Robert Eller Associates LLC

CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES

Views and Prospects of the Polycarbonate Industry

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Robert Eller Associates LLC

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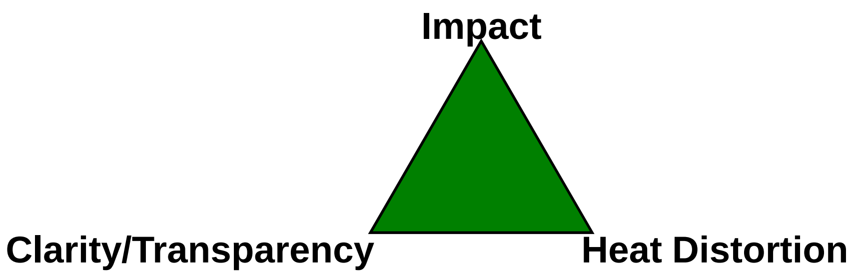
- Robert Eller Associates is a 15 year-old global plastics consulting company helping companies analyze technical, marketing and economic implications for their business to facilitate management in strategic decision making
- Offices in Akron, Ohio (home office), Paris, Shanghai, New Zealand
- Asia: Active in China (60%), India (20%), Middle East (20%)
- 5 Key Focus areas: TPE's, ETP's, Automotive, Compounding and Foams
- Multi-client studies:
  - China TPE Market: 2006
  - North America/Europe TPE: 2006
  - Automotive Soft Trim: 2004
  - Automotive Non-wovens: 2004
- Single client studies
- Mergers and acquisitons:
  - Complete management service for small acquisitions
  - Due diligence
  - Technical Advisors

Polycarbonate

- An amorphorous thermoplastic that has three critical functional values:



- Applications require two of these three functional values or be subject to substitution
- Widely used (global demand of nearly 4000 kt)
- 2007 saw exit of GE Plastics and entry of Sabic

Polycarbonate Resin Manufacturers

PC Manufacturer	Plant Locations	Capacity KT/yr	Tradename/Notes
Sabic Innovative Plastics	Spain	280	Lexan
	Netherlands	200	
	Japan	40	
	US	520	
	Saudi Arabia	260	Saudi Kayan (2009), Licensed Asahi Technology
	Total	1300	
Bayer	China	200	Makrolon China plant not yet at capacity (2008)
	Thailand	220	
	Belgium	240	
	Germany	330	
	US	260	
	Total	1250	
Teijin	Japan	120	Panlite
	Singapore	200	
	China	160	
	Total	480	

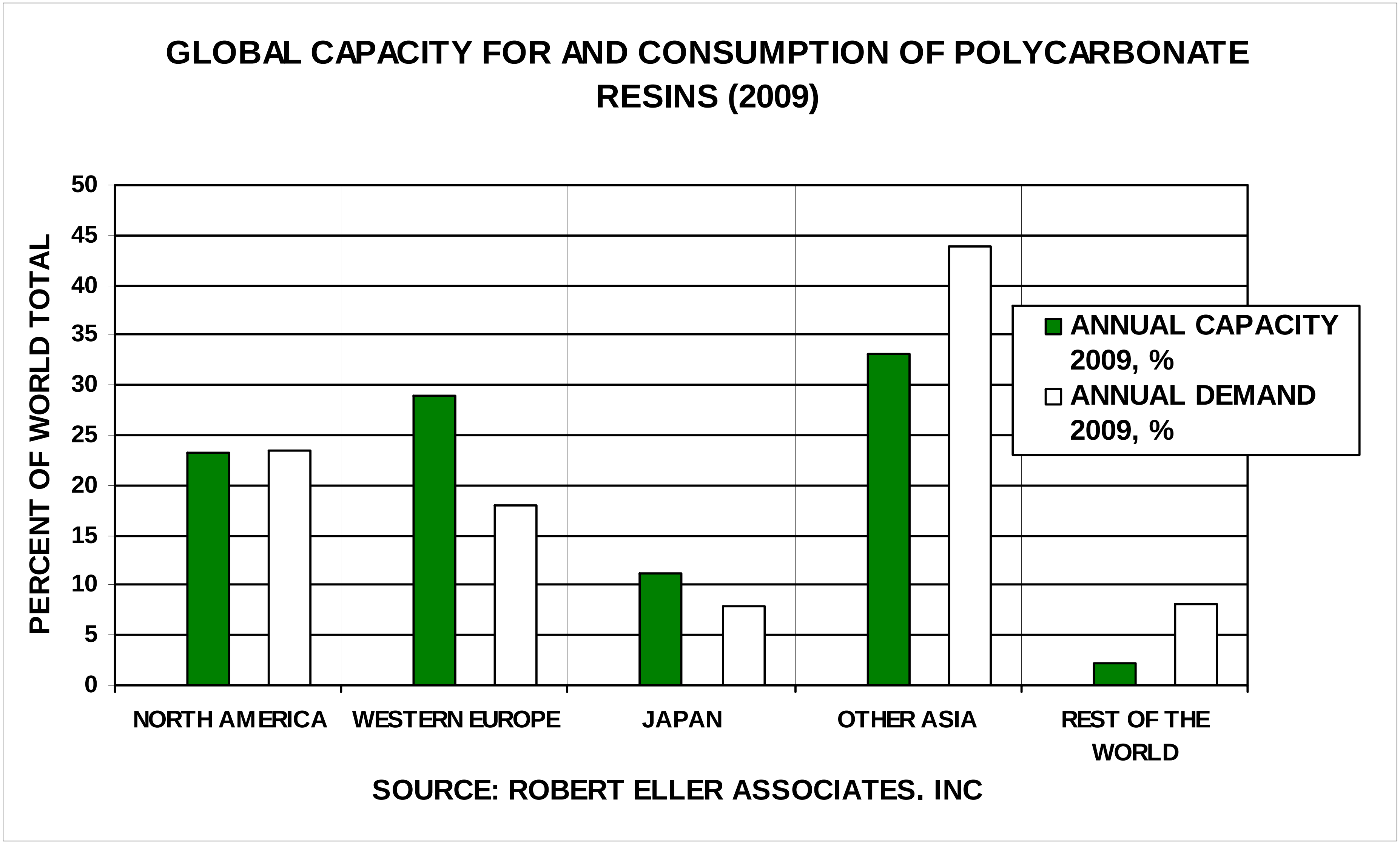
SOURCE: ROBERT ELLER ASSOCIATES LLC, 2008

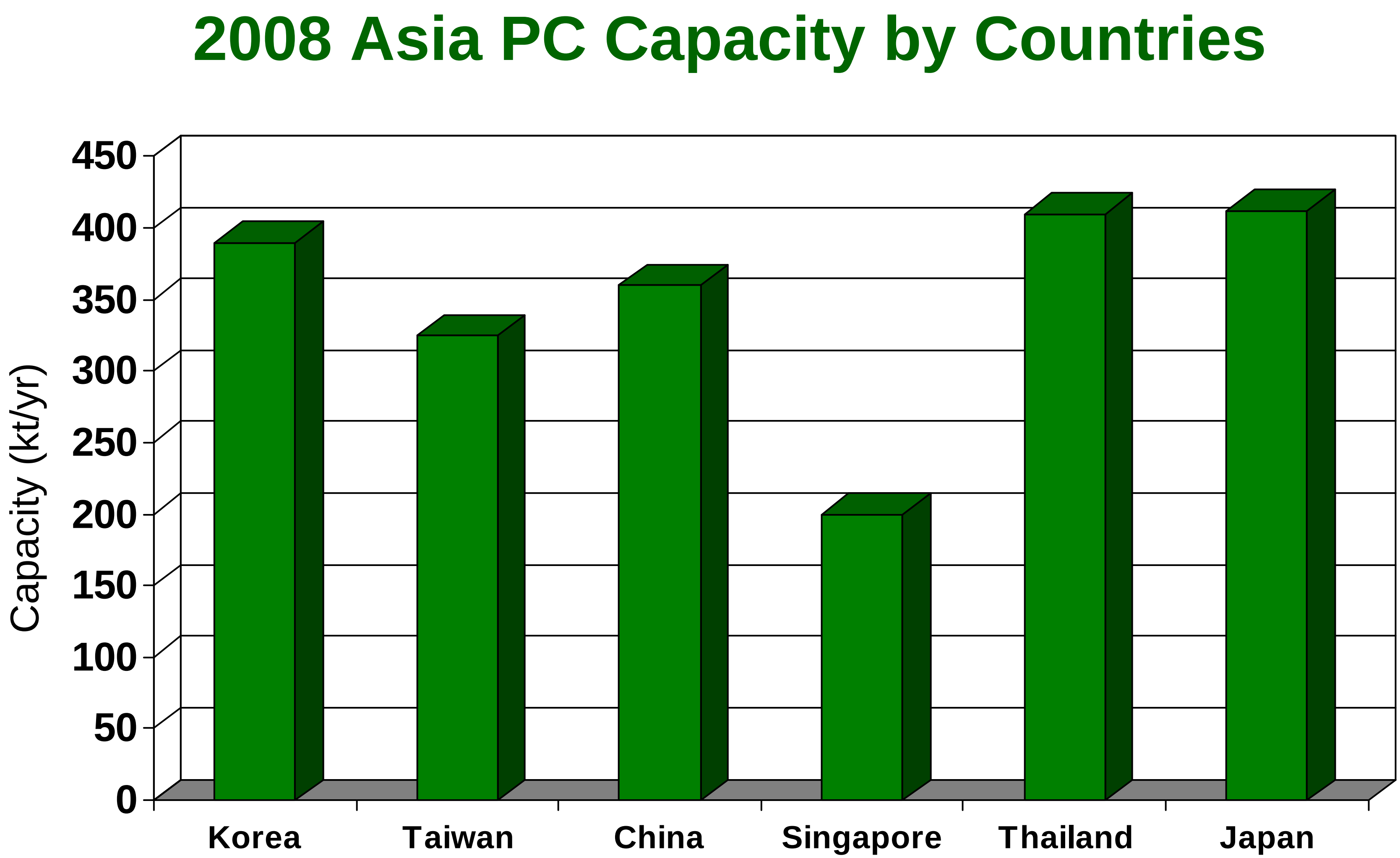
PC Manufacturer	Plant Locations	Capacity KT/yr	Tradename/Notes
Dow	Texas	84	Calibre
	Germany	134	
	Japan	55	JV with Sumitomo
	Korea	150	JV with LG
	Total	423	
Mitsubishi Engineering Plastics	Japan	110	Mitsubishi Chemical - Iupilon
	Japan	40	Mitsubishi Gas Chemical-Novarex
	Thailand	160	JV Iupilon/Novarex
	Korea	110	JV Samyang Advanced Material-Trirex
	China	80	JC MGC/Sinopec (2009)
	Total	420	
Asahi Kasei	Taiwan	150	JV with Chi Mei- Wonderlite
	Russia	65	Licensed OAO Kazanorgsintez
	Iran	25	Licensed NPC (KZPC)
	Korea	65	Licensed Honam Petrochemical
	Korea	65	Licensed Cheil Industries (Samsung)
	Saudi Arabia	(260)	Licensed Saudi Kayan (See Sabic IP)
	Total	305	

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2008

PC Manufacturer	Plant Locations	Capacity Kt/yr	Tradename/Notes
Idemitsu	Japan	47	Tarflon
	Brazil	15	JV with PC Brazil
	Taiwan	175	JV with Formosa
	Total	237	

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2008


GLOBAL CAPACITY FOR AND CONSUMPTION OF POLYCARBONATE RESINS (2009)
PERCENT OF WORLD TOTAL
0
5
10
15
20
25
30
35
40
45
50
ANNUAL CAPACITY 2009, %
ANNUAL DEMAND 2009, %
NORTH AMERICA
WESTERN EUROPE
JAPAN
OTHER ASIA
REST OF THE WORLD
SOURCE: ROBERT ELLER ASSOCIATES. INC



SOURCE: ROBERT ELLER ASSOCIATES LLC, 2008

PC Resin Supplier Strategies

- Focused on cost reduction
  - Application development/ R&D resources are reduced
  - Lower cost raw materials
  - Lower cost manufacturing
- Sabic Innovative Plastic:
  - leverage raw materials
  - translate application development/ specialty marketing skills into Sabic
  - Grow copolymers/specialty compounds segment of business
  - Will use Saudi Kayan plant as low cost entry into Asia (no real Asia manufacturing capabilities)?
  - What will Sabic do in China (Petrochina jv plant canceled)?
  - Focused in Asia on high end of market (exporters) due to high manufacturing costs from North American and European plants
- Bayer: Well positioned globally and in particular, with Thailand and Shanghai Asian plants
- Dow: Asset light JV with PIK
- Asahi Kasei: licensing technology rather than marketing resin
- Idemitsu, Teijin, MEP: following Asian strategies
- Only one western company left: Bayer Material Science

Polycarbonate Issues

- **Asian plants vs. Western plants**
  - All recent plants in Asia (Korea, China, Taiwan, Singapore…..Saudi Arabia, Russia, Iran)
  - Asian plants have typical on average 20-25% less variable manufacturing cost than Europe and North America (major cost disadvantage in importing)
- **Raw Materials: Asset light**
  - How to make money?
  - GE/Sabic sale
  - Dow/PIK JV
- **Compounding: shift to specialties**
  - Role of fabricators increasing (simplifying the supply chain)
- **Downstream converting by resin suppliers**
  - Sheet and film
- **Copolymers:**
  - Higher value, less competition?
- **Commoditization:** Is polycarbonate reaching the top of the development cycle?
  - Pricing pressures
  - Compact discs
  - Fewer new applications/resource reductions by resin manufacturers
  - Shift to Asia
- **How do you make money?**
  - Business shift to Asia
  - Low cost manufacturing plants
  - Reduced resources
  - Lower cost raw materials
  - Move to specialties (compounding/copolymers
  - What lessons can be learned from the ABS business

Global PC Major Market Segments

Market Sector	Market Share	Growth Rate (%/yr)	Notes
Electrical/Electronics	**27**	**8**	**Minimization, hi heat drivers particularly as higher power chips are used**
Building & Const.	**17**	**6**	**Driven by PC sheet in glazing**
Optical Data Storage	**15**	**2**	**Demand peaking, Teijin major supplier, lowest price segment**
Blends/compounds	**13**	**10**	**Growth in PC/ABS blends in electronic applications requiring greater heat than ABS**
Automotive	**12**	**8**	**Glazing will drive growth. exterior panels, headlamps**
Medical	**8**	**9**	**Aging demographics/BPA issues?**
Water bottles	**3**	**8**	**BPA issues?**
Other	**3**	**5**	
Films	**1**	**18**	**New growing applications**

Markets/ Market Issues

- Compact Disc
  - Music CD's are peaked and slowly decreasing (at about 10-12%/year)
  - Data storage is still growing
  - Competitive technologies: MP3, Blueray, Stick storage, higher levels of direct downloading
  - Dominated by Teijin: lowest price sector
- Automotive Glazing
  - Is plasma really needed?
  - Who will step up and build the world scale plant: the Saudis as part of their cluster program?
- Films – rapid growth opportunity
- LCD TV's
  - Large growth opportunity, Asia focused
  - Light guides, diffusion plate, reflection plate, and housings (blends)
  - Non-halogen FR required
- Asia shift: electronics, electrical, automotive
  - Mobile telephones, laptops, electronic devices, all high growth opportunities in Asia
- SIP: a reinvigorated applications development focus?
- Environmental factors
  - PC in a battle it can win?

aerodynamic styling ……and lightweight
…..and lowers the center of gravity

Photo courtesy Exatec

and allows for parts/system integration…….

Photo courtesy Exatec

Environmental Issues

- It seems every time you turn around some new environmental challenge seems to be facing polycarbonate
  - Phosgene vs. Non-phosgene Plants
    - Asahi has become big licenser of non-phosgene technology
    - No longer critical issue: technology is broadly available
  - Halogenated FR vs. Non-halogenated FR
    - A PC advantage?
    - Manageable issue: technology is broadly available
  - BPA
    - Baby bottles, medical and water bottle applications most vulnerable
    - Momentum building despite technical data supporting
    - Emotional driven issue/ Is this a battle that can be won?

Polycarbonate: A 2008 Summary

- An example of a specialty resin being transformed into a commodity?
  - Compounding opens the door to “specialties”
  - Higher value copolymers successful?
  - The risk of entry of a Dow/Chi Mei/Formosa as manufacturers?
- Suppliers struggle with how to achieve profitability?
  - Low Cost Raw Materials
  - Reduce costs (sales, applications and research costs)
  - Lower cost manufacturing sites
  - Specialties including moving downstream into sheet and film
- Markets achieving maturity
  - compact discs
- Major application development opportunity
  - Automotive glazing
- Business in major transition:
  - Shift to Asia/growth of Asia in importance
  - New names/owners
  - The end of the specialty era?
  - The end of application development ?

Thank You!

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