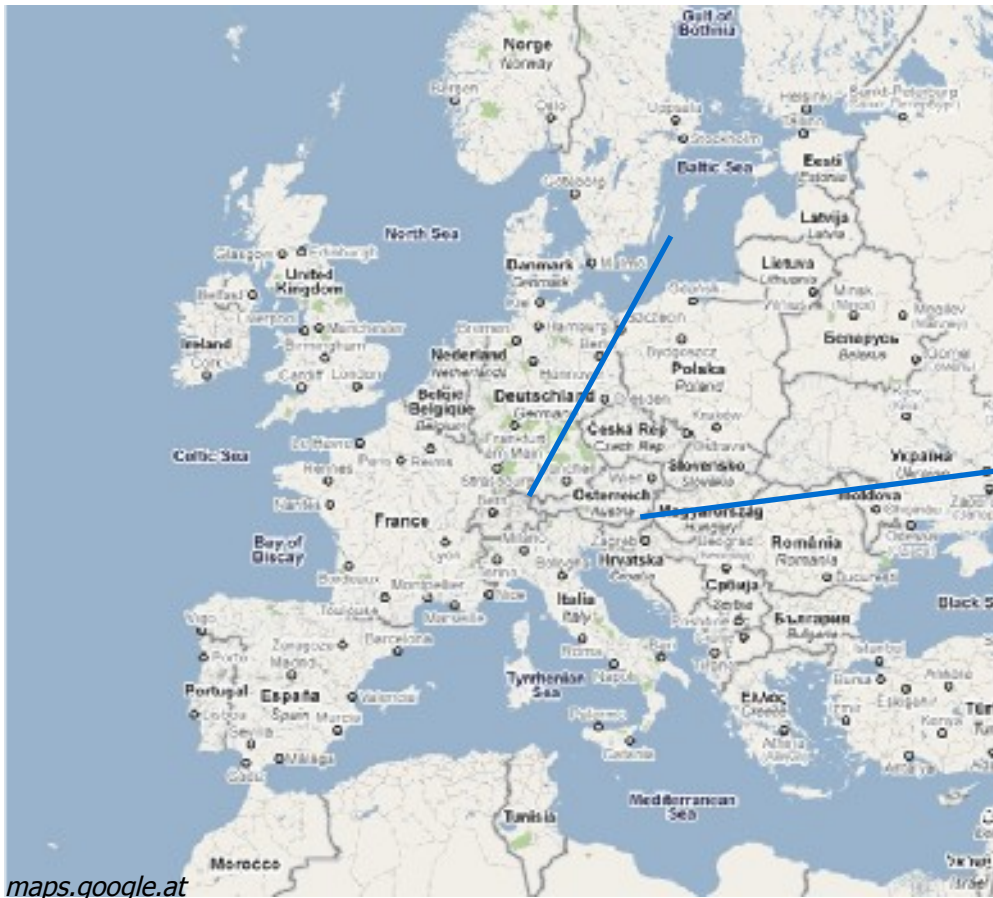


Polymer Paper based on Renewable Resources

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Where are we ...?



maps.google.at

Vienna ●

Leoben ●



www.pccl.at



Introduction

Why polymer paper?

Raw material:

- high growth rates for common paper → shortage of cellulose
- local availability of wood and water (e.g. Arabic regions)
- variations in quality of the raw material

Properties:

- anisotropic properties caused by fiber direction
- no water or fat resistance (coatings needed)
- ecological problems of paper production (outside Europe)
- often unqualified property profile (liquid paper packaging)
- often poor recycling possibilities (paper-polymer-aluminum combinations)
- storing (weather changes) and processing (humidity)

Introduction

What is polymer paper?



synthetic paper, ...
polymer paper, ...

→ >9.600.000 Hints

Products:

portfolios
handbooks
menu
stickers
tags

wrapping paper
bags
posters
company labels
tickets

maps
business cards
brochures
catalogs
envelopes

Introduction

Materials: Polyolefins, BORR-Plastics, PET, ...

Film type: (highly) filled, foamed, ...

Film structure: mono-, multilayer, mostly > 300 m, ...

Properties: printable, waterproof, biodegradable, ...

No polymer paper is based on renewable resources

AND

offers properties and look and feel of common paper and board



No alternative for common paper or board

Demands on polymer paper

- **Print- and runability**
 - using laser printing processes
 - no changes in printing processes
 - paper inks
- **Thermal resistance**
 - no melting or deformation at higher temperatures
- **Life Cycle Assessment**
 - equal or further future ecological benefits
- **Convertability**
 - to standardized dimensions (e.g. DinA4)
 - cut-, groove- and foldability

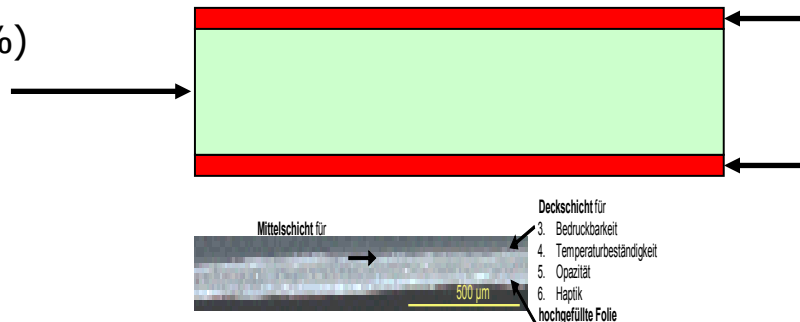
Demands on polymer paper

- **Minimal orientations**
 - no warpage or shrinkage
- **Stiffness**
 - no curling or bending
 - good haptic
- **Dimensional stability under different climates**
 - usability in different regions
- **Opacity**
 - non-transparent surface

Methodical approach

- Property profile can not be achieved by a mono-layer film
- Selected solution: **multi-layer film** in co-extrusion
- Used materials: PLA, CaCO₃, TiO₂, foaming agents

Middle layer (d~80%)
- density
- cost reduction
foamed



Outer layers (d~10%)
- printability
- temperature resistance
- opacity
- haptic
highly-filled

1. Foamed core saves material and determines grammage
2. Middle layer reduces brittleness caused by the outer layers
3. Possibility of using recycled material
4. Properties only needed in outer layers

Characterization

Paper as well as polymer methods

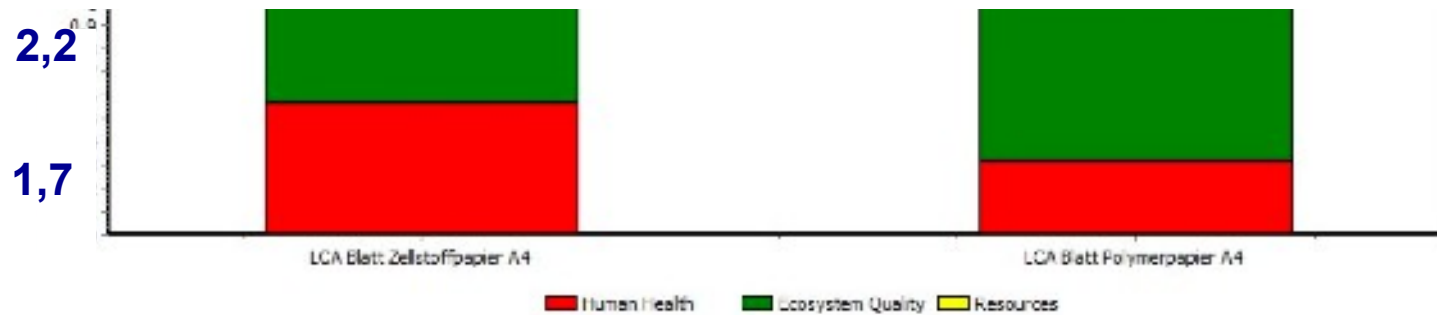
- Grammage
- Stiffness
- Opacity
- Tensile test
- Double seem number
- Printability
- Sealing
- Printability
- Restoring Force
- Thickness
- Smoothness
- Whiteness
- Dynamic mechanical analysis (DMA)
- Microscopy
- Differential scanning calorimetry
- Dynamic mechanical analysis
- Cut- and grooveability
- eco balance - LCA

Results

| | | polymer paper | common paper |
|--------------|------------------|----------------------|---------------------|
| Basis weight | g/m ² | 89,5 | 80-100 |
| Thickness | µm | 142,1 | 100-300 |
| Stiffness | mN | 129,1 | >70 |
| Double seem | - | >50 | 50-150 |
| Whiteness | % | 85,11 | >85 |
| Smoothness | s | 51,1 | 50-150 |
| Opacity | % | 93,4 | >88 |
| Fixing test | 180°C | passed | - |
| Young module | Mpa | 2795 | 2722 |

Life Cycle Assessment

LCA harming points according to Eco Indicator 99



(mPt)

0

common paper

polymer paper

Health

Eco-Toxicity

Resources

"Best of both Worlds"

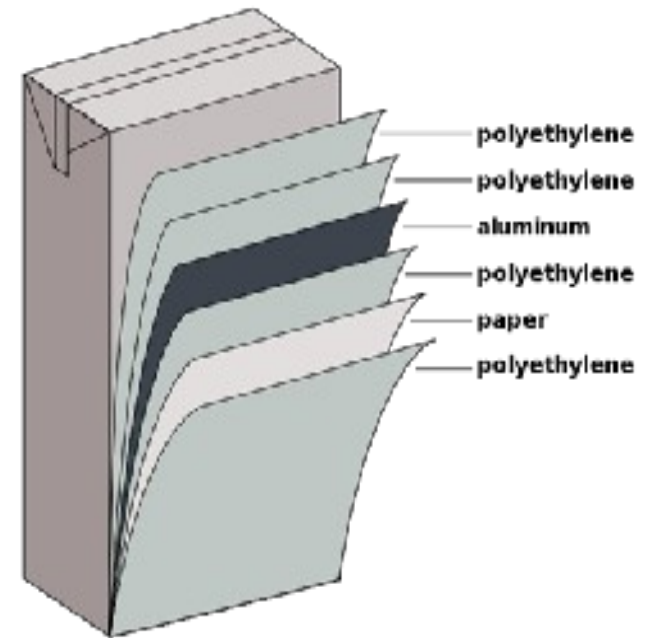
| PRODUCT | PROCESS |
|---|---|
| <p>water and fat resistance tailor-made property profile isotropic properties temperature resistance printable asymmetric structures paper-like look and feel</p> | <p>easier processing (polymer processing) common machinery usable tailor-made costs (no overengineering) functionizable (high barrier properties) lower machinery investment grammage and thickness independent storing just granulates</p> |
| ECOLOGY | |
| <p>lower ecological impact easier recycling -> Design for recycling</p> | <p>no dissimilar material combinations (paper-polymer-aluminum) biodegradable</p> |

Application

Beverage packaging

- OLD: paper (– Aluminum) – polymer
- NEW: polymer paper

- Benefit
 - lower costs
 - no dissimilar materials
 - No disposal fine
 - better and easier recycling (Design for Recycling)
 - lower investment resp. polymer processing machinery useable
 - freedom of design (round vs. angled)
 - sealable spout
 - extrusion vs. injection molding



Application

- Alternative for paper – polymer composites (e.g. beverage packaging)
- „**single source solution**“ product philosophy - sustainability by easier recycling and lower costs by omitted disposal fines
- benefits for both paper as well as polymer processors
- granulate for polymer processor → paper production “in house”!
- commercialization and market entry accomplished → IM Polymer GmbH

| Granulates | | Rolled Goods | |
|---|--|--|--|
| Ecological renewable resources biodegradable | Efficient petrochemical polymers Low cost | Enhanced functionalized (barrier, flame retardant, color...) | |

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This research work was performed at the Polymer Competence Center Leoben GmbH (PCCL, Austria) within the framework of the Kplus-program of the Austrian Ministry of Traffic, Innovation and Technology with contributions by the University of Leoben. The PCCL is funded by the Austrian Government and the State Governments of Styria and Upper Austria.

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