

31st CIRP Conference on Life Cycle Engineering (LCE 2024)

Influence of the material history on the properties of recycled glass fiber reinforced polypropylene - impact of screw speed during injection molding

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1. Supplementary material

Table 1. Material properties of ALTECH PP-H A 2030/159 GF30 CP

Propertie	Unit	Value	Test standard
Melt Volume Rate	[cm ³ /10 min]	2.24	ISO 1133
Young's Modulus	[MPa]	6300	ISO 527-1/-2
Elongation at break	[%]	3.7	ISO 527-1/-2
Charpy impact strength	[kJ/m ²]	50	ISO 179/1eU

Table 2. Testing parameters for the Melt Volume Rate of PP-GF30

Parameters	Value	Unit
Material	PP-GF30	-
Load	2.16	kg
Temperature	230	°C
Sample weight	4.5	g

Table 3. Factors and target for the statistical model in JMP

Factor	Factortype
Processing cycle	continuous
Screw speed	continuous
Target	Objective
Tensile stress at break	maximize
Elongation at break	minimize
Young's Modulus	maximize
Number-averaged fiber length	maximize
Melt Volume Rate	minimized

Table 4. P-Value and LogWorth of the fit least squares model for the single setting series

Source	LogWorth	P-Value
Processing cycle	46.237	0.000
Screw speed	0.331	0.467

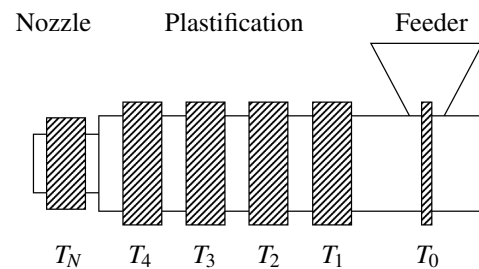


Fig. 1. Representation of the temperature zones of the injection molding system (ARBURG Allrounder 370 H 290)

Table 5. Injection molding processing parameters recommended by the material supplier, *according to the DOE

Parameter	Unit	Value					
Temperature zone	[-]	T_N	T_4	T_3	T_2	T_1	T_0
Temperature	[°C]	240	240	230	220	220	50
Injection speed	[cm ³ /s]	16					
Screw speed*	[m/min]	5				18	
Moldtemperature	[°C]	40					
Back pressure	[bar]	50					
Switch point	[cm ³]	4.2					
Packing pressure	[bar]	300					
Packing pressure time	[s]	6					
Cooling time	[s]	15					

Table 6. Custom partial factorial design of experiment, "–" = low screw speed, "+" = high screw speed, * = single setting, others = mixed setting

Series	1. cycle	2. cycle	3. cycle	4. cycle	5. cycle
1	–	+	+	+	+
2	–	+	+	–	–
3	–	+	–	+	–
4	–	+	–	–	+
5	–	–	+	+	–
6	–	–	+	–	+
7	–	–	–	+	+
8*	–	–	–	–	–
9	+	+	+	+	–
10	+	+	+	–	+
11*	+	+	+	+	+
12	+	+	–	+	+
13	+	+	–	–	–
14	+	–	+	+	+
15	+	–	+	–	–
16	+	–	–	+	–
17	+	–	–	–	+

Table 7. P-Value and LogWorth of the fit least squares model for the mixed setting series, with the number of screw speed setting = 18 m/min, for all processing cycles

Processing cycle	Factor	LogWorth	P-Value
1	Number	0.000	1.000
2	Number	0.609	0.246
3	Number	1.938	0.011
4	Number	0.649	0.224
5	Number	1.112	0.077