Biobased biodegradable packaging for cold chain maintenance in E-commerce

B2C Online Grocery – values for consumers

- Reduced time and total costs
- Higher food quality and freshness
- Better nutrition diversity
- Minimized food wastes
- …
- Trendy! Displays dynamism, business and responsibility

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B2C Online Grocery
Danish statistics…

- Buying groceries on-line: 2011 – 19% → 2013 – 35% → 2016 – 47%
- By population ‘age brackets’: 18-34 – 55%, 35-49 – 48%, 50-70 – 33%
- By range of products:
  - 18-34 year old consumers buy sweets, cakes, tee, coffee, and meat products
  - 50-70 year old consumers buy mostly fresh produce, meat and fish

E-groceries: larger markets, more packaging, higher demands…

B2C Online Groceries shipping packaging challenges

- Heightened risk of cold chain interruption

- Non-sustainable: polystyrene foam boxes with plastic-packaged ice or dry ice

- Food safety & losses
- Negative impact on the environment

- Non-recyclable: consumers are frequently left alone with useless EPS boxes, e-groceries do not want to collect boxes!

Motive idea

- Substitution of polystyrene foam boxes by bio-based biodegradable alternatives
  - Corrugated cardboard boxes
  - Biodegradable bio-based bioplastic foam boxes

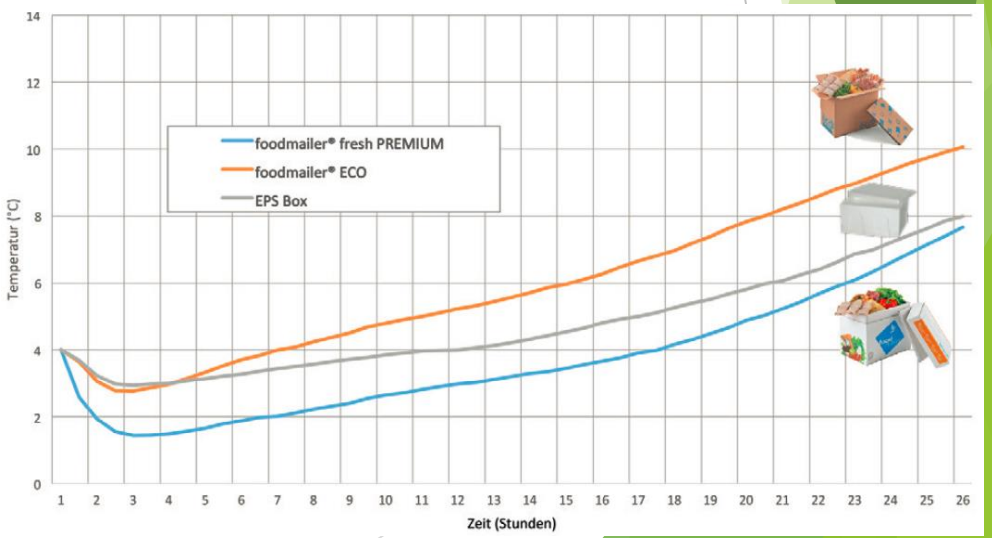
➢ Recycling?

Heat insulation

Material	Thermal conductivity, W/(m·K)
Air	0.024
Water	0.58
Polystyrene foam	0.052
Kraft paper	0.066
Natural fiber insulator	0.067

Waterproofing → Heat insulation

What is already available on the market?



Construction materials' set

- Corrugated Cardboard Box
- Corrugated, paper, or fiber-based waterproof inlays (second walls)
- Ice in bio-based biodegradable waterproof packaging or lamellate (shelled) ice (bioplastic or coated paper)
- Bio-based tissue bag with water-absorbing material

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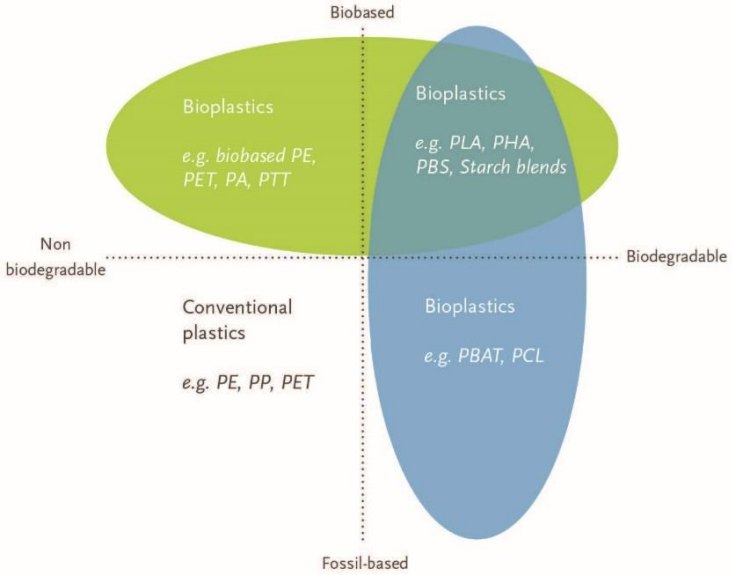
Bio-based biodegradable plastic

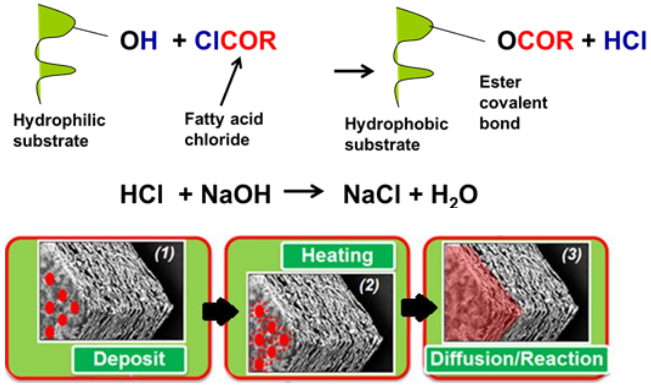
85% PLA + 15% PBAT

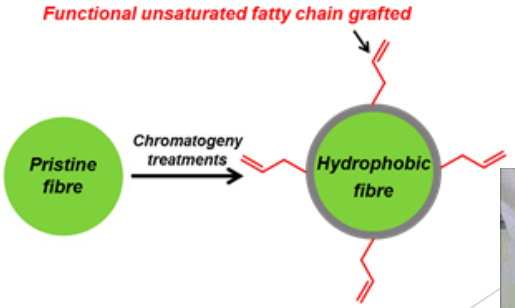


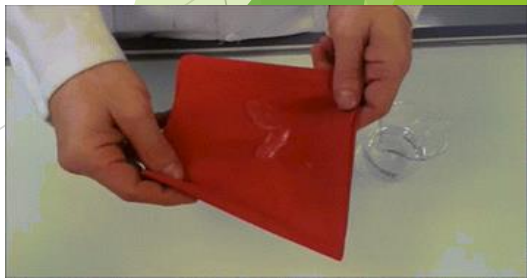
How to make paper waterproof and remain “green”?

Chromatogeny:

- A green chemistry process that brings hydrophobicity to papers and boards
- A solvent free, ultra fast technology
- Uses the reaction of Fatty Acid Chlorides with hydroxyl groups
  - Protects water sensitive material by grafting alkyl chain (fatty acid chloride) at the surface of a layer containing OH groups





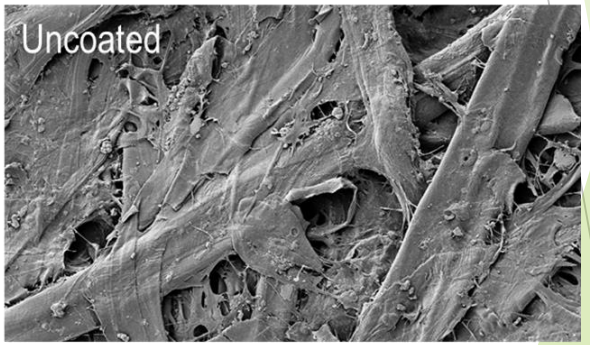


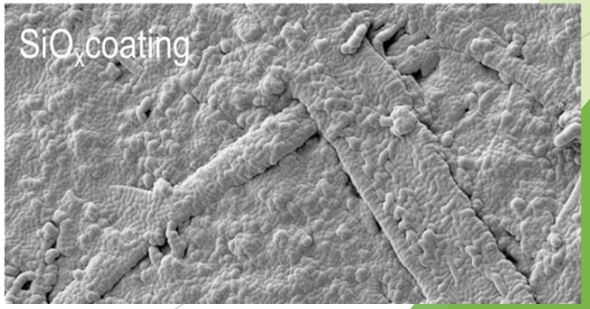
Developed by Centre Technique du Papier , France

How to make paper waterproof and remain “green”?

Waterproof paper surface by PECVD

SiOxCyHz-SiOx or DLC plasma-coatings





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Bio-based biodegradable moisture absorbing materials

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- Today the super absorbent polymers are mainly **Sodium Polyacrylate** or **Polyacrylamide** with a capacity of **100g/g** (absorption of water per gram of material).
- The work on **Foam Cellulose** allows to have something close to **30g/g**.
- **Fluff Pulp** gives around **20g/g**.
- The difference between **Foam Cellulose** and **Fluff Pulp** is not so big and this material is already available on the market.
- **Silica-powder based absorbers**

Case-study: Packaging for fresh fish home delivery
Skagenfood

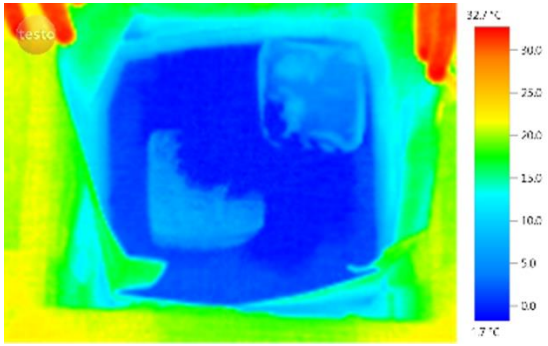
This is how fresh fish home delivery looks today

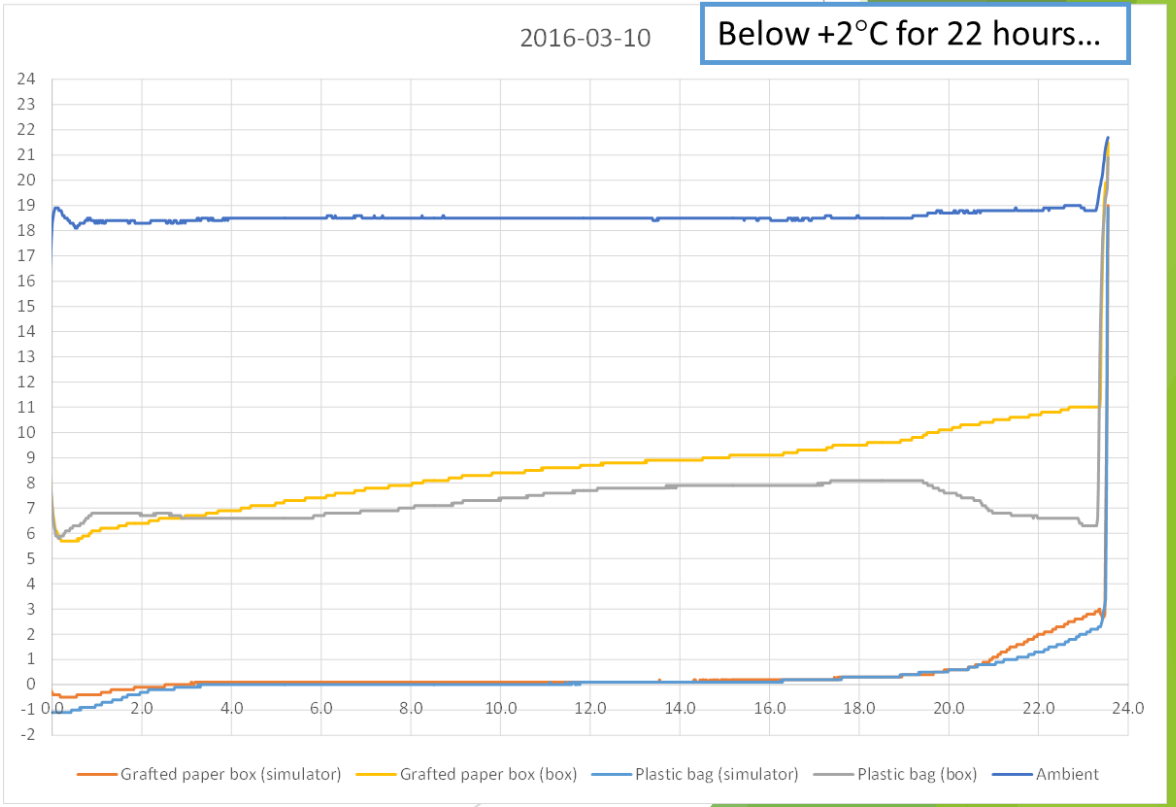
Delivery packaging components

- EPS (flamingo) box
- Lamellate (shelled) ice
- Paper wrap
- Non-woven tissue bag with water-absorbing material

Paper-based packaging alternative

Corrugated cardboard + chromatogeny-grafted paper

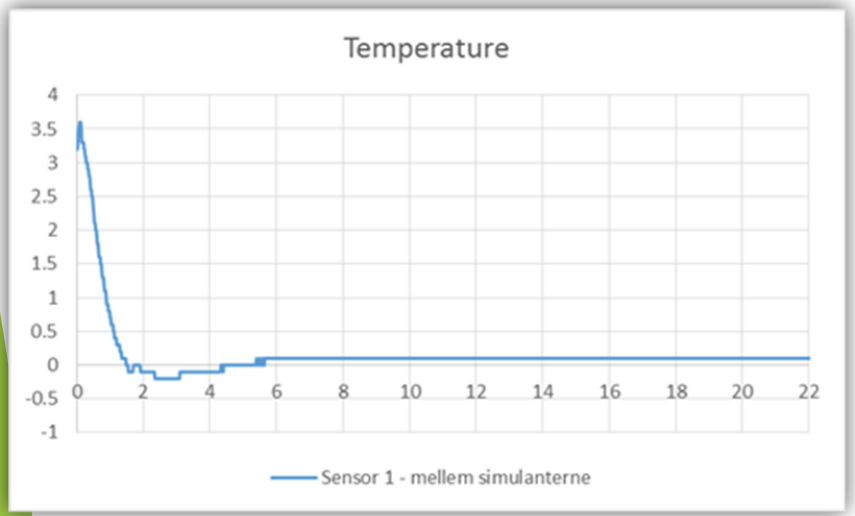


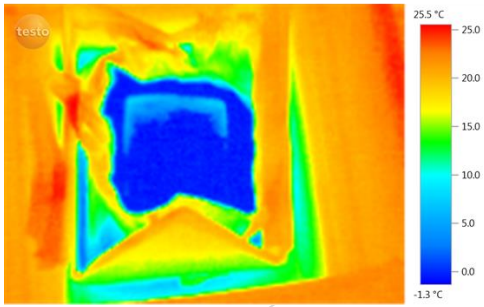


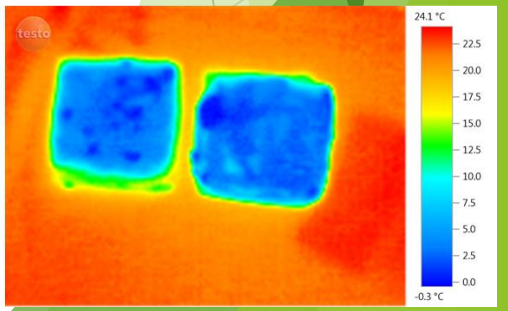
Paper and biodegradable plastic based alternative

- Thermal insulation + Waterproofing
- Corrugated box, paper pouch, biodegradable bioplastic bag…
- 2 × 450-g meat simulators, 1.5 kg of ice, below 1°C for 24 hours

After 22 hours…





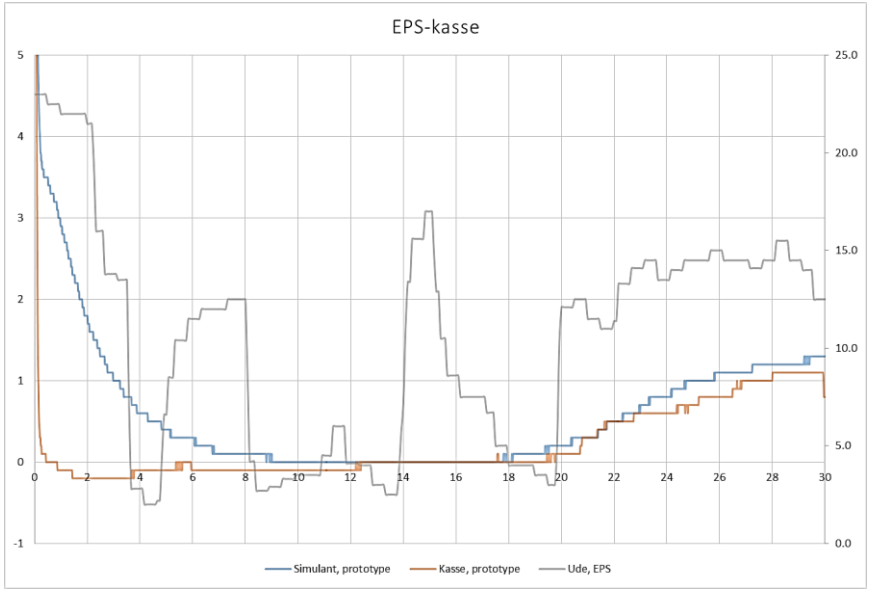


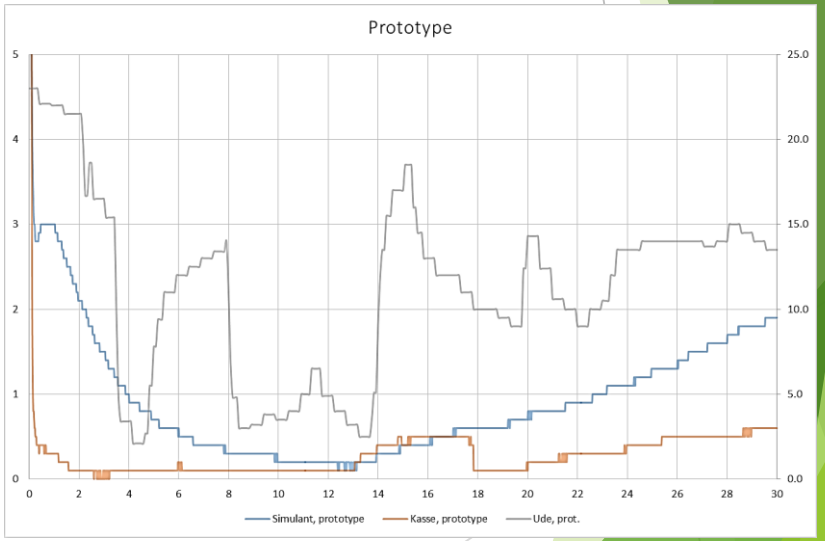
Field testing

Field testing results

	Simulanternes temperatur	
	24 timer efter pakning	**30 timer efter pakning**
EPS-kasse	0,8 °C	1,3 °C
Prototype	1,1 °C	1,9 °C

	Mængden af is	
	Startvægt	**Slutvægt**
EPS-kasse	1533 g	786 g
Prototype	1504 g	577 g





Conclusions

- State-of-the-art bio-based biodegradable packaging materials enable implementation of sustainable ‘green’ packaging for cold chain maintenance in E-commerce
- There will never be one universal kind of sustainable packaging materials but a specific sustainable solution for each type of packaging and perhaps for each type of product
- Sustainability is not necessarily an end state but is a continuing process of improvement…

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