

## Pyrolysis ramp rate comparison with Polystyrene and Polycarbonate

**Key words:**

**OPTIC-4**  
**Polystyrene**  
**Polycarbonate**  
**Polymers**  
**Pyrolysis ramp rate**

Iwan Horsting

---

### Introduction

The hyphenation of thermal sample treatment techniques such as thermal desorption and pyrolysis with gas chromatography gives a versatile and powerful tool in the study of polymers. An inexpensive system where thermal treatment at different inlet temperature ramp rates is shown. Results obtained indicate the interesting potentials of fast ramp rates for the characterization of polymer composition. The absence of a heated transfer line and switching valves, which are often present in conventional set-ups, eliminates the risk of losses of high molecular weight components. Further advantages of the technique are the simplicity and versatility as well as its inexpensive nature.

### Sample materials

Polystyrene dissolved in dichloromethane. 1 µl injected.  
Polycarbonate dissolved in dichloromethane. 1 µl injected.

### Instrumentation

Inlet: OPTIC-4 Multi Mode Inlet  
Liner: L100011, DMI liner with taper  
Auto sampler: CombiPAL  
GC-MS: Shimadzu QP2010  
GC column: : GL Sciences InertCap 5 MS/Sil, 0.25 m x 30 m, film 0.25 µm

**Methods:****OPTIC-4**

Method Type	Large Volume
Method Name	ramp_15
Equilibration Time	00:05 mm:ss
End Time	10:00 mm:ss
Initial Temperature	40 °C
Ramp Rate	5 - 60 °C/s
Final Temperature	600 °C
Temperature Control	Keep Current Temperature
Vent Mode	Fixed Time

**ATAS GL INTERNATIONAL B.V.**

De Sleutel 9, 5652AS Eindhoven , The Netherlands  
Tel. +31 (0)40 254 95 31 Fax. +31 (0)40 254 97 79  
E-mail: info@atasgl.com Internet: www.atasgl.com

Vent Time	00:30 mm:ss
Carrier Control Mode	Flow Control
Transfer Time	03:00 mm:ss
Sample Sweep Column Flow	1.0 ml/min
Transfer Column Flow	1.0 ml/min
Start Column Flow	1.0 ml/min
End Column Flow	1.0 ml/min
Vent Flow	10 ml/min
Split Flow	25 ml/min

### GC/MS

Column Oven Temp. :	45.0 °C	
Oven Temp. Program		
Rate (°C/min)	Temperature(°C)	Hold Time(min)
-	45.0	3.00
15.00	340.0	10.00
Equilibrium Time	0.0 min	
<b>GCMS-QP2010</b>		
Ion Source Temp	200.00 °C	
Interface Temp	250.00 °C	
Solvent Cut Time	1.00 min	
Detector Gain Mode	Relative	
Detector Gain	0.00 kV	
Threshold	0	
<b>MS Table</b>		
Start Time	1.00 min	
End Time	31.67 min	
ACQ Mode	Scan	
Event Time	0.30sec	
Scan Speed	1250	
Start m/z	50.00	
End m/z	400.00	
Sample Inlet Unit	GC	

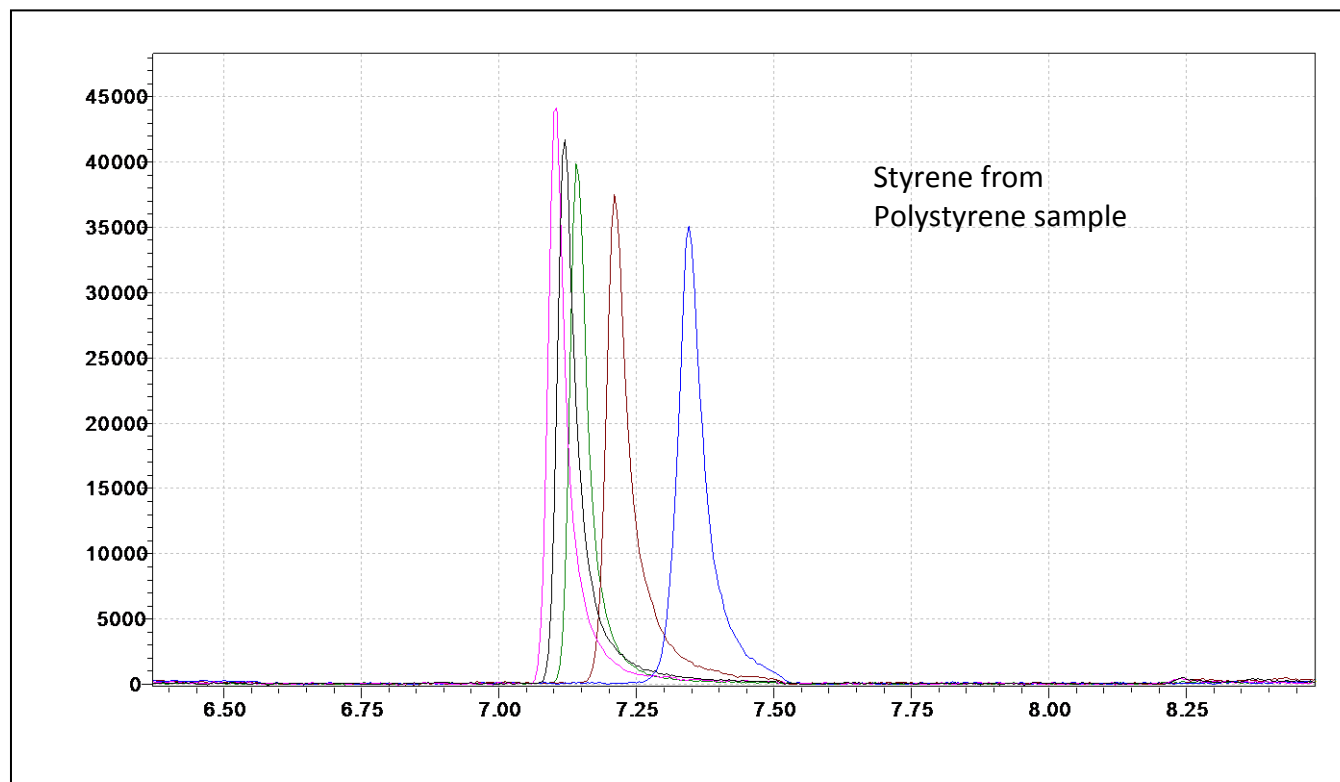
### CombiPAL:

Air Volume (µl)	0
Pre Clean with Solvent 1	0
Pre Clean with Solvent 2	0
Pre Clean with Sample	3
Filling Volume (µl)	3
Filling Speed (µl/s)	10
Filling Strokes	5
Pullup Delay (ms)	0
Inject to	OPTIC
Injection Speed (µl/s)	100
Pre Inject Delay (ms)	0
Post Inject Delay (ms)	0
Post Clean with Solvent 1	3
Post Clean with Solvent 2	3

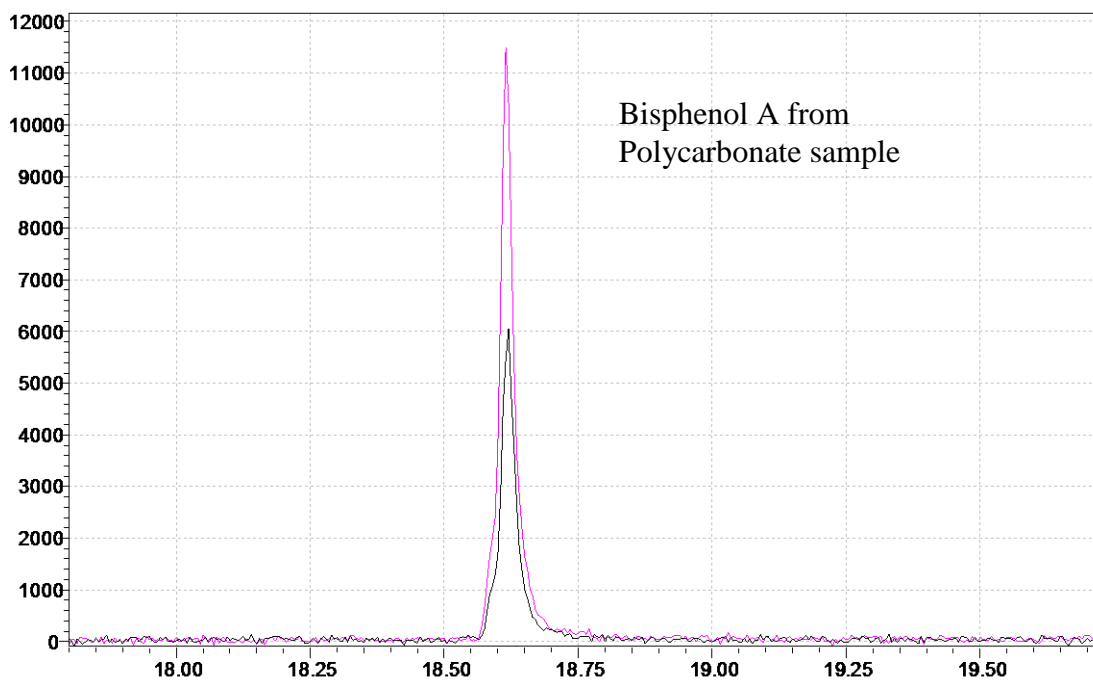
#### ATAS GL INTERNATIONAL B.V.

De Sleutel 9, 5652AS Eindhoven , The Netherlands  
 Tel. +31 (0)40 254 95 31 Fax. +31 (0)40 254 97 79  
 E-mail: info@atasgl.com Internet: www.atasgl.com

**Results:**



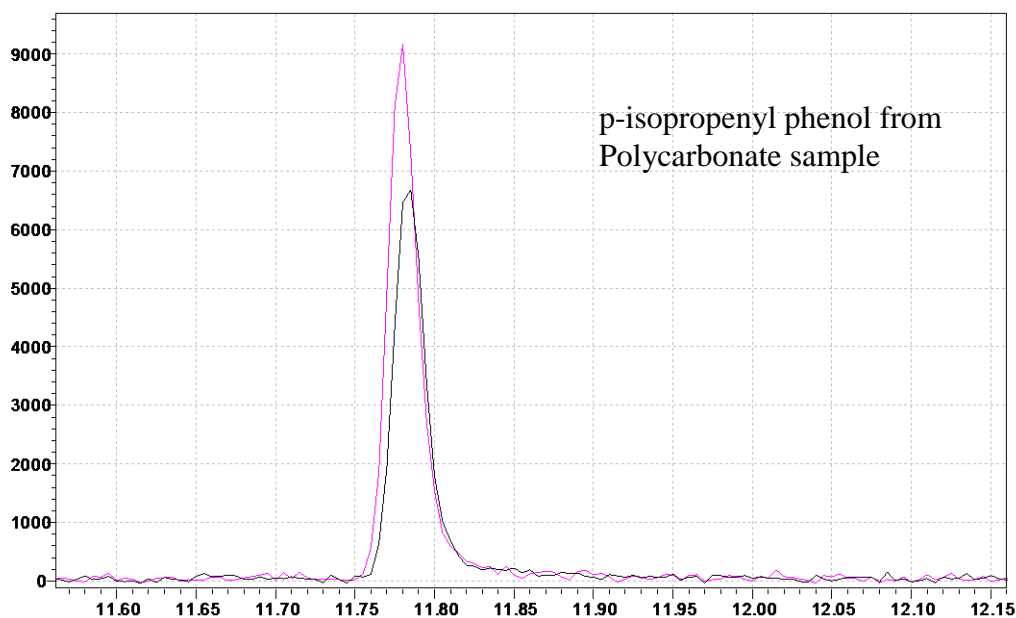
		RT	M/z	Area	Height
Blue	5°C/sec	7.345	104.00	131510	35005
Brown	10°C/sec	7.211	104.00	132088	37374
Green	20°C/sec	7.142	104.00	111031	39877
Black	30°C/sec	7.119	104.00	127139	41752
Pink	60°C/sec	7.103	104.00	120062	44120



Component shown is Bisphenol A. This is a compound used for the production of Polycarbonate.

Black: 30°C/sec

Pink: 60°C/sec



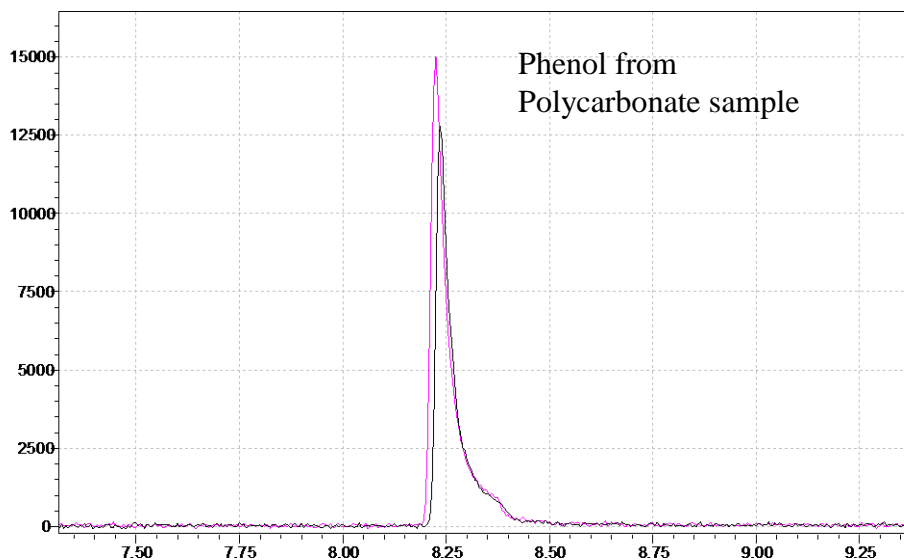
Component shown is p-isopropenyl phenol. This is a compound used for the production of Polycarbonate.

Black: 30°C/sec

Pink: 60°C/sec

**ATAS GL INTERNATIONAL B.V.**

De Sleutel 9, 5652AS Eindhoven , The Netherlands  
Tel. +31 (0)40 254 95 31 Fax. +31 (0)40 254 97 79  
E-mail: info@atasgl.com Internet: www.atasgl.com



Component shown is Phenol. This is a compound used for the production of Polycarbonate.

Black: 30°C/sec

Pink: 60°C/sec

**Conclusion:**

A fast ramp rate can improve the chromatography when the OPTIC is used as a pyrolysis instrument. For the more high molecular weight components the effect is much more as for the more volatile components.