Panel Presentation:
Green Chemistry: The View from the Middle of the Supply Chain
May 9, 2019

Moderator: Tess Fennelly, remooble

Presenters:
Annie Bevan, Superior Essex Communications
Mike Patel, Teknor Apex Company
Emily Williams, Michelman
The supply chain is often broken or slow which creates complex challenges for new technology adoption.

Supply Chain Example: Adhesive, Ink & Coating Supply

- Traditional Petro-chemistry Suppliers
- Green Chemistry Suppliers
  - Adhesive, Ink & Coating Formulators
- Metal/Parts Cleaning Formulators
- IBI Specialty Formulators
- DIY/AM Formulators
  - Distributor
  - Independent Or PL Formulators
  - Adhesive/Ink/Coating Suppliers
- PSA Converters
- Laminators
- Industrial Manufacturing Plants
- Military
- Remanufactured Products
- OE and MRO Auto/Aerospace
- Government/ Municipalities
- Commercial/Institutional
- Retailers & Others
- AM/3D Specialty Retailers

Consumers

Want to Deliver Green & Safer Chemistry

Green Chemistry is only trickling through.
Many possible deterrents to Green Chemistry Supply

- Green Definition
- Supply Chain Complexity
- Incumbency
- Confusion
- Switching Risk
- Price/Performance
- Supply & Demand
- Transparency
- New Technology
- Access/Placement

Alignment

Material Suppliers
- Additives & Other Raw Materials
- Formulators
- Compounders

Producers
- Coaters/Laminators
- Sheet/Film Etc.
- Converters/
- Fabricators/
- Brand Owners

Customers
- Retailers/
- Hospitality
- Others
Explore how compounders, extruders, molders, formulators, and fabricators face unique challenges in the adoption of green chemistry.

Discuss limitations/impediments to the growth of green chemistry encountered throughout the middle of the supply chain.

Discover ways to overcome these challenges and how to contribute to the faster adoption of safer technologies.
1. From your perspective, what is needed to make the adoption and scale-up of green chemistry in the middle of the chain faster and smoother? -critical steps for advancing these efforts.

2. Can you identify the next steps that members of the GC3 or the GC3 itself can take to promote collaborative models for green chemistry innovation and acceleration?
Emily Williams
Global Growth Platform Leader – Circular Economy
About Michelman

Established in 1949
• Specialty chemicals
• Customer-focused
• Privately held

Today, Michelman is
• Global
• Sustainable
• Technology independent

What We Do Best
Known for our industry-first and deep application expertise, Michelman has a rich history of developing innovative water-based coatings for the printing, packaging and corrugate markets.

Global Headquarters - Cincinnati, OH
Printing & Packaging

Paper Converting

Flexible Packaging

Specialty Printing
Printing & Packaging

Corrugated  Flexible  Digital
Innovating A Sustainable Future

- We define sustainability using the concept of Circular Economy
- Solutions focused on raw materials, formulating and design that enable different end of life options
- Differing regional needs
  - Compostable, recyclable, repulpable, monomaterials, biobased, renewably sourced
Who is Teknor Apex?

9 May 2019

Mike Patel
Director of Marketing and Business Development

teknorapex.com
Teknor Apex At A Glance

Established in 1924, headquartered in Pawtucket, RI

Privately held, family-owned company

Over 2,000 employees

6 business units

13 Manufacturing facilities worldwide:
USA, Singapore, China, Belgium, Germany
Global Supply. Local Support.

NORTH AMERICA
PAWTUCKET, RI
HEADQUARTERS
TPE COMPOUNDING, VINYL COMPOUNDING

INDUSTRY, CA
VINYL COMPOUNDING

HENDERSON, KY
COLORANTS
TPE COMPOUNDING

LEOMINSTER, MA
TPE COMPOUNDING

JAMESTOWN, NC
COPVC COMPOUNDS
PVC ALLOYS
VINYL COMPOUNDING

FOUNTAIN INN, SC
GARDEN HOSE, VINYL COMPOUNDING

BROWNSVILLE, TN
GARDEN HOSE
VINYL COMPOUNDING
CHEMICALS
TPE COMPOUNDING
ETP COMPOUNDING

JACKSONVILLE, TX
COLORANTS

SAINT ALBANS, VT
TPE COMPOUNDING

EUROPE
BELGIUM: GENK
TPV COMPOUNDING

GERMANY: ADELSHOFEN
TAUBAERZELL
SALES OFFICE

GERMANY: STEINSFLED
TPE COMPOUNDING
ETP COMPOUNDING

NETHERLANDS
SALES OFFICE

ASIA
SUZHOU, CHINA
VINYL COMPOUNDING

SHANGHAI, CHINA
SALES OFFICE

SHENZEN, CHINA
SALES OFFICE

SINGAPORE
COLORANTS, ETP COMPOUNDING
TPE COMPOUNDING
VINYL COMPOUNDING

TAIWAN
SALES OFFICE

Sales in 90 countries

teknorapex.com
Global Facilities Overview

California
Tennessee
South Carolina
North Carolina
Singapore
China
Global Facilities Overview

- Vermont
- Massachusetts
- Texas
- Kentucky (2 plants)
- Belgium
- Germany
Our Mission

Teknor Apex is dedicated to providing our customers superior products and services throughout our operations worldwide.

We conduct ourselves with integrity which is the cornerstone of our business reputation and foundation to build long-term, trusting partnerships with employees, customers, and suppliers.

Our work environment stimulates innovation while creating accountability and respect in our teams. We are committed to continuous learning and development so that our employees can grow to their fullest potential.

We promote the health and safety of our employees and contribute to the well-being of the communities in which we do business. Working together towards our shared vision assures a financially successful company that is a source of sustainable growth and pride for all.
Core Values

WE VALUE

INTEGRITY

PARTNERSHIP

SUSTAINABILITY

ACCOUNTABILITY

INNOVATION

SAFETY

RESPECT
Our Vision

To be the sought after provider of thermoplastic compound solutions
Our Business
6 Business Units

- CHEMICAL DIVISION
- VINYL DIVISION
- TPE DIVISION
- ETP DIVISION
- COLOR DIVISION
- HOSE DIVISION
Industries We Serve

Packaging

Consumer

Industrial

Electrical & Electronics

Building & Construction

Transportation

Medical & Regulated
Vinyl Division

Industries:
- Consumer
- Industrial
- Building & Construction
- Electrical & Electronics
- Medical & Regulated
- Transportation

Products:
- Apex® Flexible PVC
- Apex® Rigid PVC
- Apex® PVC Blends
- Apex® Calendered PVC Film
- FireGUARD® LS FR PVC
- Flexalloy® PVC Elastomer
- Halguard® LS HFFR
- AquaGuard® cPVC
TPE Division

Industries:

- Consumer
- Industrial
- Building & Construction
- Electrical & Electronics
- Medical & Regulated
- Transportation
- Packaging

Products:

- Monprene®
- Sarlink®
- Medalist®
- Elexar®
ETP Division

Industries:

- Consumer
- Electrical & Electronics
- Transportation

Products:

- Chemlon® (PA6, PA66, PA612)
- Creamid® polyamides
- Duramid® polyamides
- Other Specialty ETP compounds
Teknor Color Division

Industries:
- Consumer
- Industrial
- Building & Construction
- Electrical & Electronics
- Medical & Regulated
- Transportation
- Packaging

Products:
- Custom & Standard Colors
- Dry Colors
- Additives and Special Effects
Apex Hose Division

Industries:
- Commercial
- Residential
- RV/Marine

Products:
- Zero G®
- Apex®
- NeverKink®
- Flexalloy®
Chemicals Division

Industries:
- Industrial
- Consumer
- Transportation

Products:
- Plasticizers
- TruVis® Esters (Adipate, trimellitate and polyol esters)
Single Source - Custom Compounds

- Globalized numerous product lines - technology transfer
- Compliance with global codes and standards in diverse markets
Technology & Customer Support

We offer state-of-the-art technology and hands-on customer support

- Technical Service
- Formulation Customization
- Product Development
- Fully Equipped Analytical Lab
- A2LA Accreditation
- Specialized Services/Support
- Application Development
- Design & Launch Support
- Algor FEA / MARC Analysis
- AutoCAD & Mold Flow
- Prototyping Equipment
- Weight/Cost Reduction
- Research & Development
- Future Innovation & Solutions
- CTC Customer Collaboration
• Provides the tools for Engineers and customers to explore ideas, solve production issues, and minimize speed to market when testing new materials or concepts

• Production scale equipment provides real time part and process screening

• AD support enables concept designs from CAD and FEA to transform to real parts

• Mobile engineering team for on-site assistance
Application Development Lab

This is where we keep our problem-solving promise

- CAD/CAM Tool Development
- FEA Simulation
- Extrusion Prototyping
- Sheet Extrusion
- Profiles – co-extrusion up to 4 materials
- Wire & Cable Line
- Injection Molding Prototyping
- Blown Film
- Thermoforming
- 3D Printing: Prototype Parts and Tooling
- Specialized Lab Equipment Built to Replicate End-Use Conditions
The Advantages of Teknor Apex

How we’ve become the industry’s trusted polymer partner:

- Breadth of Polymer and Compounding Knowledge
- Expertise in a Wide Range of Industries
- Internal Efficiencies that Impact Speed to Market
- Customized Formulations & Product Development
- Application Development Support
- Intimate Customer Relationship with Superior Support

We are dedicated to providing quality products with superior support and value!
Compounder’s Perspective
Compounding Inputs

- Customer Restrictions
- Economic Targets
- Processability Requirements
- Performance Requirements
- Regulations

Custom Compounder
Compounding Process

- Raw Materials
- Compounding Process
- Compound
- Compounding Technology

GCB Innovators Roundtable
## Restrictions and Regulations

<table>
<thead>
<tr>
<th>Customer Restrictions</th>
<th>Regulations</th>
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</thead>
<tbody>
<tr>
<td>Non-DEHP</td>
<td>CA Prop 65.</td>
</tr>
<tr>
<td>Non-Phthalate</td>
<td>CPSIA</td>
</tr>
<tr>
<td>Low VOC</td>
<td>RoHS</td>
</tr>
<tr>
<td>BPA Free</td>
<td>EU REACH – no SVHC</td>
</tr>
<tr>
<td>Latex Free</td>
<td>EU BPR</td>
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<tr>
<td>Non-Animal Derived</td>
<td>EU MDR</td>
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“Green” Product Line

Biovinyl®

- First to market in 2012 with “green” product line of flexible PVC compounds based on bio-sourced plasticizers
- Required significant R&D to identify optimum formulations and viable application space – numerous challenges
- Limited success
“Green” Product Line

Terraloy®
Bioplastics for bio-content and compostability

• Starch based bioplastics
  ➢ Limited commercial success due to cost situation with natural gas on PE and PP and Braskem bio-based PE

• PLA based bioplastics
  ➢ Higher heat PLA product
  ➢ PLA product for 3D Printing
Conclusion

Is the market ready for “green”? 
Thank You.

Tel: 401-725-8000
Email: vinyl@teknorapex.com
We believe that technology that interconnects the world should also respect it
One of the largest cable manufacturers in North America

Everywhere You Live and Work

Fiber & Copper Outside Plant (OSP) wire and cable products

Copper and Optical Fiber Premises wire and cable products

Smart Building Technology

http://sustainability.superioressexcommunications.com
How is Superior Essex implementing Green Chemistry practices into our Organization?
1. The Market is Demanding It!
2012 A+D LETTERS:
A united request for greater transparency using available tools.

DISCLOSURE LETTERS ISSUED
As of Oct. 1, 2013, the following firms, listed alphabetically) had issued letters as part of the disclosure campaign:
Beck Architecture
Boora Architects
Cannon Design
EHDD
FXFOWLE
GGLO
Harley Ellis Devereaux
HDR
HKS
KMD Architects
Lake|Flato Architects
Lord, Aeck & Sargent
Mahlum
Miller Hull
Perkins+Will
RTKL
SHW Group
Siegel & Strain Architects
SmithGroupJJR
Solomon Cordwell Buenz
Architecture
Tsui Kobus & Associates
Wight & Company
WRNS Studio
Yost Grube Hall Architecture
Everywhere You Live and Work®

**Materials Transparency - Communication Cables**

1 Living Product (2 Pending)

3 Red List Free Declare Labels

55+ HPDs

55+ EPDs
CLOSING THE LOOP ON TRANSPARENCY
2. Life Cycle & Chemistry Considerations into our Product Development Process
**PRD Process**

**DRAFT PRD Sustainability Process:**

Step 1: Add Sustainability Check box on CQP Checklist/ MK003T
- EPD (informational only)
- HPD
- Red List Free
- Declare
- Living Product Challenge

Example:
Sustainability Initiative:
- EPD
- HPD
- Red List Free
- Declare
- Living Product Challenge

If HPD:
- Need confirmation from suppliers to provide .1% information
- Do not need total disclosure for HPD
- Could settle for up to .1% in product if supplier won’t confirm .1% in their material

If Red List Free, Declare, LPC:
- Need supplier to confirm commitment disclosure and the raw material is red list free to ILFI Red List 3.1.
- Must obtain disclosure to .01% in product
- Could settle for up to .01% in product supplier won’t confirm .01% in their material
3. Further Engagement with our Supply Chain
Supply Chain Engagement
Information Collected & Data Managed in toxnot

- Compositional Chemistry of Raw Materials Supplied
- Corporate Social Responsibility
- Hazardous Chemistry Assessment
- Development of Material Ingredient Reports
- Confirmation of REACH/ RoHS Compliance
- Prop 65 Compliance
- Etc.....
ToxServices recommends the following:

If FEP copolymers were to be exempt from the Red List, it is imperative that ILFI mandate manufacture-specific disclosure and analytical testing to ensure the following:

- Residual monomer levels must not exceed a specific level in the copolymer and the final material/product
- Process chemicals used during the FEP copolymerization process should be fully disclosed and, if present, should be below a specified level in the FEP copolymer and the final material/product
  - Alternatively, the use of certain process chemicals (i.e., PFCs) should disqualify FEP from the exception, but a residual in final product could also be considered
  - If no PFCs or Red List surfactants/process chemicals are used in the production of the FEP, the FEP should need to undergo a material health review to obtain full disclosure of these surfactants, understand physical form and manufacturing processes, and hazard screening of constituents.
Superior Essex’s FEP Supply Chain Optimization

- Both suppliers for FEP have confirmed:
  - No Residual Monomers or below 100ppb
  - No processing agents on the red list utilized to manufacturer the product
  - Waiting on confirmation from suppliers to confirm there are no surfactants used within the FEP co-polymerization process and a better description of if they are used how they are distilled during the process
  - Will disclose their trade name, product IDs as well as manufacturing facilities

- Further Details and thoughts to consider:
  - If the end product w/ FEP had any impurities it would de-grade the di-electric properties of FEP—would not be valuable or useful, that’s how we know they don’t exist in the final product
  - As compared to flexible PVC alternative—there is significant migration of chemistries from PVC—much more than FEP
Sustainable PVC

• Currently working in collaboration with other market leading manufacturers in the Carpet/flooring, Window, Siding and panel industries to establish to define manufacturing leadership in sustainable PVC products
THANK YOU!

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