NYLONS TO OVERCOME E-COMMERCE FOOD PACKAGING NEEDS

Alex Peters
1. E-Commerce of food & beverage: An unstoppable trend
2. E-Packaging vs Traditional packaging
3. Nylon’s role in the new E-Packaging scenario
4. Are all the Nylons the same?
   - Modification by Co-Polymerization
5. Roadmap for the future of Nylon in Food E-Packaging
   - Collaboration along the whole value chain
   - Sustainability
6. Take-aways
E-Commerce of food & beverage: an unstoppable trend

5 Reasons to Start Selling Online

Food and drink brands aim to win big in e-commerce

Kraft Heinz to invest in food tech with $100M venture capital fund

- To lead the Chicago-based fund, Kraft Heinz hired venture investor Bill Pescatello, a founding member of Peacock Equity, an investment group put together by NBCUniversal and GE Capital. In an interview with Bloomberg, Pescatello said the fund would target startups focused on supply chains, logistics, e-commerce and direct-to-consumer projects.

Food And Beverages Push Into E-Commerce, Raising Questions For The Supply Chain

By Elliott Nadler — December 16, 2014

Source: Food Logistics, December 16, 2014

E-Commerce for the Food and Beverage Industry Made Easy


E-commerce looming as growing driver of innovation

Source: Food Navigator September 07, 2017

E-Commerce for the Food and Beverage Industry Made Easy

Source: Sana June 29, 2016

Delivery, e-commerce impact foodservice packaging trends

Source: Packaging world, October 30, 2017

SOURCE: Packaging world, October 30, 2017
E-Commerce of food & beverage: an unstoppable trend

- E-Commerce sales between 2014 and 2018 grew a cumulative 88.4%.

- E-commerce channel is still only 8.5% of total North America sales, but predicted to reach almost 15% by 2020. Countries like China are expected to be as high as 35%.

- Between leaders Blue Apron and Hello Fresh, around 18 million meals per month sent direct to consumer.

"By 2022, almost 10% of all grocery sales will likely be made online. In terms of cash value, that amounts to a whopping $133.8 billion."

Sources:
- US Census Bureau News. “Quarterly Retail E-commerce Sales 3rd Quarter 2016”
- Sealed Air e-commerce survey; 2014
- Forbes, (June 2018 ) “What A Waste: Online Retail’s Big Packaging Problem”

Proportion of grocery shoppers who have shopped online for food at least once in a year

2007, 2012, 2017; % of all U.S. shoppers

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2012</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>3.9%</td>
<td>14.3%</td>
<td>23.4%</td>
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</table>
E-Packaging vs Traditional Packaging

- In the distribution channel, e-packaging has potentially **20+ touch points** compared with traditional packaging = 4-5x more opportunity for failures.

- **Different products** are **grouped together** in the secondary e-package; interaction between different e-packages and products can create problems and failures.

- Due to the increase of transport costs it is critical to minimize **weight and volume** of the e-packages.

- **Transportation conditions** in e-commerce are difficult to control: e-packages have to ensure the **shelf life of the products**.

- E-packaging is **not palletized** and tertiary packaging doesn’t exist.

- Secondary e-packaging is **disposed/recovered directly by the consumer** while in the traditional channel is done by the retailer.
Based on all these requirements, one of the best e-packaging format is FLEXIBLE, moving from rigid/brittle formats to flexible/tough e-packages.
E-Packaging vs Traditional Packaging

CAN

POUCH

Nylon’s Role In the New e-Packaging Scenario

Mechanical properties
- Puncture resistance

O₂
- Barrier

Aroma
- Pinhole resistance

Grease
- High surface tension / printability

Chemical/thermal resistance

O₂

Aroma

Grease
Nylon’s Role In the New e-Packaging Scenario

Processing and output

Versatility/ several applications FLEXIBLE packaging

ENGINEERING PERFORMANCE

COMMODITY COVERSION

NYLON
Nylon’s Role In the New e-Packaging Scenario

- E-Packaging has potentially **4 to 5 times more handling points** that traditional one: more opportunities for failures.
- E-Packaging is **not palletized** and tertiary packaging doesn’t exist.

**Mechanical properties**

- Pinhole resistance
- Puncture resistance
- Mechanical properties
Nylon’s Role In the New e-Packaging Scenario

- Different products are grouped together in the secondary E-Package; interaction between different E-packages and products can create problems and failures.

Puncture resistance

- Chemical/thermal resistance

- High surface tension / printability

- Mechanical properties

O₂

Aroma

Grease
Nylon’s Role In the New e-Packaging Scenario

- Due to the increase of transports cost is critical to minimize weight and volume of the E-packages.
- Secondary E-Packaging is disposed/recovered directly by the consumer while in the traditional channel is done by the retailer.

![Graph showing weight comparison between glass, rigid plastic, and flexible plastic bottles.](image)

- Less weight
- Less space
Nylon’s Role in the New e-Packaging Scenario

- Transportation conditions in the E-commerce are difficult to control:
  
  E-packages has enlarge the **shelf life of the products**.

**Retort E-Packaging** = **Long shelf life**

**even with storage out of refrigerator**
**Nylon’s Role In the New e-Packaging Scenario**

- **Transportation conditions** in the E-commerce are difficult to control: E-packages has enlarge the **shelf life of the products**.

![Graph showing oxygen permeation after retort treatment](image)

- **Sym. Medium barrier**: PP / Tie / NYLON / Tie / PP
- **Asym. Medium barrier**: NYLON / Tie / PP / PP / PP
- **Sym. High barrier**: PP / Tie / EVOH / Tie / PP
- **Asym. High barrier**: NYLON / EVOH / NYLON / Tie / PP
Are all NYLONS the same? - Nylon modification by copolymerization

**Homo Polyamide**

**Monomer**

Caprolactam

**Polymer**

PA6
Are all NYLONS the same? - Nylon modification by copolymerization

Co Polyamide

Monomer
- Caprolactam
- Nylon Salt or AH Salt

Polymer
- CoPA6/6.6 ≠ PA6 + PA6.6
Are all NYLONS the same? - Nylon modification by copolymerization

Ter Polyamide

Monomer

- Caprolactam
- Nylon Salt or AH Salt
- Laurolactam or ADA

Polymer

TerPA6/6.6/12 ≠ PA6 + PA6.6 + PA12
Are all NYLONS the same? - Nylon modification by copolymerization

Homo-, Co- & TerPolyamide

Crystallinity

Copolymerization Ratio

PA6

CoPA6/6.6

TerPA6/6.6/12
Are all NYLONS the same? - Nylon modification by copolymerization

Benefits of the Co-Polymerization

- Processing temp.
- Tensile modulus
- Haze
- Oxygen barrier

- C.O.F.
- Gas permeation
- Gloss
- Flex crack resistance
- Puncture resistance
- Elongation
- Thermoformability
- Shrinkage ratio
- B.U.R or Stretching ratio
- Bubble stability
- Tear resistance
- Impact resistance

Nylon modification by copolymerization

Are all NYLONS the same?
Are all NYLONS the same? - Nylon modification by copolymerization

Homo-, Co- & TerPolyamide

Thermal properties (°F)

<table>
<thead>
<tr>
<th></th>
<th>Tm</th>
<th>Tc</th>
<th>Tg</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA6 (UBE NYLON 1030B)</td>
<td>426</td>
<td>356</td>
<td>129</td>
</tr>
<tr>
<td>PA6/6.6 (UBE NYLON 5034B)</td>
<td>376</td>
<td>293</td>
<td>122</td>
</tr>
<tr>
<td>PA6/6.6/12 (UBE NYLON 6434B)</td>
<td>365</td>
<td>271</td>
<td>117</td>
</tr>
</tbody>
</table>

Are all NYLONS the same?  
Nylon modification by copolymerization
Are all NYLONS the same? - Nylon modification by copolymerization

Homo-, Co- & TerPolyamide

Elasticity modulus (MPa)

- PA6 (UBE NYLON 1030B) - 750 MPa
- PA6/6.6 (UBE NYLON 5034B) - 550 MPa
- PA6/6.6/12 (UBE NYLON 6434B) - 500 MPa
Are all NYLONS the same? - Nylon modification by copolymerization

Homo-, Co- & TerPolyamide

Elongation at break (%)

- PA6 (UBE NYLON 1030B) 390
- PA6/6.6 (UBE NYLON 5034B) 460
- PA6/6.6/12 (UBE NYLON 6434B) 510
Are all NYLONS the same? - Nylon modification by copolymerization

Homo-, Co- & TerPolyamide

Tensile strength (MPa)

- PA6 (UBE NYLON 1030B): 38 MPa
- PA6/6.6 (UBE NYLON 5034B): 25 MPa
- PA6/6.6/12 (UBE NYLON 6434B): 24 MPa
Are all NYLONS the same? - Nylon modification by copolymerization

Homo-, Co- & TerPolyamide

Puncture resistance at break

<table>
<thead>
<tr>
<th>Material</th>
<th>Def. (mm)</th>
<th>Energy (mJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA6</td>
<td>7.0</td>
<td>24.0</td>
</tr>
<tr>
<td>(UBE NYLON 1030B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA6/6.6</td>
<td>9.0</td>
<td>31.0</td>
</tr>
<tr>
<td>(UBE NYLON 5034B)</td>
<td></td>
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</tr>
<tr>
<td>PA6/6.6/12</td>
<td>11.0</td>
<td>34.0</td>
</tr>
<tr>
<td>(UBE NYLON 6434B)</td>
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</tr>
</tbody>
</table>
Are all NYLONS the same? - Nylon modification by copolymerization

Homo-, Co- & TerPolyamide

Spencer puncture energy (mJ)

- PA6 (UBE NYLON 1030B) 750 mJ
- PA6/6.6 (UBE NYLON 5034B) 900 mJ
- PA6/6.6/12 (UBE NYLON 6434B) 900 mJ
Are all NYLONS the same? - Nylon modification by copolymerization

Homo-, Co- & TerPolyamide

Tear strength (N/mm)

- PA6 (UBE NYLON 1030B)
- PA6/6.6 (UBE NYLON 5034B)
- PA6/6.6/12 (UBE NYLON 6434B)

14
34
46
The Future of Nylon in Food Packaging: Collaboration Along the Supply Chain
The Future of Nylon in Food Packaging: Collaboration Along the Supply Chain

How to boost collaboration along the chain?

Create the space for open innovation

UBE CHANGE & CHALLENGE SUMMIT

11 editions held since 2011
- Brazil (3)
- Germany (3)
- Colombia (1)
- USA (1)
- Mexico (1)
- Argentina (1)
- Russia (1)
- Turkey (ongoing)

With the participation of all the main players of the food packaging chain - Resin/additive suppliers - Machine manufacturers - Packaging companies - Food producers - End users

Collaboration with Academia and Research Institutions

The School of Packaging
Michigan State University

UBE sponsored the research lead by Dr. Almenar and her research team:

“E-commerce Food Packaging market study”

With the goal to collect beneficial information that industry can use to improve packaging for e-commerce by:
- Research about current packaging materials used in e-commerce
- Impact of e-commerce on traditional packaging
- Quantify specific problems
- Identify changes needed in materials and designs

PREPARING C&C USA 2019!!!

Focusing on e-commerce & sustainability
The Future of Nylon in Food Packaging: Sustainability

REDUCE

REUSE

RECYCLE
The Future of Nylon in Food Packaging: Sustainability

Thanks to its superior mechanical and barrier properties, usage of Nylon Copolymers in multilayer films allows downgauging the film thickness:

- **REDUCE**
  - 2-7 times better puncture resistance
  - 10-20 times better drop impact
  - 3-6 times better mechanical strength

Using UBE NYLON advanced copolymers, up to 60% downgauging can be achieved compared to films made with traditional NYLONS.

50μm monolayer airblown film.
The Future of Nylon in Food Packaging: Sustainability

- Enhanced properties
- Less return articles
- Less food waste
- Long shelf life
- Weight reduction
- CO$_2$ footprint reduction

Different materials
Complex structures

= Challenging recyclability
The Future of Nylon in Food Packaging: Sustainability

WHAT CHANGES ARE NECESSARY TO IMPROVE THE RECYCLABILITY OF FLEXIBLE PACKAGING?

E-COMMERCE BRING US NEW OPPORTUNITIES!
- IMPROVEMENT OF THE LOGISTICS: CLOSE THE LOOP!
- CUSTOMER EDUCATION: SORTING AT HOME
- NEW PACKAGING DESIGN: MORE LOGICAL, EASIER TO SORT

INNOVATION IN MATERIALS:
- BIO-BASED / BIODEGRADABLE MATERIALS
- MULTILAYER STRUCTURES SELF-COMPATIBILIZED
- IMPROVEMENTS IN THE RECYCLING TECHNOLOGY

COLLABORATION WITHIN THE SUPPLY CHAIN
COLLABORATION RESIN SUPPLIERS WITH RECYCLERS

RECYCLE
Conclusions

1. **E-COMMERCE IS GROWING:** Packaging needs to adapt.

2. **E-PACKAGING IS A WIN-WIN THROUGHOUT THE VALUE CHAIN.**

3. **FLEXIBLE PACKAGING IS THE BEST SOLUTION OVER OTHER PACKAGING ALTERNATIVES**
   1. Nylon will play a central role in this packaging revolution.
   2. Not all nyons are the same: UBE “E-NYLONS” Co- and Ter-Polymers show enhanced properties, ready for the new e-packaging.

4. **COLLABORATION ALONG THE E-PACKAGING VALUE CHAIN IS THE WAY TO CHANGE THE CURRENT PARADIGM.**
Important Notice:

- The contents of the written materials were prepared based on materials, information, and data available at present time; they may be revised according to new information.
- The numerical data described in these written materials are averaged values obtained by measurement under prescribed conditions; they are not guaranteed values.
- UBE does not guarantee the quality or safety of your company’s finished product even if UBE’s materials and the data described in these written materials or data prepared by other companies are used to manufacture the finished product. Determination of the suitability of the finished product shall be the responsibility of your companies.
- Specific applications may be subject to standards and regulations, commercial property rights, etc., so these should be fully researched and studied by your company.

NOT ALL “NYLON” IS “NYLON”!

Let’s talk about it!