

# MANAGING THRU THE POLYAMIDE 66 SHORTAGE

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# *What Propelled Us to Today??*

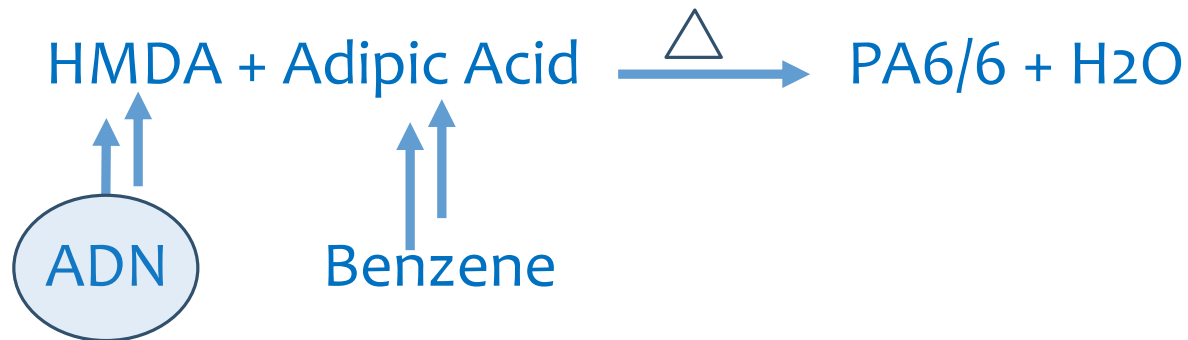
- **Chronic shortages of ULTEM, the past 10 yrs**
- **Evonik plant explosion, PA12 global mess**
- **SABIC SAP conversion, ‘the mother of all mess’s**
- **Nine (9) Force majeures in 8 months in Nylon 66, global shortage**

“He who forgets history, is doomed to repeat it”

George Santayana

# WHY IS 66 NYLON SUPPLY SO TIGHT?

## PA6/6 Chemisty



Adiponitrile or ADN is on worldwide allocation

# The Chemistry to ADN

## Two Routes

*“DuPont C<sub>4</sub> Process”*

Butadiene plus Hydrogen Cyanide

*“Monsanto C<sub>3</sub> Process”*

Propylene plus ammonia

**ADN Plants are hazardous, highly specialized and costly to build**

# WHY IS 66 NYLON SUPPLY TO TIGHT?

- The majority of ADN capacity is supplied via merchant market
- ADN monomer capacity increases, have been slower than demand growth
- Invista and Ascend run their monomer businesses as Profit Centers
- Ascend is the only captive ADN producer too
- Butachimie produces only ADN
- Prior to Invista, DuPont ran the monomer operations as a Cost Center and was a captive producer of ADN

# Polymerization of PA6/6

## North America

Ascend

DowDuPont

Invista

## Europe

DowDuPont

Invista

Solvay / BASF

Radici

Celanese / Nilit

## Asia

DowDuPont

Asahi Kasei

Toray

## NA Monomer

Ascend

Invista

## EU Monomer

Invista [adipic only]

Solvay / BASF [adipic only]

Butachimie

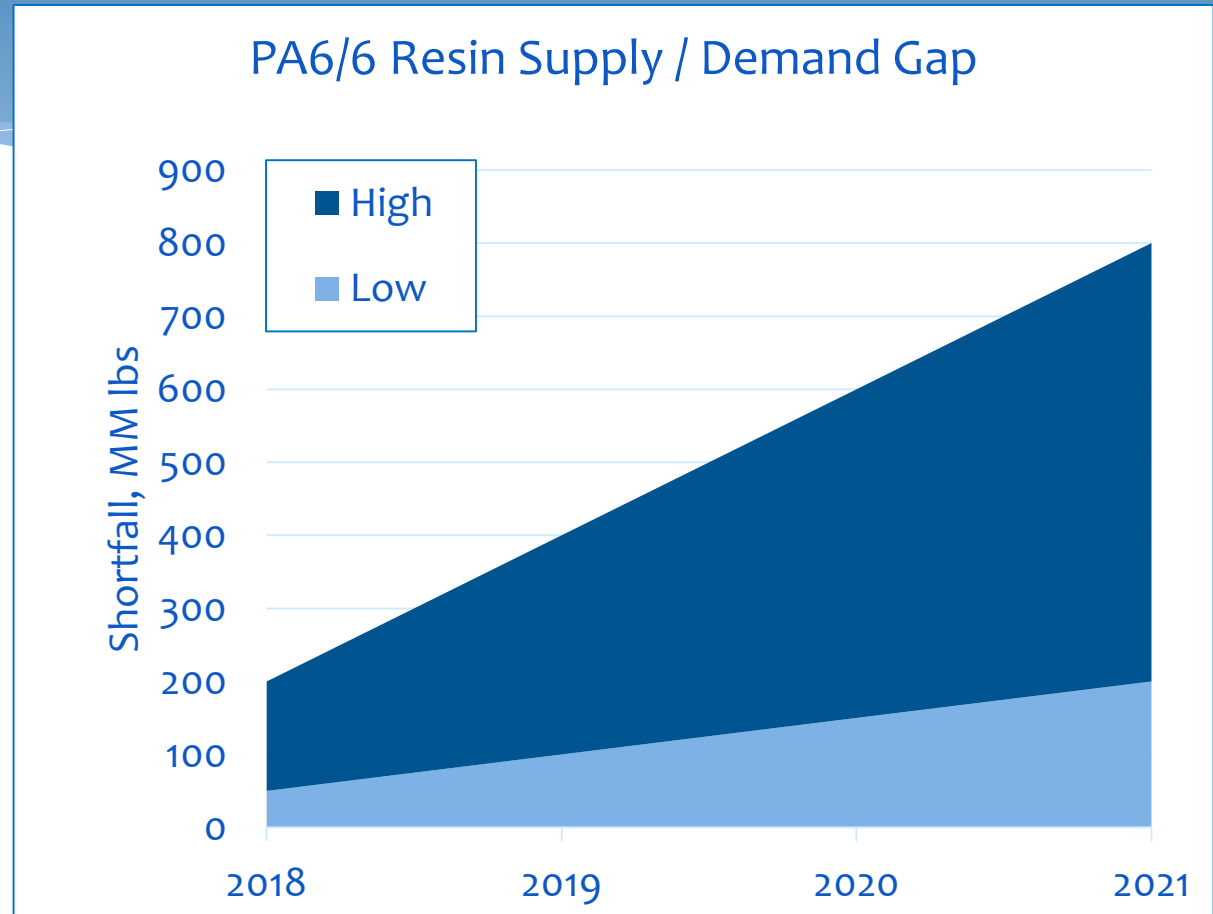
Radici [adipic only]

## Asia Monomer

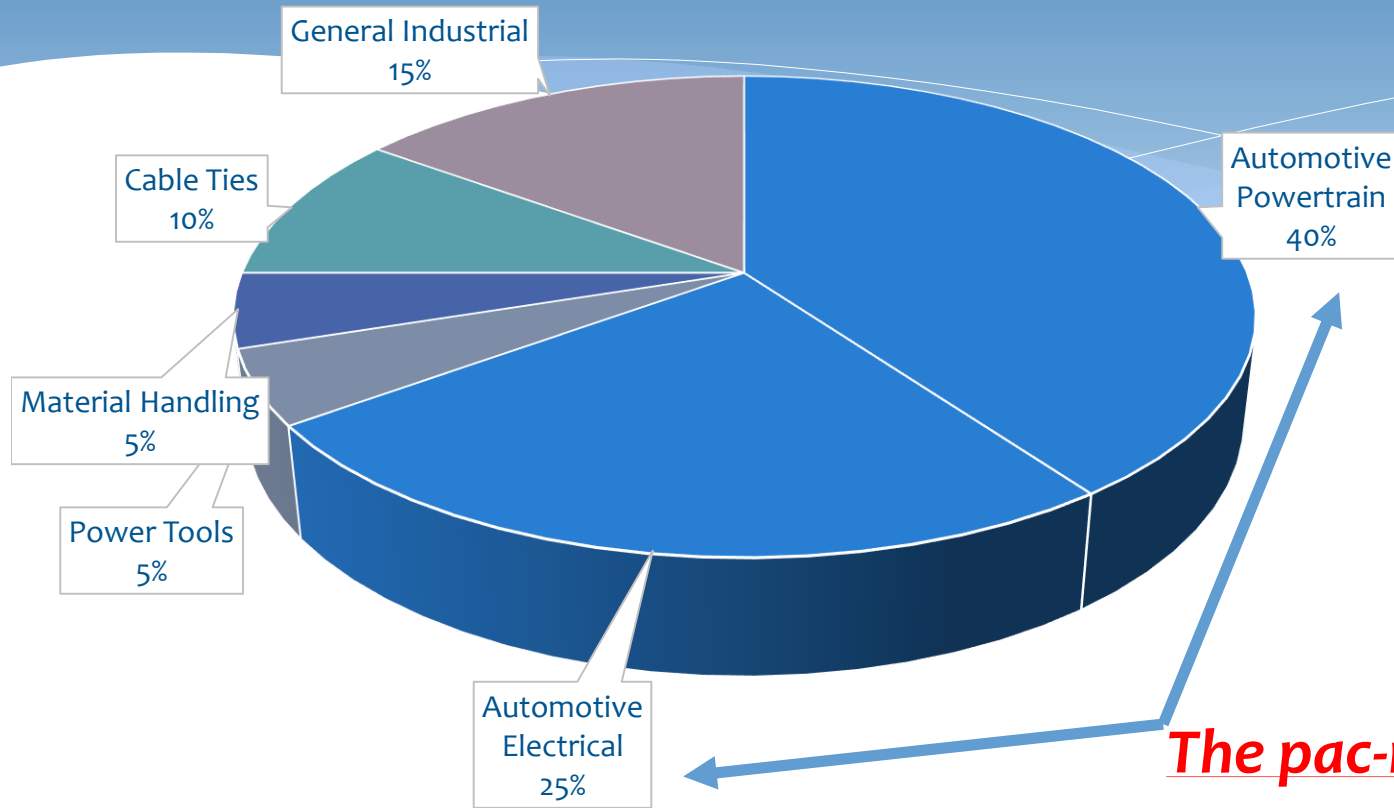
Asahi Kasei [adipic only]

# WHY IS 66 NYLON SUPPLY SO TIGHT?

- Incremental ADN capacity, 2019
- New ADN Capacity, late 2020
- *The wild cards:*
  - Car builds
  - ‘The economy’



# Global Nylon 6/6 Demand by End Market



*The pac-man effect!*

So, what do you do?

#1 – what market(s) are you supplying



# Protecting Your Business and Your Customer's Business

*In the Automotive Market*

OEM

Bosch (Tier 1), Sub-assembly

Device Mfg (Tier 2)

Molder

Most Tier 1's have global resin supply contracts

**So, what do you do?**

**#2 – Contact your OEM or Tier 1 asap**

# Protecting Your Business and Your Customer's Business

## If you're supplying Automotive PA6/6 App's

- Most likely you'll get resin
- Most likely you will get 'body slammed' on purchase price

So, what do you do?

**#2 – Contact your OEM or Tier 1 asap AGAIN**

# Protecting Your Business and Your Customer's Business

## If you're supplying Automotive PA6/6 App's

- *You have a profit margin problem!*
- *Insist on Tier 1 price protection on resin*
- *Pass thru every cost increase immediately*
- *Place orders on a 30/60/90 basis (don't rely on blanket orders)*
- *Sell your parts on replacement cost, not on your inventory cost*

**So, what do you do?**

**#3 – Be Pro-active**

# Protecting Your Business and Your Customer's Business

## If you're supplying Non Automotive PA6/6 App's

- Most likely you won't get enough resin, if any at all
- Most likely you will get 'body slammed' on purchase price  
(and kicked in the head for good measure)

**So, what do you do?**

**#4 – Contact your OEM asap**

# Protecting Your Business and Your Customer

## If you're supplying Non Automotive PA6/6 App's

- *You have a profit opportunity!*
- *Get PolySource Involved, let us help define material options*
- *We'll dissect your current material and application and provide options*
- ***Start now**, supply is only going to get worse and who knows how long it will take to approve a new material*

**So, what do you do?**

**#5 – Be Pro-active!**

# *We Didn't have Any Warning On the 1<sup>st</sup> Three!*

1. Chronic shortages of ULTEM, the past 10 yrs
2. Evonik plant explosion, PA12 global mess
3. SABIC SAP conversion, 'the mother of all mess's
4. **Nine (9) Force majeure in 8 months in Nylon 66, global shortage**

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# Dissecting the Current Grade

Injection	Dry (English)	Dry (SI)		
Drying Temperature	176 °F	80 °C		
Drying Time - Desiccant Dryer	2.0 to 4.0 hr	2.0 to 4.0 hr		
Suggested Max Moisture	0.20 %	0.20 %		
Processing (Melt) Temp	527 to 563 °F	275 to 295 °C		
Melt Temperature, Optimum	545 °F	285 °C		
Mold Temperature	158 to 248 °F	70 to 120 °C		
Mold Temperature, Optimum	212 °F	100 °C		
Holding Pressure	7250 to 14500 psi	50.0 to 100 MPa		
Drying Recommended	yes	yes		
Hold Pressure Time	3.00 s/mm	3.00 s/mm		
Maximum Screw Tangential Speed	472 in/min	12 m/min		

Physical	Dry	Conditioned	Unit	Test Method
Density	1.39	--	g/cm <sup>3</sup>	ISO 1183
Molding Shrinkage				ISO 294-4
Across Flow	1.1	--	%	
Flow	0.30	--	%	
Water Absorption				ISO 62
Saturation, 73°F (23°C), 0.0787 in (2.00 mm)	5.7	--	%	
Equilibrium, 73°F (23°C), 0.0787 in (2.00 mm), 50% RH	1.8	--	%	

Mechanical	Dry	Conditioned	Unit	Test Method
Tensile Modulus	1.60E+6 (11000)	1.16E+6 (8000)	psi (MPa)	ISO 527-2
Tensile Stress (Break)	29000 (200)	20300 (140)	psi (MPa)	ISO 527-2
Tensile Strain (Break)	3.0	4.0	%	ISO 527-2
Flexural Modulus	1.38E+6 (9500)	870000 (6000)	psi (MPa)	ISO 178
Flexural Stress	40600 (280)	28300 (195)	psi (MPa)	ISO 178
Poisson's Ratio	0.34	0.34		ISO 527

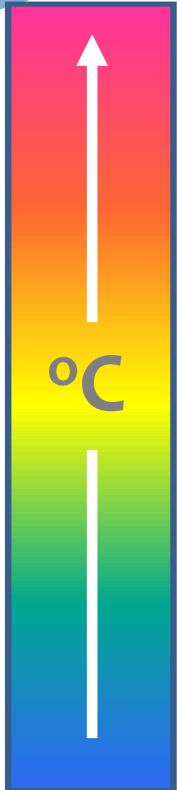
Impact	Dry	Conditioned	Unit	Test Method
Charpy Notched Impact Strength				ISO 179/1eA
-40°F (-40°C)	4.8 (10)	4.8 (10)	ft·lb/in <sup>2</sup> (kJ/m <sup>2</sup> )	
73°F (23°C)	6.2 (13)	8.1 (17)	ft·lb/in <sup>2</sup> (kJ/m <sup>2</sup> )	
Charpy Unnotched Impact Strength				ISO 179/1eU
73°F (23°C)	36 (75)	38 (80)	ft·lb/in <sup>2</sup> (kJ/m <sup>2</sup> )	
Notched Izod Impact Strength				ISO 180/1A
-40°F (-40°C)	4.8 (10)	4.8 (10)	ft·lb/in <sup>2</sup> (kJ/m <sup>2</sup> )	
73°F (23°C)	5.7 (12)	7.1 (15)	ft·lb/in <sup>2</sup> (kJ/m <sup>2</sup> )	

# Dissecting the Current Grade

Thermal	Dry	Conditioned	Unit	Test Method
Heat Deflection Temperature				
66 psi (0.45 MPa), Unannealed	502 (261)	--	°F (°C)	ISO 75-2/B
264 psi (1.8 MPa), Unannealed	486 (252)	--	°F (°C)	ISO 75-2/A
Melting Temperature <sup>4</sup>	504 (262)	--	°F (°C)	ISO 11357-3
CLTE				ISO 11359-2
Flow	1.0E-5 (1.8E-5)	--	in/in/°F (cm/cm/°C)	
Flow : -40 to 73°F (-40 to 23°C)	1.3E-5 (2.4E-5)	--	in/in/°F (cm/cm/°C)	
Flow : 131 to 320°F (55 to 160°C)	7.2E-6 (1.3E-5)	--	in/in/°F (cm/cm/°C)	
Transverse	4.6E-5 (8.3E-5)	--	in/in/°F (cm/cm/°C)	
Transverse : -40 to 73°F (-40 to 23°C)	3.6E-5 (6.5E-5)	--	in/in/°F (cm/cm/°C)	
Transverse : 131 to 320°F (55 to 160°C)	7.8E-5 (1.4E-4)	--	in/in/°F (cm/cm/°C)	
Electrical	Dry	Conditioned	Unit	Test Method
Comparative Tracking Index (CTI)	PLC 1	--		UL 746
Comparative Tracking Index	400	--	V	IEC 60112
Flammability	Dry	Conditioned	Unit	Test Method
Burning Rate <sup>5</sup> (0.0394 in (1.00 mm))	1.1 (28)	--	in/min (mm/min)	ISO 3795
Flame Rating				UL 94 IEC 60695-11-10 -20
0.030 in (0.75 mm)	HB	--		
0.06 in (1.5 mm)	HB	--		
FMVSS Flammability	B	--		FMVSS 302
Fogging - G-value (condensate)	6.0E-4	--	g	ISO 6452
Fill Analysis	Dry	Conditioned	Unit	
Ejection Temperature	410 (210)	--	°F (°C)	
Additional Information	Dry	Conditioned	Unit	Test Method
Emission of Organic Compounds	10.0	--	µgC/g	VDA 277
Odor	3.00	--		VDA 270



# Strong Options



30% GF	HDT	Pro's	Con's
HTN	290	< water absorp.	*hot oil
PA6/6	260		
PA6	220	close cousin nylon	> water absorp.
PBT	215	< water absorp.	Impact
POK	210	Impact	UV
POM	160	< water absorp.	Impact
PP	150	cost	strength

# Protecting Your Business and Your Customer

## *Automotive*

### Start Now

- Connect with your customer and / or the Tier 1
- Is there contract pricing
- Pass thru resin increases immediately
- Get forecasts and place orders with your suppliers

**Supply is only going to tighten**

# Protecting Your Business and Your Customer's Business

## *Non Automotive*

### Start Now

- Connect with your customer and / or the Tier 1
- Pass thru resin increases immediately
- Meet with your PolySource Application Development Engr.
- Get started on submitting test parts in new materials asap

**Supply is only going to get worse**

# Protecting Your Business and Your Customer's Business



**Thanks for Joining the Discussion today!**

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