Industry/University Cooperative Research in North America

The Wood-Based Composites Center

The National Science Foundation

Chip Frazier
T.M. Brooks Professor of Sustainable Biomaterials
Director, Wood-Based Composites Center
Virginia Tech
Blacksburg, Virginia, U.S.A.


Map: VectorTemplates.com

Our folks

Arauco North America
Arclin
Boise Cascade
Columbia Forest Products
Fraunhofer WKI Institute for Wood Research
Georgia-Pacific Chemicals
Henkel Corporation
Momentive Specialty Chemicals
Queensland, Australia Government
Solenis
Willamette Valley Company

The Research Spectrum in North America

Principal drivers:

- Federal initiatives
- Money, university revenue
- Publications
- Graduates

- Market forces
- Innovation
- Money, profits

The Research Spectrum in North America

Positive qualities:

- Public service
- Developing students
- Long-term focus

- Practical
- Rapid & efficient
- Accountable

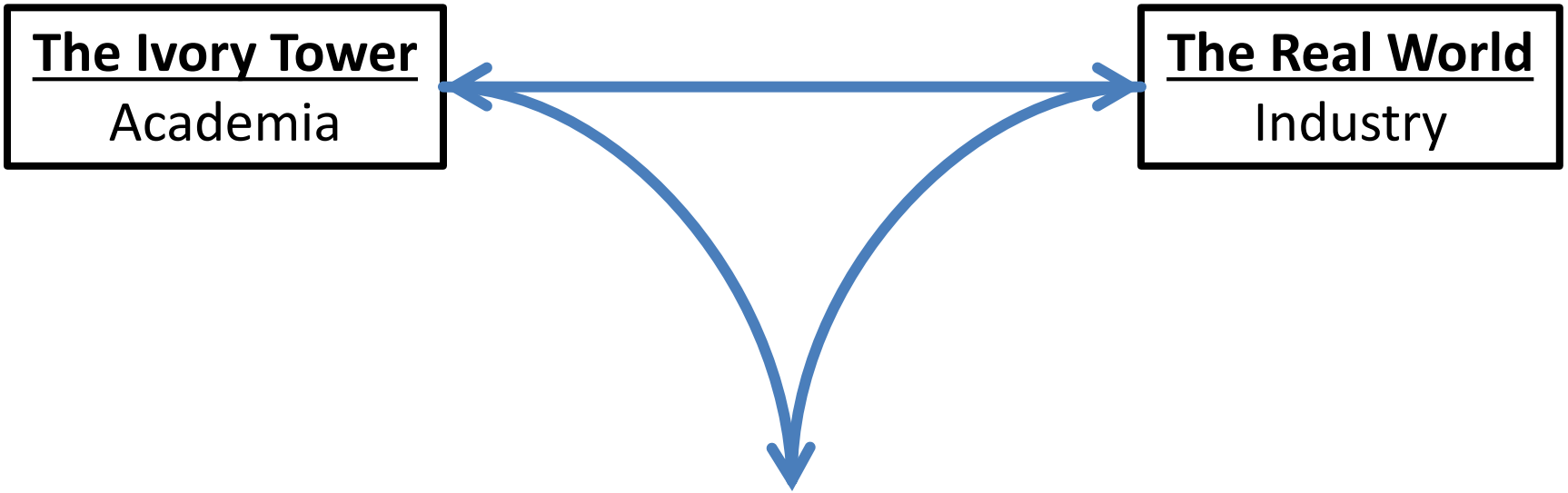
The Research Spectrum in North America

Negative qualities:

- Slow & inefficient
- Perhaps poor accountability
- Often less practical value

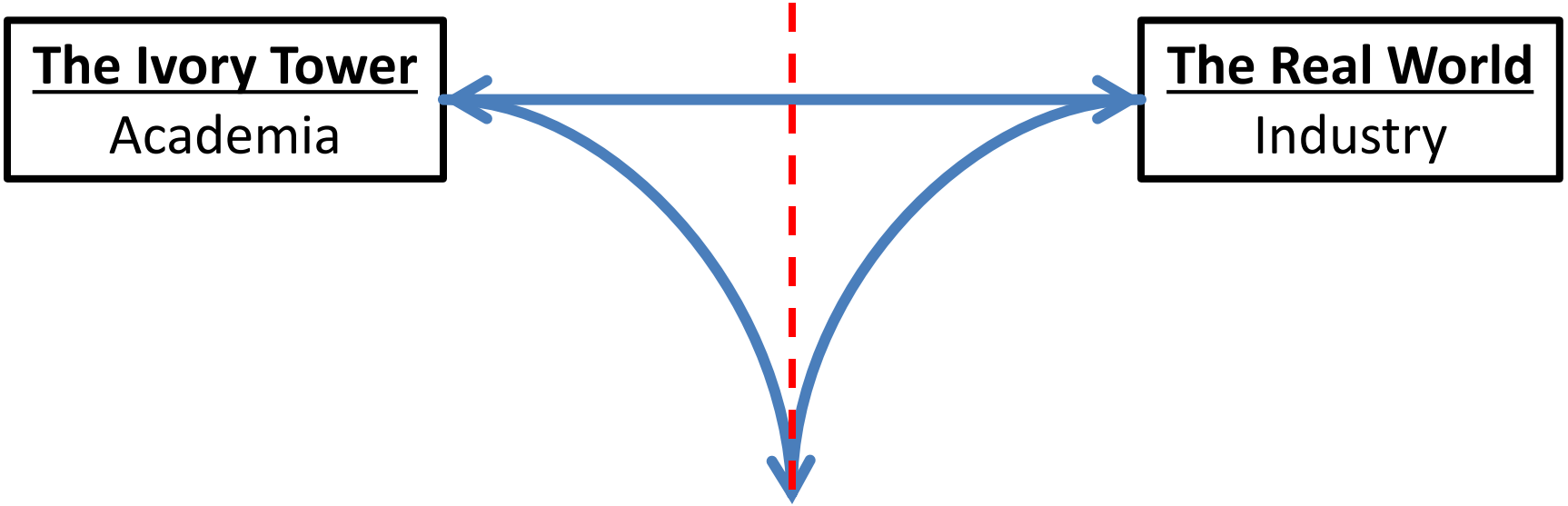
- Short-term focus
- Perhaps superficial

Merits & faults are found both in academia & industry…



Merits in each may be enhanced through collaboration;
faults in each may be neutralized in collaboration.

In which domain will collaboration occur?



Public Domain:

- Broad participation
- Broad focus

Private Domain:

- Limited participation
- Limited focus

The U.S. National Science Foundation

- Independent federal agency created "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…"
- Annual budget of $7.2 billion (FY 2014).
- Funding source for 24 percent of all federally supported basic research conducted by U.S. colleges and universities.

The U.S. National Science Foundation

Industry/University Cooperative Research Centers program- I/UCRC:

- Small program, annual budget ~ $15 million (~ 0.2% of the NSF budget).
- Leveraging a small federal investment into a large industrial investment.
- 30+ years of successful operation.

A little federal funding- a lot of industry funding

NSF
$120,000/yr
(maximum)

Industry
$300,000/yr
(minimum)

Official NSF sites

OSU Oregon State University

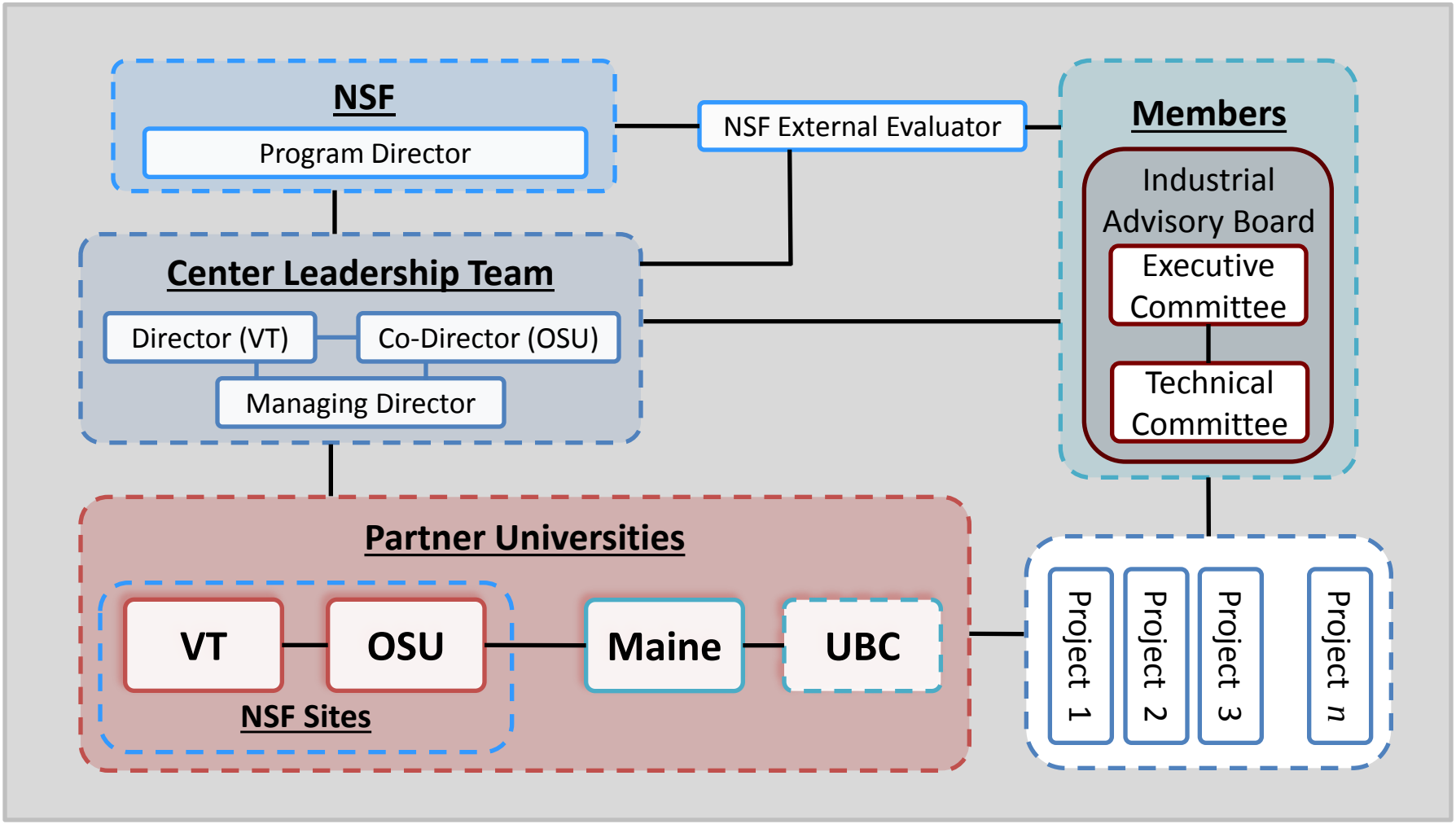
VirginiaTech

Current sub-contractors

THE UNIVERSITY OF MAINE

UBC

Wood-Based Composites Center, 1 of about 60 I/UCRC's



WBC Industry Advisory Board

Executive Committee:	Technical Committee:
• Meet once/year • Strategic planning • Establish/oversee Center bylaws • Review membership costs/benefits • Review Center mission, objectives • Review Center metrics • Manage recruiting initiatives • Oversee Center finances	• Meet twice/year • Establish/monitor Center research • Select and oversee research projects • Provide recommendations/feedback to the Executive Committee • Serve as consultant to specific projects, not all projects.
VP of Check Writing	Director of R&D

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Major objective is to engage each member through multiple contacts.

Members drive the Center

- Members create the research agenda.
- Faculty **compete** for funds, annually.
- Competition based upon:
  - Scientific merit
  - Responsiveness to industry needs.
  - Responsiveness to industry feedback.
  - Performance on yearly deliverables.

Members drive the Center

- Membership fees are pooled.
- Faculty submit proposals.
- Members review proposals, and…
  - Accept
  - Reject, or
  - Accept w/ designated changes.
- Members award funding based upon merit.

Research in the public domain

- Ultimately, research results are released to the public.
- Research is precompetitive; tends to focus on broader industry needs.
- Intellectual property is protected.
- This model tends to attract faculty that are committed to industry service.

What research do we conduct?

The research that our members request.

Current/Recent Projects:

- Improving blending efficiency and resin distribution of the rotary drum blending process using discrete element modeling.
- Ranking resins by their effects on durability of wood composites.
- Accelerated weathering for the development of an NDT product durability assessment toolkit.
- Multi-scale accelerated weathering of wood composite materials.
- Checking in maple plywood.
- Wetting and diffusion associated with selected liquid/wood interfaces.
- Multi-scale investigation of adhesive bond durability.
- Investigation of micro-scale wood/adhesive interaction.

What research do we conduct?

The research that our members request.

Current/Recent Projects (continued):

- Fundamentals of formaldehyde detection and emission determination.
- Filler effects in PF Resoles
- Understanding the differences in bonding characteristics of Douglas-fir and southern yellow pine wood.
- Biogenic formaldehyde emission.
- Adhesion fundamentals in spotted gum (*Corymbia sp*.).
- Fiber quality in medium density fiberboard production.

Investigation of micro-scale wood/adhesive interaction

Investigators: Fred Kamke, John Nairn, Lech Muszynski

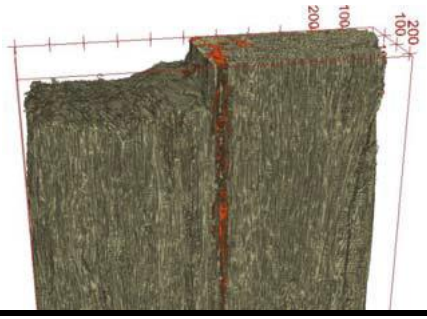
Goal:

- Quantitate the role of adhesive penetration on bond performance.

Approach:

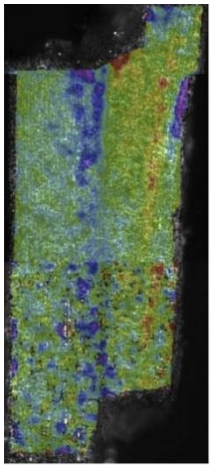
- Develop micron-scale numerical model to predict bond behavior as affected by adhesive penetration, adhesive modulus, and wood anatomy.
- Characterize 3D adhesive penetration patterns using micro X-ray computed tomography – basis for numerical model.
- Measure 2D strain of adhesive bonds and compare to model predictions.

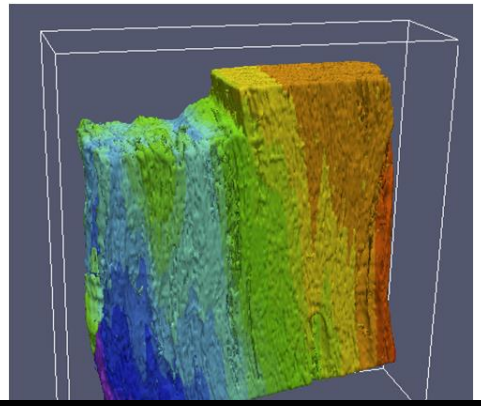
Investigation of micro-scale wood/adhesive interaction



3D micro X-ray computed tomography

Digital image correlation: 2D strain fields in micro-bonds





3D modeling of stress/strain
Including virtual experiments to failure.

Investigation of micro-scale wood/adhesive interaction

2014 Forest Products Society Wood Award for outstanding graduate student research:

Dr. Jesse Paris
R&D Chemist
Willamette Valley Company

Improving blending efficiency and resin distribution of the rotary drum blending process using discrete element modeling.

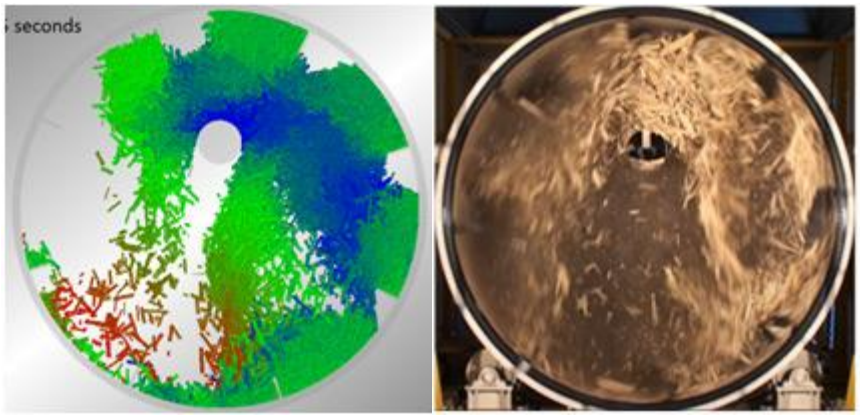
Investigator: Greg Smith

Goal:

- Reduce flake surging and its impact on blender operation

Approach:

- Model flakes as discrete elements.
- Experimentally verify flake motion and surging.
- Use modeling results to help optimize boom placement & function.



Fundamentals of Formaldehyde Detection and Emissions Determination

Investigators: Barbara Cole, Ray Fort, Doug Gardner

Goal:

- Determine the amount and sources of formaldehyde in native wood, and the mechanisms by which it is formed.

Approach:

- Investigate effects of
  - temperature on native formaldehyde emissions.
  - wood moisture on native formaldehyde emissions.
- Determine which wood components (lignin, carbohydrates, other) are sources of native formaldehyde.

Filler effects in PF Resoles

VirginiaTech

Investigator: Chip Frazier

Goal:

- Determine effects of filler particle size & filler chemistry on PF resole penetration and performance.

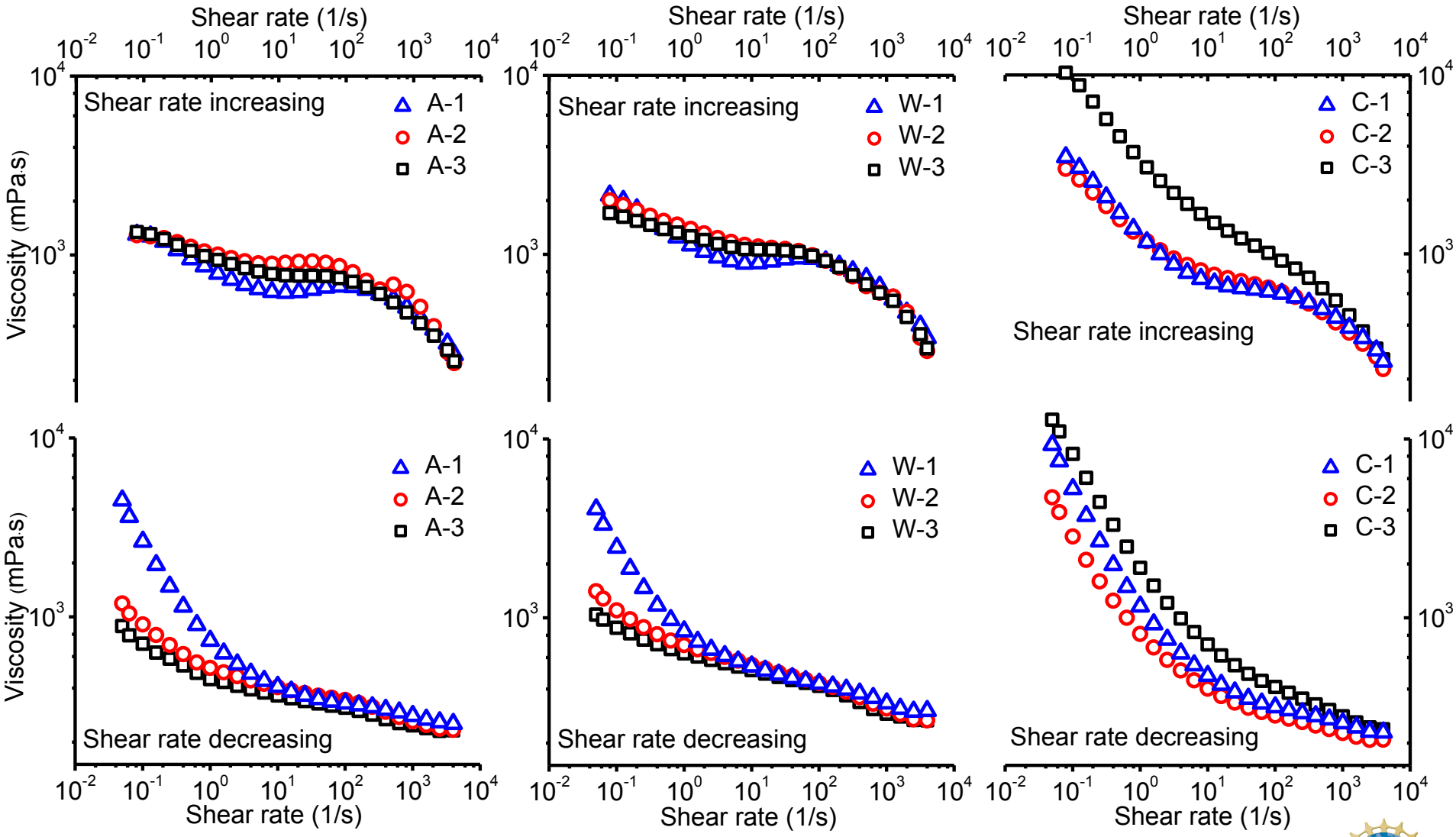
Approach:

- Fillers: corn cob residue, alder bark, and walnut shell
- Characterize filler
  - Chemical composition
  - Surface chemistry & impact on adhesive surface tension.
  - Impact on adhesive rheology
- Measure performance using mode-I fracture & relate to adhesive penetration.

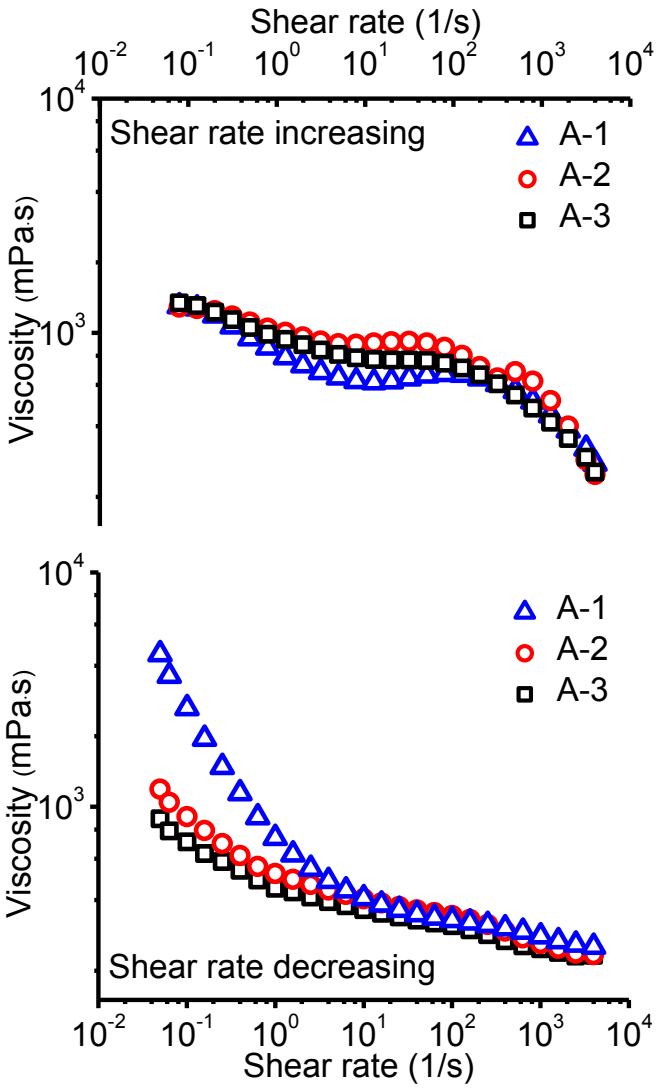
WBC

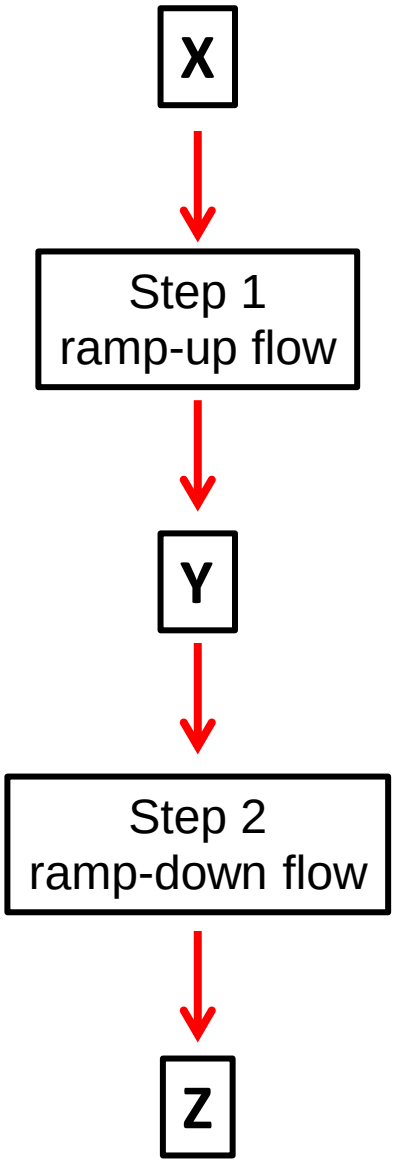
NSF

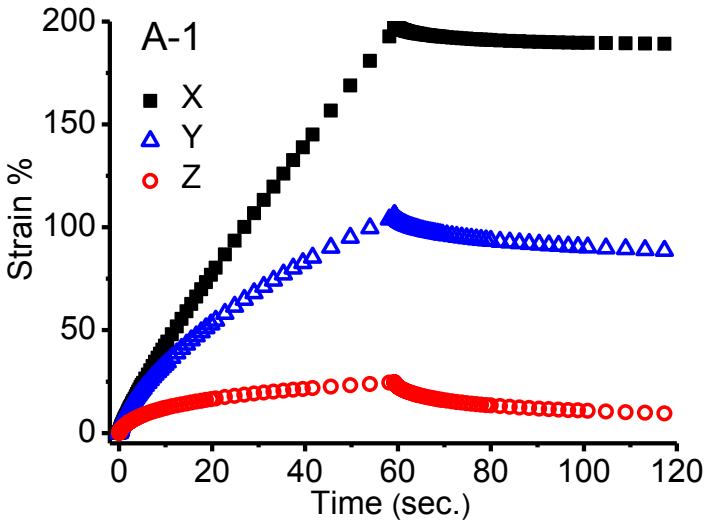
Filler effects in PF Resoles



Filler effects in PF Resoles

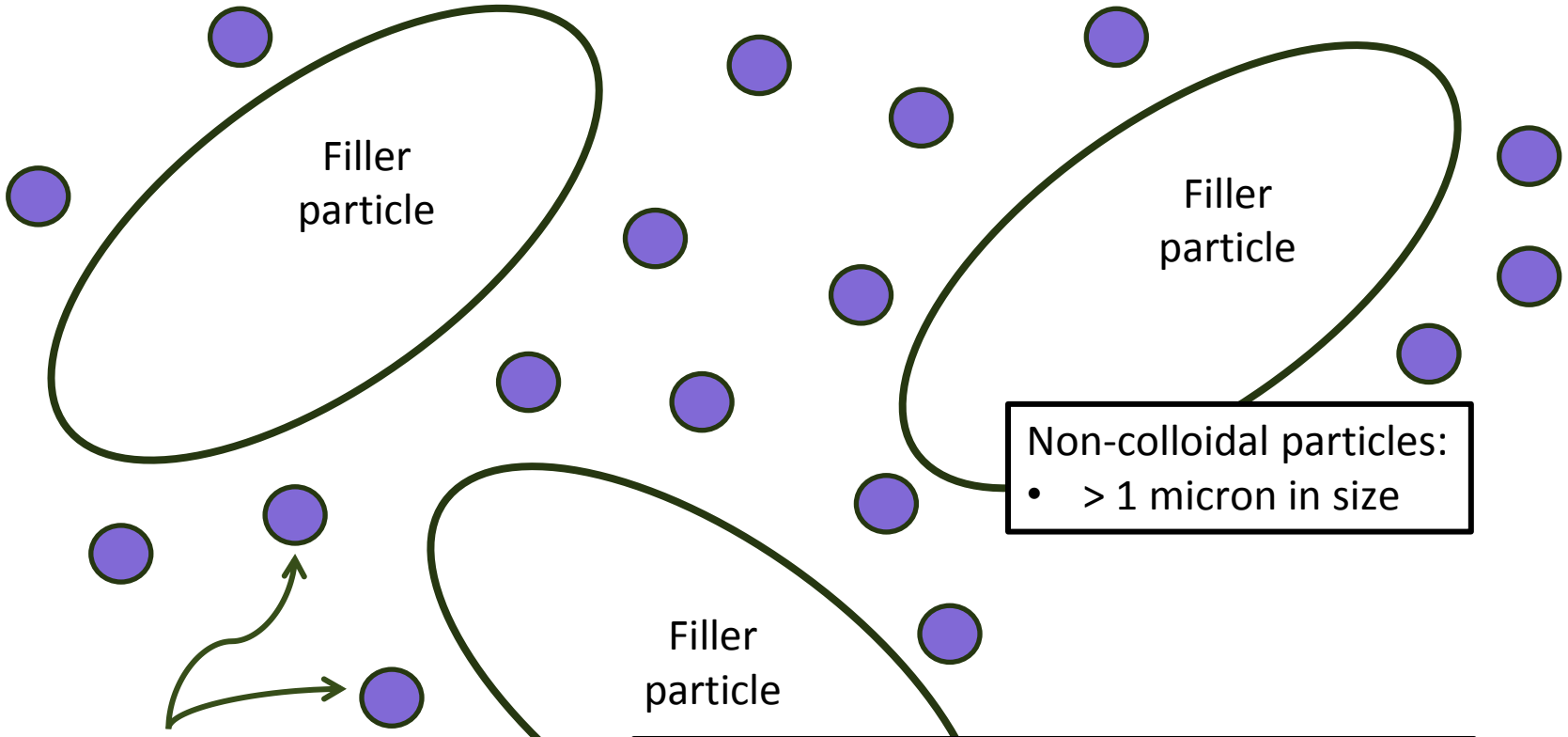






Detection of liquid-state network structures dependent upon filler type, particle size, and shear history.

Filler effects in PF Resoles



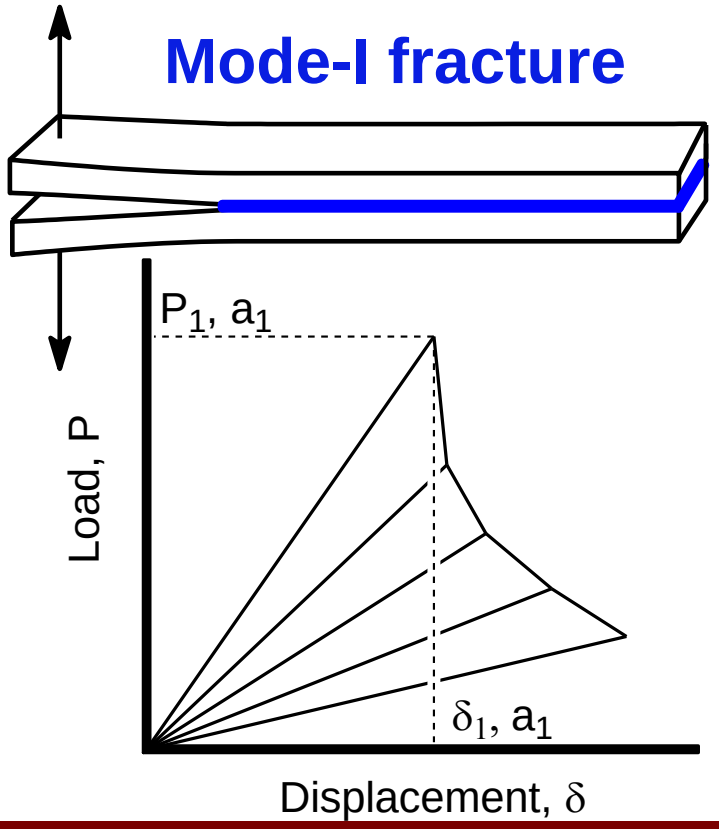
Non-colloidal particles:
- > 1 micron in size

Colloidal particles:
- < 1 micron in size
- Dissolved polysaccharides
- Dissolved lignin
- Associated PF chains
- Dissolved extractives

Formulated adhesives exhibit unique liquid-state structures.

Determine how liquid-state structures translate to the solid-state bondline.

Filler effects in PF Resoles



Adhesion fundamentals in spotted gum (*Corymbia sp*.)

VirginiaTech

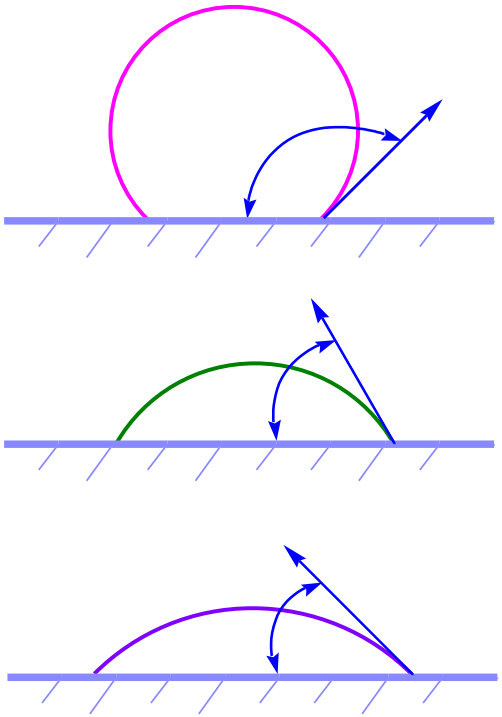
Investigator: Chip Frazier

Goal:

- Advance fundamental knowledge in the science and technology of adhesion in *Corymbia sp.* (spotted gum).

Approach:

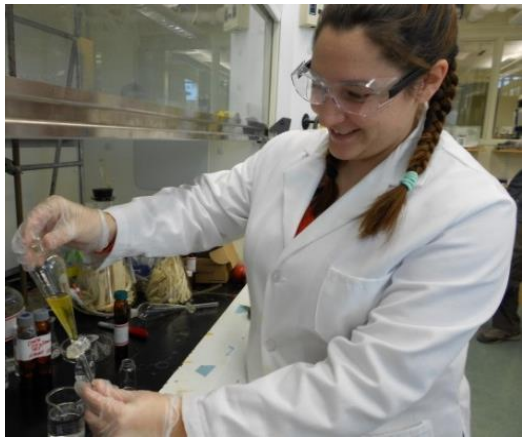
- Measure surface chemistry of spotted gum and Gympie messmate (*Eucalyptus cloeziana),* using contact angle analysis.
- Compare sensitivities to heat-induced surface change.

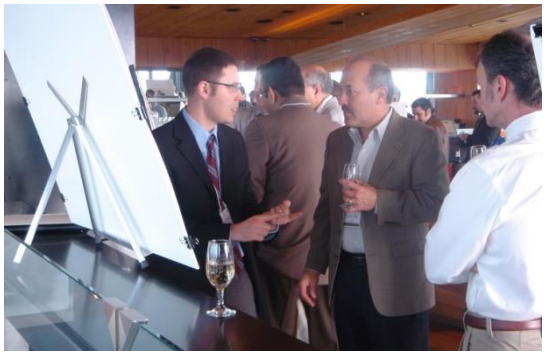


The value proposition in the I/UCRC model

Precompetitive Research

Professional Networking





Student Recruiting

The I/UCRC model & its impact on students

Our students enjoy the greatest benefit:

- Industry-selected, relevant research.
- Regular scrutiny, review by industry professionals.
- Extended industry Interaction.
- Accountability for meeting project deliverables.
- Improved presentation skills.
- Networking.

Acknowledgements

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