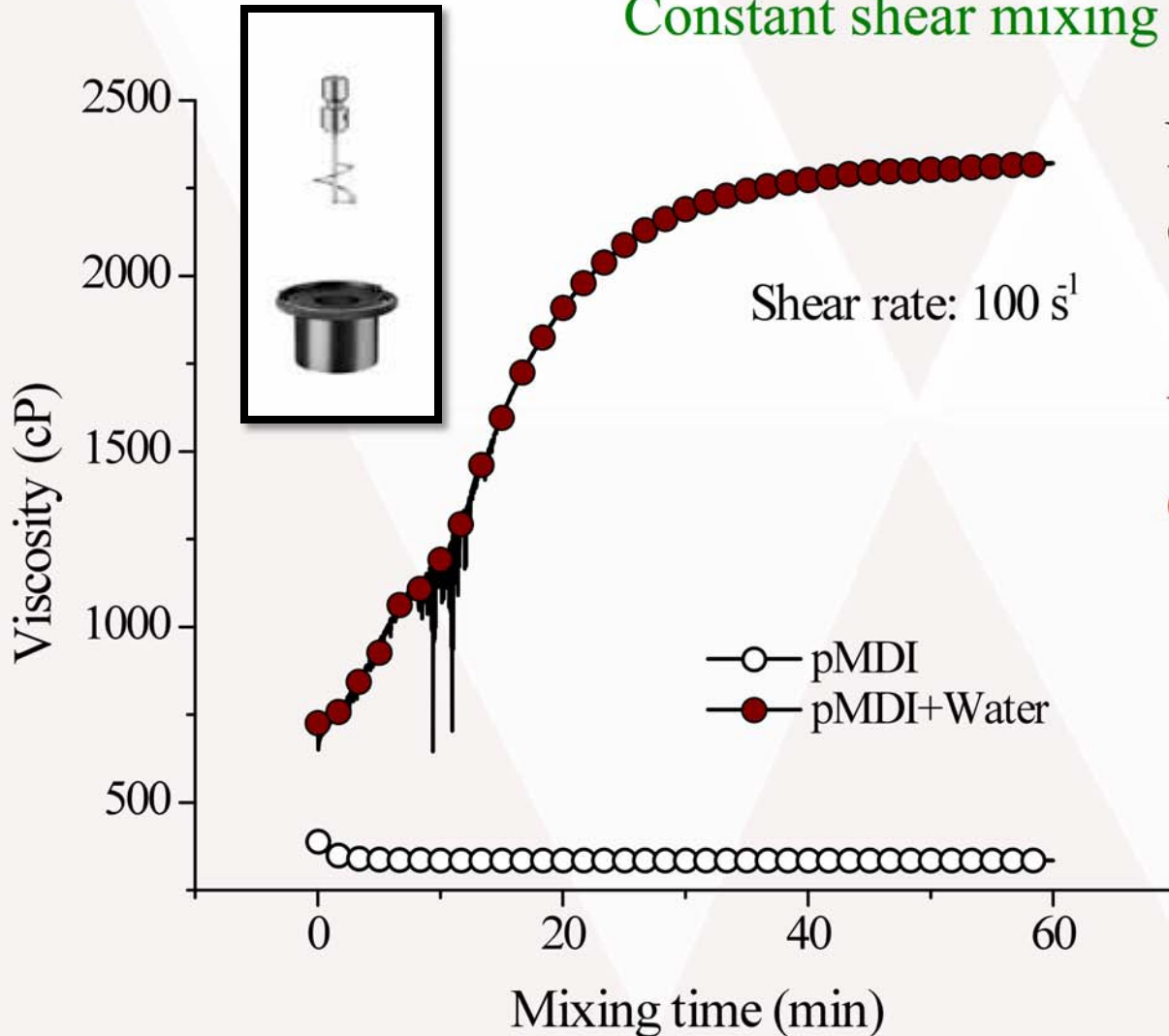
No curing for pMDI
over 1 h mixing

Shear rate: 100 s^{-1}



REZ-FLEX/pMDI Rheology

Constant shear mixing at 77 °F

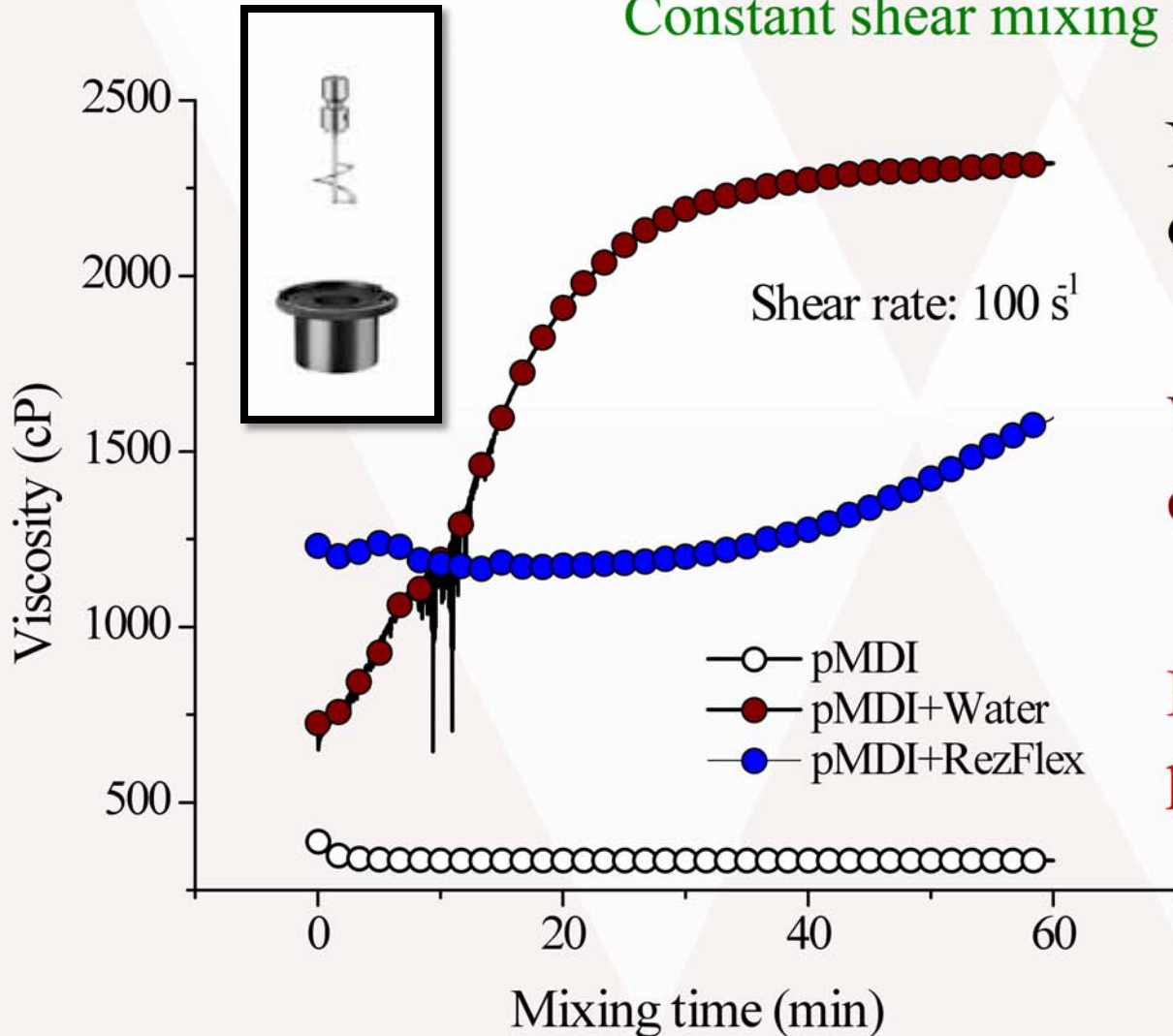


No curing for pMDI over 1 h mixing

Water showed severe curing over 1 h mixing

REZ-FLEX/pMDI Rheology

Constant shear mixing at 77 °F



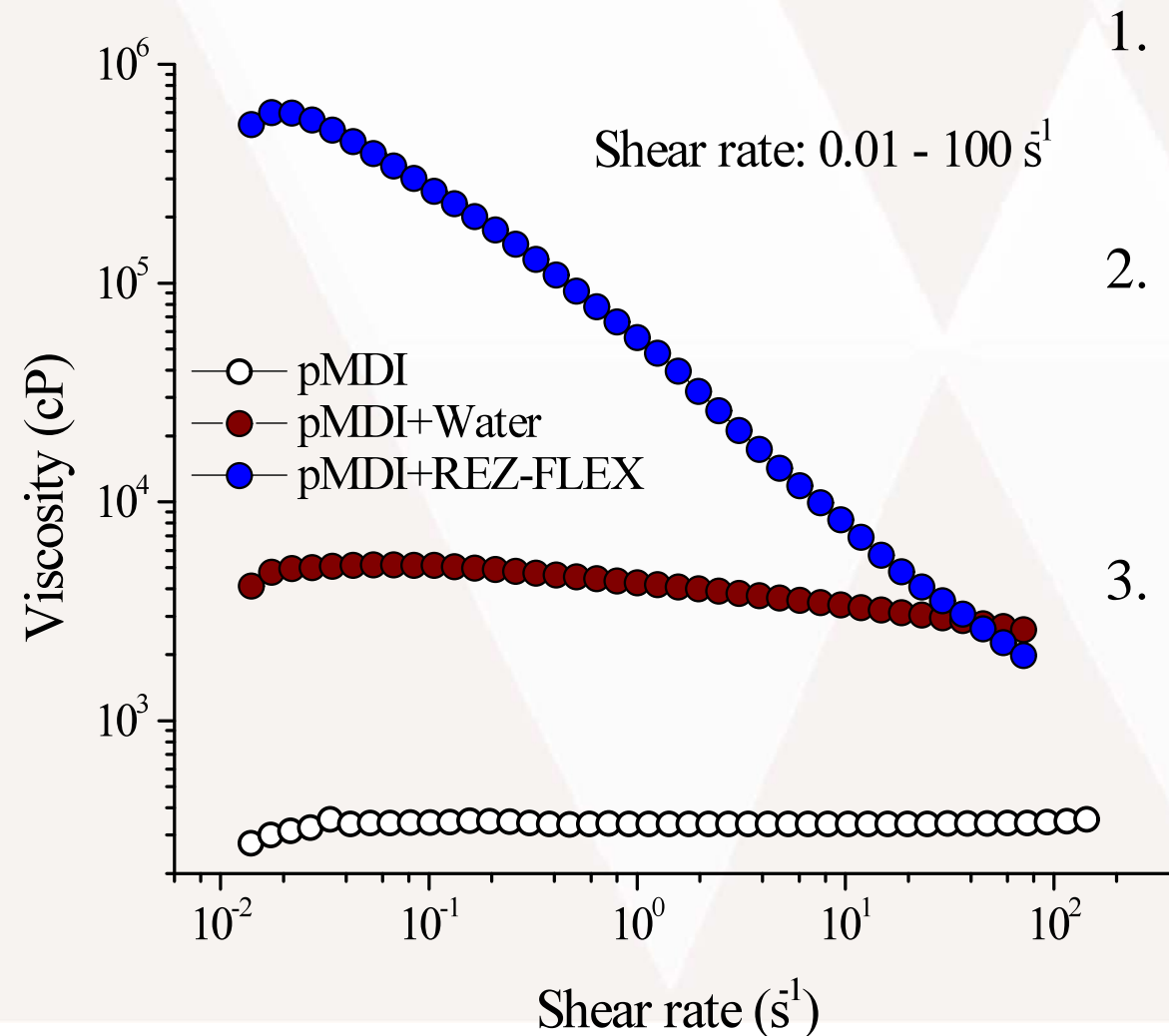
No curing for pMDI over 1 h mixing

Water showed severe curing over 1 h mixing

REZ-FLEX reduced pre-cure



Viscosity profile following 1 h mixing



1. pMDI didn't change over 1 h mixing

2. Water + pMDI blend didn't shear thin, poor spraying efficiency.

3. Blend with REZ-FLEX showed high viscosity at low shear rate and low viscosity at high shear rate.

- Good stability
- Good sprayability

MILL TRIALS

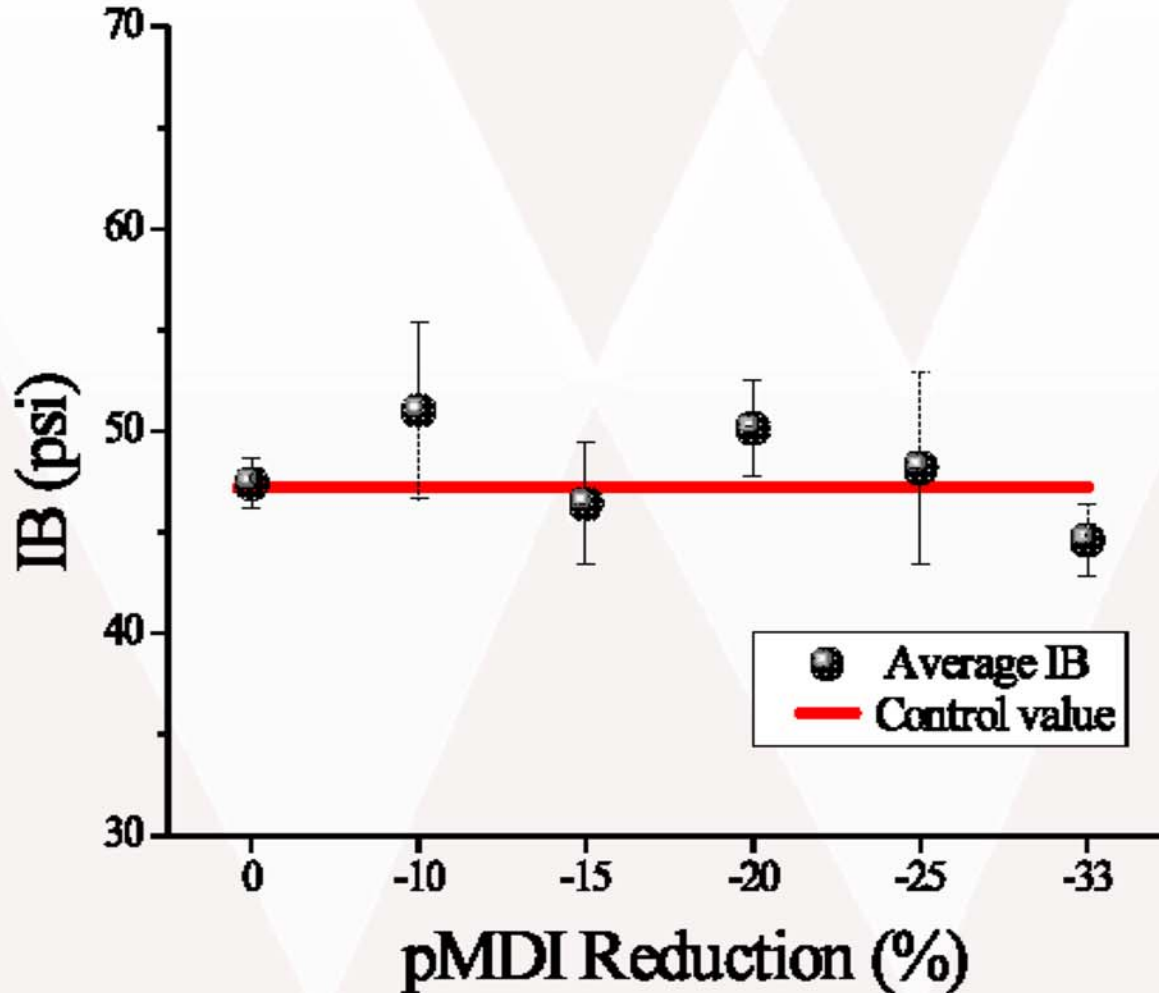
- Several Particleboard Mill Trials
- Core and face application
- Reduce pMDI application
- Closely monitor press and blender build up





Average IB Strength From Trials

20 – 25% resin reduction without property drop





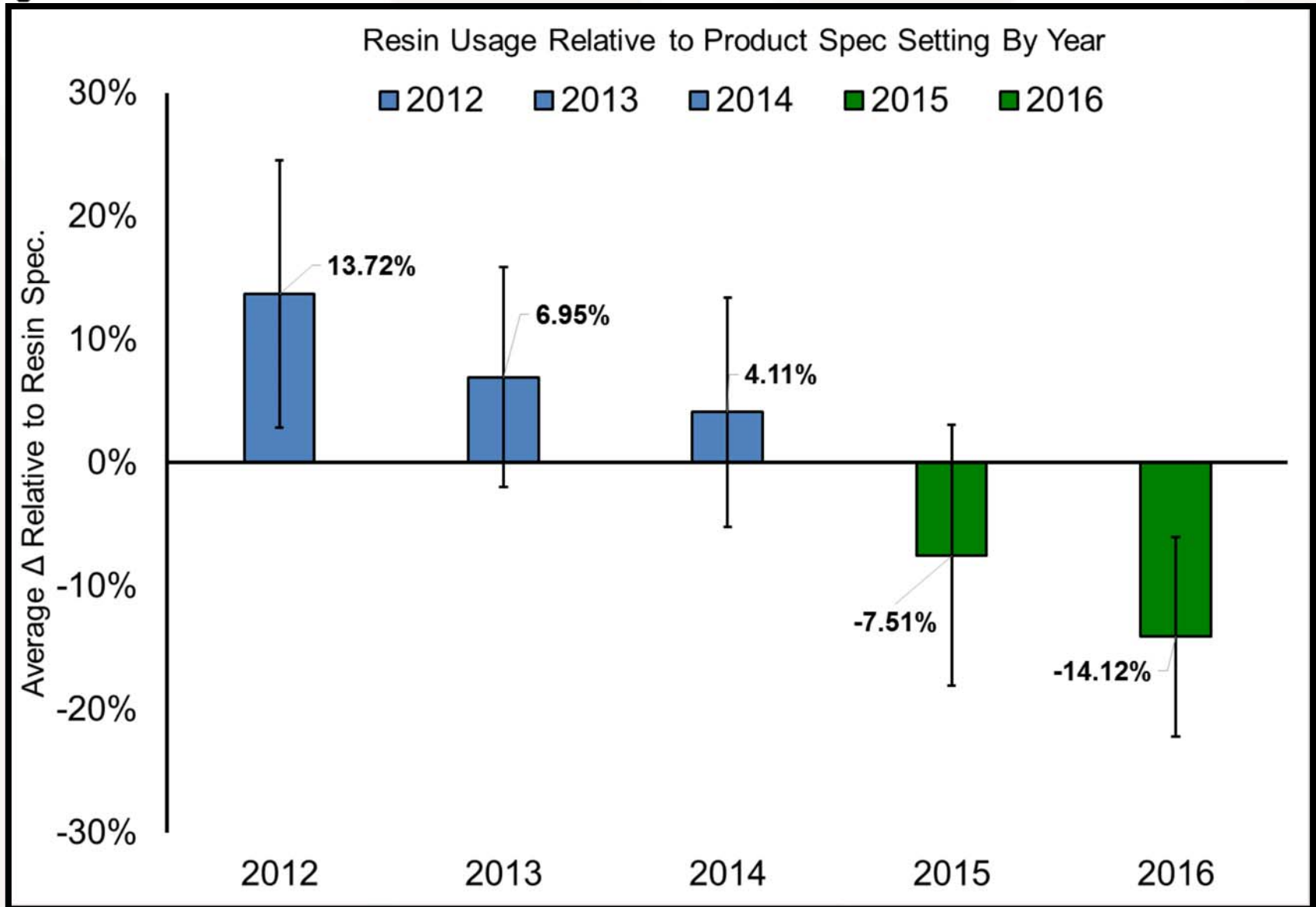
Mill Trial Conclusions

- Data clearly shows:
 - With REZ-FLEX, pMDI reductions over 20% are possible, while maintaining panel properties.
- Blender build-up is similar or less than normal
- Results warranted full scale production with REZ-FLEX

Full Mill Scale Results

- November 2014 start (Successfully running full time)
 - pMDI usage
 - Other advantages





FULL MILL SCALE RESULTS

- Significant savings 17% reduction for the year
- Up to 26% pMDI reduction in one month
- Continuous Improvement-through data





ADVANTAGES

- Resin Reduction without affecting properties
- More efficient resin distribution
- Pathway for other enhancers
- Less “pitting”
- Reduced “free” pMDI in plant
- Overall cost reduction \$\$\$\$



Engineered pMDI Additive

REZ-FLEX
(patent pending)

REZ-FLEX

A thick black horizontal line with a wavy, undulating pattern underneath it, resembling a stylized wave or a decorative border.

Commercially Successful
pMDI Extender