# A novel approach towards an articificial leather made of poly(butylene succinate)

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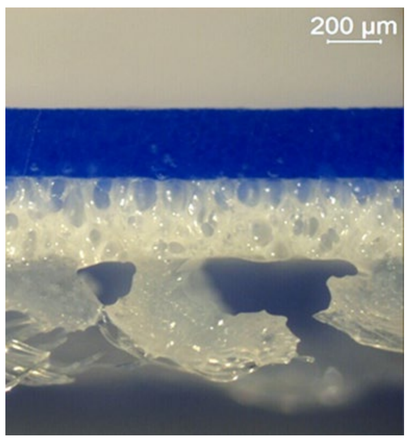
## Problem description

- Artificial leather products are material composites consisting of at least two different materials:




- The textile substrate often is made from PET, cotton or mixtures therefrom
- The substrate is coated by a porous structured PU or PVC

Macroscopic structure of a common artificial leather [Source: FILK]

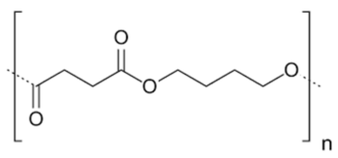
- Due to the variety of components, recycling of these products is accompanied with high process engineering and energy costs and therefore would neither be economical nor sustainable.

## Research goals

- Realization of a sustainable product design in order to fulfill the demands of a circular economy for artificial leathers (“Green deal”)
- Manufacturing of an artificial leather, where the textile **and** the coating layer consist of only one polymer material.

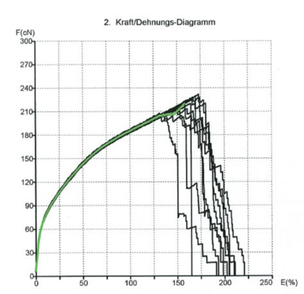
## Approach towards a single-component artificial leather

- Use of a meltable and easy recycleable biobased polymer
- Use of poly(butylene succinate) (PBS) as polymer for the fibre as well as for the matrix (mp. 115°C)
- PBS is biodegradable (end-of-use scenario)

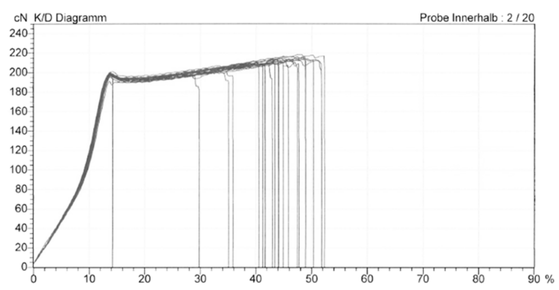



## Melt spinning of PBS

- Partially oriented multifilament yarns (24/30f) were melt spun from commercially available PBS at extrusion temperature of around 190°C.
- The spinning parameters were varied with respect to install an optimized process without filament breaks.
- Winding speeds = 1800–3000 m/min; linear density (yarn): 50–230 dtex
- The POYs were drawn with drawing ratios of 1.5–2 at processing speeds of 200–500 m/min, the fully drawn yarns (FDYs) reached tenacities of up to 27 cN/tex at 30-50% elongation and show a certain elasticity.

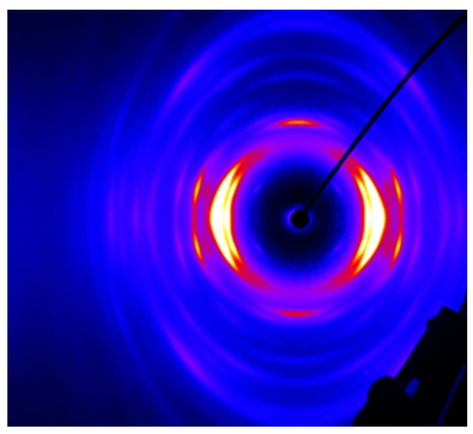



Force elongation diagram of PBS POY 134f30

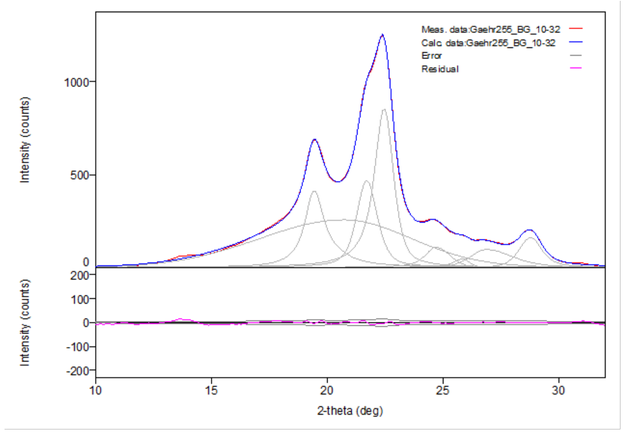



Force elongation diagram of PBS FDY 78f30

- Investigations of the structure by WAXS show a relatively high cristallinity for PBS fibres of 61%



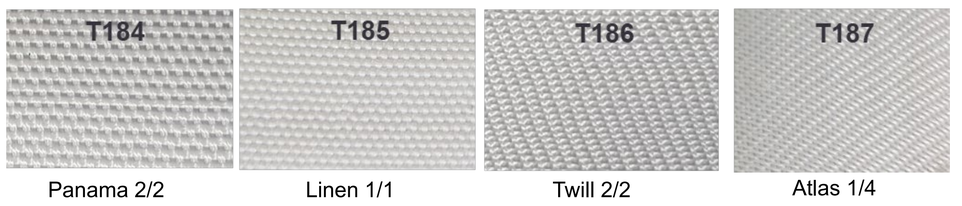
X-ray diffraction pattern of PBS FDY




X-ray peak analysis of PBS drawn yarn

## PBS textile manufacturing

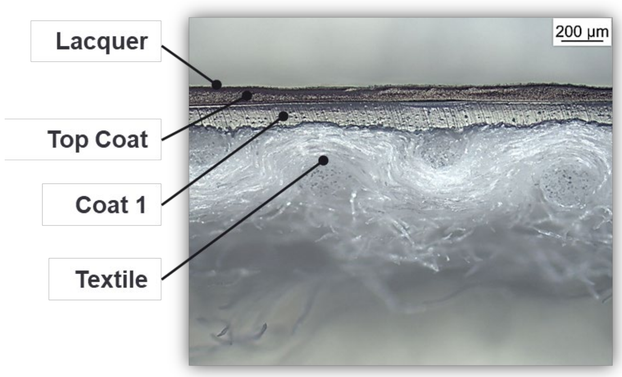
- Manufacturing of PBS nonwovens (needle felts) from PBS staple fibers as well as knitting or weaving of PBS endless fibre yarns is possible without any problems
- Woven fabrics made from PBS yarns (100%):



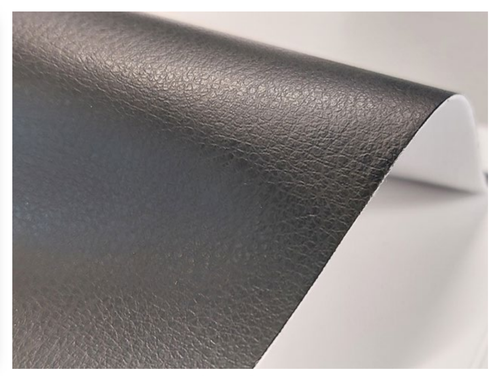

Panama 2/2 | Linen 1/1 | Twill 2/2 | Atlas 1/4

## Artificial leather manufacturing via hotmelt extrusion

- Compounding
  - ↓ formulation and pigmentation of the topcoat for before extrusion
- Extrusion of the topcoat
  - ↓ with a wide-slite nozzle on a structured transfer paper
- Extrusion of adhesion layer (Coat 1)
  - ↓ with a wide-slit nozzle on the topcoat
  - ↓ lamination of the hotmelt
- Lacquer finish (aquous PU dispersion)
  - gravure print process




Cross section of the final PBS artificial leather



PBS artificial leather

## Biodegradability/Composting (DIN 13432)

PBS after 2 weeks

PBS after 10 weeks

PBS-PBAT after 10 weeks

## Conclusions and outlook

- Commercial PBS polymer allows melt spinning of multifilament yarns
- Woven, knitted and nonwoven fabrics as reinforcing layer were made of PBS multifilament yarns and fibers without any problems
- PBS is suited for hotmelt extrusion in order to produce single-component artificial leathers
- The final PBS products show a good biodegradability
- Further development should focus on the creation of a more flexible PBS matrix

## Acknowledgements

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