TPEs: IMPACT OF GLOBALIZATION, MARKET SHIFTS, AND NEW TECHNOLOGIES

PRESENTED BY:
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OCTOBER 23, 2007
mydox/papers/RAPRA 07.ppt
PRESENTATION OUTLINE

• Globalizing TPE marketplace
• Key TPE marketplace trends
• TPE industry structure shifts
• Expanding properties envelope
• New materials fabrication technologies
• Automotive supply chain implosion effects
• Talc effects
• Body/glazing seals
• The rubber attack
• Non-automotive TPE markets
Specialty Thermoplastic Elastomers . . . Markets, Economics, Technology, Intermaterials Competition

A Europe/U.S./Japan Multiclient Industry Analysis
Completed January 2007

Robert Eller Associates, Inc.
CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES
MANAGEMENT DECISIONS

ANALYSIS

TECHNICAL
ECONOMIC
MARKET

Specialty Thermoplastic Elastomers ... Markets, Economics, Intermaterials Competition, and Industry Structure in China

ENGINEERING TPEs AND SUPER-TPVS
THERMOSET RUBBERS
METALLOECNE PLASTOMERS/ELASTOMERS

A China Multiclient Industry Analysis

Robert Eller Associates, Inc.
CONSULTANTS TO THE PLASTICS AND RUBBER INDUSTRIES
TPE FAMILIES . . .
CHANGING STRUCTURE, INCREASED INTRA-TPE COMPETITION

NOTE: (a) RECYCLATE-BASED TPV

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
TARGET MARKETS FOR TPEs

METAL SUBSTITUTION
  AUTO
    - FASCIA
    - FENDERS
  TUBING
  SHEET

PLASTICS
  FILMS, TUBING
  SOFT TOUCH

RUBBER SUBSTITUTION
  HOSE
  TUBE
  BELTS
  SEALS
  GROMMETS, BUSHINGS

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
GLOBALIZING TPE MARKETPLACE

• The TPE marketplace is rapidly globalizing.

• Investment and technology flows are following the globalization pattern of the TPE compounding industry.

• Most major TPE compounders have established Asia (China) operations.

• A new class of Asian TPE compounders is emerging (eventually global competitors?).

• China: fastest vehicle production growth region.
GLOBAL INVESTMENT FOLLOWS THE TPE MKTS.

JAPAN

ASIA - MAINLY CHINA (a)

NORTH AMERICA

WEST EUROPE

EAST EUROPE

TURKEY

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

R/mydox/papers/RAPRA 07.ppt
KEY TPE MARKETPLACE TRENDS

- Automotive vehicle production stagnation in N. America and Europe
- End use market shift to Asia, E. Europe, Mexico
- Forward integration of SEBS resin suppliers to compounding (TSRC, Kuraray)
- Expanding properties envelope (SEBS and o-TPV)
- New metallocene polyolefin and ionomer technologies challenge SEBS and o-TPV
- Improved transparency of SEBS compounds
KEY TPE MARKETPLACE TRENDS

• Renewed attack (SEBS and o-TPV) on rubber applications
• Profitability erosion
• Parallel supply chain in China
• Segregation into commodity and specialty sectors
• Automotive supply chain implosion
• Use of single TPE for all interior applications
• Growing importance of talc
• Shift of resin capacity investment to monomer rich regions
TPE INDUSTRY STRUCTURE SHIFTS

• Strengthening of Japanese resin companies in N. America and Europe
• Korean TPE suppliers challenging the incumbents? (Hyundai EP via SK acquisition)
• TPE compounders broadening product lines
• Renewed growth of European compounders in N. America ($ weakness driver?)
• Resin suppliers riding a wave of new reactor technology (direct access to TPE markets)
• Tier 1s shifting to o-TPE compounding in-house?
• Enhanced role for masterbatch
GLOBAL WET RAZOR PRODUCTION HISTORY

- N. AMERICAN PRODUCTION
- EUROPEAN PRODUCTION
- INDIAN PRODUCTION
- CHINESE PRODUCTION


<table>
<thead>
<tr>
<th>Year</th>
<th>N. American</th>
<th>European</th>
<th>Indian</th>
<th>Chinese</th>
</tr>
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<tr>
<td>2000</td>
<td>21</td>
<td>44.9</td>
<td>890</td>
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<td>2005</td>
<td>31</td>
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<td>1,440</td>
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<tr>
<td>2010</td>
<td>21</td>
<td>278</td>
<td>1,307</td>
<td>2,460</td>
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Source: ROBERT ELLER ASSOCIATES, INC., TPE MULTICLIENT STUDY, 2007
TOOTHBRUSH MANUFACTURING SHIFT

GLOBAL TOOTHBRUSH PRODUCTION HISTORY

- N. AMERICAN PRODUCTION
- EUROPEAN PRODUCTION
- INDIAN PRODUCTION
- CHINESE PRODUCTION

<table>
<thead>
<tr>
<th>Year</th>
<th>N. American</th>
<th>Europe</th>
<th>India</th>
<th>China</th>
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<tbody>
<tr>
<td>2000</td>
<td>2,580</td>
<td>187</td>
<td>104</td>
<td>21</td>
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<tr>
<td>2005</td>
<td>4,670</td>
<td>203</td>
<td>68</td>
<td>68</td>
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<tr>
<td>2010</td>
<td>12,040</td>
<td>270</td>
<td>190</td>
<td>70</td>
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</table>

SOURCE: ROBERT ELLER ASSOCIATES LLC, CHINA TPE MULTICLIENT STUDY, 2006
PARALLEL SUPPLY CHAINS IN CHINA TPE MARKETS

NATIONALITY BASED

U.S. COMPOUNDERS → TRANSPLANT MULTINATIONAL OEMs AND FABRICATORS
EUROPEAN COMPOUNDERS
JAPANESE COMPOUNDERS → JAPANESE OEMs AND FABRICATORS
KOREAN COMPOUNDERS → KOREAN OEMs AND FABRICATORS
TAIWANESE COMPOUNDERS → TAIWANESE OEMs AND FABRICATORS
CHINESE COMPOUNDERS → CHINESE OEMs AND FABRICATORS

U.S. → HIGH QUALITY PRODUCTS (EXPORT)
EUROPE → "PREMIUM" DOMESTIC PRODUCTS
JAPAN → LOW QUALITY DOMESTIC PRODUCTS
KOREA →
TAIWAN →
CHINA →

SOURCE: ROBERT ELLER ASSOCIATES, INC., 2007

r/mydox/papaers/RAPRA07-ParaSuppChChinaTPE07.vsd
lg/myfiles/visio/RAPRA07-ParaSuppChChinaTPE07.vsd
# o-TPVs in China

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Position</th>
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<tbody>
<tr>
<td>EXXONMOBIL</td>
<td>- Dominates (via export from U.S.)</td>
</tr>
<tr>
<td></td>
<td>- 50% Share</td>
</tr>
<tr>
<td></td>
<td>- Name recognition/premium</td>
</tr>
<tr>
<td>Other West. Compounders</td>
<td>- Have been slow to invest (starting)</td>
</tr>
<tr>
<td></td>
<td>- Starting to serve domestic markets</td>
</tr>
<tr>
<td>Taiwan/Korean Compounders</td>
<td>- Minor role via export</td>
</tr>
<tr>
<td>Local Domestic Compounders</td>
<td>- Primarily smaller TPV comp'drs.</td>
</tr>
<tr>
<td></td>
<td>- Strong presence in p-TPVs</td>
</tr>
<tr>
<td></td>
<td>- Parallel supply chain</td>
</tr>
<tr>
<td></td>
<td>- Cost advantages (30%)</td>
</tr>
<tr>
<td></td>
<td>- Recyclate use?</td>
</tr>
<tr>
<td>Japanese</td>
<td>- Primarily serve Japanese auto OEMs</td>
</tr>
<tr>
<td></td>
<td>- More focus on India</td>
</tr>
<tr>
<td></td>
<td>- Mitsui is leader</td>
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<tr>
<td></td>
<td>- Shift possible in future?</td>
</tr>
</tbody>
</table>
# CHINA vs. INDIA

<table>
<thead>
<tr>
<th>POT’L DOMESTIC MARKET SIZE</th>
<th>CHINA</th>
<th>INDIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1.3 BILLION PEOPLE</td>
<td>• 1.0 BILLION PEOPLE</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INFRASTRUCTURE</th>
<th>CHINA</th>
<th>INDIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Agressively Building Infrastructure around Economic Dev’ment Zones, Facilities often in place waiting for new plants</td>
<td>• Roads/Ports/Logistics Poor</td>
<td></td>
</tr>
<tr>
<td>• Continuity to a Plan, a sense of constancy</td>
<td>• Golden Quadrangle a help, but only a start</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GOVERNMENT</th>
<th>CHINA</th>
<th>INDIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Excellent Central Planning = Strength</td>
<td>• Democratic Gov’t changed freq. (Elections every 4 years)</td>
<td></td>
</tr>
<tr>
<td>• Becoming very business friendly</td>
<td>• New Gov’ts means a stop-start</td>
<td></td>
</tr>
<tr>
<td>– Continually opening up for more foreign investmt</td>
<td>• Bureaucracy that is not highly business friendly</td>
<td></td>
</tr>
<tr>
<td>– Floating of the Yuan</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
AUTOMOTIVE TPE MARKET EFFECTS

- 40-50% of TPE demand in most regions
- Source of technology innovation
- Supply chain implosion driving technical innovation
- Automotive vehicle production stagnation in N. America and Europe
- In-house compounding by Tier 1s
- Growth of low cost vehicles
- Use of single TPE for all interior applications
- Growing importance of talc filler/reinforcement/masterbatch
AUTOMOTIVE SUPPLY CHAIN IMPLOSION

• Reshaped auto supply chain is:
  - Accelerating the drive for lower cost technical solutions
  - Accelerating modularization
  - Encouraging fabrication machinery-driven innovation
  - Shortening path between resin and assembled part

• Implosion effect is more severe in N. America than in Europe
PETROCHEM PRICE INCREASES
GLOBAL COMPETITION
OFFSHORE COMPETITION
IMPORTED COMPETITORS
RAW MATERIAL PRICE INCREASES
VEHICLE PRICE DECREASES
FUEL COSTS (PROD. LINE FIT)

RAW MATERIALS
COMPOUNDER
TIER 1 FABRICATOR
TIER 2, 3 SUPPLIERS
PROCESS TECHNOLOGY LAG
LEGACY COSTS
MARKET SHARE LOSS
OVER CAPACITY
STOCKHOLDER PRESSURES

ELIMINATE/REDUCE:
- MULTIPLE STEPS (2-SHOT MOLD, NEG.-FORM)
- EXCESSIVE LOGISTICS
- SCRAP GENERATION
- INEFFECTIVE PROCESS TECHNOLOGIES
- SALES/MARKETING COSTS
- EXCESS LABOR COSTS
- OVER-GLOBALIZATION?

PRESSURES PASSED DOWN THE SUPPLY CHAIN:
PRICING PRESSURES
SUPPLY CHAIN "MANAGEMENT"
DEMAND SLOWDOWN
REVISED SPECIFICATIONS
GLOBALIZATION PRESSURES

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
% OF CARS SOLD IN THE U.S.,
MANUFACTURED OUTSIDE OF N. AMERICA

% OF U.S. SALES

THROUGH AUG. 2007

SOURCE: MOODY'S ECONOMY.COM
GROWTH OF LOW COST VEHICLES IN THE GLOBAL FLEET

SOURCE: ROBERT BOSCH GmbH

SALES, MM UNITS

2006 2010 2014

LOW-COST VEHICLES
OTHERS
AUTOMOTIVE TPE TARGETS AND THE RUBBER INTERFACE

**AUTO TPE SYSTEMS TARGETS**

- **BODY/GLAZING SEALS**
  - **BODY SEALS**
  - **GLAZING SEALS**
    - **DOORS**
    - **HOOD**
    - **REAR DECK**
    - **FIXED**
    - **MOVEABLE**

- **HVAC**
- **EXTERIOR**
  - **DOORS HOOD**
  - **REAR DECK**

- **INTERIOR**(a)
  - **AIRBAG DOORS**
  - **COATED FABRIC**
  - **FLOOR SYSTEMS**
  - **SKINS**
  - **ACOUSTIC**
  - **CARPET BACKING**
  - **MATS**

- **BOOTS/BELLOWS**
  - **STEERING**
  - **POWER TRAIN**
  - **DOOR**
  - **ELECTRICAL**

- **ELECTRICAL**
  - **CABLE JACKET**
  - **OTHER**

- **Hose/Tube/Duct**(c)
  - **HOSE**
  - **FLEX MANDREL**(b)
  - **AIR MGT. - DUCT**
  - **TUBE**
    - **W. WASHER**
    - **EGR**
    - **VAC TUBE (NL)**

**NOTES:**
* = RUBBER/TPE INTERFACE
(a) DOES NOT INCLUDE RIGID-FILLED TPOs USED IN INTERIORS
(b) RE-USABLE MANDREL TO MFR. HOSE (TPVs COMPETING WITH NYLON)
(c) E.G., FUEL, COOLANT, OILS, OTHER HOSE

**SOURCE:** ROBERT ELLER ASSOCIATES LLC, 2007
Crank Case Ventilation Hose

TPE Grade Name: DuPont™ E-TPV
Material Type: s-TPV
Process: Co-extrusion
Status: Concept
Key Features: Blow-by gas resist.
Product: Fan shroud
Manufacturer: Sur-Flo
Material Type: TPV (Nexprene)
TPE Supplier: Solvay Engineering Polymers
Note: Used in Dodge Ram HD pickup
2- color door trim skin on single natural fiber panel substrate
Vehicle: BMW 5 Series
Tier 1: Johnson Controls
Photo: BMW
BODY/GLAZING SEALS

- Rapid growth
- High volume potential
- In-house compounding vs. merchant supply
- Evolution to in-line compounding?
- Systems will be key to TPE penetration
- Will be o-TPV vs. SEBS battleground
- 2-shot molding opportunity
Vehicle: 2007 DCX Dodge Ram
Supplier: JYCO (compound, profile, design)
Material: o-TPV
- Little guy scoops the big guys
- First o-TPV dynamic body seal

SOURCE: JYCO
EXPANDING/SHIFTING PROPERTIES ENVELOPE

- Inroads into SEBS markets by advanced olefin technologies
- Market share shift between TPEs
  - Reactor TPO
  - Improved metallo-plastomers
  - Dow's Infuse™ OBC
- POEs with high melt strength, broadened service temperature, low gloss
- POE/branched PPs
  - Compete with o-TPVs
  - Profiles/thermoforming
  - Enhanced foam properties
INTRA-TPE COMPETITION:
ROLE OF IMPROVED POLYOLEFIN TECHNOLOGY

- Broad range of new PO technologies becoming avail.
- SEBS and TPO compound ingredients
- POE displacement of EPDM in TPOs almost complete
- Will stimulate transparent TPO, elastic fibers, elastic films
- Versatile molecular architecture control
- Still young technologies with broad growth pot’l., e.g.:
  - Nano morphology control (clear TPOs, e.g., from Mitsui)
  - Long-chain branching control
- Direct sale to fabricators or compounders?:
  - Dow
  - Mitsui Chemical
  - ExxonMobil
  - Sumitomo
  - Borealis
  - JPP
NEW MATERIALS/FABRICATION COMBINATIONS

• Small part, 2-shot molding started
• Shift to large part, 2-shot molding
  - Competition with thermoformed skins
  - Evolving to 3-layer (skin/foam/substrate)
  - Shifts the supply chain
• Co-fabrication (blow, inject, profile extrude)
• Increased role for polyolefin foams
  - 2-shot injection
  - Acoustics
  - Semi-structural applications
  - Role in all-PO constructions
NEW TPE FABRICATION TECHNOLOGY:
LARGE-PART, 2-SHOT MOLDING CHALLENGES SKINS

CURRENT PROCESS

- COMPOUNDING
- MAKE SKIN
- TRIM SKIN
- TRIMMED SKIN
- PU FOAM FORMULATION
- BACK-FOAM
- MOLD SUBSTRATE
- SUBSTRATE
- NON-RECYCLABLE SCRAP
- DOOR TRIM OR INSTRUMENT PANEL
- ASSEMBLY

- LABOR INTENSIVE
- HIGH SCRAP
- MULTI STEP
- MULTI MATERIAL
- NON-RECYCLABLE
- DIFFICULT CRAFTSMANSHIP

2-SHOT

- TPE COMPOUND (CAN BE FOAMABLE)
- SHOT 1
- SHOT 2
- 3-LAYER DOOR TRIM OR INSTRUMENT PANEL
- ASSEMBLY

- LOW LABOR
- LOW SCRAP
- SINGLE STEP
- 1-2 CLOSELY RELATED MATERIAL FAMILIES
- EASILY RECYCLED
- HIGH CRAFTSMANSHIP

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
2-Shot Molded Door Medallion

Vehicle: Dodge Caliber ('07)
Molder: Lear
Material: Thermoplastic Elastomer On PP
LARGE-PART, 2-SHOT, SOFT TOUCH DEVELOPMENT

Part: Instrument Panel Upper
Skin Compound: COPE (Foamed Pibiflex from P Group)
Substrate: PBT/ASA (Ultradur® S4090IGX from BASF)
Injection Machine: Engel
Foam Technology: Trexel
SOURCE: ROBERT ELLER ASSOCIATES LLC
LARGE-PART, 2-SHOT, SOFT TOUCH: TRUCK IP UPPER

Part: Truck IP Upper
Status: Prototype
Skin Compound: COPE (foamed Pibiflex from P Group)
Substrate: PBT/ASA (Ultradur® S4090IGX from BASF)
Molding Machine: Engel Duo Series (for Dolphin process)
Tier 1: IAC

SOURCES: POLYMOTIVE; ROBERT ELLER ASSOCIATES LLC
TALC EFFECTS

• New micro-talcs broaden the properties envelope

• Exterior and interior applications

• For exterior applications:
  - Europe ahead (front-end modules, e.g., BMW X5; hatchback, e.g., Renault Modus)
  - Could accelerate exterior panel penetration

• Role for masterbatch
BMW X5 Front-end Module

Compound: 30% talc-filled TPO
Molder: Plastic Omnium
Filler Type: Jetfine® 3CA (Rio Tinto Minerals)
Key Features: Class A finish, zero gap, low temp. (-40°C) impact, weight save, high scratch resistance, meets European pedestrian safety requirements

SOURCES: PLASTIC OMNIUM; ROBERT ELLER ASSOCIATES LLC, 2007
### TPE/RUBBER SUBSTITUTION STATUS

| BODY/GLAZING SEALS       | - STARTED  
|                         | - WILL ACCELERATE  
|                         | - FOAMING REQUIRED?  
| HOSE                    | - NO SIGNIFICANT PENET. YET  
|                         | - REQUIRES PARADIGM SHIFT  
| TUBING                  | - o-TPV STARTING  
|                         | - TPU, SEBS WELL ADVANCED  
| BELTS                   | - UNLIKELY PENET. IN AUTO  
|                         | - MAJOR o-TPV, TPU TARGET  
| BOOTS/ BELLOWS/ DUCTING | - SUBSTANTIAL PENETRATION.  
|                         | - SHIFT TO HIGHER PERF. TPEs?  
| GROMMETS, BUMPERS, GASKETS | - MODERATE PENETRATION  

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
TPE vs. TSR PATH TO MARKET

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007
## KEY DEVELOPMENTS IN NON-AUTOMOTIVE GLOBAL TPE MARKETS

<table>
<thead>
<tr>
<th>TPE MKT. SEGMENT</th>
<th>ASIA SHIFT</th>
<th>KEY DEVELOPMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building/Construction</td>
<td>No</td>
<td>- Stagnation in U.S. &amp; W. Europe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Credit crunch effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Intermaterials competition in roofing (EPDM, TPO, SEBS, SEBS/SBS construction)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Continued penetration in glazing seals by SEBS &amp; olefinic TPEs in Europe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Severe compound price erosion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Glazing seals under-developed in N. America</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Eastward expansion in Europe</td>
</tr>
<tr>
<td>Consumer/Housewares</td>
<td>Yes</td>
<td>- Dominated by SEBS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Increased participation by SBS compounds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Very strong Asia shift</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Maturing of soft touch, 2-shot technologies</td>
</tr>
</tbody>
</table>

(Continued)
<table>
<thead>
<tr>
<th>TPE MKT. SEGMENT</th>
<th>ASIA SHIFT</th>
<th>KEY DEVELOPMENTS</th>
</tr>
</thead>
</table>
| Medical             |            | - Higher value market  
- Intensified competition by Western compounders seeking to capture value  
- No significant China shift yet, but starting  
- PVC replacement (tubing, films, bags, closures) is driver |
| Footwear            | Yes        | - Dominated by SBS and TPU  
- Already strongly shifted to Asia |
| Appliance/Tools     | Yes        | - Dominated by SEBS  
- Very strong Asia shift  
- Maturing soft touch, 2-shot technologies |
| Pers. Care/Cosmetics|            | - Anticipated strong penetration of elastic fibers |

(Continued)
### KEY DEVELOPMENTS IN NON-AUTOMOTIVE GLOBAL TPE MARKETS (Cont’d.)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Developments</th>
</tr>
</thead>
</table>
| Sports/Leisure              | Yes   | - Very strong Asia shift  
- Dominated by SEBS  
- Maturing soft touch, 2-shot technologies |
| Wire/Cable                  |       | - Relatively undeveloped TPE market segment  
- PVC replacement will drive TPEs  
- Non-halogen requirements starting in Europe (WEEE and RoHS) |
| Fluid Handling/Industrial   |       | - TPE tubing growth  
- Recent o-TPV penetration into EPDM tubing  
- Enhanced role for high clarity TPEs  
- Abrasion resistance required for industrial applications |
| Food/Pharma Pkg.            |       | - Role for clear TPEs  
- Role for TPEs in closures, replacing thermoset elastomers |
### KEY DEVELOPMENTS IN NON-AUTOMOTIVE GLOBAL TPE MARKETS (Cont’d.)

<table>
<thead>
<tr>
<th>TPE MKT. SEGMENT</th>
<th>ASIA SHIFT</th>
<th>KEY DEVELOPMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical/ Electronic/ Telecom.</td>
<td>Yes</td>
<td>- Role for conductive TPEs (e.g., gasketing)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Enhanced role for soft touch (potentially high value)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Enhanced role for colored TPEs</td>
</tr>
<tr>
<td>Coated Fabrics</td>
<td></td>
<td>- A relatively undeveloped but promising market for SEBS and o-TPEs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Recent improvement of TPU coating grades</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Possible entry by improved o-TPE and SEBS grades</td>
</tr>
</tbody>
</table>

**SOURCE:** ROBERT ELLER ASSOCIATES LLC, 2007
TPE COMPOUND VALUE KILLERS

• ANY COMMODITY APPLICATION VIA EXTENDED SUPPLY CHAIN
• COMPETITION WITH PVC
• DIRECT 1:1 COMPETITION WITH EPDM
• CASCADE TO LOWER VALUE TPEs
• MOST AUTO APPLICATIONS (NOT ALL)
• COMPETITION WITH CHINESE COMPOUNDERS
• FABRICATOR IN-HOUSE COMPOUNDMING
• MULTIMATERIALS CONSTRUCTION
• MULTI-STEP FABRICATION
TPE RESIN/COMPOUND VALUE CREATORS

• SYSTEMS COST SAVINGS POTENTIAL
• MONOMATERIALS CONSTRUCTION POT’L.
• IMPROVED ADHESION
• 2-SHOT MOLDING (ESP. LARGE PARTS)
• FOAMING
• CO-PROCESSING
• GLOBAL SPECIFICATIONS
• ELIMINATION OF CROSSLINKING
• MASTERBATCHES
• CONTROLLED RHEOLOGY
• SPECIALTY NICHES (IN-MOLD DECORATION)
• IMPROVED ACOUSTIC PROPERTIES
**o-TPV PROFITABILITY DRIVERS**

<table>
<thead>
<tr>
<th>INCREASE</th>
<th>DECREASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMPROVED PROPERTIES</td>
<td>AUTOMOTIVE DEPENDENCE</td>
</tr>
<tr>
<td>-- FOAMING</td>
<td>-- TECHNOLOGY PROLIFERATION</td>
</tr>
<tr>
<td>-- ADHESION</td>
<td>-- INCREASED COMPETITION</td>
</tr>
<tr>
<td>-- COLOR CONTROL</td>
<td>-- PRICE PRESSURES</td>
</tr>
<tr>
<td>MOMENTUM FROM PREVIOUS MARKETING</td>
<td>CASCADE TO LOWER PRICED TPEs</td>
</tr>
<tr>
<td>CHINA MARKET PENETRATION (FOR EARLY ENTRANTS)</td>
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</tr>
<tr>
<td>RUBBER PENETRATION</td>
<td>DIRECT COMPOUNDING OF TPVs?</td>
</tr>
<tr>
<td>-- HOSE</td>
<td>- COMPETITION FROM IMPROVED STYRENIC TPEs?</td>
</tr>
<tr>
<td>-- BELTING</td>
<td></td>
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<tr>
<td>-- SYSTEMS COST SAVE</td>
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</tbody>
</table>

SOURCE: ROBERT ELLER ASSOCIATES LLC, 2007

SHORT TERM  TIMING  LONG TERM

r/mydox/papers/RAPRA07-oTPVprofitDrivers07.vsd
lg/myfiles/visio/RAPRA07-oTPVprofitDrivers07.vsd
SUMMARY

• Rapidly changing global TPE marketplace:
  - Changing regional character/industry structure (Asia shift in consumer mkts.)
  - Shifting TPE demand to lower cost regions
  - Internationalizing N. American resin/compound market
  - Imported compounds from China/India to Europe/N. America

• Commoditization of low end TPE compound markets (shifting supplier rankings and target markets)
• New technologies driving TPEs deeper into TSR markets:
  - Seals
  - Hose
  - Tubing
  - Boots/Bellows
  - Roofing
  - Coated Fabrics

• Continued profitability pressure from:
  - Consolidated customer base
  - Raw material price increases
  - Global pricing structures
  - Direct paths to market by resin suppliers
  - Increased in-house compounding
  - Masterbatch use by fabricators
• Expanding properties envelope

• Blurring the interface between SEBS & o-TPV:
  - Compound formulations
  - Market sector dominance
  - Product lines

• Many opportunities for capturing value (via systems approach)