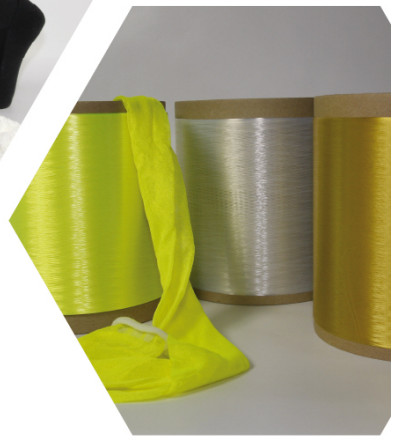
# „Caremelt® - a new bio-based hot melt adhesive developed by TITK“




TITK POLYMERE VIELFALT

04.03.2021

Andreas Krypczyk

# TITK (Thüringisches Institut für Textil und Kunststoff-Forschung)

1991

200

TITK

OMPG

smart polymer

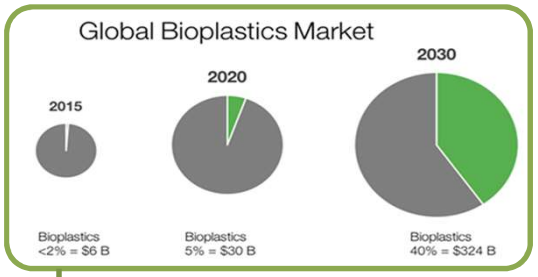
- Native polymers and chemical research
- Synthetic polymers
- Textiles and composites
- Functional polymers

# There is no planet B

## Use of renewable resources


$CO_2$-Neutral

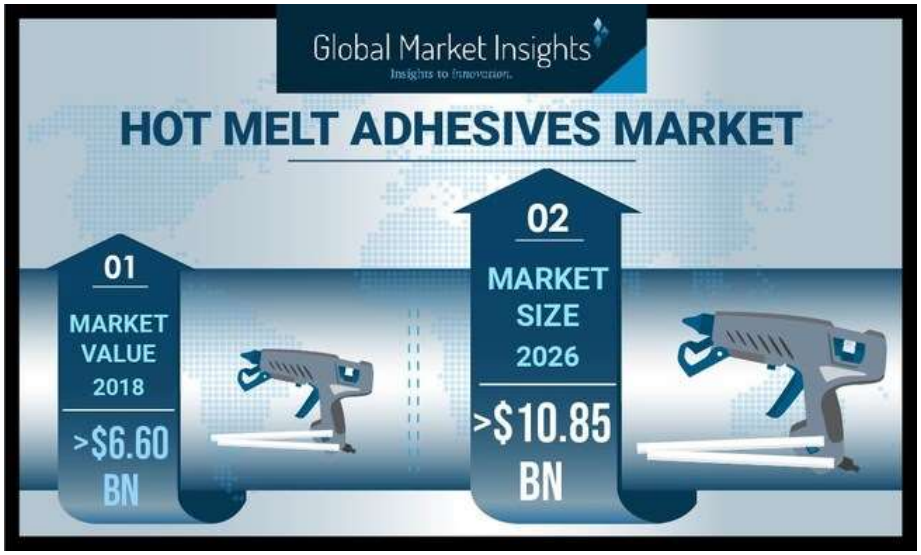
Use of renewable materials




Market oriented

No commercial hot melt adhesive based on renewable resources available

# What about the market?




- Paper & packaging
- Healtcare
- Transport industry
- Construction industry
- Electrical industry
- Furniture industry
- Shoe and leather industry
- Others

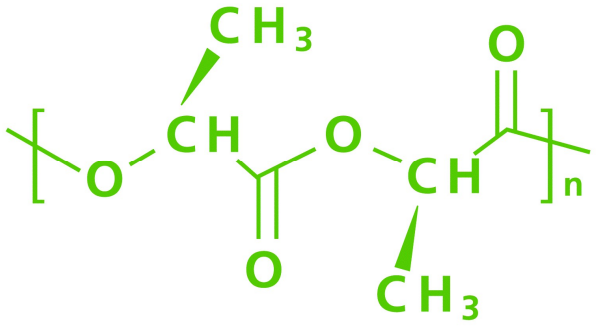
# What base polymer?

Base polymer should be bio based and bio degradable

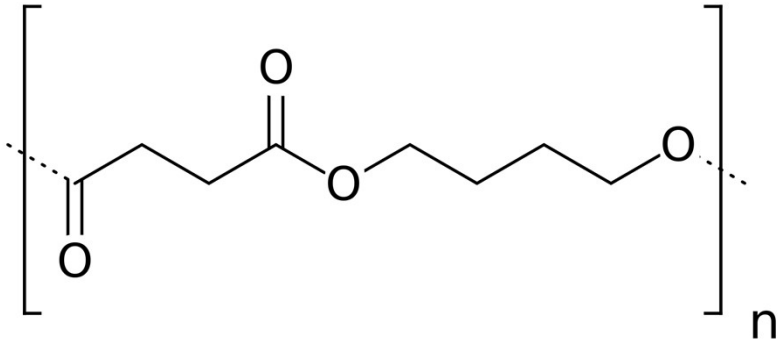
| Biopolymer | Bio based | Bio degradable | Properties |
|---|---|---|---|
| PLA | ✓ | ✓ | ✓ |
| PBS | (✓) | ✓ | ✓ |
| PHB | ✓ | ✓ | x |
| TPS | ✓ | ✓ | x |
| CAB | ✓ | ✓ | x |
| PCL | x | ✓ | ✓ |
| PBAT | x | ✓ | ✓ |

# PLA / PBS

**PLA** (**P**oly **l**actic**a**cid)




**PBS** (**P**oly**b**utylen**s**uccinate)




Carbohydrate based Polyesters (e.g. corn, potatoes, turnips)


# Bio based hot melt adhesive

**Petroleum based hot melt adhesive**

EVA, PO

Hydrocarbon resins

PE Wax

**Bio based hot melt adhesive**

PLA, PBS

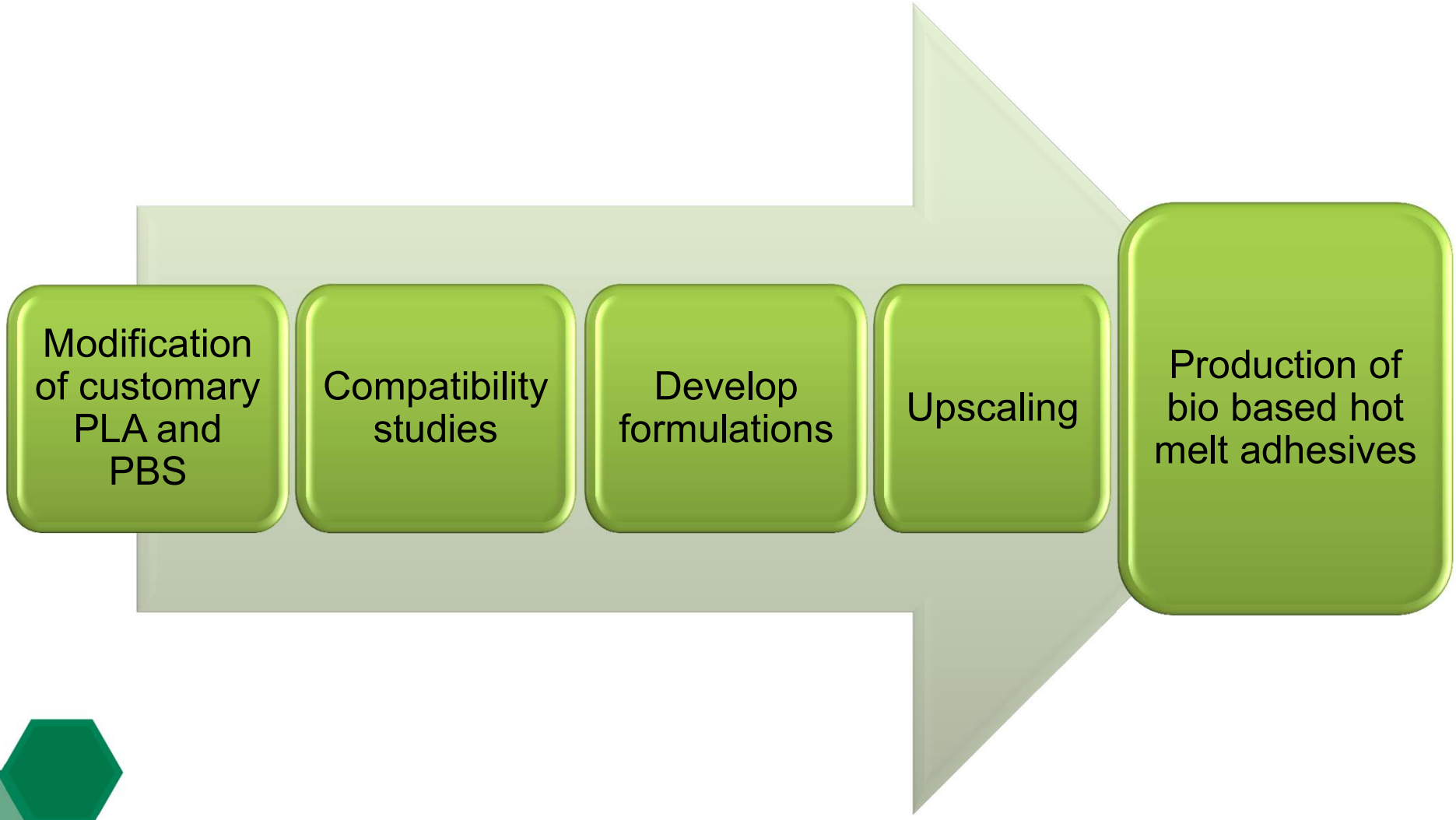
Bio based resins

Bio based waxes


**PLA, PBS**

- Small range of materials
- Not designed for hot melt adhesives
- Brittle
- High melting point
- High viscosity

# Solution path



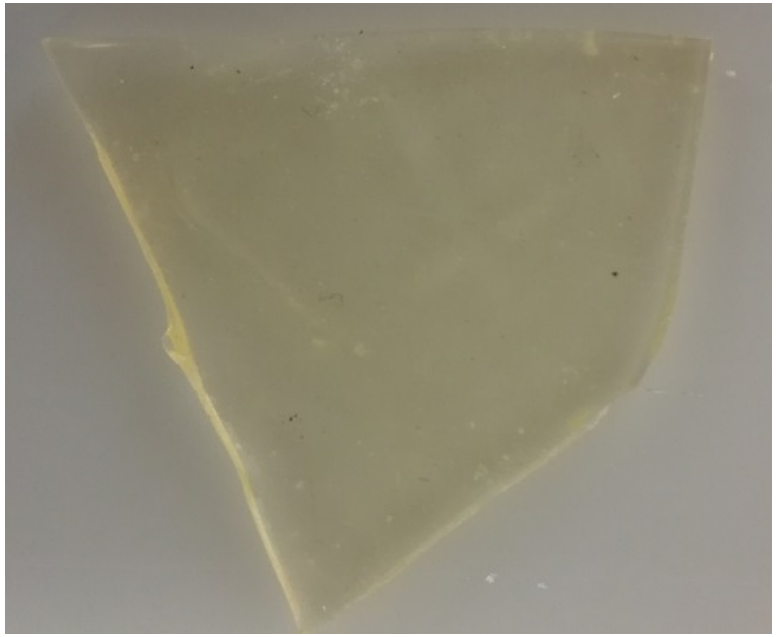
# Flexibilisation of PLA

| Name | Tensile modulus [MPa] | Tensile strengh [MPa] | Ultimate Elongation[%] |
|---|---|---|---|
| PLA | 3.000 | 71,0 | 9 |
| EVA28 | 4 | 5,3 | 360 |
| PLA-WM1.15 | 137 | 7,1 | 340 |
| PLA-WM1.20 | 35 | 18,7 | 380 |
| PLA-WM2.20 | 7 | 12,3 | 370 |

Flexibilisation of PLA by use of bio based softeners

# Compatibility

Visual homogeneous



# Compatibility research

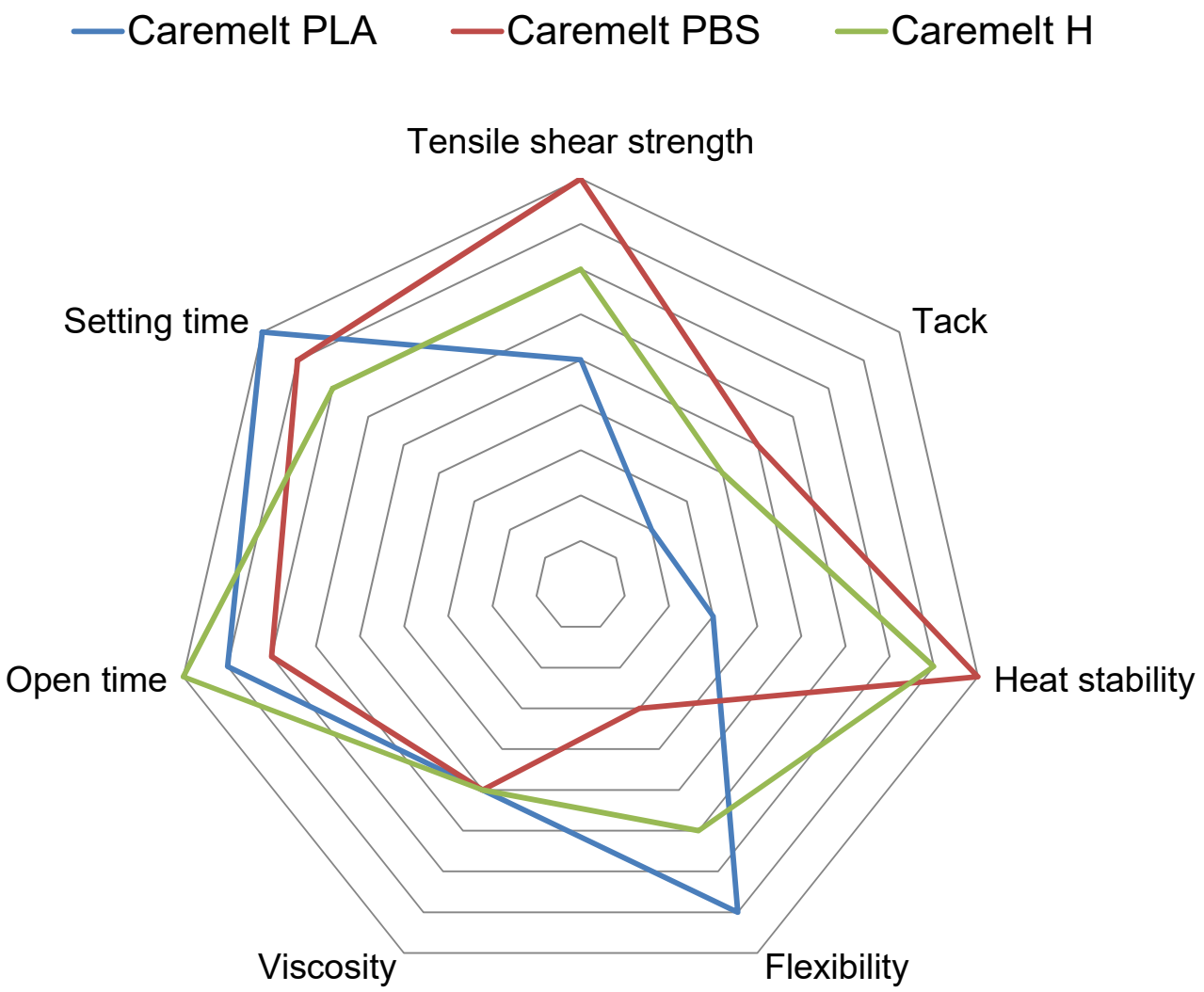
| | Resins | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [redacted] | | | | | | | | | | | | |
| PLA | x | x | ✓ | x | x | x | x | x | ✓ | x | x | ✓ | x |
| PBS | x | ✓ | x | x | x | x | x | x | ✓ | x | x | ✓ | x |

| | Waxes | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | [redacted] | | | | | | | |
| PLA | x | x | x | ✓ | x | x | x | x |
| PBS | x | x | ✓ | x | x | x | x | x |

# Testing matrix

| Characteristic | Standard / Method | Parameter |
|---|---|---|
| Adhesion / cohesion | DIN EN 1465 | > 2,0 MPa (stainless steel) |
| Heat resistance | S.A.F.T. | > 70°C |
| Viscosity | Rheometer | 1.000 – 30.000 MPa*s (140°C) |
| Melting point | DSC | 70 – 100°C |
| Open Time | TITK method | 20 – 300s |
| Setting Time | TITK method | 20 – 300s |
| Flexibility | TITK method | ≥ 3 (1 – 5) |

# Performance



# What does it cost?

| | EVA | PLA | PBS |
|---|---|---|---|
| Polymer (40%) | 0,60 € | 1,00 € | 1,80 € |
| Resin (40%) | 0,80 € | 0,80 € | 0,80 € |
| Wax (20%) | 0,25 € | 0,40 € | 0,40 € |
| Price / kg Materials | 1,65 € | 2,20 € | 3,00 € |
| Price / kg Manufacturing | 1,35 € | 1,35 € | 1,35 € |
| **Total price** | **3,00 €** | **3,55 €** | **4,35 €** |
| | | + 18,3 % | + 45,0 % |

# Technical overview

- Bio based and bio degradable
- Good heat stability
- Good adhesion to wood, paper and other polyesters
- No change of manufacturing process

- Poor adhesion to Polyolefins (i.e. PP, PE)
- More expansive than standard products
- Decent flexibility
- Sufficient thermal stability

# Pre-trials

Device: Drying cabinet

Temperature: 160 – 200° C

Sample size: 20 – 100g

Engine: Human power

# Lab tests small/big

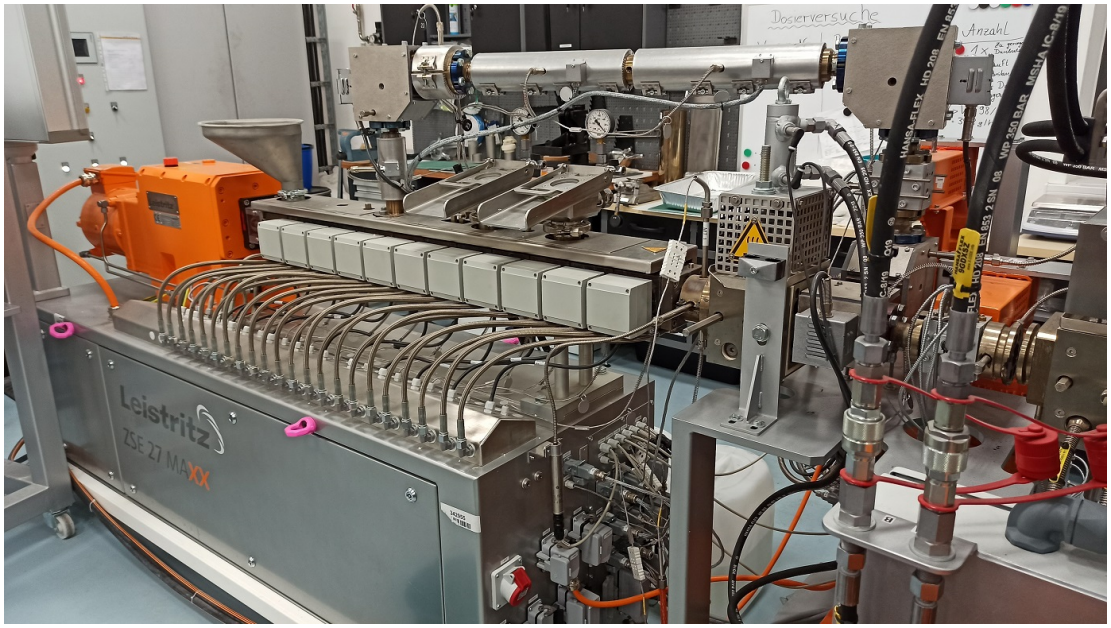
Devices: 1l/20l Reactor

Temperature: 160 – 180° C

Sample size: 500g – 15 kg

Anchor stirrer

# Pilot-plant scale

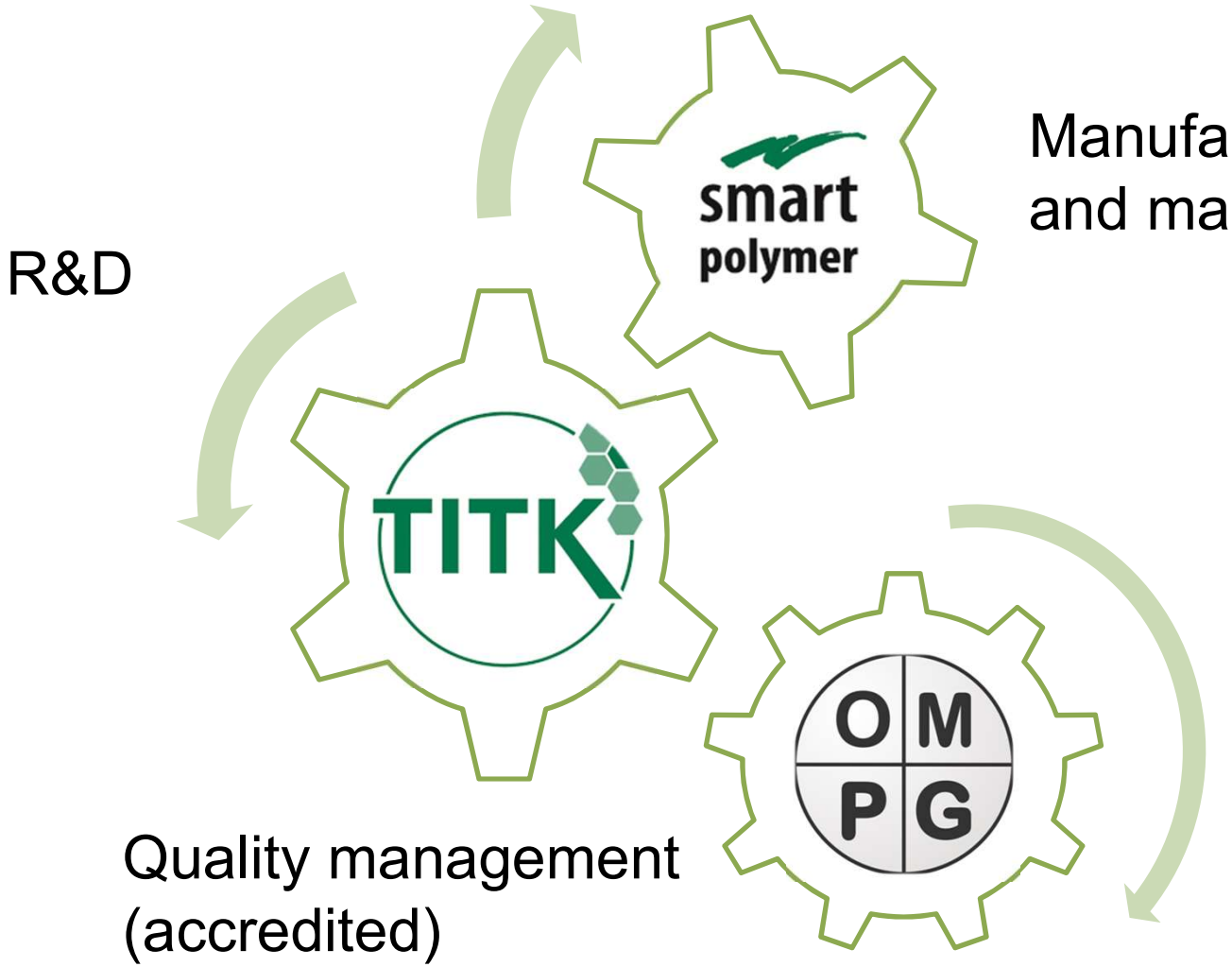



Device: Twin-screw extruder

Temperature: 120 – 160° C

Sample size: 100kg – 1.000 kg

# TITK and subsidiaries

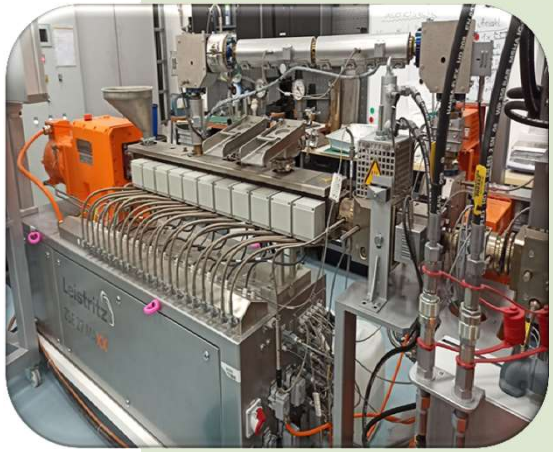



Manufacturing
and marketing

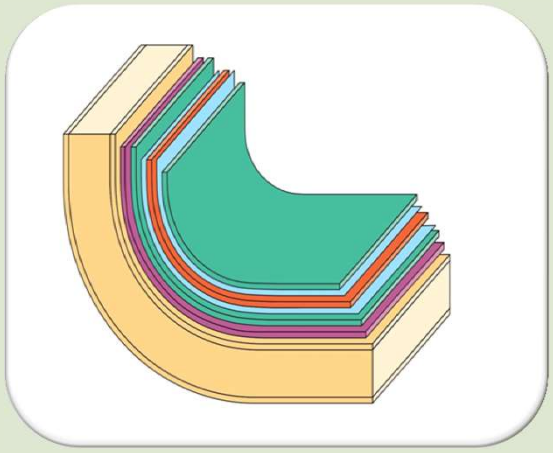
R&D

Quality management
(accredited)

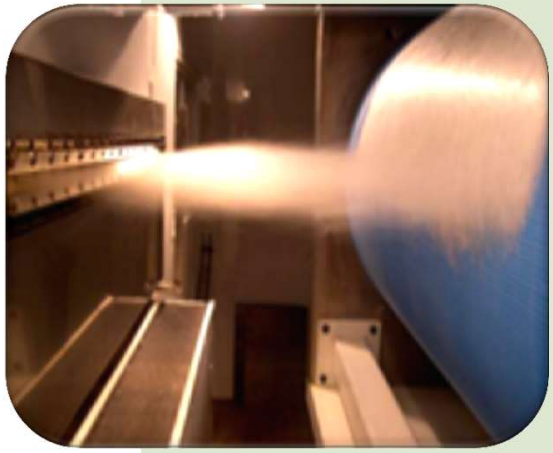
# Extrusion / Granule

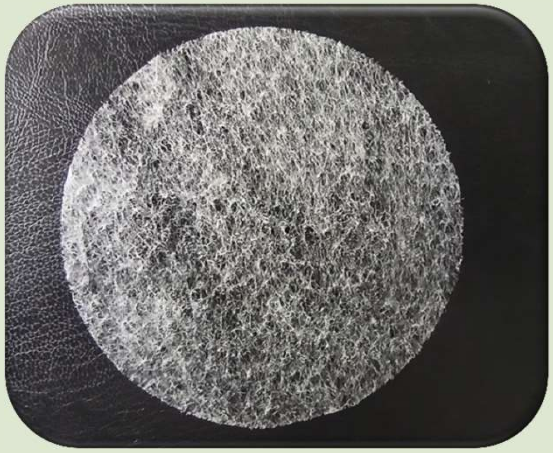


# Lamination / Composite films



# Melt Blowing / Hot melt webs





# What about the competition?

Focus on tapes and PLA used as base polymer (formulation only about 40% bio based)

Henkel

Focus on PBS as a bio polymer (formulation very brittle)

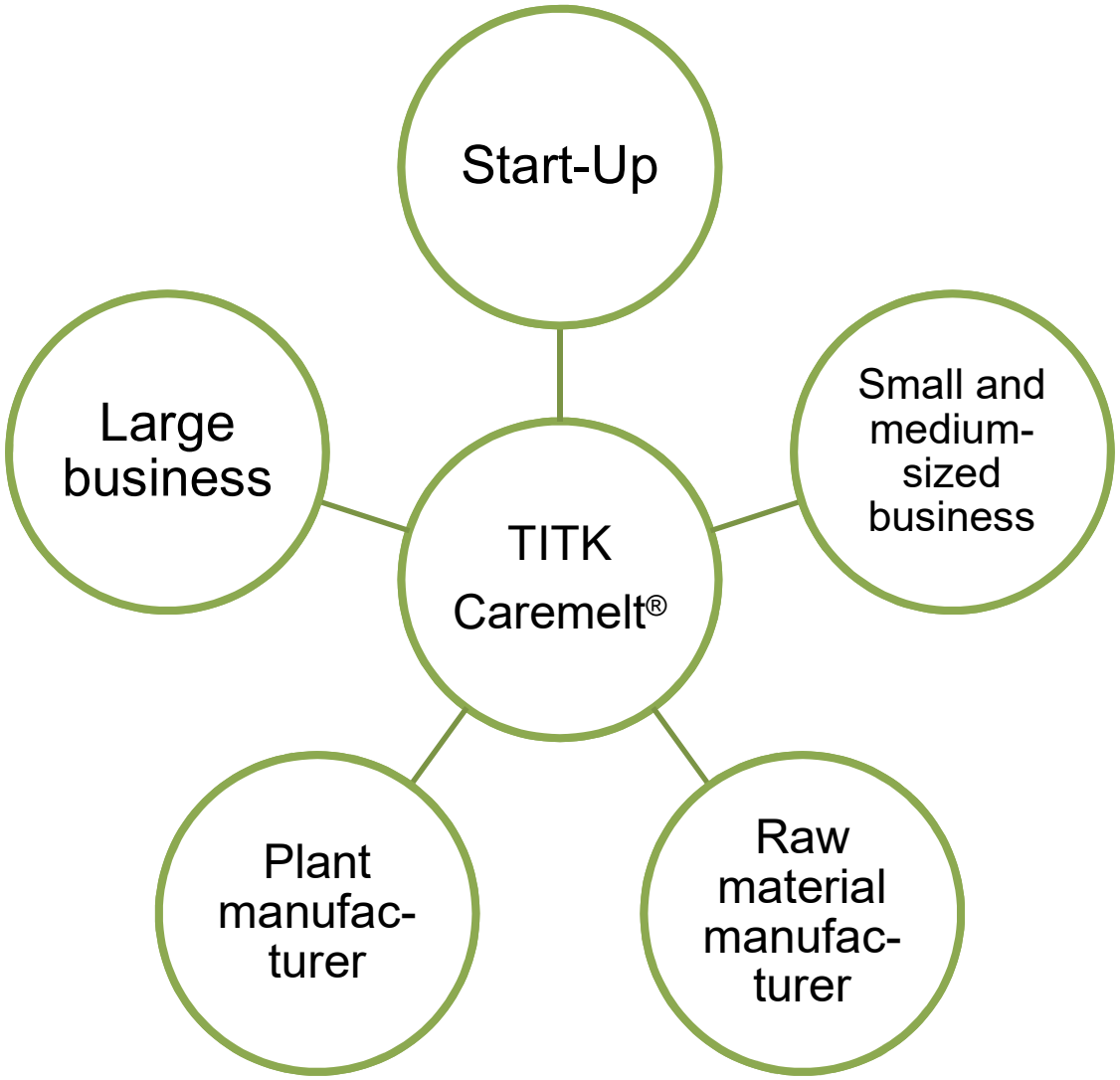
Intercol

H.B. Fuller

Jowat Klebstoffe

Synthetic base polymer (formulation 70% bio based)

# Network


Start-Up
Large business
Small and medium-sized business
TITK Caremelt®
Plant manufac-turer
Raw material manufac-turer

# Many thanks

**TITK e.V.**
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