

Cellulose Biocomposite Overview

PacWest

May 2022



West Fraser

About West Fraser

An integrated solid forest products company primarily focused on wood products.

- Founded in 1955 in Quesnel, BC.
- Core business is producing lumber, engineered wood products (OSB, laminated veneer lumber (LVL), MDF, plywood), pulp and newsprint, biomass residuals and renewable energy.
- 10,000+ employees in 63 operations in Western Canada, across the Southern United States, EU and UK.
- North America's largest lumber producer.



West Fraser Operations

☆ CORPORATE OFFICES

● LUMBER

- Canada
 1. Quesnel
 2. Williams Lake
 3. Smithers
 4. Chetwynd
 5. Fraser Lake
 6. 100 Mile House
 7. Blue Ridge
 8. Hinton
 9. Edson
 10. Sundre
 11. High Prairie
 12. Manning

U.S.

13. Joyce
 14. Huttig
 15. Henderson
 16. New Boston
 17. Leola
 18. Mansfield
 19. Russellville
 20. Maplesville
 21. Opelika
 22. McDavid
 23. Perry
 24. Lake Butler
 25. Maxville
 26. Whitehouse
 27. Blackshear
 28. Fitzgerald
 29. Dudley
 30. Augusta
 31. Newberry
 32. Armour
 33. Seaboard
 34. Angelina

▲ PULP & NEWSPRINT

35. Hinton (NBSK)
 36. Quesnel (NBSK)
 37. Quesnel (BCTMP)
 38. Slave Lake (BCTMP)
 39. Whitecourt (newsprint)

ENGINEERED WOOD

■ PLYWOOD

40. Edmonton
 41. Quesnel
 42. Williams Lake

■ MDF, PARTICLEBOARD & FURNITURE

- Canada
 43. Blue Ridge (MDF)
 44. Quesnel (MDF)

U.K.

45. Cowie, Scotland (PB & MDF)
 46. South Molton, England (PB & furniture)

■ VENEER & LVL

47. Rocky Mountain House
 48. Slave Lake

■ OSB

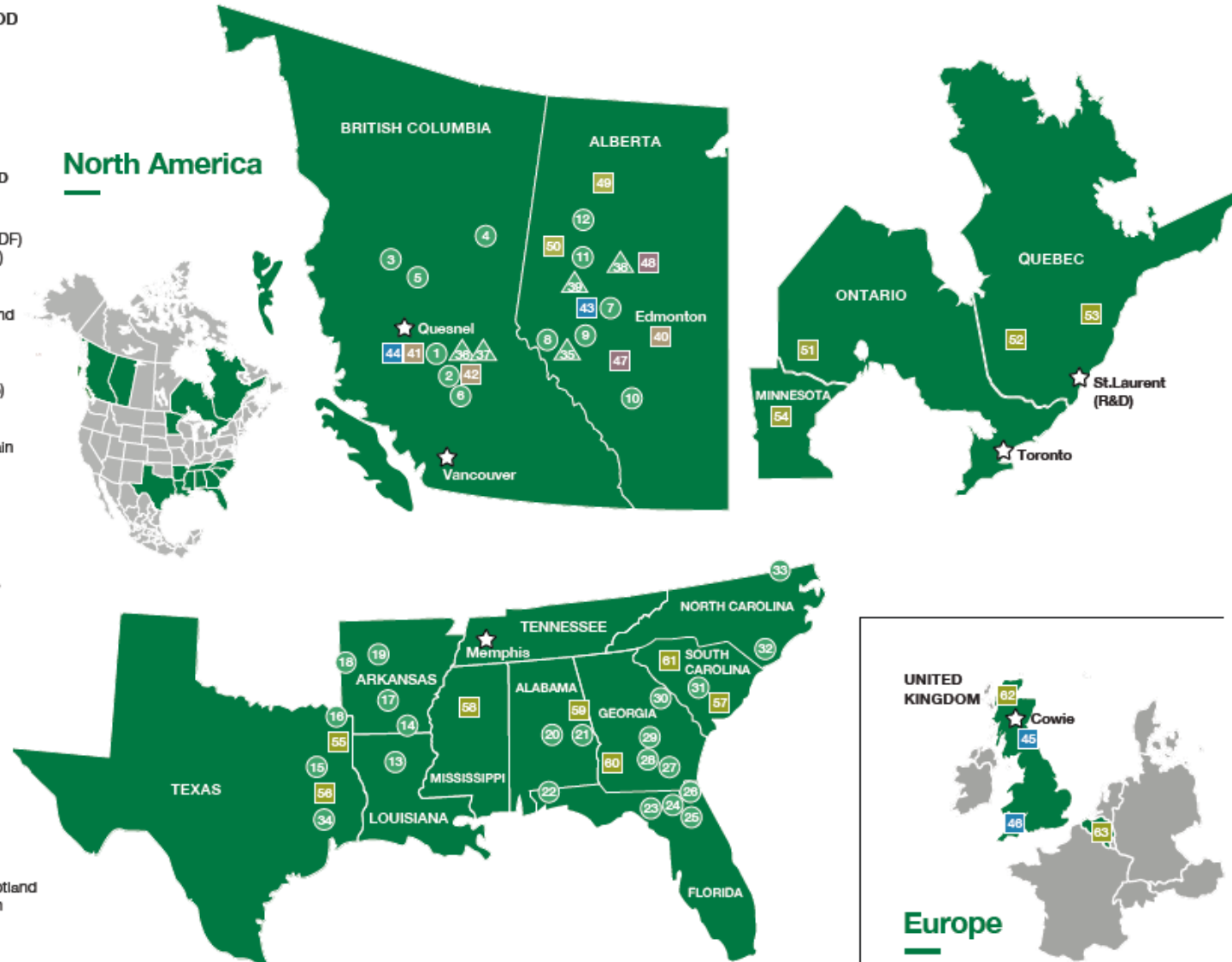
- Canada
 49. High Level
 50. Grande Prairie
 51. Barwick
 52. La Sarre
 53. Chambord

U.S.

54. Bemidji
 55. Jefferson
 56. Nacogdoches
 57. Allendale
 58. Guntown
 59. Huguley
 60. Cordale
 61. Joanna

U.K. & Europe

62. Inverness, Scotland
 63. Genk, Belgium



Sustainability

- Driving force towards biodegradable plastics
 - Science Based Target Initiative (SBTi)
 - West Fraser dedicated to reduce Scope 1 and 2 emissions by 46 % and Scope 3 by 25 % by 2030, and achieve net zero by 2050
 - Single use plastic bans intensifying globally
 - Microplastic pollution leading to health problems (e.g., cancer <https://www.nature.com/articles/d41586-021-01143-3>)
 - Recycling issues, such as collection, separation (components and contaminations)
- Advantages of biodegradability/compostability
 - Inherently contains large amounts of natural, carbon neutral materials
 - Doesn't require extensive waste collection infrastructure
 - Compostable is better; however, "life-span" limit product portfolio

General Product Information

- What is the product?
 - Cellulose Reinforced Plastic Composite. Cellulose is dispersed in a PP/PVC/PE matrix at load levels suitable for compounding, injection molding and extrusion applications.
 - Currently, a material with limited sustainable attributes; however, Propel with fully biodegradable plastic components are under development
- Basic Product composition
 - Pulp
 - Additives
 - Virgin plastics

Product Forms

1. Cellulose Masterbatch.

- 85% active cellulose level.
- Suitable for addition into PP, PVC, PE
- Readily dispersible using conventional compounding techniques.

2. Cellulose Letdowns

- 10%, 20%, 30%, 40% active cellulose level.
- Currently available in PVC, PP, HDPE, TPO
- Ready for direct molding or extrusion.

Compelling Value Proposition: Key Differentiators of WF Composite

1. Better mechanical properties vs incumbents
2. Properties are more isotropic
3. Excellent processing characteristics
 - Significantly faster machine press times in multiple applications tested
4. Lower part mass (“light-weighting”)
5. Price/Value
 - Competitive with glass-filled PP

<https://oilprice.com/>



Markets/Industries and Applications (Initial)

Markets/Industries

- Appliances
- Automotive
- Building and Construction
- Consumer Durables
- Consumer Non-Durables
- Furniture
- Household Goods
- HVAC
- Industrial
- Packaging

Potential Applications

- Consoles
- Door panels
- Knobs, shifters
- Air vent and HVAC parts
- Pen grips
- Razor grips
- Kitchen utensils, tools
- Kitchenware
- Power tools
- Hand tools
- Fan blades
- Housings
- Etc.

Simple View of Value Chain: Focus of Initial Efforts



Target 1b

Lower
Emphasis
than
OEM's

Very Selective

Not an
Emphasis
Up-Front

Target 1a

75%+ of Targets

Value Chain	Benefits of West Fraser Composite to the Value Chain
OEM	Achieves Class A surface finish
	Lightweight yet strong
	Achieves color requirements
	Good chemical resistance
	Low part mass
	Meets key performance standards
Injection Molder	Uniform shrinkage
	Very good flow characteristics
	Very good molding cycle time
	Wide molding processing temp range
	Good surface bonding
	Very low moisture absorption
	Compounder
Integrates easily w/ other additives	
Low wear and tear on equipment	
Easy to compound	

Other Potential Benefits Over Alternative Materials

Glass Reinforced Composites	Filled/Unfilled Plastic Compounds
Improved molding cycle time.	Higher modulus.
Reduced mass.	Superior mold flow in large parts.
Weight savings on finished parts.	Fast filling of molds.
Can reduce energy requirements.	Improved chemical resistance.
Less abrasive, reduced wear and tear on equipment.	Lower wall thickness.

Product Properties Comparison-PP Composites

			<i>Product Comparison</i>		
Physical Properties	Method	Units	Propel 30% Cellulose	Glass Fiber 30%	Talc 30%
Specific Gravity	ASTM D792		1.01	1.12	1.13
Mechanical Properties	Method	Units	WF 30% Cellulose	Glass Fiber 30%	Talc 30%
Tensile:					
Modulus	ASTM D638	psi	535,000	940,000	550,000
Strength	ASTM D638	psi	7,400	6100	4500
Elongation @ Yield	ASTM D638	%	5.0	1.1	2.1
Flexural:					
Modulus	ASTM D790	psi	465,000	690,000	395,000
Strength	ASTM D790	psi	11,700	10,500	7,500
IZOD Impact:					
Notched	ASTM D256	ft-lbs/in	0.5	0.7	0.35
Unnotched	ASTM D256	ft-lbs/in	6.0	3.0	3.5
HDT @ 0.45 MPa	ASTM D648	MPa	147 °C	157 °C	137 °C
HDT @ 1.8 MPa	ASTM D648	Mpa	95 °C	141 °C	79 °C
24 hour Moisture Uptake		%	0.50	0.05	0.05

Product Properties Comparison-PVC Composites

			<i>Product Comparison</i>			
Physical Properties	Method	Units	Propel 30% Cellulose	Propel 35% Cellulose	Propel 40% Cellulose	40% Wood filled PVC
Specific Gravity	ASTM D792	g/cm ³	1.38	1.39	1.40	1.40
CLTE	D696	In/in/F x10 ⁻⁵	1.6	1.4	1.2	2.2
Mechanical Properties	Method	Units	Propel 30% Cellulose	Propel 35% Cellulose	Propel 40% Cellulose	40% Wood filled PVC
Flexural:						
Modulus	ASTM D790	psi	850,000	1,100,000	1,300,000	700,000
Strength	ASTM D790	psi	11,700	11,500	12,500	8,000
IZOD Impact:						
Notched	ASTM D256	ft-lbs/in	0.60	0.55	0.50	0.35
Unnotched	ASTM D256	ft-lbs/in	3.50	3.25	2.85	1.40
HDT @ 0.45 MPa	ASTM D648	MPa	105 °C	110 °C	114 °C	100 °C
HDT @ 1.8 MPa	ASTM D648	Mpa	77 °C	80 °C	82 °C	73°C
24 hour Moisture Uptake		%	0.5	0.7	0.8	0.9

Conclusions

- Propel is a proprietary cellulose filled plastic
- Currently available compounded materials include PVC, PE and PP
- Development ongoing with fully biodegradable plastics
- Material properties are optimized for usual plastics processing equipment and end-use applications
- Value is competitive for direct replacement

Thank You!

Matyas Kosa, PhD | Bioproducts Lead

Office: 250.991.5380 | Mobile: 250.255.4931

e-mail: Matyas.Kosa@westfraser.com