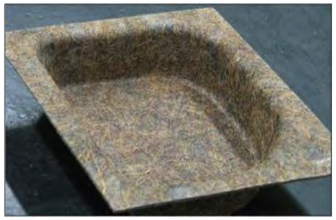
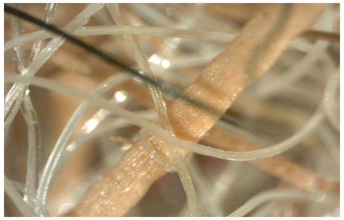
Creating Innovations utilizing renewable resources

Walter L. Bradley, Ph.D., P.E.

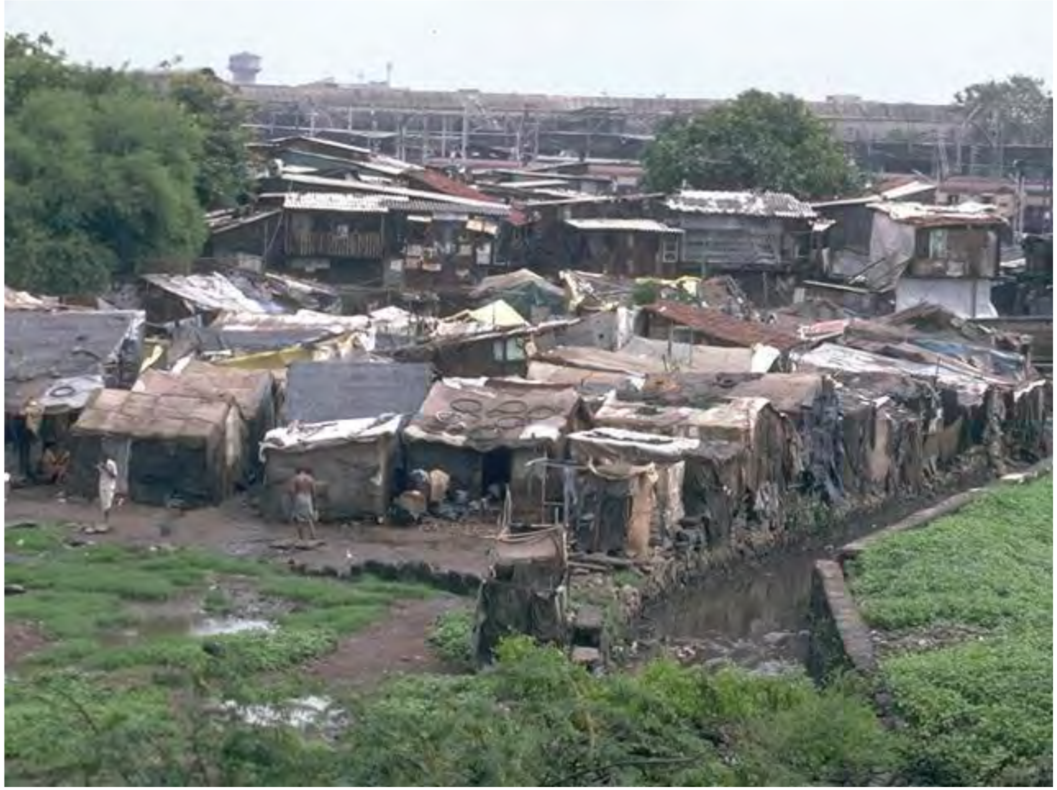
Distinguished Professor of Mechanical Engr.

Baylor University

HOW CAN WE HELP POOR FARMERS?

CREATE INNOVATIVE NEW MATERIALS USING ABUNDANT, RENEWABLE RESOURCES THAT ARE UNDER UTILIZED (AGRICULTURAL WASTE) AND OWNED BY POOR FARMERS (<$2/DAY)

A Great Need

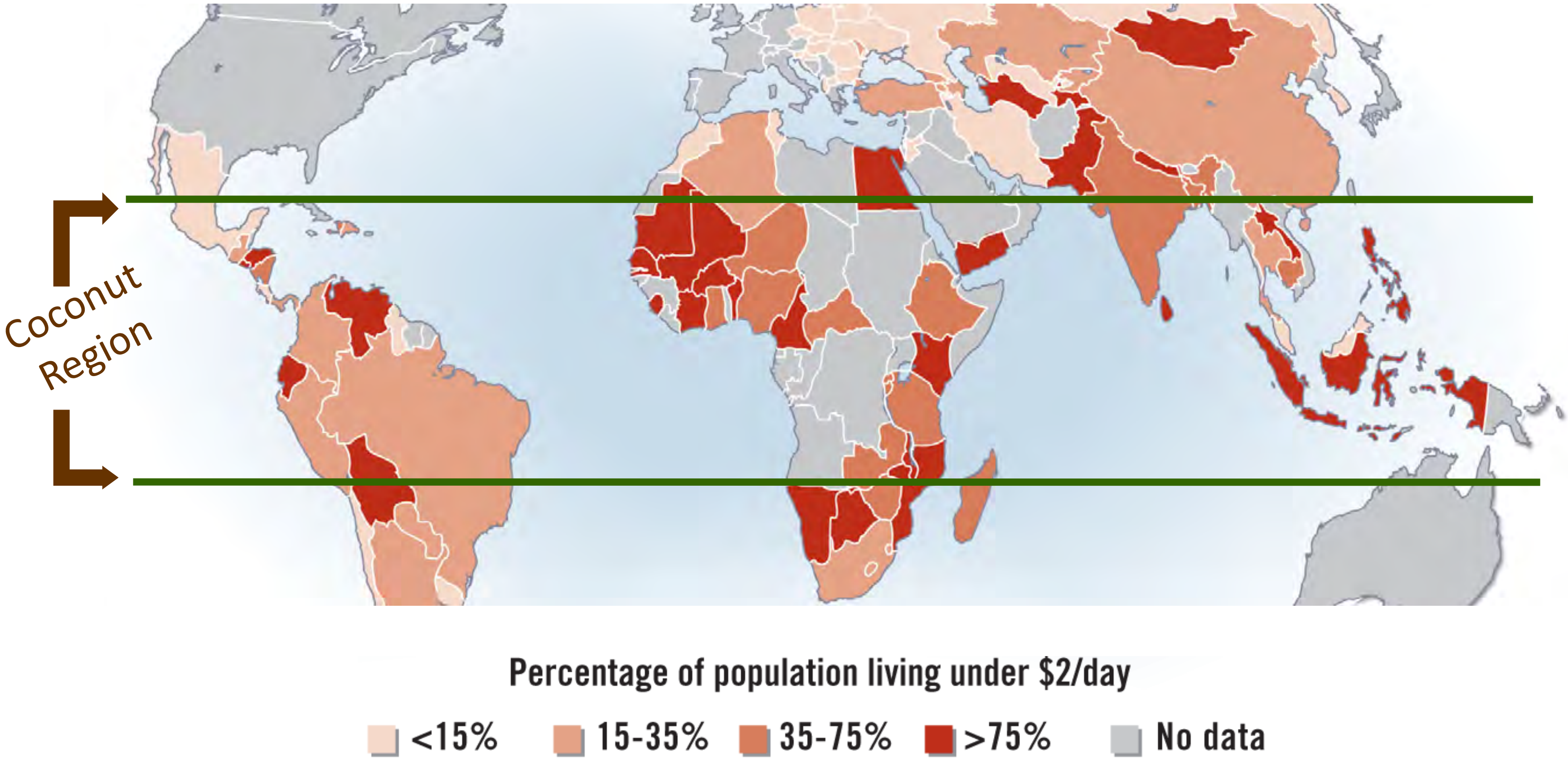


How can we speak of God's love to them?

Coconut Family in Indonesia--$500/yr income for family

Children of Coconut Farmers, Indonesia

COCONUTS!



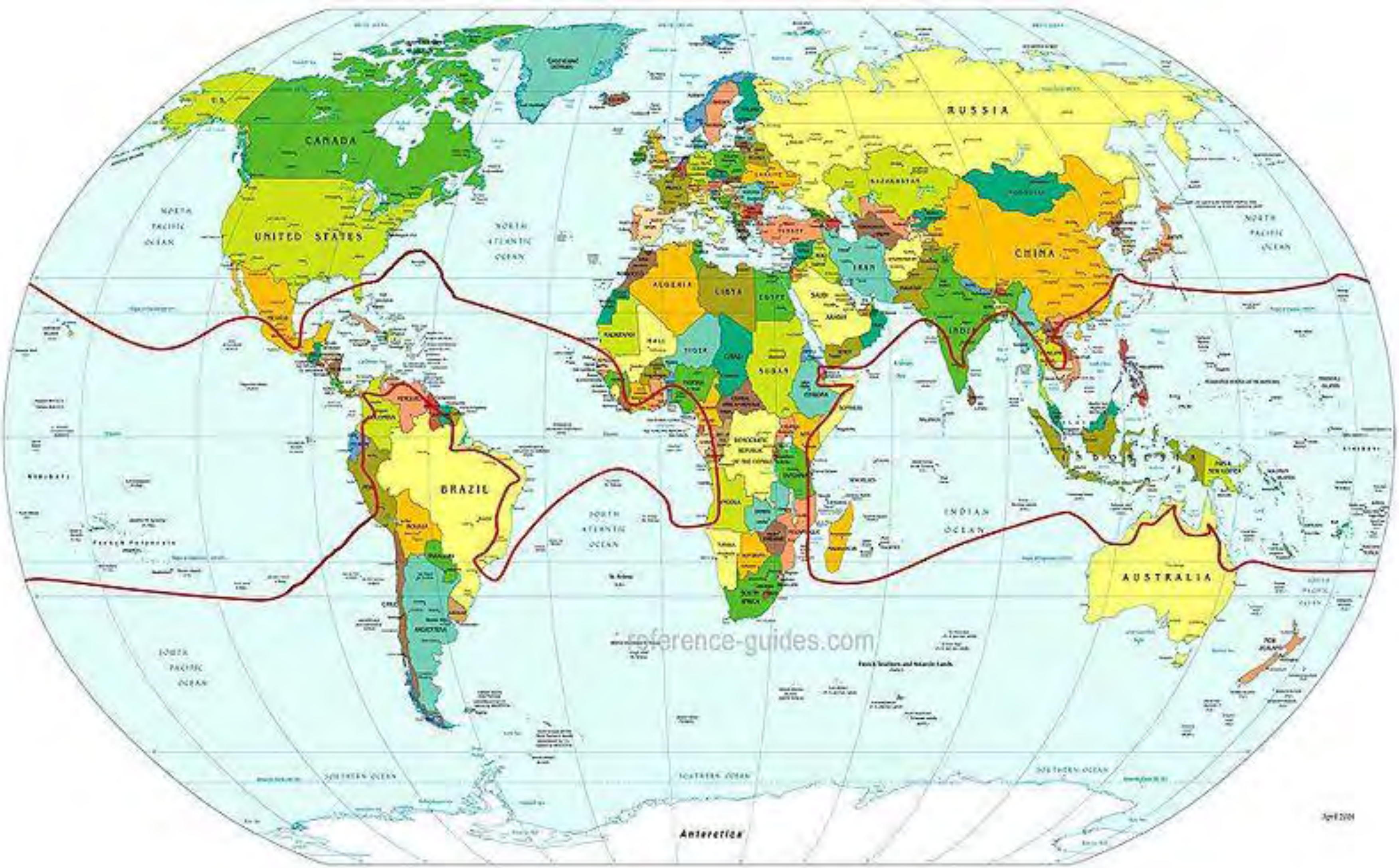
Approximately **50 BILLION** coconuts fall from the tree every year!

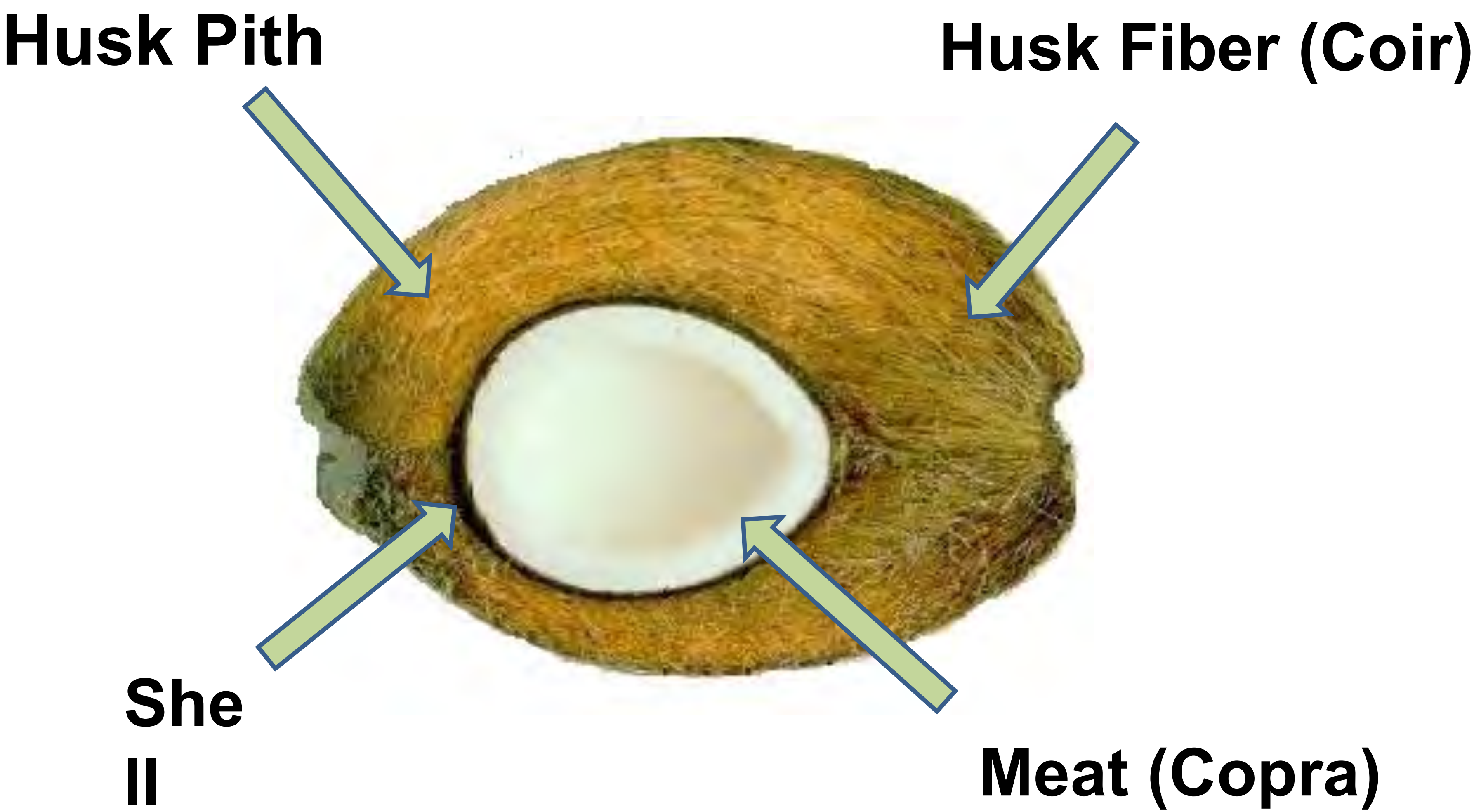
Worldwide Production of Coconut Oil -- 2008

Rank	Country	Metric Tons
1	Indonesia	19,500,000
2	Philippines	15,300,000
3	India	10,900,000
4	Brazil	2,800,000
5	Sri Lanka	2,200,000
6	Thailand	1,500,000
7	Mexico	1,200,000
8	Viet Nam	1,100,000
9	Papua New Guinea	700,000
10	Malaysia	500,000
11	Myanmar	370,000
11	U. Rep. of Tanzania	370,000
13	Ghana	320,000

Source: FAOSTAT 2008

GLOBAL COCONUT DISTRIBUTION




Husk Pith
Husk Fiber (Coir)
She
ll
Meat (Copra)

- Helping impoverished farmers

PEOPLE

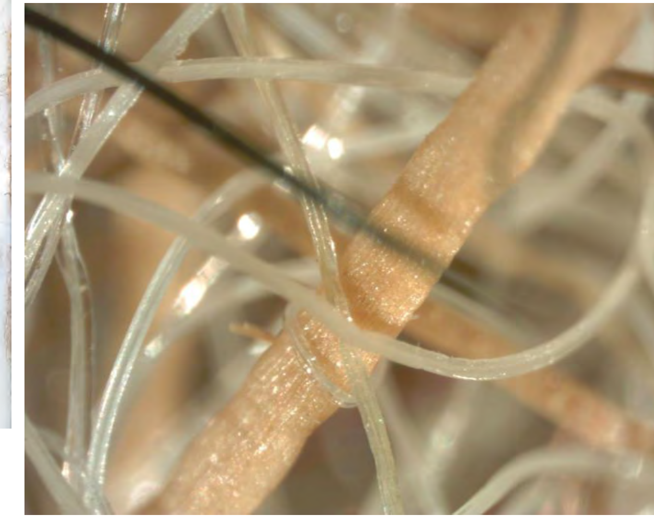
PLANET

- Stewardship of renewable resources

- Improving performance
- Reducing cost
- Improving sustainability

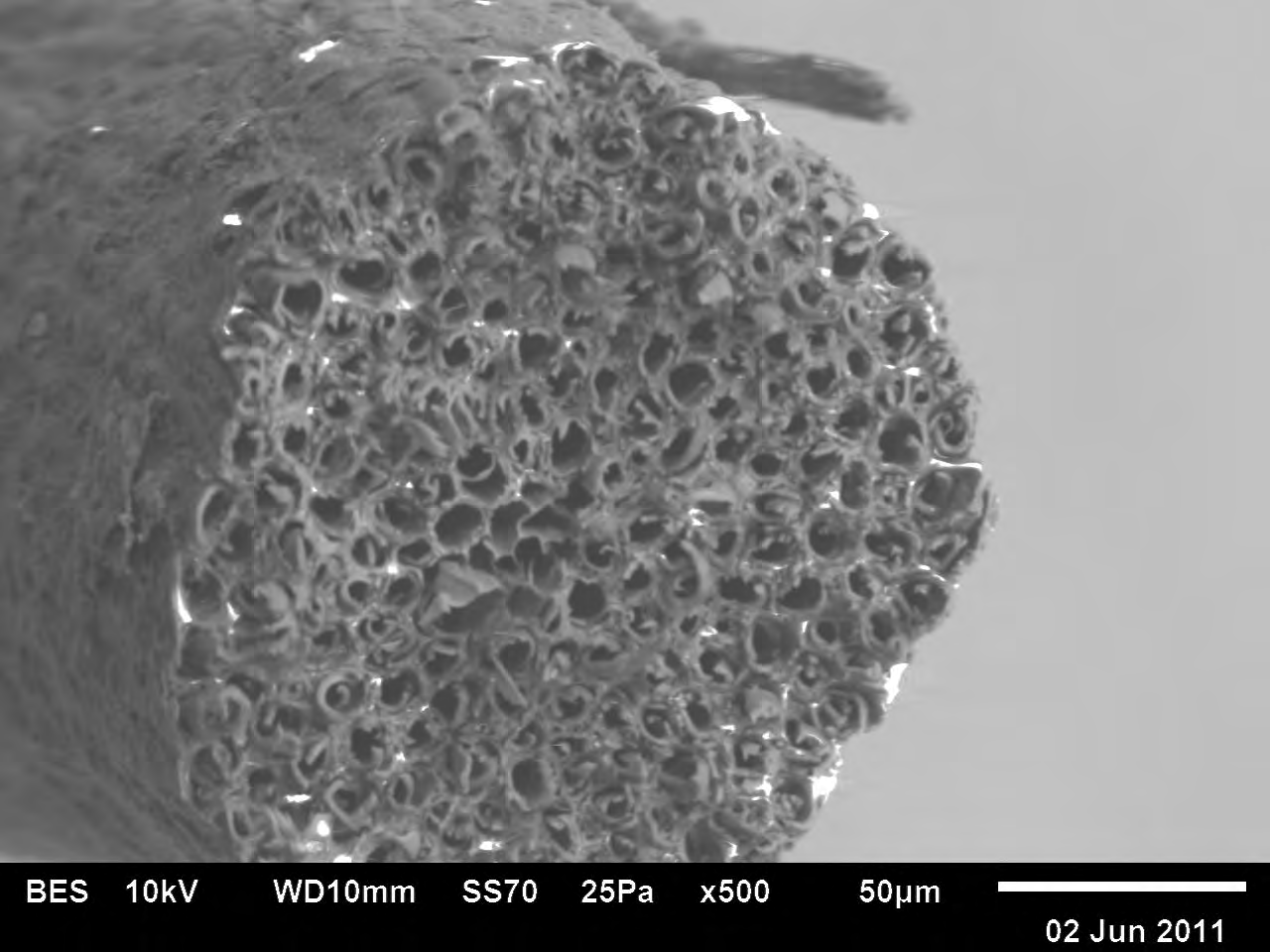
PROFITS

WHOLE TREE'S GENESIS



Patent Pending: **"NON-WOVEN FABRIC COMPOSITES FROM LIGNIN-RICH LARGE DIAMETER NATURAL FIBERS" BAYU-0027 (208614.00115)**

WHOLE TREE IS "BORN"


BES 10kV WD10mm SS70 25Pa x500 50µm
02 Jun 2011

FUNDING AND APPLICATIONS

NCIIA
National Collegiate Inventors & Innovators Alliance

VentureWell

Angel Investors

National Science Foundation
WHERE DISCOVERIES BEGIN

Applications

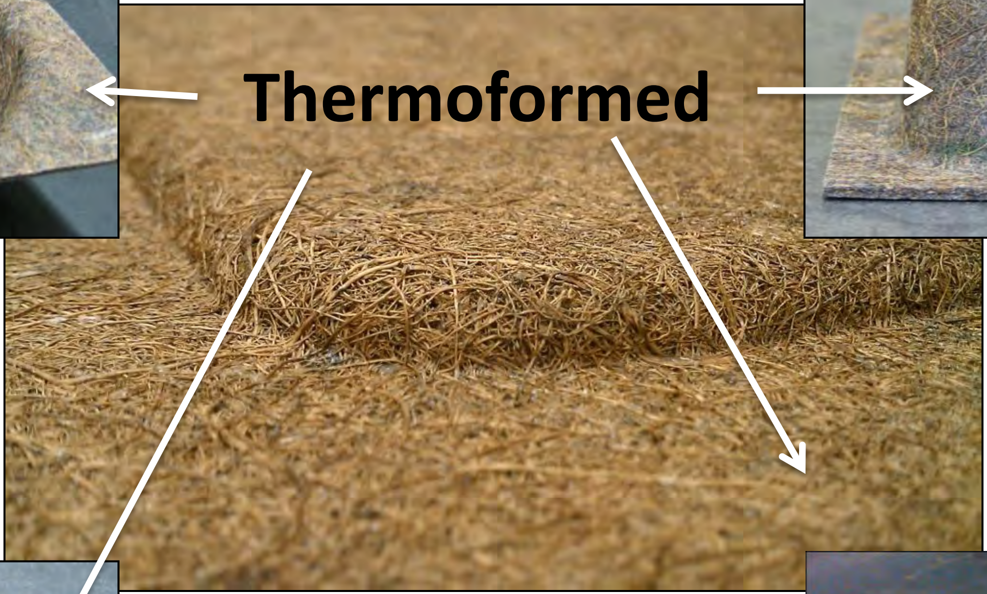
Automotive Interiors
Building Construction Materials
Consumer Products
Packaging

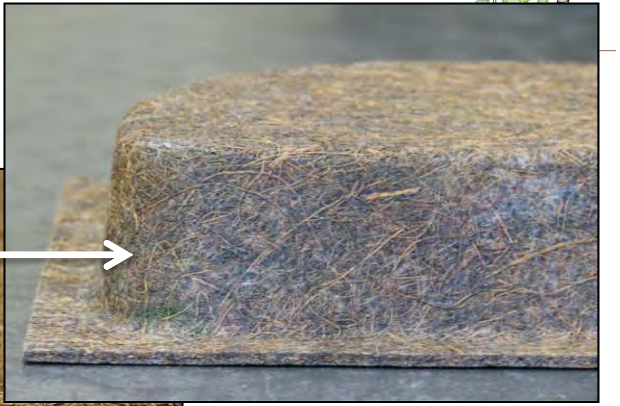
COIRFORM—NONWOVEN FABRIC COMPOSITE

Coconut fibers (called coir)….Milled and baled….Combined with binder polymeric fibers into needle-punched felt.

Felt compression molded or thermo-formed into parts!

COIRFORM





creating innovations utilizing renewable resources

OUR MATERIAL FEATURES

WHOLE *TREE*
natural fiber composite

Husk's function in nature

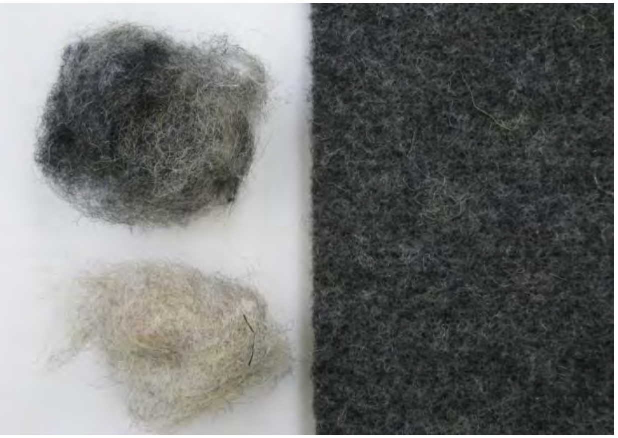
- Help nut survive impact after 60-80 ft drop
- Help nut avoid microbial attack
- Help nut survive forest fires

Physical Properties of Coir Fiber

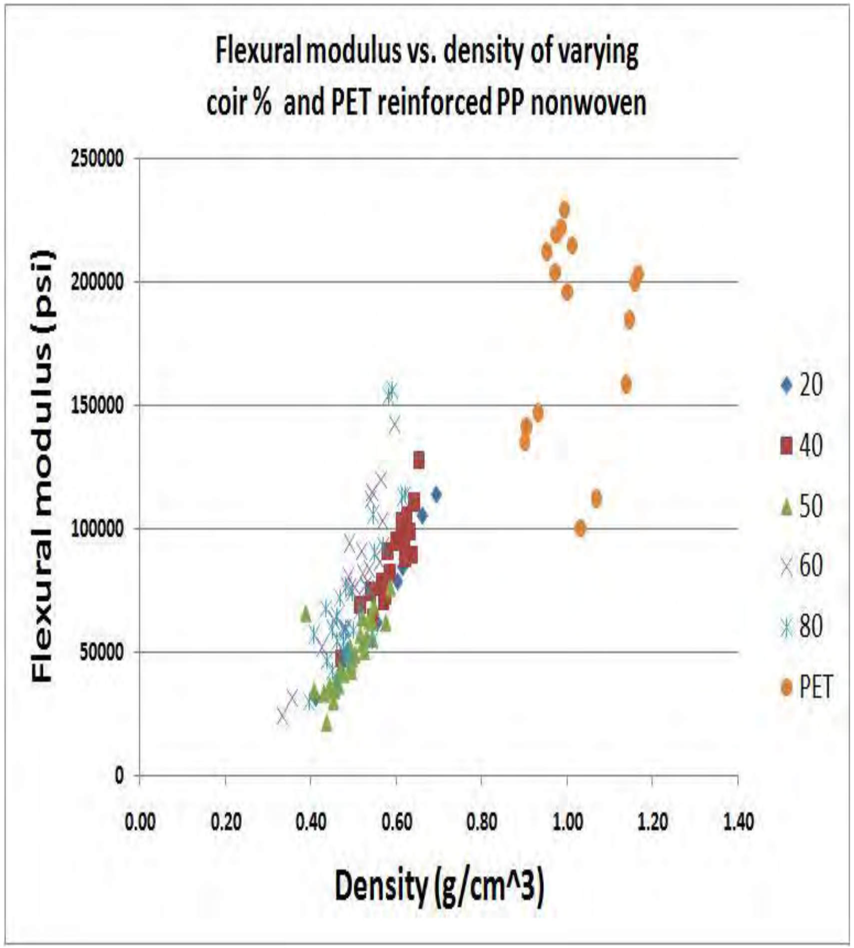
- Naturally burn resistance (high lignin)
- Excellent ductility (~25%) and formability
- Density ~ 1.2 g/cc; low composite density
- Large diameter fibers (150-250 um)
- Excellent bending stiffness (EI)
- Durable in wet environments
- Resistance to mold and microbial attack
- No problems with odor
- Moderate tensile strength and stiffness

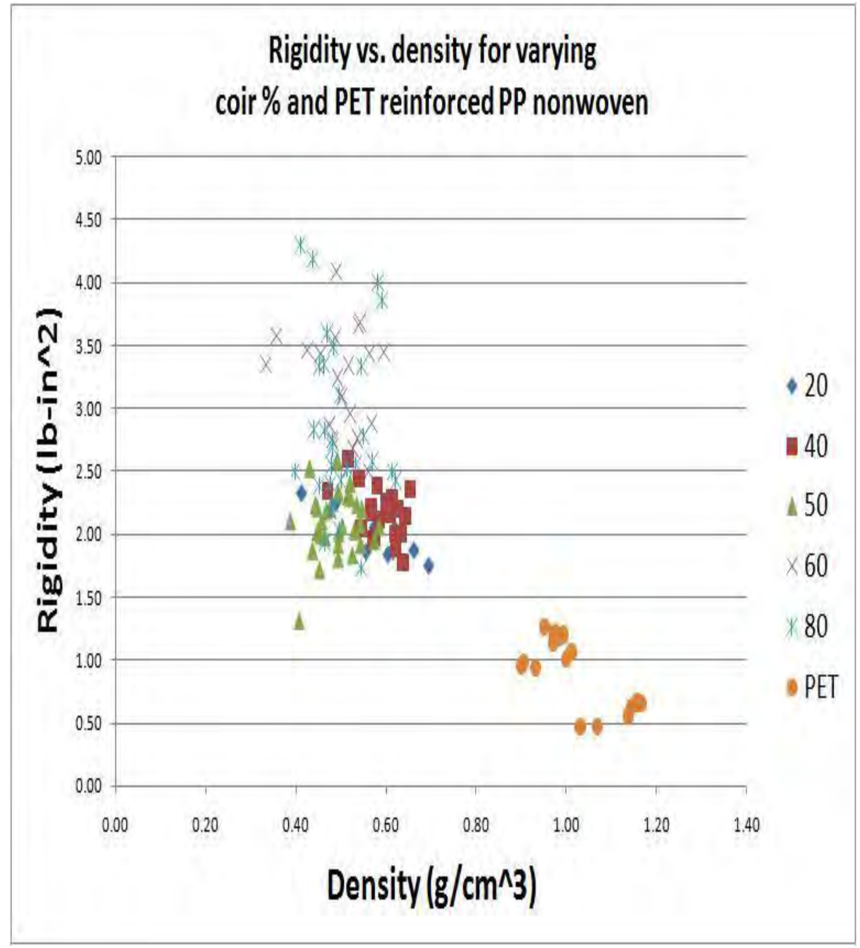
wholetree

Non-woven Fabric Composite



Coir:PP vs. PET:PP





Strategic Alliances

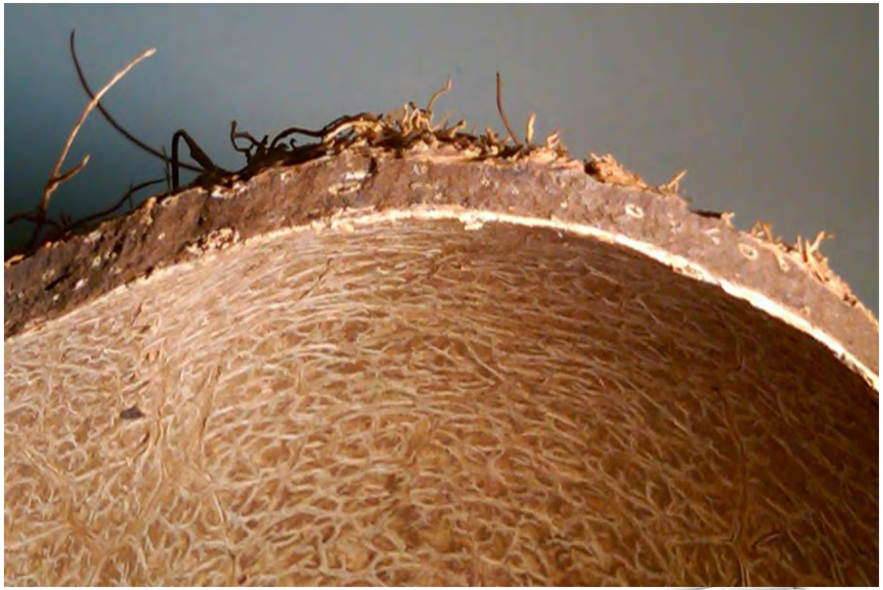
- Hobbs Bonded Fibers - Waco, TX
  - Produces advanced textiles
  - Thermoformable composites
- Baylor University
  - Provides ongoing R&D support

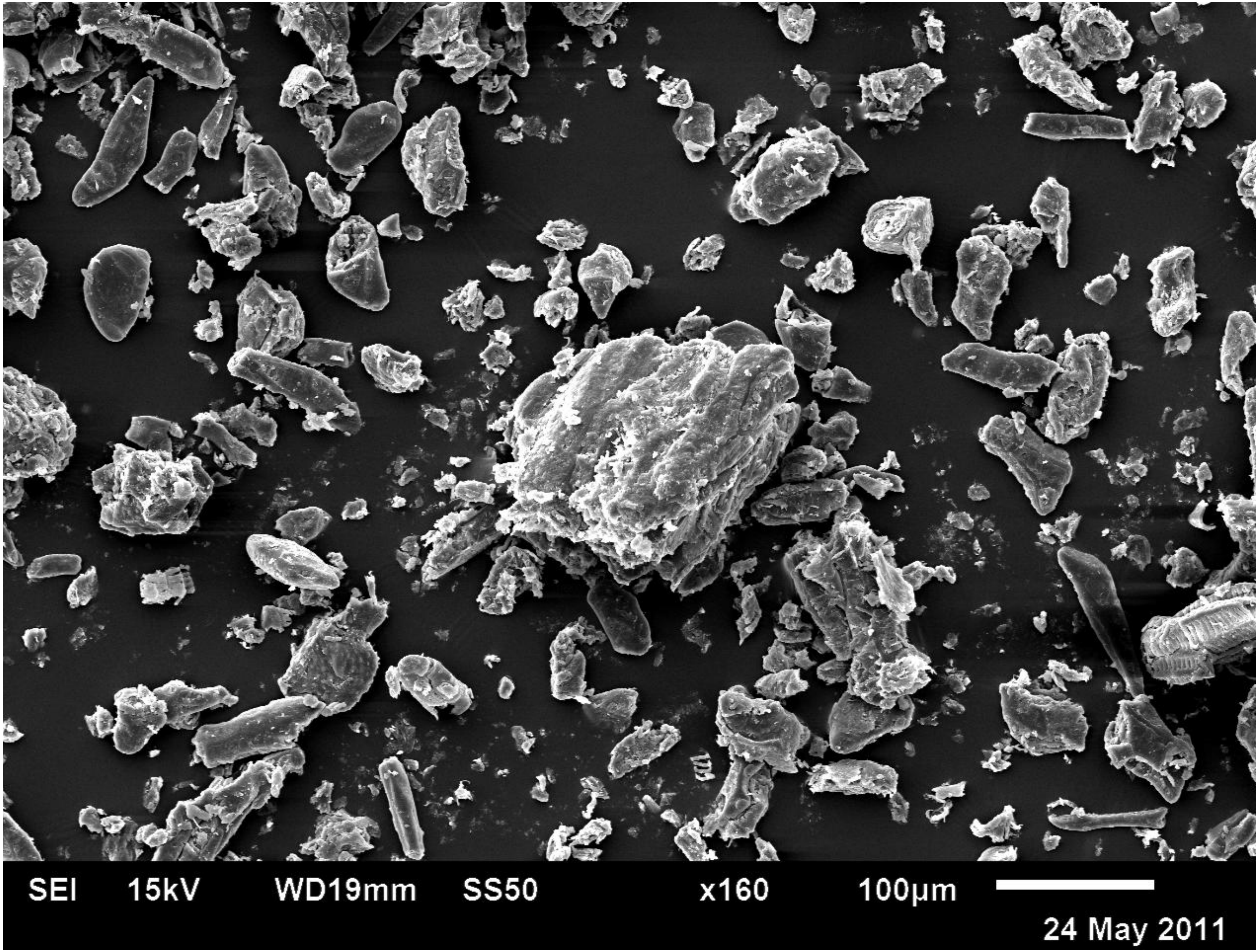
What is the unique physical property of coconut shell? High hardness!

How hard is coconut shell?

Coconut Shell is 4X harder than the hardest maple hardwood!

Coconut Shell is 10X harder than the pine wood!




SEI
15kV
WD19mm
SS50
x160
100µm
24 May 2011

Coconut Shell Powder (CSP) -- Reinforcement in Polypropylene, Polyethylene or Co-polymer of PP/PE

Improving neat resin properties while reducing cost

- **Significantly increases tensile and flexural moduli**
- **Modest increase in tensile strength**
- **Good retention of ductility and Izod impact toughness**
- **Good UV resistance; reduces UV degradation in polymers**
- **High lignin content resists odor development associated with natural materials**

- **Possible uses of CSP in plastics, cosmetics and other applications**

Automotive

http://www.geminigroup.net/interior_trim/index.html

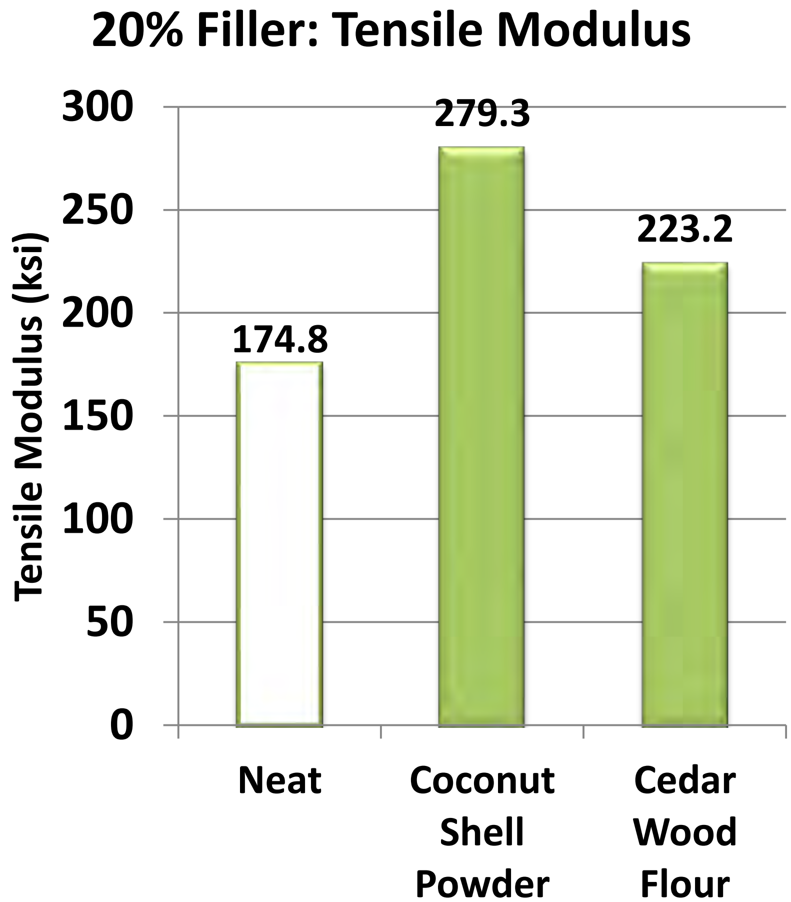
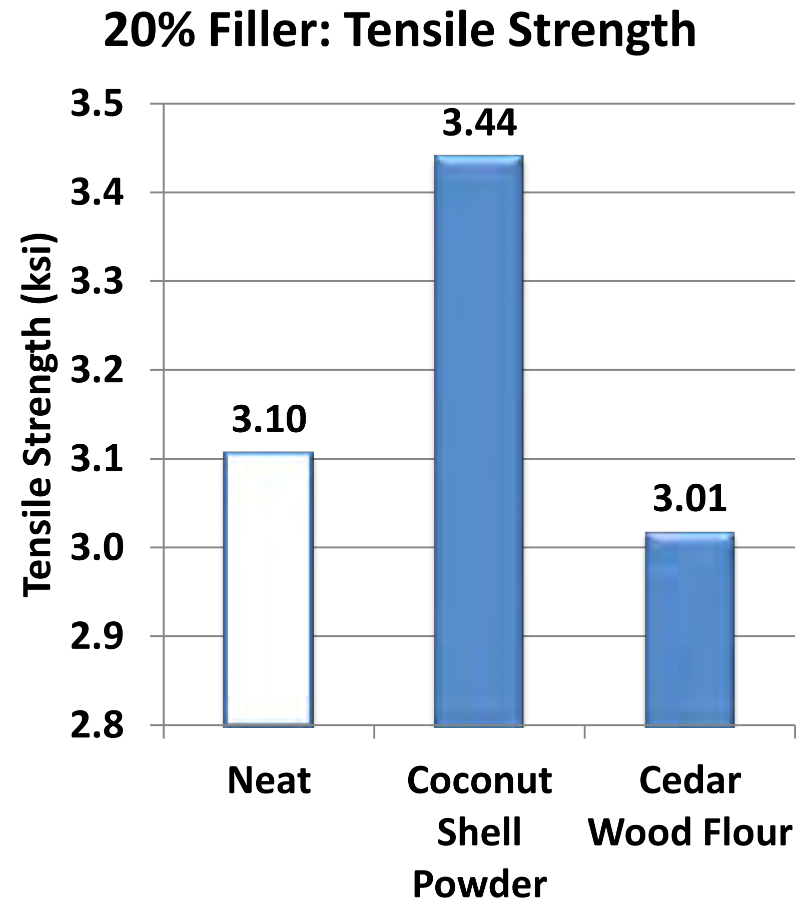
Toys

Construction
Plastic Lumber / trim / panels

Decking

austinwholesaledecking.com

Consumer goods / Packagi


20% Filler: Tensile Modulus
Tensile Modulus (ksi)
300
250
200
150
100
50
0
174.8
279.3
223.2
Neat
Coconut Shell Powder
Cedar Wood Flour

20% Filler: Tensile Strength
Tensile Strength (ksi)
3.5
3.4
3.3
3.2
3.1
3.0
2.9
2.8
3.10
3.44
3.01
Neat
Coconut Shell Powder
Cedar Wood Flour

SUMMARY

1. CoirForm non-woven fabric composites made with coir and a polymeric binder fibers offer substantial improvements in properties with significant reductions in cost.

2. Coconut shell power as a reinforcement in polyolefins offers a significantly improved performance at a substantially reduced cost.

3. Both make more environmentally friendly polymeric composites.

POTENTIAL TO HELP POOR COCONUT FARMERS IS HUGE!

Acknowledging those who made major contributions to this work

- Elisa Teipel
- Stanton Greer
- Sean Conroy
- Matt Kirby
- David Fait
- Ben Peterson
- David Hagen
- Ryan Vano

Thank you for your interest?

QUESTIONS?