

# **Moldflow Material Testing Report**

## **MAT2238**

### **NatureWorks PLA**

Prepared for:

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Prepared on:

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18 July, 2007

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# Contents

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Summary .....	4
Viscosity .....	9
Thermal conductivity .....	15
Specific heat .....	17
Pressure-Volume-Temperature .....	19
Shrinkage .....	22
Mold verification .....	28
Contact details .....	32
Selecting material data from the User database .....	33

# Summary

## Description

Family name	MISCELLANEOUS
Trade name	NatureWorks PLA
Manufacturer	Cargill Dow LLC
Family abbreviation	PLA
Material structure	Amorphous
Data source	Moldflow Plastics Labs : pvT-Measured : mech-Supplemental
Date last modified	18-JUL-07
Date tested	27-OCT-04
Data status	Non-Confidential
Material ID	20529
Grade code	MAT2238
Supplier code	CDLLC
Fibers/fillers	Unfilled

## Recommended Processing

Mold surface temperature	24	°C
Melt temperature	200	°C

<b>Mold temperature range (recommended)</b>		
Minimum	10	°C
Maximum	38	°C

<b>Melt temperature range (recommended)</b>		
Minimum	170	°C
Maximum	230	°C

Absolute maximum melt temperature	270	°C
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Ejection temperature	52	°C
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Maximum shear stress	0.50	MPa
Maximum shear rate	100000	1/s

**Maximum shear stress and maximum shear rate values have been supplemented with generic estimates.**

## Rheological Properties

<b>Cross WLF Viscosity Model</b>		
n	0.2500	
Tau	1.00861e+005	Pa
D1	3.31719e+009	Pa-s
D2	373.15	K
D3	0	K/Pa
A1	20.194	
A2	51.600	K

<b>Juncture loss method coefficients</b>		
C1	3.0e-005	Pa <sup>(1-c2)</sup>
C2	2.0	

<b>Transition temperature</b>		
Ttrans	57	°C

Moldflow Viscosity Index	VI(240)0166	
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<b>Melt mass-flow rate (MFR)</b>		
Temperature	210	°C
Load	2.00	Kg
Measured MFR	8.0	g/10min

## Thermal Properties

<b>Specific heat data</b>		
Temperature (T) °C	Specific heat (Cp) J/Kg-°C	Heating/Cooling rate °C/s
230	2114.0	-0.33
190	2060.0	-0.33
160	2020.0	-0.33
140	1994.0	-0.33
100	1955.0	-0.33
70	1901.0	-0.33
65	1880.0	-0.33
62	1851.0	-0.33
60	1804.0	-0.33
58	1725.0	-0.33
55	1590.0	-0.33
52	1483.0	-0.33

<b>Thermal conductivity data</b>		
Temperature (T) °C	Thermal conductivity (k) W/m-°C	Heating/Cooling rate °C/s
48.4	0.111	0.0
68.1	0.178	0.0
87.8	0.198	0.0
109	0.197	0.0
129.4	0.198	0.0
149.6	0.192	0.0
169.7	0.195	0.0
190.6	0.195	0.0
211.9	0.205	0.0
233	0.195	0.0

### PVT Properties

Melt density	1.0727	g/cm <sup>3</sup>
Solid density	1.2515	g/cm <sup>3</sup>

#### 2-domain Tait PVT model coefficients

b5	348.15	K
b6	9.547e-008	K/Pa
b1m	0.000826	m <sup>3</sup> /Kg
b2m	8.503e-007	m <sup>3</sup> /Kg-K
b3m	1.62800e+008	Pa
b4m	0.00622	1/K
b1s	0.000821	m <sup>3</sup> /Kg
b2s	4.469e-007	m <sup>3</sup> /Kg-K
b3s	2.14200e+008	Pa
b4s	0.006079	1/K
b7	0.000e+000	m <sup>3</sup> /Kg
b8	0.000e+000	1/K
b9	0.000e+000	1/Pa

### Mechanical Properties

#### Mechanical properties data

Elastic modulus, 1 <sup>st</sup> principal direction [E1]	3500	MPa
Elastic modulus, 2 <sup>nd</sup> principal direction [E2]	3500	MPa
Poissons ratio [v12]	0.3600	
Poissons ratio [v23]	0.3600	
Shear modulus [G12]	1287	MPa

#### Transversely isotropic coefficient of thermal expansion [CTE] data

Alpha1	8.500e-005	1/C
Alpha2	8.500e-005	1/C

**Mechanical and CTE data have not been tested for this material. The data has been supplemented with generic estimates for unfilled PLA.**

### Shrinkage Properties

Corrected residual in-mold stress (CRIMS) model coefficients	
A1	0.774279
A2	-0.067007
A3	-0.001653
A4	0.76073
A5	-0.069824
A6	-0.001222

Residual strain model coefficients		
	Parallel	Perpendicular
A1	0.087087	0.12389
A2	-1.1694	0.82773
A3	0.000481	0.001074
A4	-3.5725e-009	4.9257e-008
A5	-0.002347	-0.006106

**These shrinkage models are valid for Moldflow Plastics Insight™ 6.1 only. Shrinkage models for previous software versions are available upon request.**

### Filler Properties

Filler data	
Description	Weight %



# Viscosity

## Method:

MPL Viscosity Test Method (QOP-14-M)

## Instrument:

Arburg Allrounder 270S Injection Molding Machine

## Test Specifications:

Sample Form:	Granules
Pre-Processing:	Dried at 70°C for 4 hours in a hopper dryer
Moisture Level:	0.0183 %
Capillary A: Length:	32.0097 mm
L/D:	16.00485
Die Entry Angle:	90 degrees
Capillary B: Length:	7.9688 mm
L/D:	3.9844
Die Entry Angle:	90 degrees
Barrel Diameter:	30 mm
Plastication Time:	20 sec
Dwell Time:	20 sec
Corrections:	Bagley, Rabinowitsch and shear heating
Date Tested:	04-OCT-04

## Operator's Notes:

Testing was performed per standard testing procedures.  
No anomalies were noted during the course of testing.

### Apparent Viscosity Data

Temperature (°C)	Apparent Shear Rate (sec <sup>-1</sup> )	Apparent Viscosity (Pa-s)	Die Diameter (mm)	Die L/D
185.7	229	1256.1	2	16
185.8	25248	42.55	2	16
187.5	344	931.47	2	16
188.3	2585	219.98	2	16
189	789	504.77	2	16
189.1	6392	112.37	2	16
189.1	12669	67.27	2	16
191.3	1299	340.26	2	16
197.2	63293	15.83	2	16
199.4	229	915.34	2	16
200.2	344	709.73	2	16
200.7	25185	31.12	2	16
201.8	789	402.08	2	16
201.8	2585	184.08	2	16
202.1	12669	53.68	2	16
202.2	6404	93.24	2	16
204	1324	273.56	2	16
210	63547	13.05	2	16
212.5	229	675.43	2	16
212.7	25210	27.09	2	16
213.6	344	536.62	2	16
214.4	2597	147.82	2	16
214.5	12554	47.84	2	16
214.8	789	333.61	2	16
215.1	6430	81.99	2	16
216.7	1324	234.16	2	16
224.8	63586	11.3	2	16
226.1	229	541.16	2	16
226.7	25121	24.16	2	16
227.3	344	445.74	2	16
228.1	789	281.18	2	16
228.1	2597	126.77	2	16
228.1	12580	42.6	2	16
228.6	6404	64.56	2	16
229.8	1324	200.3	2	16
186.5	33257	55.47	2	3.98
187.3	25248	64.39	2	3.98
188.7	229	1344.2	2	3.98
189.2	2585	313.16	2	3.98
189.4	12669	103.26	2	3.98
189.7	6392	170.71	2	3.98
190.9	344	989.24	2	3.98
192.6	789	547.64	2	3.98
196.2	1299	367.18	2	3.98
200	63293	28.86	2	3.98
201.8	25185	51.85	2	3.98
202.6	12669	84.64	2	3.98
202.7	229	996.54	2	3.98

Temperature (°C)	Apparent Shear Rate (sec <sup>-1</sup> )	Apparent Viscosity (Pa-s)	Die Diameter (mm)	Die L/D
203.5	344	786.65	2	3.98
203.5	2585	240.09	2	3.98
204.1	6404	130.69	2	3.98
204.7	789	468.95	2	3.98
207.8	1324	314.16	2	3.98
215.2	63547	24.06	2	3.98
216.4	25210	45.65	2	3.98
216.8	12554	75.62	2	3.98
217	2597	198.57	2	3.98
217.7	229	744.67	2	3.98
218.4	344	591.36	2	3.98
218.4	6430	107.83	2	3.98
218.8	789	375.16	2	3.98
220.6	1324	263.93	2	3.98
230	63586	20.88	2	3.98
230.8	25121	39.99	2	3.98
231.1	2597	164.26	2	3.98
231.3	12580	59.21	2	3.98
231.7	229	563.98	2	3.98
232	6404	91.6	2	3.98
233.1	344	456.29	2	3.98
233.3	789	303.63	2	3.98
234.5	1324	221.76	2	3.98

### Calculated Viscosity Data

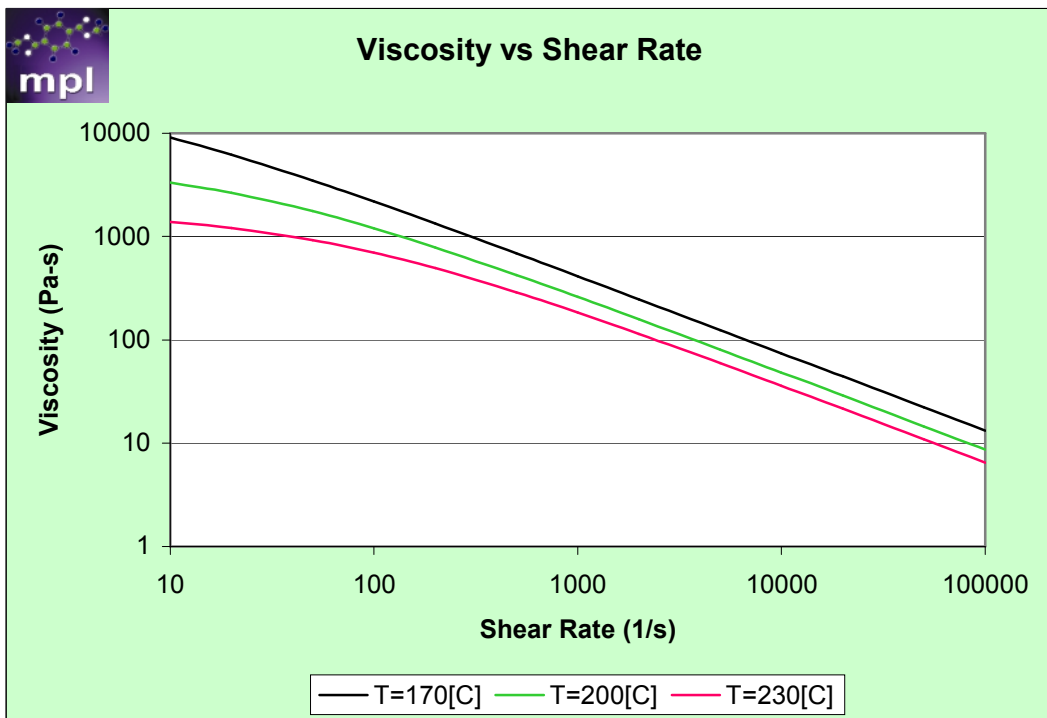
Temperature (°C)	Shear Rate (sec <sup>-1</sup> )	Calculated Viscosity (Pa-s)
185.7	229	907.11
185.8	25248	28.91
186.5	33257	23.3
187.3	25248	28.32
187.5	344	663.48
188.3	2585	152.37
188.7	229	861.95
189	789	359.11
189.1	6392	77.03
189.1	12669	46.27
189.2	2585	150.48
189.4	12669	46.09
189.7	6392	76.42
190.9	344	628.56
191.3	1299	242.13
192.6	789	340.92
196.2	1299	226.61
197.2	63293	12.56
199.4	229	723.79
200	63293	12.15
200.2	344	545.73
200.7	25185	24.01
201.8	789	300.83
201.8	25185	23.72
201.8	2585	128.06
202.1	12669	39.45
202.2	6404	65.38
202.6	12669	39.22
202.7	229	687.16
203.5	344	520.07
203.5	2585	125.51
204	1324	202.49
204.1	6404	63.98
204.7	789	289.78
207.8	1324	193.47
210	63547	10.89
212.5	229	591.5
212.7	25210	21.13
213.6	344	451.15
214.4	2597	110.86
214.5	12554	34.86
214.8	789	255.95
215.1	6430	56.81
215.2	63547	10.35
216.4	25210	20.39
216.7	1324	174.88
216.8	12554	34.1
217	2597	107.91
217.7	229	547.53
218.4	6430	55.01

Temperature (°C)	Shear Rate (sec <sup>-1</sup> )	Calculated Viscosity (Pa-s)
218.4	344	422.69
218.8	789	244.25
220.6	1324	167.67
224.8	63586	9.49
226.1	229	484.72
226.7	25121	18.65
227.3	344	375.87
228.1	789	220.02
228.1	2597	96.81
228.1	12580	30.76
228.6	6404	50.27
229.8	1324	152.52
230	63586	9.09
230.8	25121	18.03
231.1	2597	94.17
231.3	12580	29.95
231.7	229	447.75
232	6404	48.83
233.1	344	348.96
233.3	789	208.03
234.5	1324	145.64

**Rheological Data**

Cross WLF Viscosity Model		
n	0.2500	
Tau	1.00861e+005	Pa
D1	3.31719e+009	Pa-s
D2	373.15	K
D3	0	K/Pa
A1	20.194	
A2	51.600	K

Juncture loss method coefficients		
C1	3.0e-005	Pa <sup>(1-c2)</sup>
C2	2.0	



# Thermal conductivity

**Method:**

ASTM D 5930, Standard Test Method for Thermal Conductivity of Plastics by Means of a Transient Line-Source Technique.

**Instrument:**

Moldflow K-System II

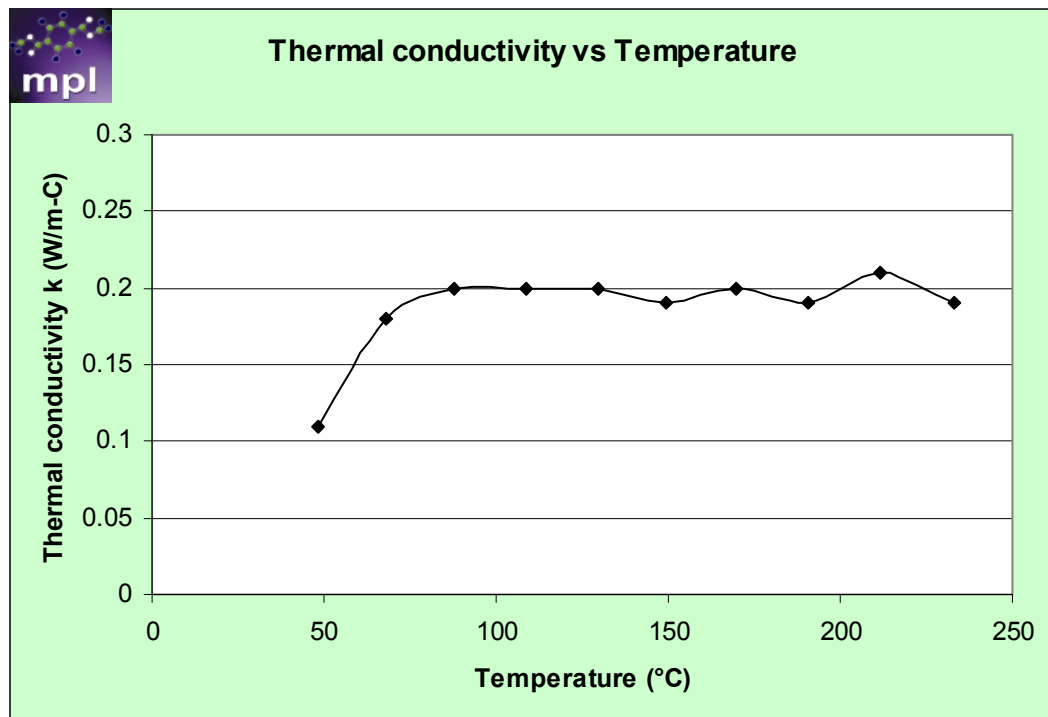
**Test Specifications:**

Sample Form:	Granules
Pre-Processing:	Dried at 70°C for 4 hours in a hopper dryer
Moisture Level:	0.0183 %
Probe Constant:	0.863
Probe Length:	50 mm
Data acquisition time:	45 sec
Probe Voltage:	3.0 V
Date Tested:	04-OCT-04

**Operator's Notes:**

Testing was performed per standard testing procedures.  
No anomalies were noted during the course of testing.

Thermal conductivity data		
Temperature (T) °C	Thermal conductivity (k) W/m-°C	Heating/Cooling rate °C/s
48.4	0.111	0.0
68.1	0.178	0.0
87.8	0.198	0.0
109	0.197	0.0
129.4	0.198	0.0
149.6	0.192	0.0
169.7	0.195	0.0
190.6	0.195	0.0
211.9	0.205	0.0
233	0.195	0.0





# Specific heat

**Method:**

ASTM E 1269, Standard Test Method for Determining Specific Heat Capacity by Differential Scanning Calorimetry

ASTM D 3418, Standard Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry

**Instrument:**

Perkin Elmer Pyris Diamond Differential Scanning Calorimeter

**Test Specifications:**

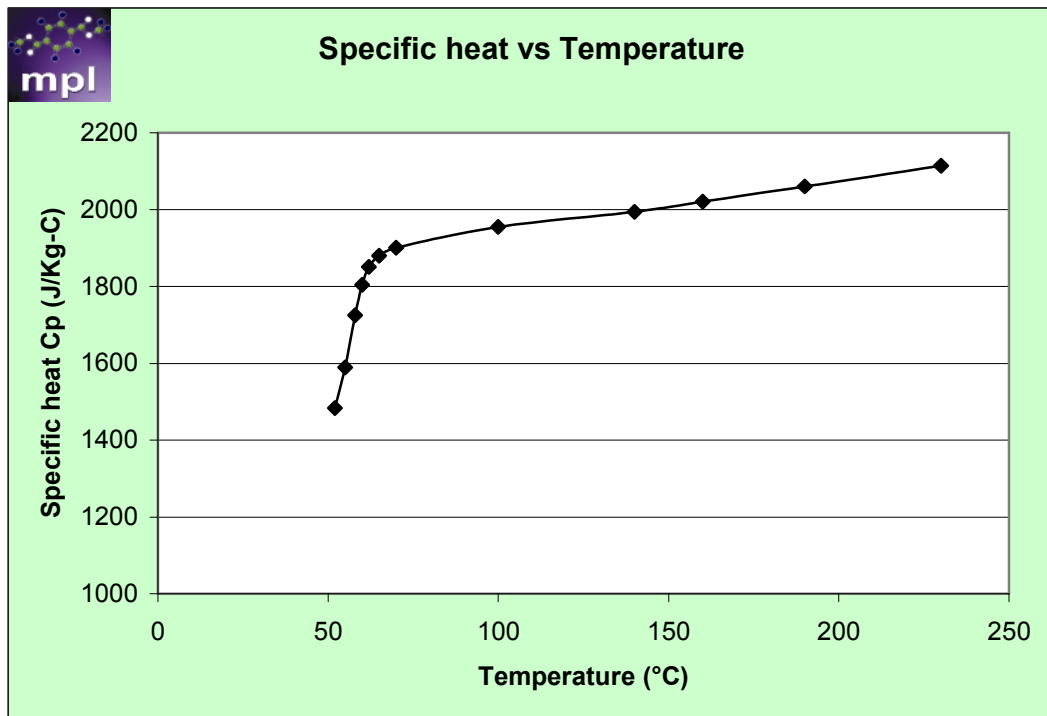
Sample Form:	Granules
Pre-Processing:	Dried at 70°C for 4 hours in a hopper dryer
Moisture Level:	0.0183 %
Initial Temperature:	240°C
Final Temperature:	50°C
Cooling Rate:	20°C/min
Equilibrium Time:	2 min
Sample holder material:	Aluminium
Sample holder dimensions:	6.7 mm diameter, 1.6 mm tall
Sample holder mass:	25 mg (pan + lid)
Purge gas:	99.99% pure nitrogen
Purge gas flow rate:	30 cm <sup>3</sup> /sec
Date Tested:	04-OCT-04

**Operator's Notes:**

Testing was performed per standard testing procedures.  
No anomalies were noted during the course of testing.

Specific heat data		
Temperature (T) °C	Specific heat (Cp) J/Kg-°C	Heating/Cooling rate °C/s
230	2114.0	-0.33
190	2060.0	-0.33
160	2020.0	-0.33
140	1994.0	-0.33
100	1955.0	-0.33
70	1901.0	-0.33
65	1880.0	-0.33
62	1851.0	-0.33
60	1804.0	-0.33
58	1725.0	-0.33
55	1590.0	-0.33
52	1483.0	-0.33

Ttrans	57	°C
Ejection temperature	52	°C



# Pressure-Volume-Temperature

**Method:**

High Pressure Indirect Dilatometry

**Instrument:**

Gnomix pvT Apparatus

**Test Specifications:**

Sample Form:	Molded Plaque
Pre-Processing:	Not required
Scan type:	Isothermal Cooling
Date Tested:	06-OCT-04

**Operator's Notes:**

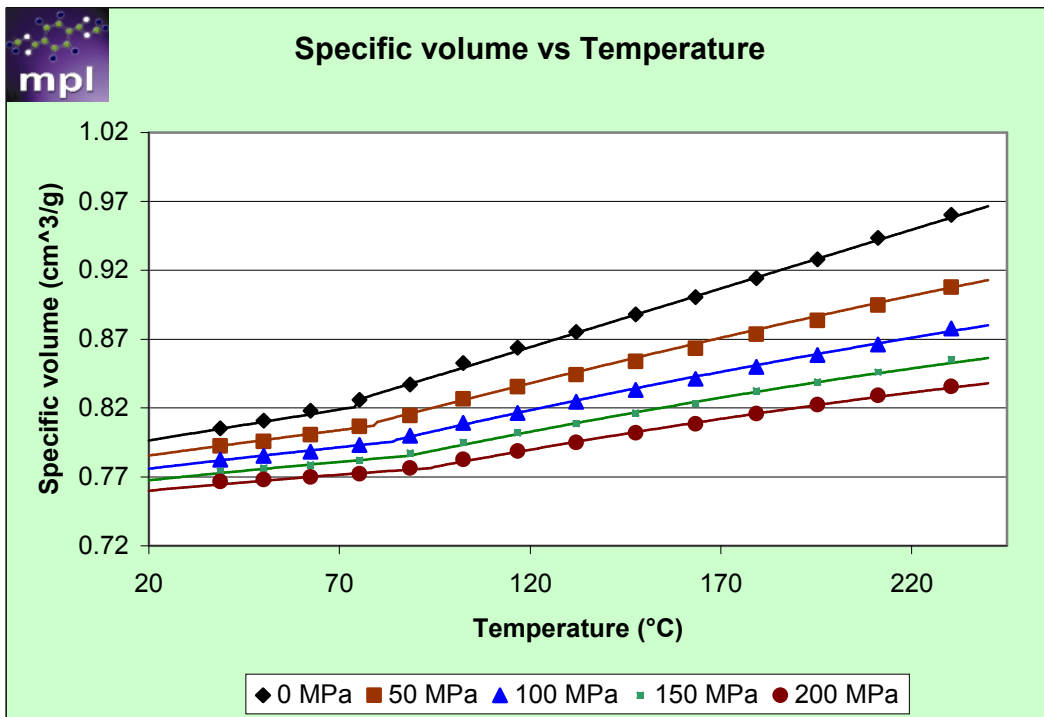
Testing was performed per standard testing procedures.  
No anomalies were noted during the course of testing.

**pvT Experimental Data**

Temperature (°C)	Pressure (MPa)				
	0 MPa	50 MPa	100 MPa	150 MPa	200 MPa
38.79	0.8052	0.7923	0.7825	0.7741	0.7666
50.13	0.8108	0.7957	0.7851	0.7763	0.7681
62.41	0.8180	0.8004	0.7883	0.7787	0.7698
75.25	0.8259	0.8066	0.7930	0.7819	0.7721
88.43	0.8369	0.8145	0.7997	0.7873	0.7764
102.4	0.8526	0.8264	0.8090	0.7950	0.7827
116.7	0.8638	0.8353	0.8164	0.8019	0.7887
132.	0.8753	0.8441	0.8244	0.8086	0.7950
147.7	0.8879	0.8538	0.8329	0.8162	0.8018
163.3	0.9005	0.8635	0.8411	0.8231	0.8084
179.3	0.9142	0.8736	0.8499	0.8322	0.8158
195.3	0.9279	0.8836	0.8584	0.8388	0.8224
211.2	0.9435	0.8948	0.8661	0.8460	0.8291
230.4	0.9601	0.9078	0.8778	0.8553	0.8356

Melt density	1.0727	g/cm <sup>3</sup>
Solid density	1.2515	g/cm <sup>3</sup>

2-domain Tait PVT model coefficients		
b5	348.15	K
b6	9.547e-008	K/Pa
b1m	0.000826	m <sup>3</sup> /Kg
b2m	8.503e-007	m <sup>3</sup> /Kg-K
b3m	1.62800e+008	Pa
b4m	0.00622	1/K
b1s	0.000821	m <sup>3</sup> /Kg
b2s	4.469e-007	m <sup>3</sup> /Kg-K
b3s	2.14200e+008	Pa
b4s	0.006079	1/K
b7	0.000e+000	m <sup>3</sup> /Kg
b8	0.000e+000	1/K
b9	0.000e+000	1/Pa



# Shrinkage

## Method:

MPL Shrinkage Test Method (QOP-17-M)

## Instrument:

Battenfeld BK-T 1500/400 Injection molding machine  
 Test mold inscribed with a fine grid pattern  
 Thermoline TRH 460 Temperature-Humidity Cabinet  
 OGP Smartscope Flash 400 metrology system

## Test Specifications:

Sample Form:	Granules
Pre-Processing:	Dried at 70°C for 4 hours in a hopper dryer
Moisture Level:	0.0354 %
Date Molded:	18-OCT-04
Post-Processing:	Conditioned at 23°C / 50% relative humidity for 7 days
Date Measured:	25-OCT-04
Shrinkage Data Correlated With:	Moldflow Plastics Insight™ 6.1
Default Model:	Residual Stress (CRIMS)

## Operator's Notes:

Testing was performed per standard testing procedures.

No anomalies were noted during the course of testing.

Shrinkage measurements have been corrected to account for mold thermal expansion.

Data for some process conditions may have been removed in the determination of the favored model.

### Shrinkage Experimental Data

Process Condition	Melt Temperature (°C)	Mold Temperature (°C)	Flow Rate (cc/sec)	Part Thickness (mm)	Packing Pressure (MPa)	Packing Time (sec)	Cooling Time (sec)
1	206.9	23.3	34.2	2	53.3	15	20
2	205.1	23.8	54.2	2	56.8	15	20
3	206.4	24.2	71.7	2	56.9	15	20
4	206.0	24.6	22.2	2	56.7	15	20
5	207.3	24.6	10.7	2	57.0	15	20
6	205.1	23.8	35.9	2	53.3	15	30
7	206.9	23.3	39.2	2	56.8	15	40
8	207.8	24.2	42.4	2	74.3	15	20
9	205.5	24.6	42.6	2	92.8	15	20
10	206.0	25.5	42.1	2	112.0	15	20
11	206.4	24.6	52.7	2	112.7	15	20
12	205.5	24.6	70.2	2	112.8	15	20
13	205.1	24.6	21.9	2	111.9	15	20
14	205.1	25.0	11.0	2	111.8	15	20
15	207.3	25.0	35.6	2	106.7	15	30
16	207.3	25.0	41.6	2	112.5	15	40
17	179.1	24.6	32.4	2	109.7	15	20
18	177.3	24.2	32.4	2	59.3	15	20
19	233.3	25.0	38.3	2	113.0	15	20
20	236.1	26.3	36.3	2	57.0	15	20
21	202.8	37.6	36.3	2	112.5	15	20
22	202.8	37.6	41.6	2	68.0	15	20
23	206.0	22.9	28.8	1.7	108.7	15	20
24	206.0	23.8	28.3	1.7	33.8	15	20
25	206.0	25.9	51.7	3	112.8	20	20
26	205.5	24.6	52.5	3	45.4	20	20
27	203.2	25.9	62.0	5	113.3	35	20
28	202.3	25.0	62.0	5	45.7	35	20

### Part Shrinkage

Process Condition	Average Measured Parallel	Average Measured Perpendicular	Maximum Predicted Volumetric
1	0.31%	0.35%	7.34%
2	0.28%	0.35%	7.08%
3	0.28%	0.33%	7.09%
4	0.30%	0.35%	6.86%
5	0.30%	0.32%	6.61%
6	0.28%	0.34%	7.26%
7	0.32%	0.31%	7.07%
8	0.27%	0.25%	5.87%
9	0.04%	0.05%	4.68%
10	-0.09%	-0.06%	3.62%
11	-0.14%	-0.11%	3.54%
12	-0.17%	-0.13%	3.54%
13	-0.05%	-0.02%	3.62%
14	0.07%	0.07%	3.61%
15	0.00%	0.02%	3.91%
16	-0.11%	-0.09%	3.57%
17	-0.01%	0.00%	4.03%
18	0.34%	0.29%	6.22%
19	-0.24%	-0.20%	3.32%
20	0.26%	0.33%	6.80%
21	0.01%	-0.08%	3.67%
22	0.27%	0.25%	6.39%
23	-0.06%	-0.07%	4.44%
24	0.30%	0.32%	8.04%
25	-0.02%	0.02%	2.07%
26	0.30%	0.32%	6.31%
27	0.12%	0.22%	2.55%
28	0.37%	0.46%	6.89%



### Residual Stress Coefficients

Corrected residual in-mold stress (CRIMS) model coefficients	
A1	0.774279
A2	-0.067007
A3	-0.001653
A4	0.76073
A5	-0.069824
A6	-0.001222

### Residual Strain Coefficients

Parallel				
	Coefficient	Lower Limit	Upper Limit	Centroid
1	0.087087	0.009092	0.080366	0.044424
2	-1.1694	2.7556e-008	0.000267	0.000168
3	0.000481	0.010027	1.3277	0.57562
4	-3.5725e-009	10254.00	1.57580e+005	81160.00
5	-0.002347	0	0	0

Perpendicular				
	Coefficient	Lower Limit	Upper Limit	Centroid
1	0.12389	0.009092	0.080366	0.045571
2	0.82773	2.7556e-008	0.000267	0.000176
3	0.001074	0.010027	1.3277	0.56343
4	4.9257e-008	739.39	75947.00	24801.00
5	-0.006106	0	0	0

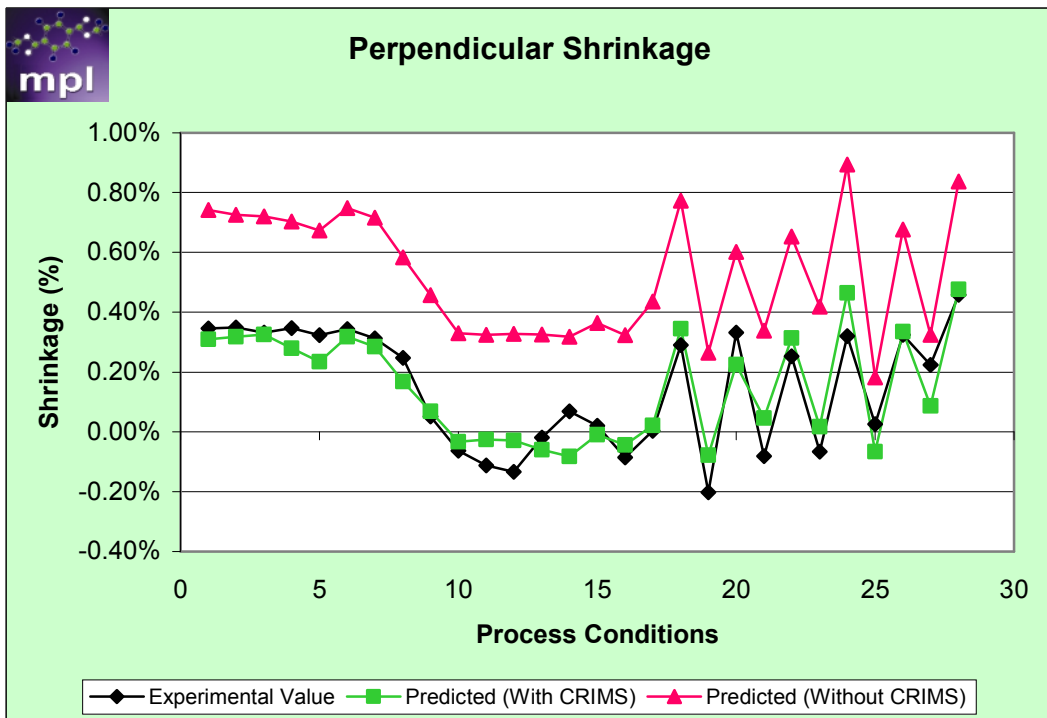
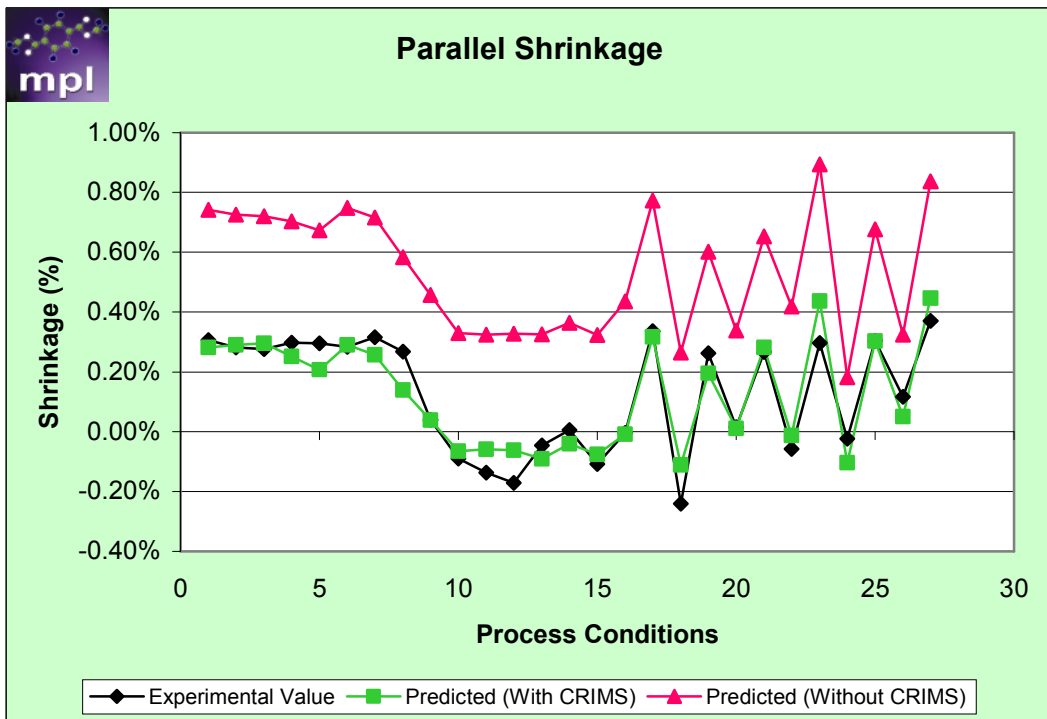
**These shrinkage models are valid for Moldflow Plastics Insight™ 6.1 only. Shrinkage models for previous software versions are available upon request.**

### Observed Shrinkage

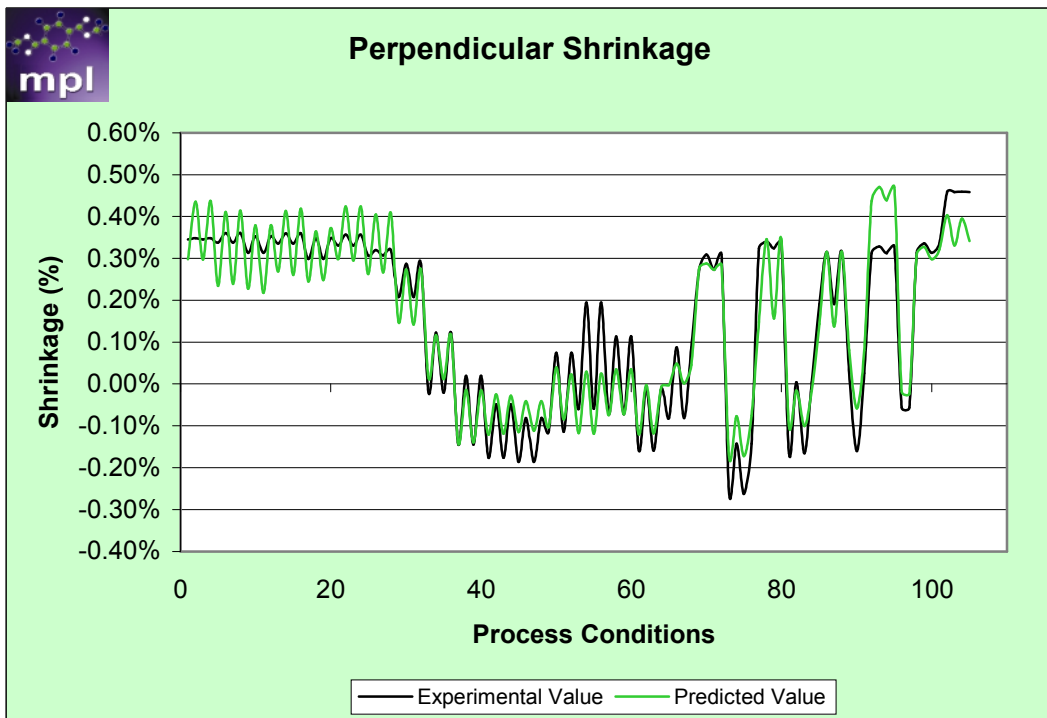
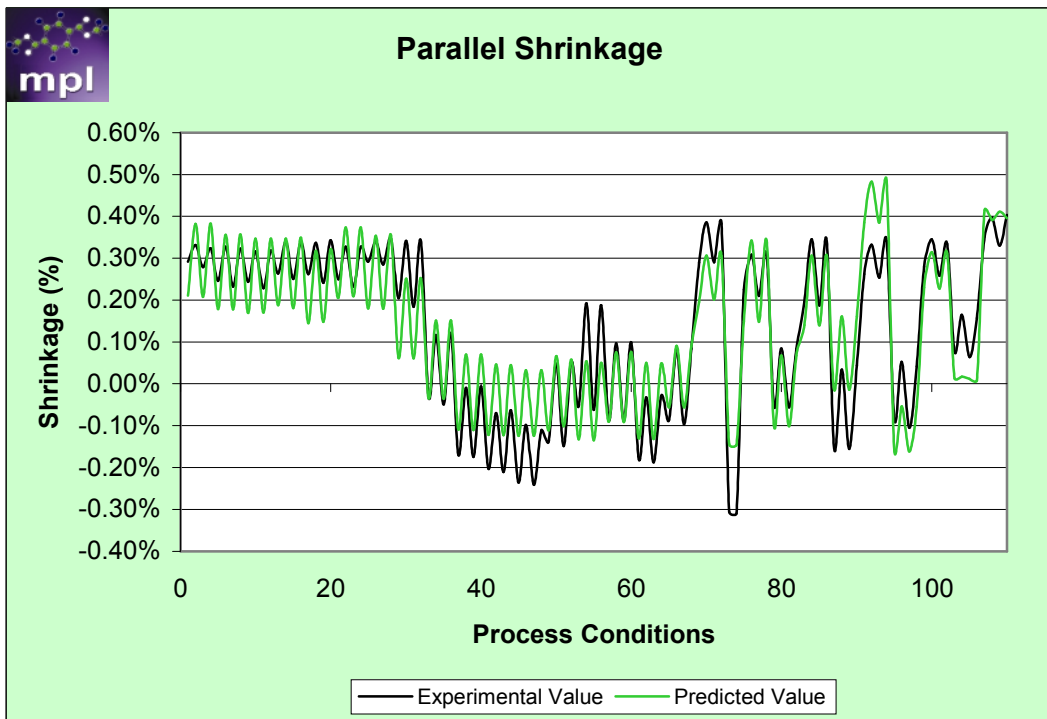
Observed nominal shrinkage	
Parallel	0.142%
Perpendicular	0.153%

Observed shrinkage	
Minimum Parallel	-0.172%
Maximum Parallel	0.370%
Minimum Perpendicular	-0.203%
Maximum Perpendicular	0.458%

### Residual Stress Plots



### Residual Strain Plots



# Mold verification

**Method:**

MPL Mold Verification Test Method (QOP-16-M)

**Instrument:**

Battenfeld BK-T 1500/400 Injection Molding Machine

**Test Specifications:**

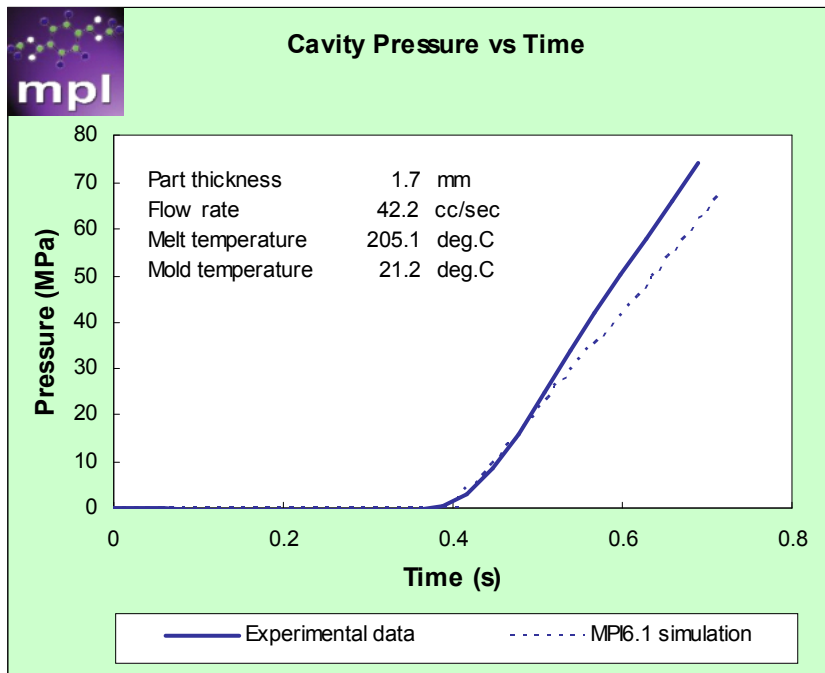
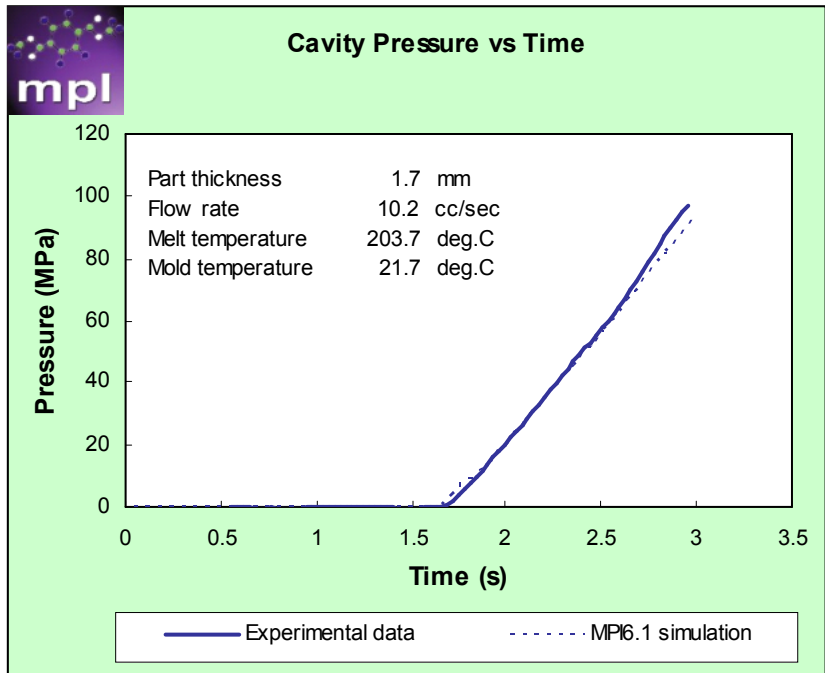
Sample Form:	Granules
Pre-Processing:	Dried at 70°C for 4 hours in a hopper dryer
Moisture Level:	0.0354 %
Date Tested:	18-OCT-04

**Operator's Notes:**

Testing was performed per standard testing procedures.  
No anomalies were noted during the course of testing.

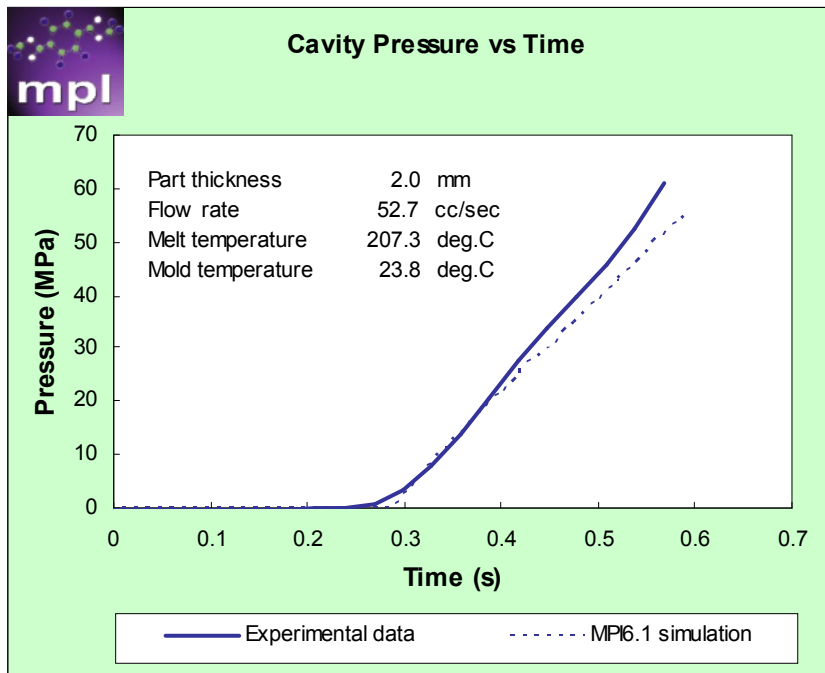
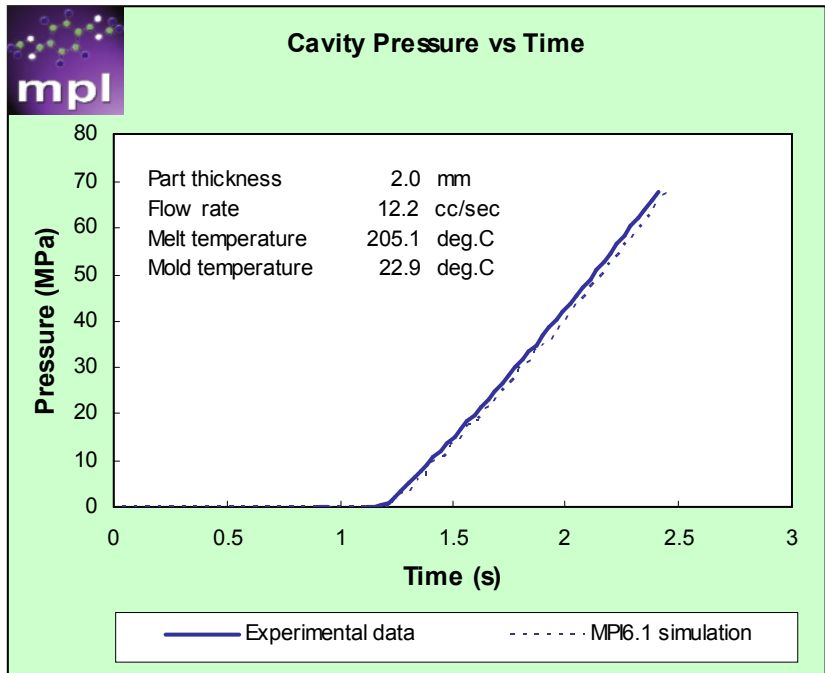
**1.7mm tag die**

Experiment Number	Flow Rate (cc/sec)	Melt Temperature	Mold Temperature
cyc1466	10.2	203.7	21.7
cyc1472	42.2	205.1	21.2



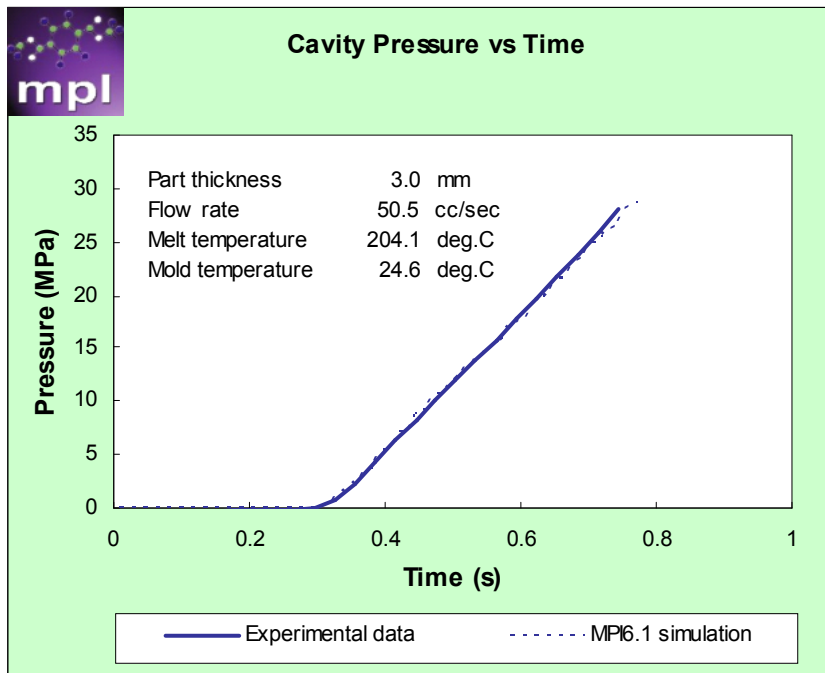
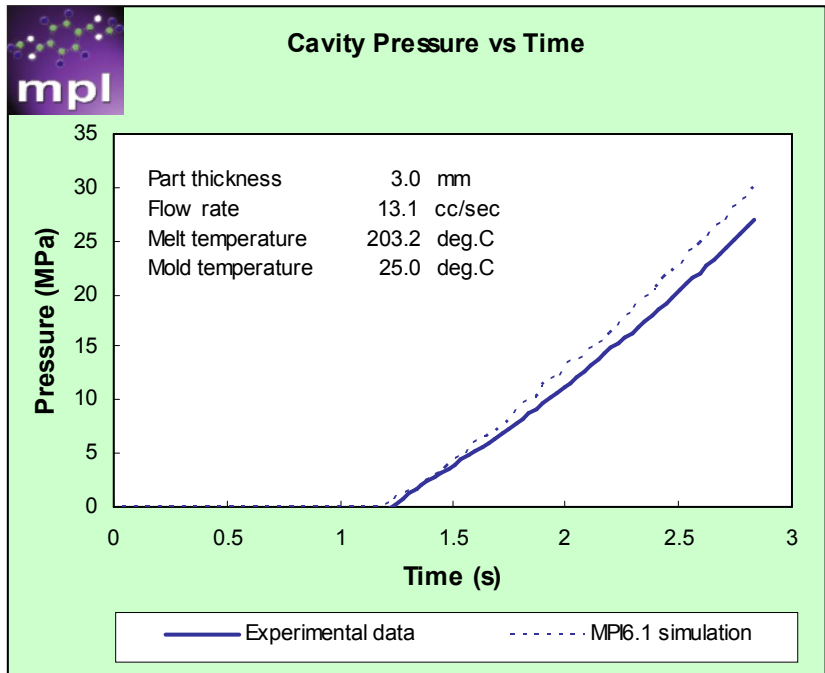
**2mm tag die**

Experiment Number	Flow Rate (cc/sec)	Melt Temperature	Mold Temperature
cyc1319	12.2	205.1	22.9
cyc1325	52.7	207.3	23.8



**3mm tag die**

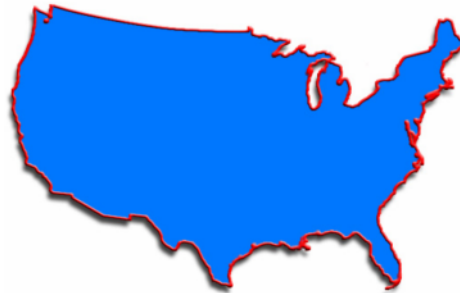
Experiment Number	Flow Rate (cc/sec)	Melt Temperature	Mold Temperature
cyc1493	13.1	203.2	25
cyc1500	50.5	204.1	24.6



## Contact details

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For testing enquiries please email [mpl@moldflow.com](mailto:mpl@moldflow.com)

For data fitting and database enquiries please email [datafitting@moldflow.com](mailto:datafitting@moldflow.com)

Find out more about Moldflow's testing service on [www.plasticszone.com](http://www.plasticszone.com)

Moldflow's corporate website: [www.moldflow.com](http://www.moldflow.com)




## Selecting material data from the User database

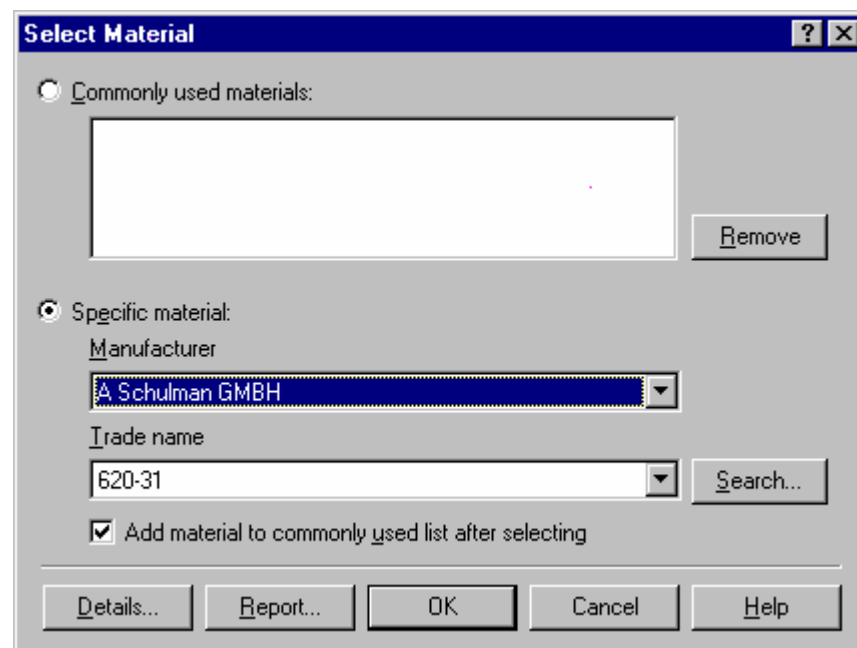
In order to use material data supplied by MPL, the 21000.udb file must be added to the User database.

A standard **PC** installation will have created a directory drive:\My MPI x.x Projects\udb (where x.x is the version of MPI installed on the system). Add the material data file to this directory.

A standard **Unix** installation will have created a directory <home directory>/mpixxx-files/udb (where xxx is the version of MPI installed on the system). Add the material data file to this directory.

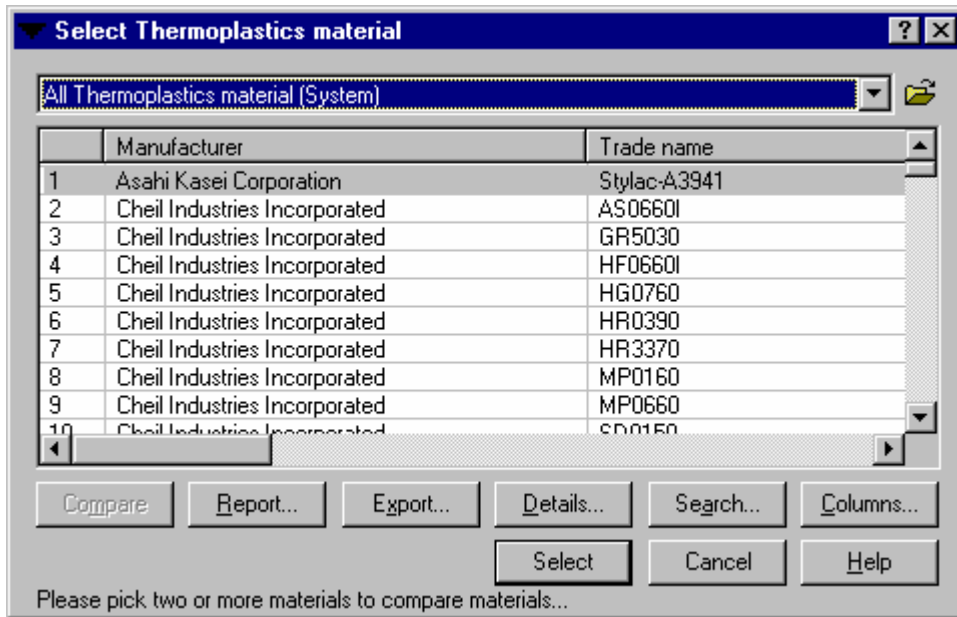
Once the material data file has been added to the appropriate directory, the material can be selected from the User database by following these steps:

- Start Moldflow Plastics Insight™.
- Open an existing project or create a new project.
- Open an existing study or create a new study. This will bring up the material icon  in the 'Study Tasks' window.
- Double click on the material icon to bring up the 'Select Material' dialog box.

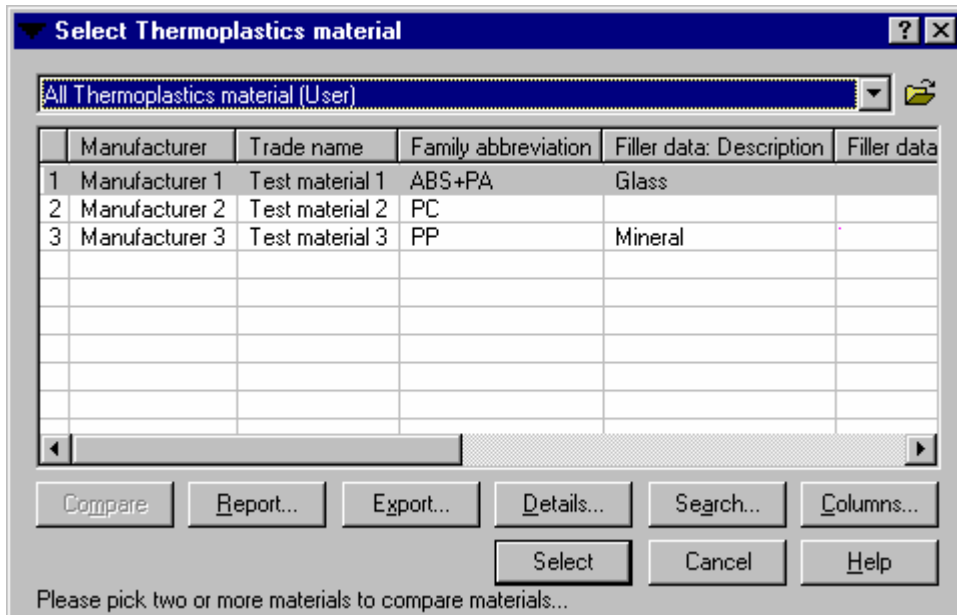


- Click **Search**.
- Click **Clear Filters** before clicking **Search** or **OK** (depending on the version of MPI that is installed).

- From the drop down menu select 'All Thermoplastics material (User)'.



- Highlight the desired material and click **Select** or **OK** (depending on the version of MPI that is installed).



- Click **OK** to use this material in an analysis or **Details** to view the material data.