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

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

Flexural Rigidity (lb-in²)

distance from tail (inches)

- ski & binding EI
- old EI
DPM PROTOTYPE TOOLING
Skis
Skis
Braiding
Braiding
Skis
Skis
Skis
Molding
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 Lay up 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

- **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

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

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

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
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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