Composites in Sporting Goods

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Areas of Composite Usage at K2 Sports

- Skis
- Snowboards
- Snowboard Bindings
- Inline Skates
- Nordic Skis
- Nordic Ski Poles
- Nordic Ski Boots
- Snowshoes

Composite Usage at K2 Sports

- Types of Products
- Types of Composites for Each
- Design Drivers
- Material Selection Considerations
- Examples

Skis

- Skis
- Type of Composite
  - Wet Lay up Glass and Carbon Epoxy
    - Di functional epoxy with amine curing agent
    - Woven, non-woven, stitched uni and braided glass and carbon
    - Process: Wet Lay up Compression Molding
- Design Drivers
  - Stiffness and geometry driven
  - Manufacturing driven
  - Cost driven
  - Failures typically driven by:
    - Bond Failures
    - Imperfections in structure
- Material Selection Drivers
  - Cost
  - Bonding – Must join many dissimilar materials

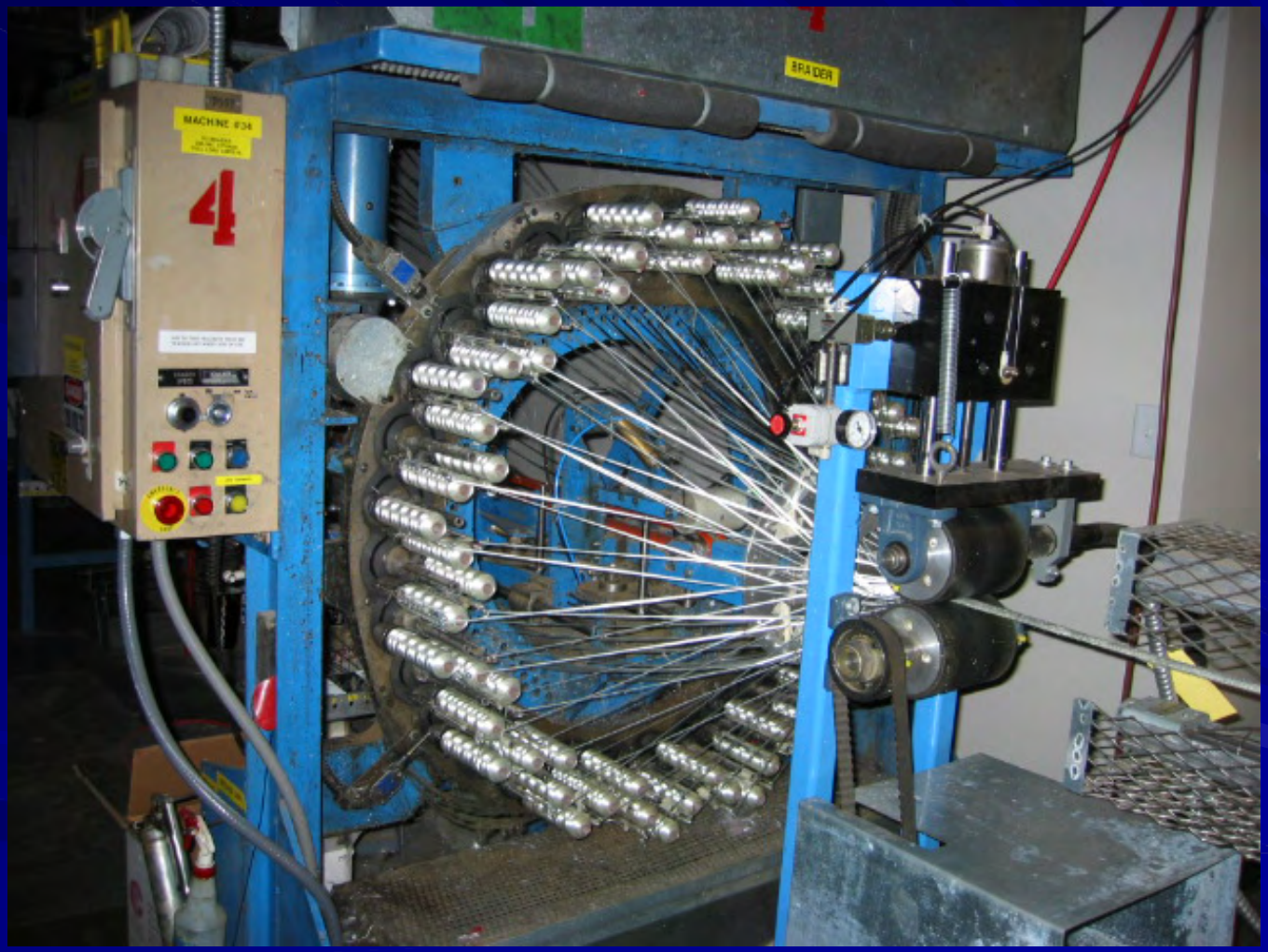

SKi & Binding - stiffness distribution
Flexureal Rigidity (lb-in^2)
1000000
100000
10000
1000
0
10
20
30
40
50
60
distance from tail (inches)
ski & binding EI
old EI

Skis


DPM PROTOTYPE TOOLING

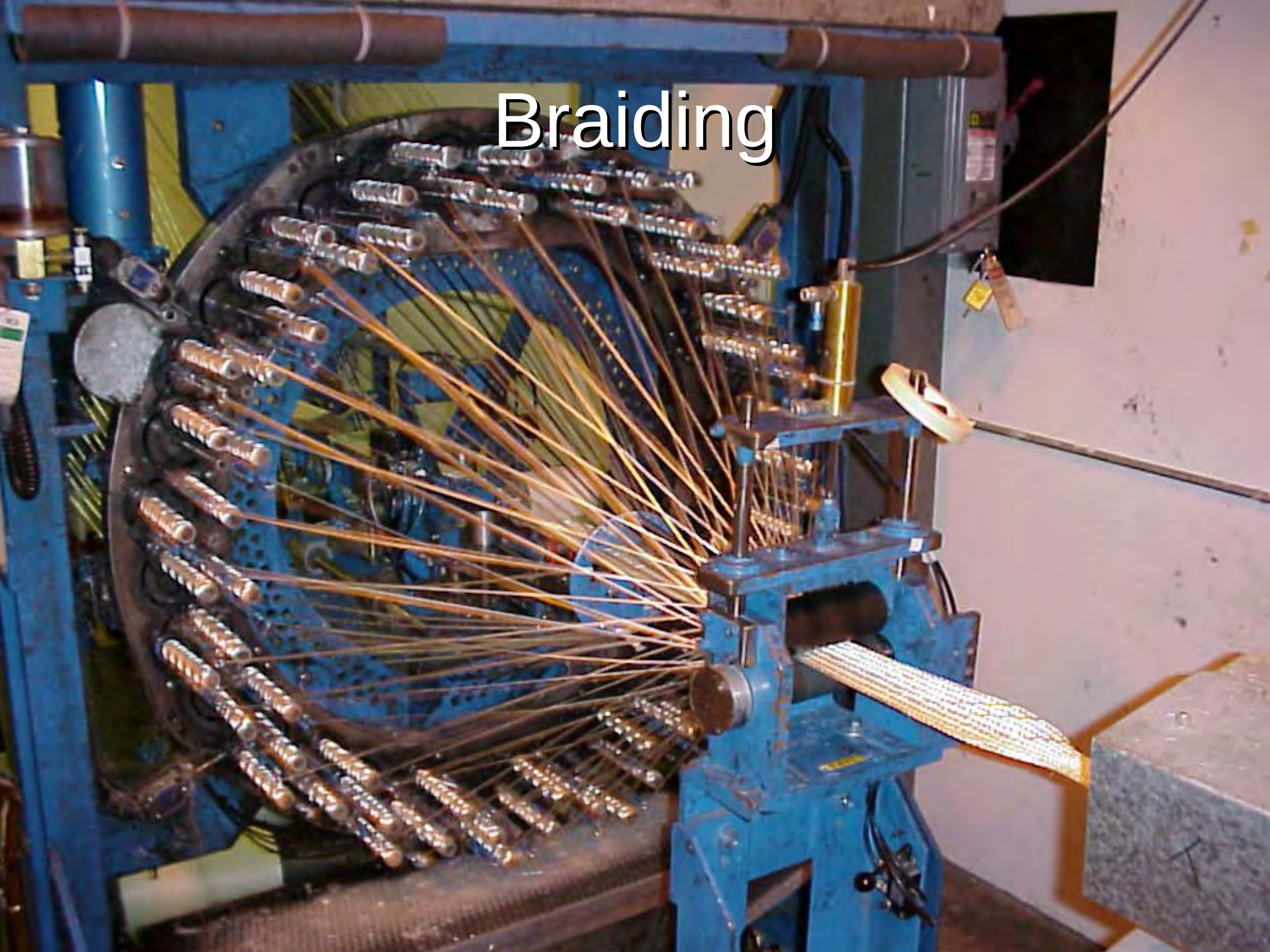
Skis

Skis

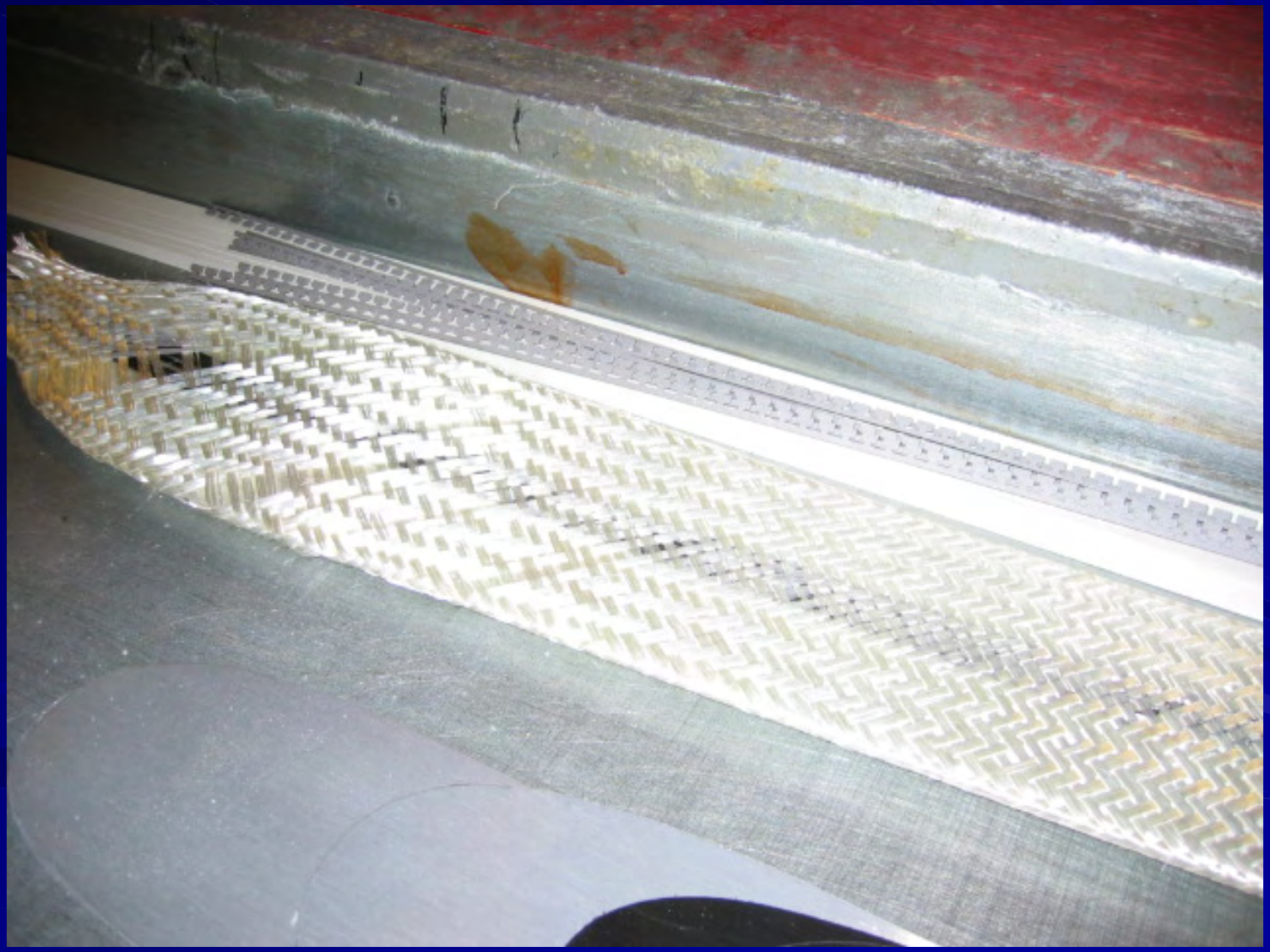


Braiding

Braiding



Skis



Skis

Skis

Molding

Snowboards

- Snowboards
- Type of Composite
  - Wet Lay up Glass and Carbon Epoxy
    - Di functional epoxy with amine curing agent
    - Woven, non-woven, stitched uni and braided glass and carbon
    - Process: Wet La yup compression molding
- Design Drivers
  - Stiffness and geometry driven
  - Manufacturing driven
  - Cost driven
  - Some weight considerations
  - Failures typically driven by:
    - Core Failures
    - Imperfections in structure
    - Bond Failures
- Material Selection Drivers
  - Cost
  - Weight
  - Bonding – Must join many dissimilar materials

Snowboad Bindings

- Snowboard Bindings
- Type of Composite
  - Injection molded glass nylon
- Design Drivers
  - Shape – complex
  - Strength
  - Weight
  - Cost
- Material Selection Drivers
  - Strength
  - Low temp. high rate loadings
  - Complex shapes
  - Cost

Inline Skates

- Price Point Skates
- Components
  - Frame
  - Base
- Type of Composite
  - Injection molded Glass/PP and Glass/Nylon
- Design Drivers
  - Stiffness
  - Strength
  - Geometry
  - Cost

Inline Skates

- Performance Skates
- Components
  - Base
  - Cuff
- Type of Composite
  - Wet Layup or Prepreg Glass and Carbon
  - Process: Vacuum bag hand layup over male tool
- Design Drivers
  - Weight
  - Stiffness
  - Geometry
  - Strength

Nordic Skis

- Nordic Skis
- Type of Composite
  - Wet Lay up Glass and Carbon Epoxy
    - Di functional epoxy with amine curing agent
    - Woven, non-woven, stitched uni and braided glass and carbon
- Design Drivers
  - Weight
  - Stiffness and geometry driven
  - Manufacturing driven
  - Cost driven
- Material Selection Drivers
  - Weight
  - Cost
  - Bonding – Must join many dissimilar materials

Nordic Ski Poles

- Nordic Ski Poles
- Type of Composite
  - Prepreg Carbon and Glass Epoxy
  - Wet processing carbon and glass epoxy
- Design Drivers
  - Stiffness
  - Weight
  - Strength must meet a minimum criteria
  - Cost

Nordic Ski Poles

- Nordic Ski Poles
- Type of Composite
  - Prepreg Carbon and Glass Epoxy
  - Wet processing carbon and glass epoxy
- Design Drivers
  - Stiffness
  - Weight
  - Strength must meet a minimum criteria
  - Cost
- Material Selection Drivers
  - Processing

Nordic Ski Poles

- Nordic Ski Poles
- Prepreg Construction
- Design Drivers
  - Stiffness
  - Weight
  - Strength must meet a minimum criterium
  - Cost
- Process is table rolling of prepreg similar to golf shafts.
- Stiffness/Weight Considerations
  - Most material is longitudinal
  - Minimal material in hoop direction (10%)
  - Weight drives a very thin structure
  - Cost and Export regs make higher modulus fibers difficult.
- Strength
  - Tested after the other criteria are met to ensure a minimum level

Nordic Ski Poles

- Nordic Ski Poles
- Wet Layup Construction
- Design Drivers
  - Cost
  - Stiffness
  - Weight
  - Strength must meet a minimum criteria
- Process is a wet bath impregnation process.
- This is a processing driven item

- Construction Considerations
  - Most material is longitudinal
  - Minimal material in hoop direction (10%)
  - Thicker structure than prepreg shafts
  - Processing nuances are tricky
- Strength
  - Tested after the other criteria are met to ensure a minimum level

Nordic Ski Boots

- Nordic Ski Boots – External parts
- Type of Composite
  - Wet Lay up Glass and Carbon Epoxy
- Design Drivers
  - Geometry
  - Stiffness
  - Weight
  - Joints
- Material Selection Drivers
  - Stiffness to weight
  - Processing

Nordic Ski Boots

Nordic Ski Boots

- Nordic Ski Boots – Internal
- Type of Composite
  - Glass or carbon epoxy sheet die cut
- Design Drivers
  - Stiffness
  - Weight
  - Cost
- Material Selection Drivers
  - Stiffness
  - Cost

Snowshoes

- Snowshoes
- Type of Composite
  - Thermoplastic coated fabric
- Design Drivers
  - Tear Strength
  - Hole Pullout Strength
  - Abrasion
  - Low Temp Properties
  - Decoration
  - Cost

Conclusion

- Types of Composites
  - Pre preg Glass and Carbon Epoxy
  - Wet Layup Glass and Carbon Epoxy
  - Injection molded thermoplastic
  - Coated Fabrics
- Overall Drivers
  - Cost
  - Manufacturing
  - Stiffness
  - Weight
  - Strength
  - Tooling Cost and Flexibility

Conclusion

- Types of Composites
  - Prepreg Glass and Carbon Epoxy
  - Wet Layup Glass and Carbon Epoxy
  - Injection molded thermoplastic
  - Coated Fabrics
- Products
  - Skis
  - Snowboards
  - Snowboard Bindings
  - Inline Skates
  - Nordic Skis
  - Nordic Ski Poles
  - Nordic Ski Boots
  - Snowshoes

Future Directions

- The natural and eco element is gaining momentum.
- Recycling
- Natural Composites
- Cost/Processing issues may gain more importance

Discussion

- Questions, comments and discussion