



## Grades Selected by Customers For Caps and Closures

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Gilles Jobin  
Equistar Chemicals,  
A LyondellBasell Company

lyondellbasell

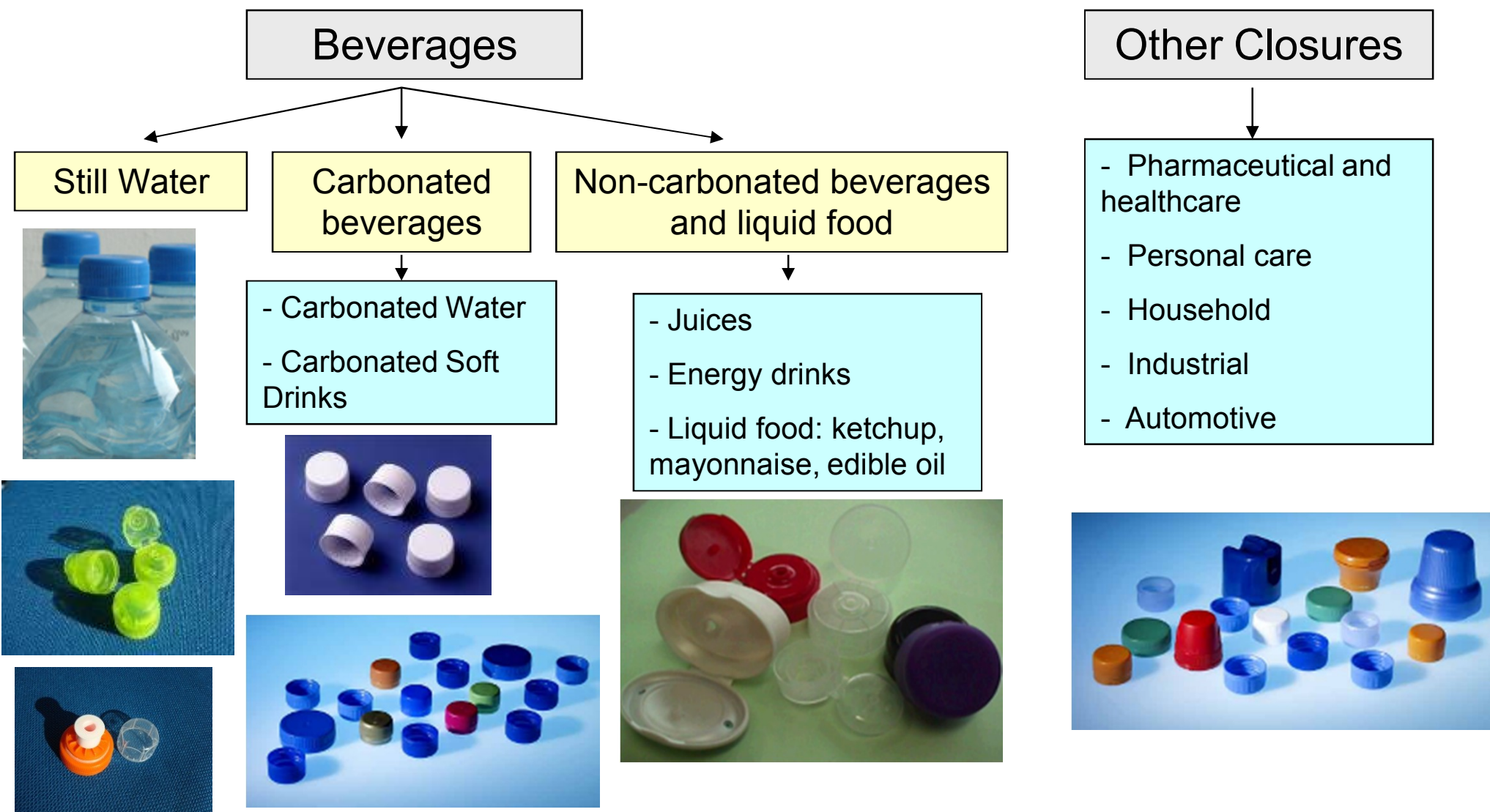
# LyondellBasell – Caps and Closures

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- Global asset base for PP and PE
- Product innovation and technology for PP and PE
- In combination with:
  - Dedicated Applications Development Technical Service in PP and PE
  - Good organoleptics
  - Product reliability and consistency



# Customer Caps and Closures Application Segments



# Polypropylene and Polyethylene Potential Benefits

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- Easy processability
- Reduced production costs
- New design opportunities
- Product differentiation
- Material savings through down gauging

# Advantages of Polypropylene and Polyethylene

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## PP

- Easy processing (compression and injection molding)
- Ideal for living hinges
- Low density / high stiffness (downgauge / light weight)
- High temperature capability
  - Dimensional stability
  - Excellent for hot fill
- Good organoleptics
- 2 piece beverage closures with liner
- Superior environmental stress cracking resistance
- Grades with good clarity

## PE

- Exceptional impact strength, particularly at low temperatures
- Slight compressibility (good sealing)
- Excellent organoleptics
- 1 piece beverage closures (linerless)
- Grades with good environmental stress cracking resistance
- Established recycle stream
- LDPE ideal for tear band applications (milk, juice, 5 gallon water, etc.)

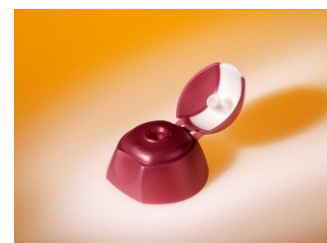
# Pro-fax Polypropylene Grades

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- **Pro-fax** SB912 (6 MFR Impact Copolymer)
  - Good stiffness/impact balance
    - 220 kpsi flex modulus, 1.4 ft-lbs/in notched Izod
  - Contains nucleation (faster set-up), antistat and slip agent
  - Used primarily in beverage 2 piece closures (compression and injection molded)
- **Pro-fax** SV956 (35 MFR Impact Copolymer)
  - Good stiffness/impact balance
    - 230 kpsi flex modulus, 0.8 ft-lbs/in notched Izod
  - Contains nucleation (faster set-up), antistat and slip agent
  - Used in injection molded thin wall closures, detergent spouts/closures, liquid food jars, juice, etc.
- **Pro-fax** 6329 (14 MFR homopolymer)
  - Softer homopolymer
    - 170 kpsi flex modulus, 0.7 ft-lbs/in notched Izod
  - Used in injection molded automotive and household cleaner closures

# Hinged Polypropylene Closures

- Require excellent hinge performance, reasonable impact performance at room temperature, good aesthetics
- Typical customer applications: liquid food (ketchup), snap-on caps for personal hygiene items such as shampoo, shower gel, body lotion



	<i>Pro-fax</i> 6523	<i>Pro-fax</i> 6331	<i>Pro-fax</i> SB912	<i>Pro-fax</i> SB787	<i>Pro-fax</i> SR549M
Polymer Type	Homo	Homo	Impact Copolymer	Impact Copolymer	Random Copolymer
Characteristics	General purpose	Larger and more complex designs	Added impact	Added impact, more complex designs	Clarified: Superior aesthetics
MFR @2.16kg, 230°C, dg/min	4	12	6	22	11
Flexural Modulus, kpsi	200	210	220	140	160
Notched Izod 23°C, ft-lbs/in	1.0	0.6	1.4	1.5	1.2
HDT @66 psi, °F	190	200	235	175	170

All grades used by customers in Caps and Closures applications



# Pro-fax Polypropylene Grades for Closures

Grade Name	Melt Flow Rate (g/10min) ASTM D1238	Flexural Modulus (psi) (1% Secant) ASTM D790	Notched Izod Impact (73°F) (ft-lbs/in) ASTM D256	HDT (°F) (66 psi) ASTM D648	Comments
<b>Homopolymers</b>					
6523	4	200000	1.0	190	General purpose, enhanced heat stability
6331	12	210000	0.6	200	General purpose
6331NW	12	240000	0.8	235	Nucleated, Antistat
6331W	12	210000	0.6	200	Antistat
6329	14	170000	0.7	205	Improved Impact and Stress Cracking Resistance, Closures
PD702	35	170000	0.6	190	General Purpose, Labware, USP
PD702NW	35	200000	0.8	230	Nucleated, Antistat
<b>Random Copolymers</b>					
SR549M	11	160000	1.2	170	General purpose, clarified
RP320N	12	135000	0.9	170	General purpose, barefoot
<b>Impact Copolymers</b>					
7523	4	180000	1.6	180	Medium impact, enhanced heat stability
SB912	6	220000	1.4	235	Nucleated, Antistat and High Mold Release for Compression and Injection Molded Closures
EP445P	18	170000	3.2	215	Nucleated, antistat, mold release
SG702	18	150000	N.B.	180	Superior impact/stiffness balance
SB787	22	140000	1.5	175	Medium impact, low blush
SG722	25	150000	N.B.	210	Nucleated, antistat, mold release
SV954	35	210000	0.9	235	Nucleated, antistat, mold release
SV956	35	230000	0.8	240	Nucleated, antistat, high mold release

Data Sheets, Product Stewardship Bulletins and Material Safety Data Sheets are available at [www.lyondellbasell.com](http://www.lyondellbasell.com)



# Alathon HDPE Grades

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- **Alathon M5320X01**
  - A 2 MI, 0.953 density bimodal resin
  - Primary market applications are still water and carbonated soft drink caps
  - Provides an outstanding combination of flowability, mechanical properties and ESCR
  - Excellent organoleptics
  - Available outside North America as ACP 5331 H (GX 4088)
- **Alathon L5355**
  - A fractional melt, 0.953 density bimodal resin
  - Primary market applications are compression molded still water and carbonated soft drink caps
  - Provides outstanding mechanical properties and ESCR
  - Excellent organoleptics

# Equistar Polyethylene Closure Grades

Grade Name	Melt Index (g/10min) ASTM D1238	Density (g/cc) ASTM 1505	Spiral Flow (inch) Equistar Method <sup>1</sup>	Flexural Modulus (psi) (1% Secant) ASTM D790	Tensile Strength at Yield (psi) ASTM D638	Comments
<b>Alathon HDPE</b>						
M5370	6.9	0.953	8.9	189000	4130.0	
M6080	7.9	0.96	8.6	190000	4250	
H5112	12	0.951	13.8	158400	3,830 <sup>2</sup>	Broad MWD
H5618	18	0.956	11.7	203800	4230	
H5220	20	0.952	11.6	157000	3790	
H5520	20	0.952	14.8	167400	3,920 <sup>2</sup>	
H6030	30	0.965	15.7	224000	4,100 <sup>2</sup>	
H5234	34	0.952	15.4	169000	3,820 <sup>2</sup>	
<b>Petrothene LDPE</b>						
NA204000	7	0.918	-	30000	1600	Broad MWD
NA214000	10	0.918	-	21000	1580	Broad MWD
NA860008	24	0.921	-	32000	1770	Available with lubricant as NA860241
NA870252	38	0.921	-	33000	1850	Contains lubricant

<sup>1</sup> Measures the number of inches of flow produced when molten resin is injected into a long, spiral channel (0.625" insert) at a constant injection pressure of 1000 psi with a melt temperature of 440 °F

<sup>2</sup> Tensile strength @ break.

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# Global Caps and Closures Customer Requirements

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- Aging society (different market implementation in regions)
  - ease of use
  - lower opening torque
- Downgauging
- Tamper evidence
- Differentiated design for brand protection (against fraud)
- Long shelf life
- Consumer issues/awareness
  - organoleptics
  - environmental concerns (incl. weight saving)
  - health/lifestyle
  - increase in single households/mobility
- Increase in specialization but also in commoditization
- How can we address these trends with you?

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Thank you for your attention

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