

# HEARTLAND

## Imperium-Filled rPP Composites

Scope: Replace 20% TF-PP

## Project Goal

The goal of this project is to create a hemp filled PP composite material with good tensile, and flex performance with notched impact performance exceeding 2.00 ft-lb/in

## Strategy and Workflows

Strategy will be focused on recycled/reprocessed PP in conjunction with 20-30% hemp filler, impact modifier, and coupling agent.

Trials Performed:

HHPC0622\_01

HHPC0922\_01

# IZOD Impact Data

Trial	#	Sample Description	Izod Impact Notched (ft-lb/in)	Izod Impact Notched Std. Dev	Type of Break	Izod Impact UnNotched (ft-lb/in)	Izod Impact UnNotched Std. Dev.	Type of Break
HHPC062 2-01	1	NBPP 30 Melt; 20% Hemp; 10% Impact modified	<b>1.61</b>	0.06	H	<b>4.85</b>	0.63	H
	2	NBPP 30 Melt; 30% Hemp; 10% Impact modified	<b>1.45</b>	0.07	H	<b>5.09</b>	0.49	C
	3	NBPP 30 Melt; 20% Hemp	<b>1.19</b>	0.06	H	<b>4.39</b>	0.24	C
	4	NBPP 30 Melt; 30% Hemp	<b>1.00</b>	0.04	H	<b>3.49</b>	0.55	C
	5	NBPP 30 Melt, repro	<b>3.44</b>	0.26	H	<b>15.49</b>	0.80	N
	6	N20N-00 ?	<b>9.92</b>	0.40	H	<b>16.37</b>	0.00	N
HHPC09 2-01		UP3589 NBPP; 20% Hemp; 10% Impact modified	<b>1.58</b>	0.10	H	<b>6.66</b>	0.50	H
		UP3589 NBPP; 30% Hemp; 10% Impact modified	<b>1.31</b>	0.09	H	<b>5.01</b>	0.23	H
		Deltco NBPP; 20% Hemp; 10% Impact modified	<b>2.28</b>	0.13	H	<b>7.46</b>	0.72	H
		Deltco NBPP; 30% Hemp; 10% Impact modified	<b>1.74</b>	0.14	H	<b>6.27</b>	0.61	H

TDS for control material [INEOS N20N, control, #6] indicates a "No Break" notched IZOD impact performance. Our testing shows a value of 9.92 ft-lb/in with a hinged break. The discrepancy between the observed and TDS reported impact performance, draws into question all of the Impact performance data.

This sample identity needs to be confirmed (arrived UNlabelled)

Verified with our internal standard. Instrument is functioning properly and not an issue.

ASTM D256 – Notched

ASTM D4812 - Unnotched

# Flex Testing

Trial	#	Sample Description	Flexural Strength (psi)	Flexural Strength Std. Dev.	Flexural Modulus (psi)	Flexural Modulus Std. Dev.
HHPC0622-01	1	NBPP 30 Melt; 20% Hemp; 10% Impact modified	<b>4264</b>	72	<b>183257</b>	4429
	2	NBPP 30 Melt; 30% Hemp; 10% Impact modified	<b>5075</b>	67	<b>237883</b>	4677
	3	NBPP 30 Melt; 20% Hemp	<b>4290</b>	58	<b>197457</b>	5873
	4	NBPP 30 Melt; 30% Hemp	<b>4696</b>	57	<b>255841</b>	5591
	5	NBPP 30 Melt, repro	<b>3474</b>	73	<b>122566</b>	5039
	6	N20N-00 ?	<b>4691</b>	66	<b>166036</b>	3380
HHPC0922-01	1	UP3589 NBPP; 20% Hemp; 10% Impact modified	<b>3250</b>	71	<b>134740</b>	5120
	2	UP3589 NBPP; 30% Hemp; 10% Impact modified	<b>4362</b>	90	<b>204543</b>	4086
	3	Deltco NBPP; 20% Hemp; 10% Impact modified	<b>3627</b>	13	<b>136535</b>	5296
	4	Deltco NBPP; 30% Hemp; 10% Impact modified	<b>4475</b>	50	<b>189807</b>	2629

ASTM D790 - Molded

# Tensile Testing

Trial	#	Sample Description	Tensile Strength (psi)	Tensile Strength Std. Dev.	Elongation at Break (%)	Elongation Std. Dev.	Tensile Modulus (psi)	Tensile Modulus Std. Dev.
HHPC06 22-01	1	NBPP 30 Melt; 20% Hemp; 10% Impact modified	<b>2787</b>	30	<b>4.64</b>	0.18	<b>218747</b>	9215
	2	NBPP 30 Melt; 30% Hemp; 10% Impact modified	<b>3194</b>	36	<b>3.99</b>	0.24	<b>283236</b>	6055
	3	NBPP 30 Melt; 20% Hemp	<b>2588</b>	17	<b>4.12</b>	0.18	<b>240790</b>	7067
	4	NBPP 30 Melt; 30% Hemp	<b>2701</b>	21	<b>3.12</b>	0.20	<b>314423</b>	7678
	5	NBPP 30 Melt, repro	<b>2682</b>	17	<b>21.45</b>	6.24	<b>128801</b>	2345
	6	N20N-00 ?	<b>3174</b>	40	<b>2 broke, 5 didn't</b>	4.16	<b>190480</b>	2840
HHPC09 22-01	1	UP3589 NBPP; 20% Hemp; 10% Impact modified	<b>2554</b>	28	<b>9.29</b>	0.84	<b>162912</b>	7124
	2	UP3589 NBPP; 30% Hemp; 10% Impact modified	<b>3079</b>	26	<b>6.04</b>	0.50	<b>245741</b>	2720
	3	Deltco NBPP; 20% Hemp; 10% Impact modified	<b>2800</b>	30	<b>8.69</b>	0.99	<b>166436</b>	3303
	4	Deltco NBPP; 30% Hemp; 10% Impact modified	<b>3193</b>	28	<b>6.56</b>	0.34	<b>222359</b>	4759

# MFI Testing

Trial	#	Sample Description	MFI (g/10 min)	MFI Std. Dev.
HHPC0622-0 1	1	NBPP 30 Melt; 20% Hemp; 10% Impact modified	11.0	0.0
	2	NBPP 30 Melt; 30% Hemp; 10% Impact modified	4.9	0.5
	3	NBPP 30 Melt; 20% Hemp	16.0	0.5
	4	NBPP 30 Melt; 30% Hemp	8.0	0.0
	5	NBPP 30 Melt, repro	50.5	0.1
	6	N20N-00 ?	30.4	0.8
HHPC0922-0 1	1	UP3589 NBPP; 20% Hemp; 10% Impact modified	8.5	0.7
	2	UP3589 NBPP; 30% Hemp; 10% Impact modified	2.8	0.2
	3	Deltco NBPP; 20% Hemp; 10% Impact modified	8.8	1.6
	4	Deltco NBPP; 30% Hemp; 10% Impact modified	4.7	0.2

Conditions: 5.00 kg @ 190C

**Thank You**

# **HEARTLAND**

Sustainability Without Compromise