April 24, 2023

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Plastics App, Example Lab Test Report – WO 502193

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1. Project:

Compounding, Molding & Testing of Polypropylene Glass Fibers composition.

2. Equipment:

2.1. Twin screw extruder, Coperion, ZSK18, D-18mm, 48L/D
2.2. Injection molding machine, BOY 22A, 22 ton, D=24mm, 22L/D
2.3. Hot air circulation oven, 0.1°C Temperature readout.
2.4. Melt flow indexer, Wance Testing Machine
2.5. Thermal Analysis, Perkin Elmer, Modulated DSC 600
2.6. IR Spectroscopy, Perkin Elmer, Spectrum 2, FTIR
2.7. Specific Gravity, Density Kit, Mettler Toledo
2.8. Determination of Ash, Muffle Furnace (CARBOLITE Gero) & Analytical scale (Mettler Toledo)
2.9. Optical microscopy
2.10. Testometric, M500-50CT
- Tensile properties, full scale load cell 50kN
- Flexural properties, full scale load cell 1kN, Span distance 64mm

2.11. Izod Impact - Zwick, D-7900, type 5101

3. Test methods:

3.1. Compounds preparation by twin screw extruder.
3.2. Injection molding of test specimens of thermoplastic materials, ISO 294
- Tensile ISO 527 1A
- Impact bars ASTM D256
- Color Chip, 3,2,1mm
  - Compounds were dried @ 80°C prior to injection

3.3. MFI, ISO 1133 @ 230°C / 2.16Kg
3.4. Differential Scanning Calorimetry, ISO 11357
3.4.1. Determination of composition, through thermal analysis of transition temperatures.
- Temperature ramp scan, Heat @ 10°C/min, -30°C→230°C→0°C→230°C

3.5. FTIR for film, pressed @ 220°C, 10 Ton
3.6. Specific Gravity, ISO 1183 @ RT & Ethanol
3.7. Determination of Ash, ISO 3451 @ 700°C
3.8. Optical microscopy, magnification X7

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3.9. Mechanical properties evaluation:

3.9.1. Determination of Tensile properties, ISO 527

- The test was performed at speed of 1 (mm/min) for modulus and 50 (mm/min) for Strength & Break properties

3.9.2. Determination of Flexural properties, ISO 178

- The test was performed at speed of 2 (mm/min)

3.9.3. Determining the Izod Pendulum Impact Resistance of Plastics, ASTM D 256

4. Raw Materials:

- PP - Polypropylene Homopolymer, Carmel Olefins, Capilene R50, MFI-12
- CA - PP-g-MAh, Polyram, Bondyram 1101
- GF - Generic, PP compatible, Chopped Glass fibers

5. Sample description

Compound	Inj.#	PP	CA	GF
PA-310521-C1	**M1**	77%	3%	20%
PA-310521-C2	**M2**	67%	3%	30%

Table 1: Sample description

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6. Results & Discussion

6.1. IR spectroscopy

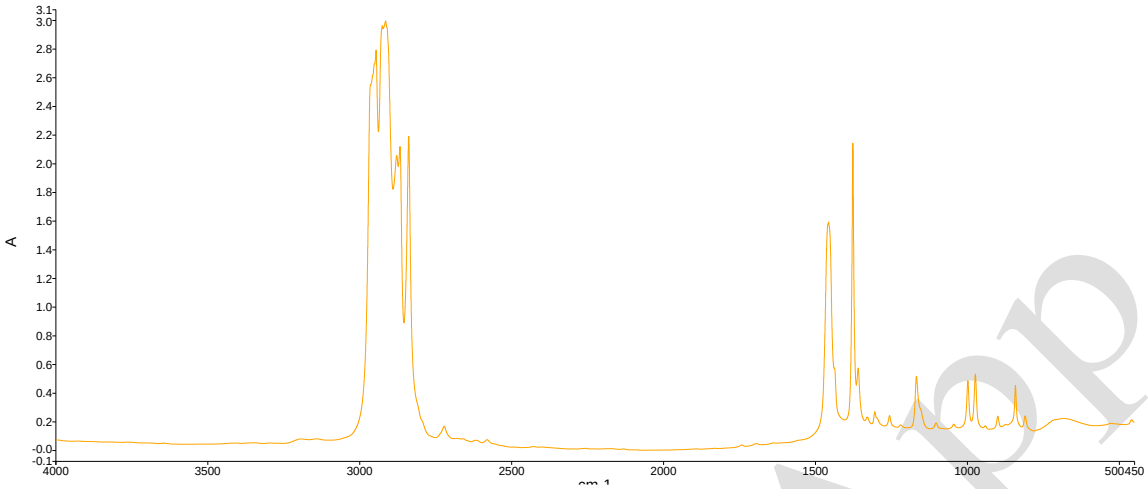

Figure 1: Typical FTIR scan of pressed sample

FTIR absorbance of all compounds are characteristic to polypropylene (PP) with glass fibers (GF).

6.2. Thermal analysis

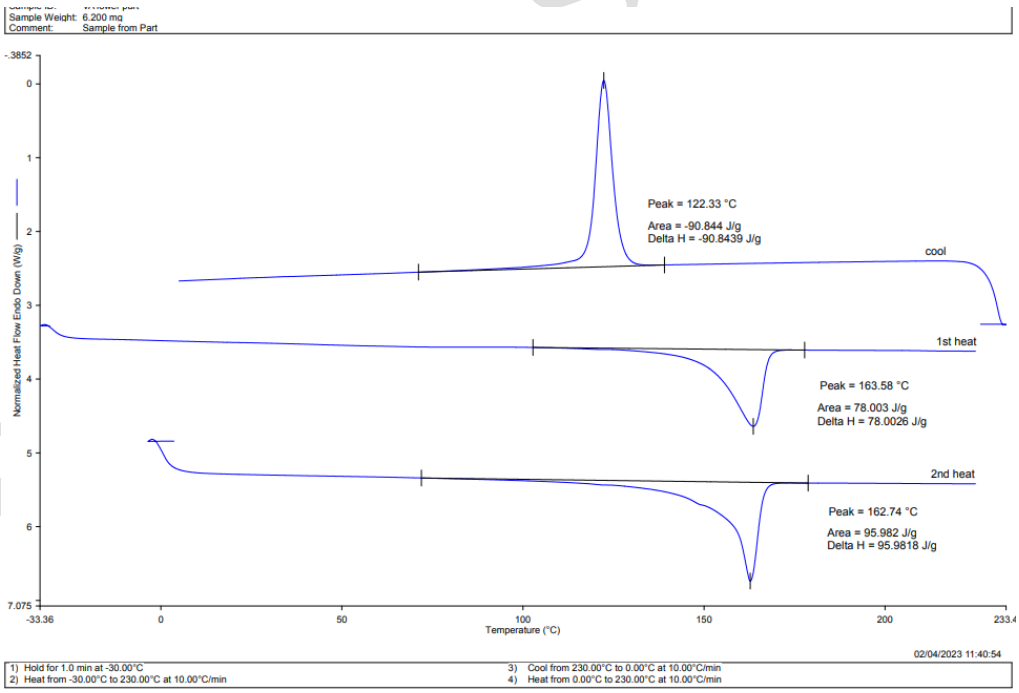

Figure 2: Typical DSC scan

The thermograms are typical of PP.
The relatively high crystallization temperature, Tc, suggests strong nucleation effect.

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6.3. **Optical microscopy**

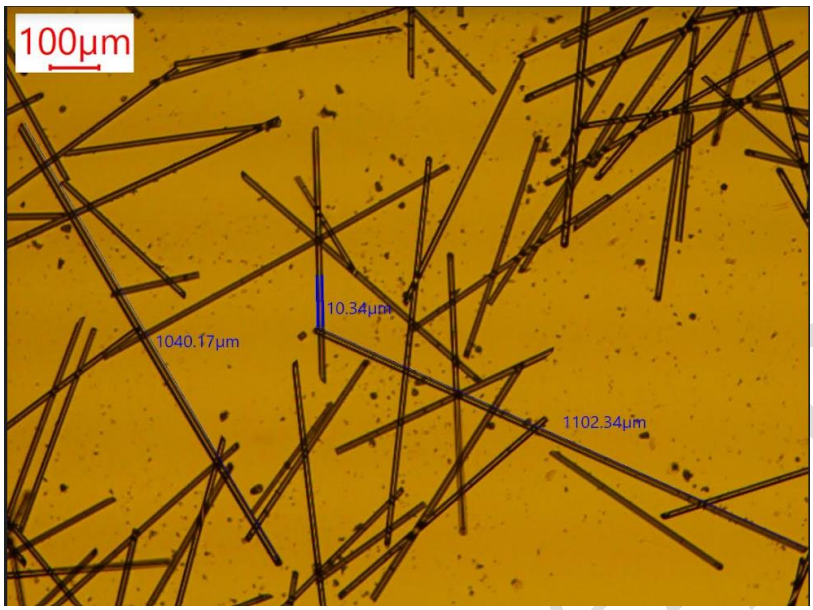

Figure 3: Typical microscope image of Ash residues, magnification X7

Microscope image of the ash residues are typical to GF, without any additional components. Fibers' length seem to be well preserved during compounding & molding

6.4. **Typical properties**

Properties	Standard	Unit	C1M1	C2M2
Density	ISO 1183	gr/cm³	1.03	1.12
Ash content	ISO 3451	%	19.7	29.3
MFI (230°C / 2.16 Kg)	ISO 1133	gr/10min	6.7	6.5
Tensile Modulus	ISO 527	MPa	4,750	6,853
Tensile Strength	ISO 527	MPa	68	92
Strain at Break	ISO 527	%	3.4	3.2
Flexural modulus	ISO 178	MPa	5,273	7,126
Flexural strength	ISO 178	MPa	80	116
Izod Impact notched	ASTM D256	J/m	93 C	123 C

Table 2: Typical properties

Density & Ash content as well as other properties match expectations and typical performance of those compounds.

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7. Conclusion and Remarks:

General

7.1. The combined results of evaluation and performance are compatible for hPP w 20% & 30% GF.

Processing

7.2. Compounding process was smooth without any events & feeding was stable.

7.3. Injection went well w/o difficulties.

8. Appendixes:

Appendix A - Mechanical properties, full results
Appendix B - Injection parameters
Appendix C - Extrusion parameters.

With kind regards,

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Appendixes

A. Mechanical properties – full results

A.1. Tensile test results:

Testometric
materials testing machines

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Customer :
Sample # : 1
Note : PP 20%GF
Injection date : 01.06.21

Test Name : 1_ Tensile - Default
Test Type : Tensile
Test Date : 09/06/2021 15:40
Test Speed : 1.000 mm/min
Pretension : 20.000 N
Width : 9.750 mm
Thickness : 3.850 mm
Extensometer : M2
Gauge Length : 50.000 mm
Sample Length : 170.000 mm

Test No	Secant Modulus 0.050 to 0.250 % (MPa)	Stress @ Yield (MPa)	Stress @ Break (MPa)	Strain @ Yield (%)	Strain @ Break (%)
1	3834.192	54.290	53.810	2.660	3.016
2	3849.131	54.103	53.722	2.745	3.135
3	3638.138	54.085	52.531	2.875	3.785
4	3733.608	54.743	53.208	2.702	3.766
5	3748.278	54.356	53.208	2.724	3.530
Min	3638.138	54.085	52.531	2.660	3.016
Mean	3760.669	54.315	53.296	2.741	3.446
Max	3849.131	54.743	53.810	2.875	3.785
S.D.	85.339	0.266	0.511	0.081	0.356

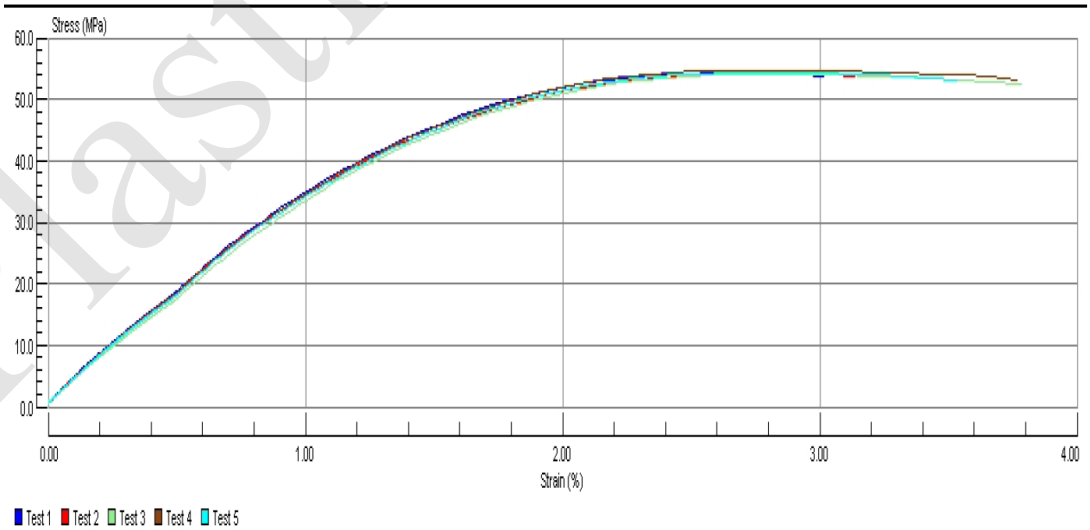

Figure 4: Typical tensile curve. results for – M1

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A.2. **Flexural test results:**

Testometric
materials testing machines

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Customer :
Sample # : 1
Note : PP 20%GF
Injection date : 01.06.21

Test Name : 1_3 Point Bending - 64mm
Test Type : 3 Point Flexural
Test Date : 14/06/2021 15:56
Test Speed : 2.000 mm/min
Preload : 1.200 N
Width : 9.750 mm
Thickness : 3.850 mm
Span : 64.000 mm

Test No	Secant Modulus 0.050 to 0.250 % (MPa)	Bending Strength @ Peak (MPa)
1	3709.694	78.849
2	3752.389	80.642
3	3845.783	78.716
4	3736.178	79.845
5	3766.099	80.576
Min	3709.694	78.716
Mean	3762.029	79.726
Max	3845.783	80.642
S.D.	51.311	0.917

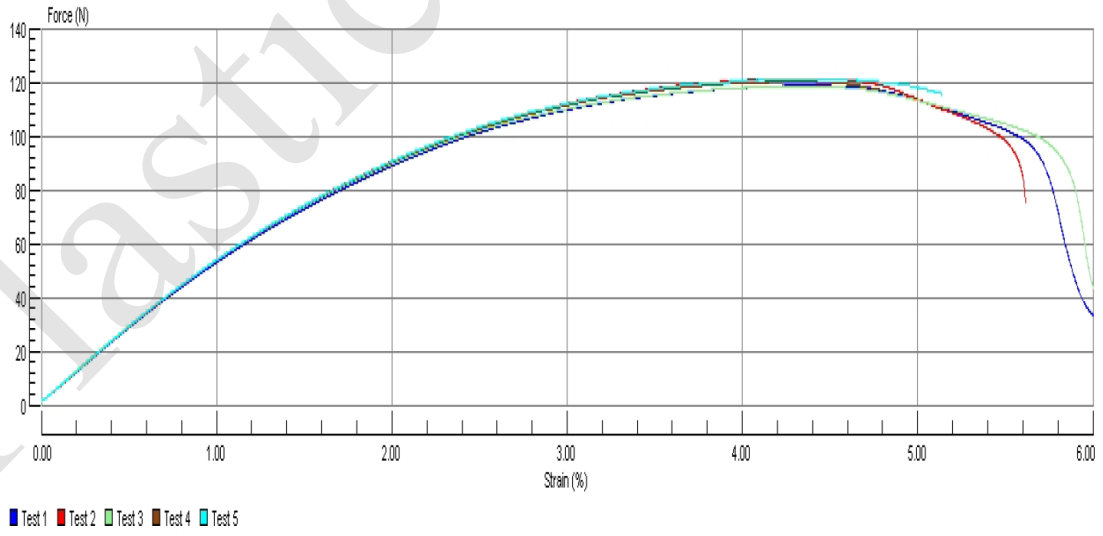

Figure 5: Typical flexural curve, results for- M1

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A.3. **Impact test results:**

Izod Impact Notched [J/m]	PA-310521-C1M1	PA-310521-C2M2
s.1	93 C	120 C
s.2	93 C	123 C
s.3	91 C	123 C
s.4	95 C	126 C
s.5	93 C	123 C
Average	**93 C**	**123 C**
Std.	5	6

Table 3: Impact test results

B. Injection parameters

Project: PP w GF		Trial number: 1	Operator: Orit	Date: 01.06.21
	Sample number	M1	M2	
Temp.	T1: rear [°C]	180	180	
	T2 [°C]	190	190	
	T3 [°C]	200	200	
	T4 [°C]	210	210	
	T5: nozzle [°C]	220	220	
	Tmold [°C]	40	40	
Dosing	Materials	PA-310521-C1	PA-310521-C2	
	Material ratio [phr]	100	100	
	Stroke [mm]	74	74	
	Screw speed [rpm]	150	150	
	Back pressure [bar]	5	5	
	Dosing time [s]	11	10	
Injection parameters	Injection speed [mm/s]	150	150	
	Max. injection pressure [bar]	80	80	
	Max. actual pressure [bar]	65	68	
	Holding pressure [bar]	35	35	
	Injection time [s]	0.72	0.82	
	Holding P. time [s]	15	15	
	Switch over point [mm]	12	12	
	Cushion [mm]	2.6	2.7	
Mold	Mold	Standard	Standard	
	Valve 1: Impact+Chip [Y/N]	Y	Y	
	Valve 2: Tensile [Y/N]	Y	Y	
	Valve 3: Weld line [Y/N]	N	N	
	Cooling time [s]	10	10	
	Cycle time [s]	36	36	
	Full shot weight [g]	28.9	31.4	
	No. of samples collected	12	12	

Table 4: Injection parameters

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C. Extrusion parameters

Project: PP w GF			Trial: 1			Operator: Orit			Date: 31.05.21
	Sample number		PA-310521-C1			PA-310521-C1			
Materials	Hoper 1 feeder name		A15			A15			
	Hoper 1 location		B1			B1			
	Hopper 1 materials		PP: BR			PP: BR			
	Hopper 1 material ratio [%]		76.25: 3.75			76.25: 3.75			
	Hopper 1 output [rpm]		35			23			
	Hopper 1 output [Kg/hr | %]		4	80%		3.5	70%		
	Hoper 2 feeder name		DSR			DSR			
	Hoper 2 location		B4			B4			
	Hopper 2 materials		GF			GF			
	Hopper 2 material ratio		100			100			
	Hopper 2 output [rpm]		2.7			4			
	Hopper 2 output [Kg/hr | %]		1	20%		1.5	30%		
Working parameters	Screw design		Comp. 6.4			Comp. 6.4			
	Screw speed [1/min]		350			350			
	Torque [%]		35			43			
	Side feeder Y/N [rpm]		Y	250		Y	250		
	Pressure [bar]		2			3			
	Total output [Kg/hr]		5			5			
	Vent#1	Vent#2	Vac. [mbar]	O	O	O	O	O	O
	Die			2 holes, 5 mm			2 holes, 5 mm		
	Pelletizer speed [m/min]			4.5			4.5		
Temp	Tm [°C]			212			213		
	T1 [°C]			220	220		220	220	
	T2 [°C]			220	219		220	219	
	T3 [°C]			220	220		220	220	
	T4 [°C]			220	220		220	220	
	T5 [°C]			220	220		220	218	
	T6 [°C]			220	220		220	220	
	T7 [°C]			220	220		220	220	
	Sample size [Kg]			1.5			1.5		

Table 5: Extrusion parameters

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