

Mineral fillers for active packaging

M. Piontek

ERSCP 2012

02.-04. Mai 2012, Bregenz

Otto Glöckel-Straße 2, A-8700 Leoben, Tel.: +43 3842 402 3501

kv@unileoben.ac.at

www.kunststofftechnik.at

Table of content

1. Introduction
2. Materials
3. Coating and doping step
4. Material processing
5. Characterization
6. Results
7. Conclusion

Introduction

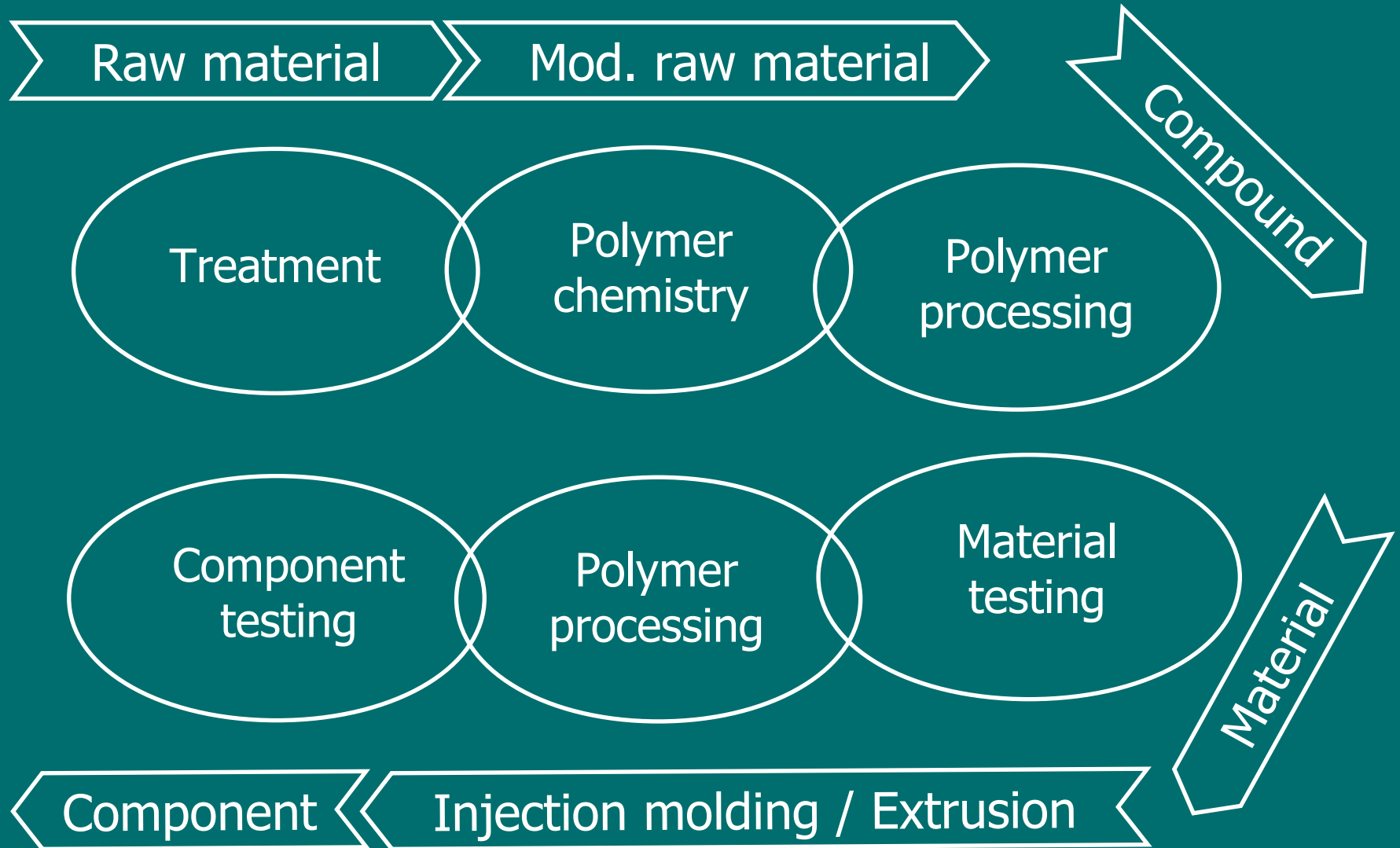
What means “active packaging”?

- Interaction between the packaged goods and the packaging
- Extension of the defensibility
- Dynamical expiration date

How can it be realized?

- Using mineral fillers
- Doping the fillers with volatile agents
- Transfer of volatile agents onto the packaged goods
- Absorption of agents from the packaging

Process chain at MUL



Materials

Polymer

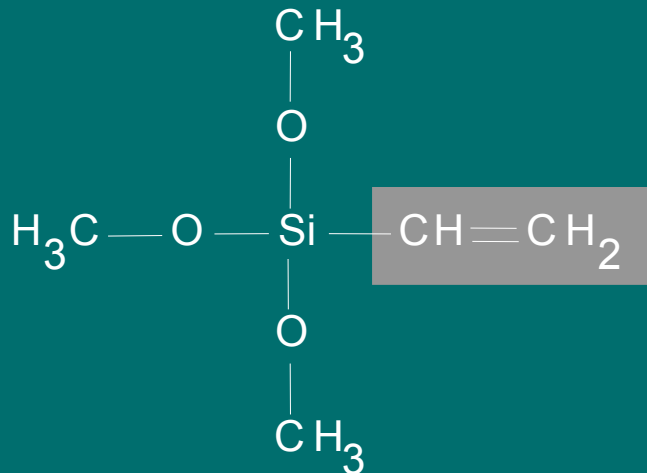
- Polypropylene (MFR 5 g/10min; 230°C/2.16 kg)
- Low Density Polyethylene (MFR 0.75 g/10 min; 190°C/2.16 kg)

Mineral fillers (50 wt%)

- Zeolite (grit size ~ 10 μm)
- Talcum (grit size ~ 10 μm)
- Average grit size before milling ca. 6 mm
- Pulverization with a spiral jet mill

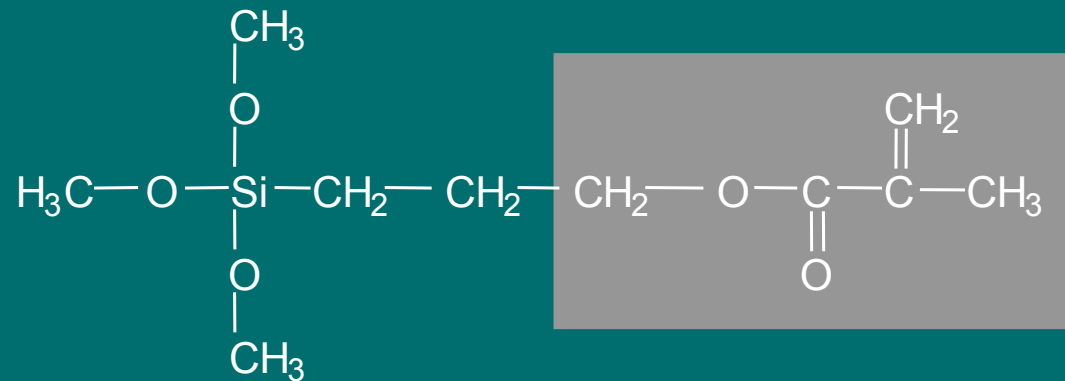
Coating and doping of mineral fillers

Coating agent with double bonds



Vinyltrimethoxysilane

Zeolite



3-(Trimethoxysilyl)propylmethacrylate

Talcum

Doping agent $\text{NaSO}_4 \rightarrow$ water absorption

Correlation doping agent : filler - 1 : 1

Coating and doping of mineral fillers

Simple coating step:

- Coating in a dissolver mixture (water/ethanol)
- Add on the reagent
- Heating onto 60°C
- Stirring at room temperature
- Drying at 120°C

Simple doping step:

- Doping of the filler in dissolver mixture (agent/filler/water)
- Washing the doped filler with distilled water
- Drying at 70°C

Drying before processing !!!

Preparation of compounds

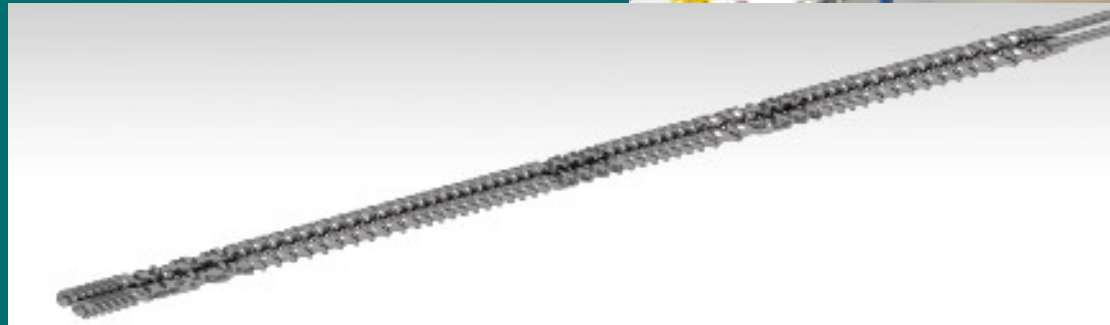
Machine:

- Co-rotating twin screw extruder Theysohn TSK 30/40D with under water granulation ECON EUP 100

Process data:

- Melt temperature 200°C
- Process water temperature 20°C
- Mass flow rate 6 kg/h

Screw geometry:



Film production

Machine:

- Single screw extruder E 30 P (Dr. Collin Inc.)

Films:

- width 250 mm
- thickness 100 μm

Process data:

- Melt temperature 220°C
- Screw speed 80 upm
- Chill roll temperature 30°C



Production of tensile test specimen

Machine:

- Injection molding machine Allrounder 470 A, Arburg

Specimen:

- Dog bone shape according to ISO 527-1

Process data:

- Melt temperature 200°C
- Mold temperature 30°C
- Cooling time 12 s



Characterization

- Rheological test

Machine: rotational rheometer MCR501, Anton Paar
Plate-plate measurements in nitrogen atmosphere
190°C melt temperature; 0.1 to 500 rad/s frequency range

- Tensile test

Machine: Zwick Z10, Zwick
ISO 527 (23°C; 50 % moisture)

- Charpy impact test

Machine: pendulum system CEAST RESIL 25, INSTRON/CEAST
ISO 179 (23°C; 50 r.H.)

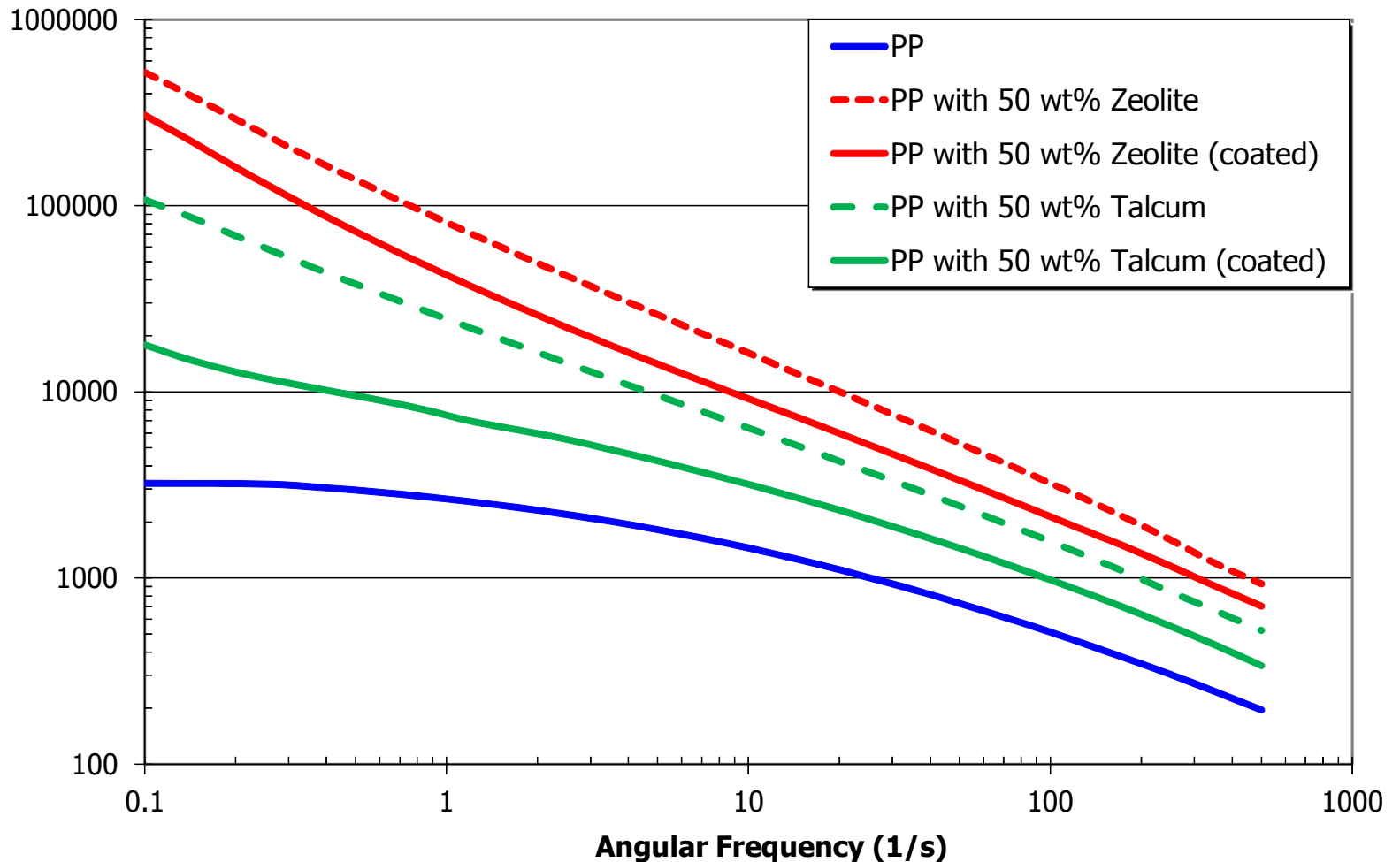
- Oxygen permeation

ASTM F 1928:1998

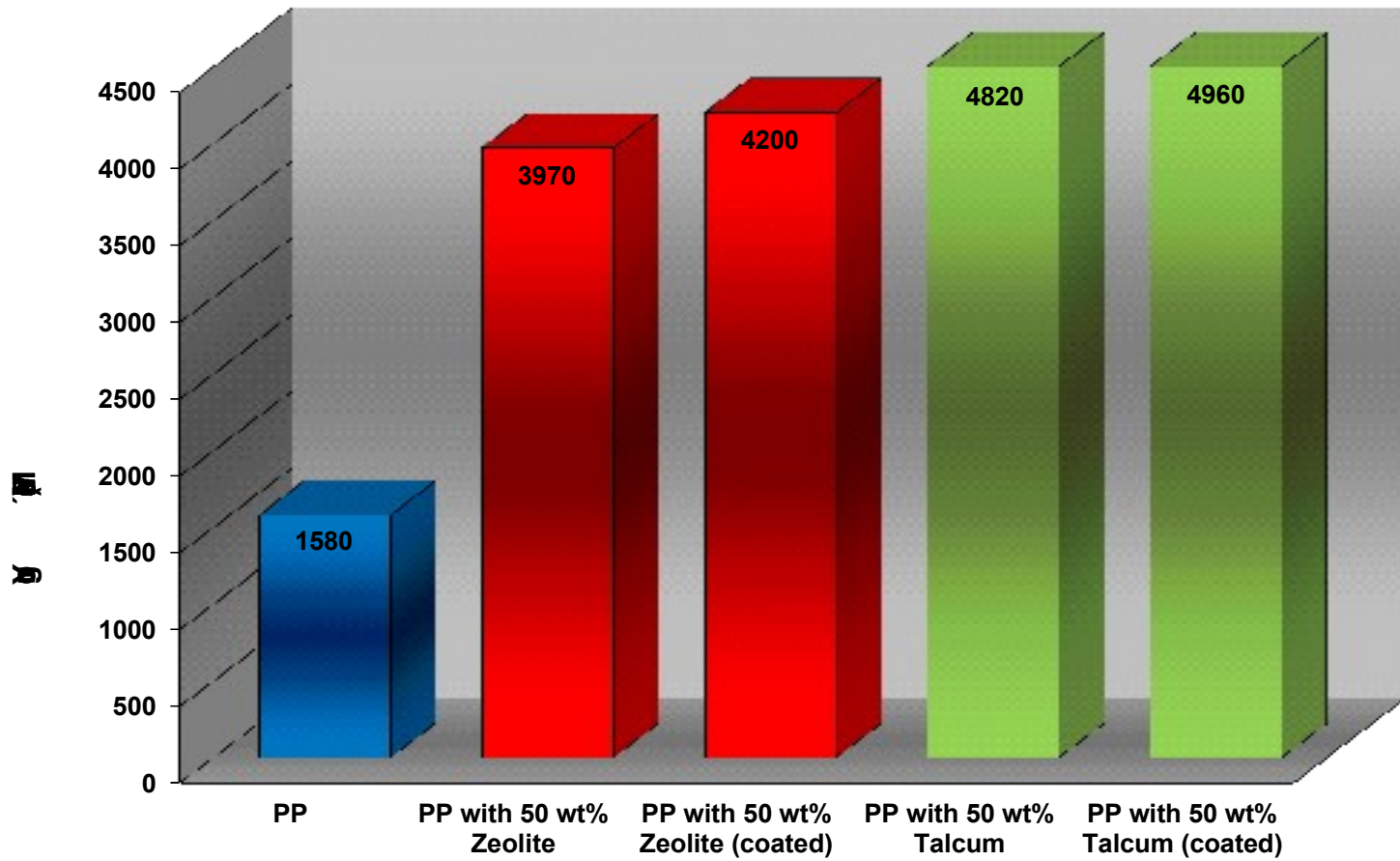
- Water absorption

Inlay of a defined plate in water; Measuring the mass increasing

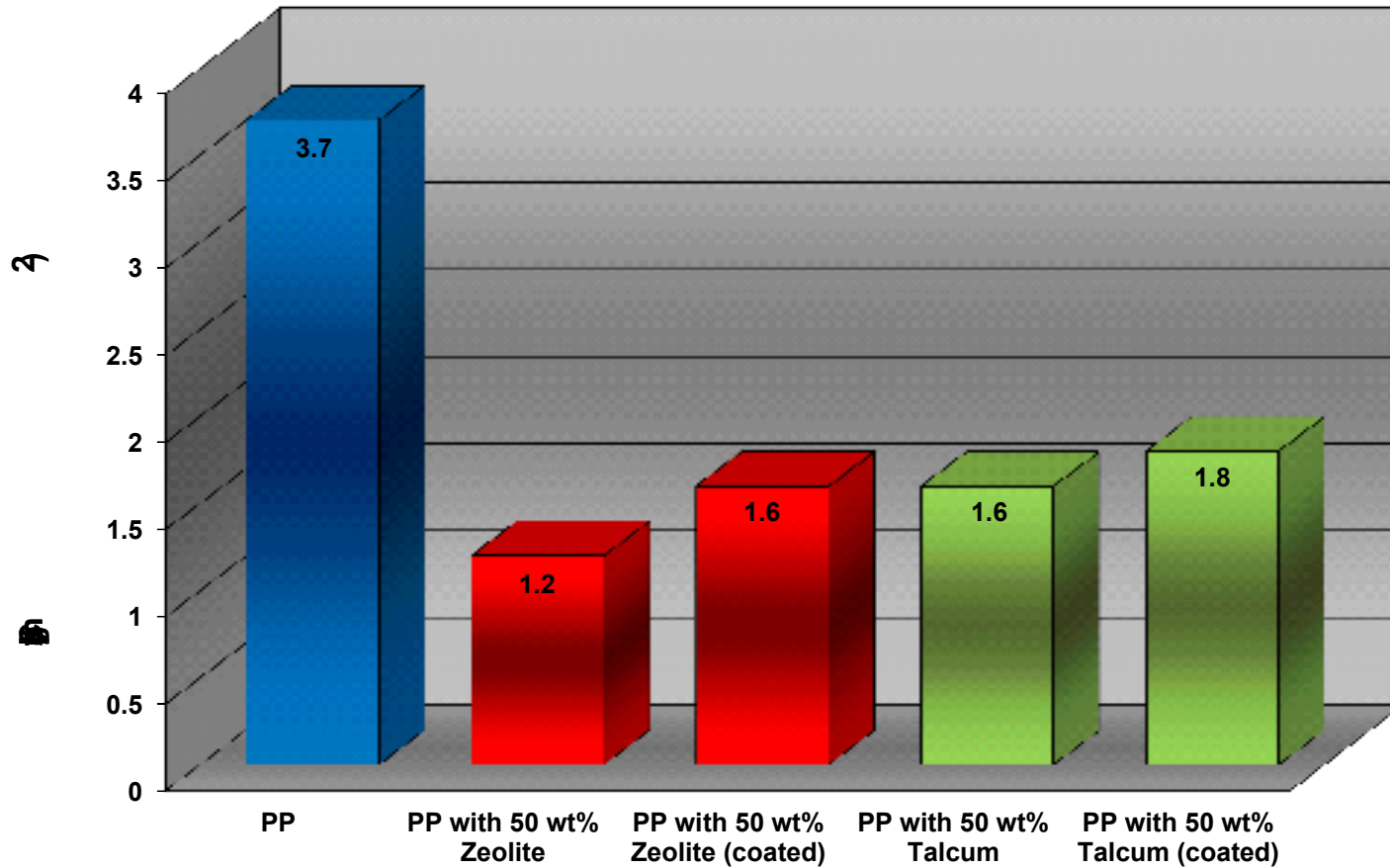
Results – Complex viscosity



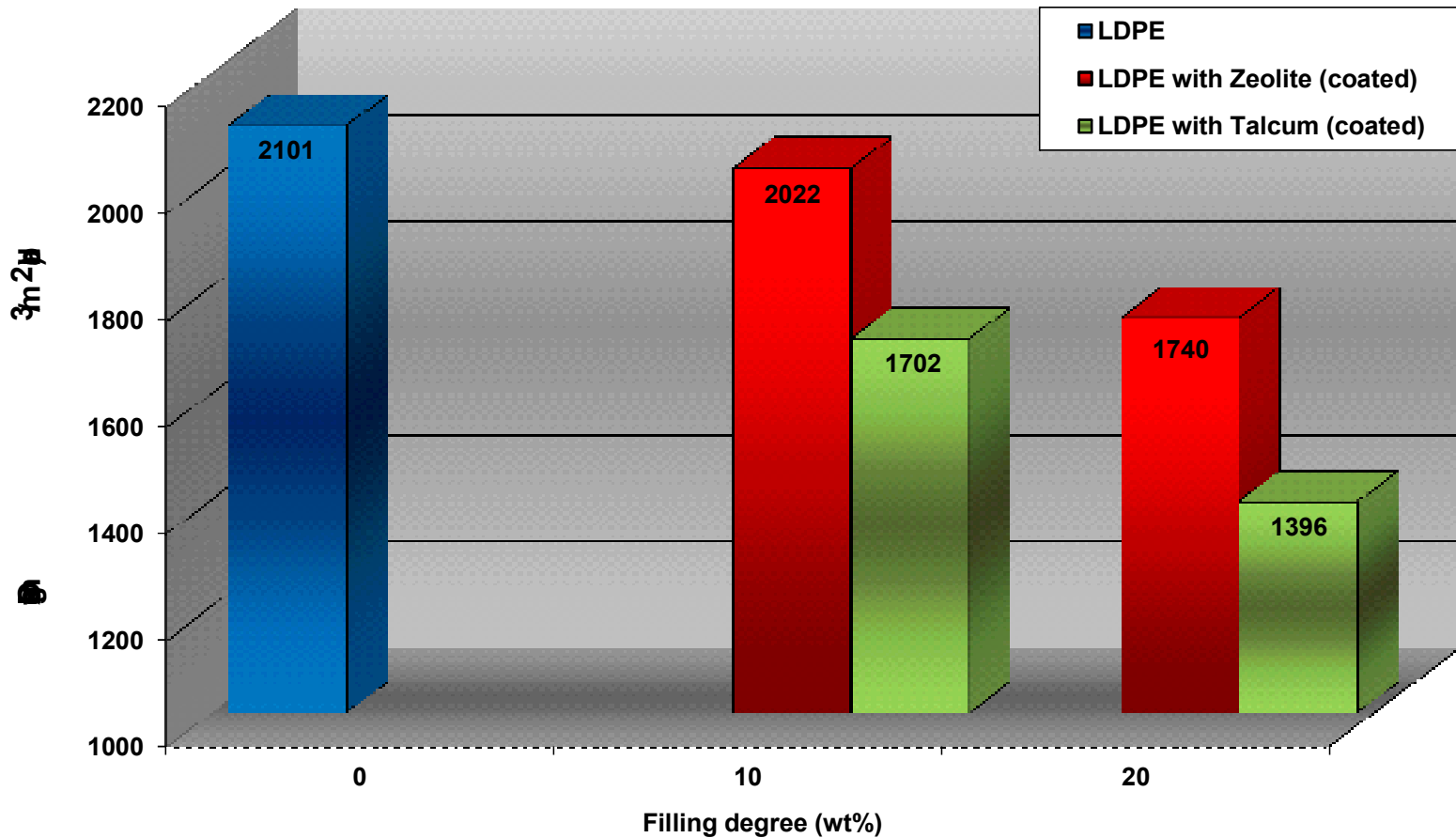
Results – Young's Modulus



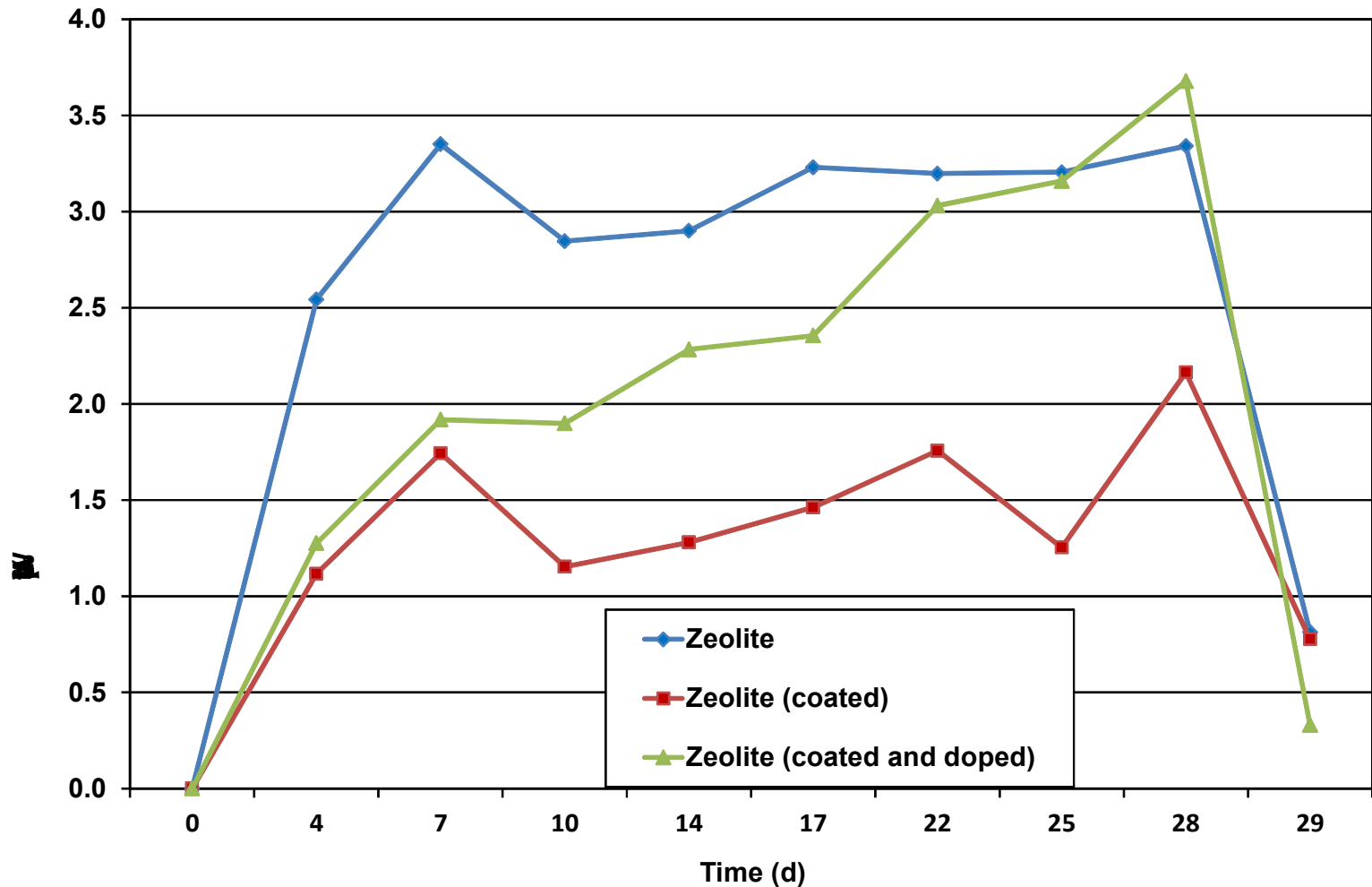
Results – Charpy impact test



Results – Oxygen permeation



Results – Water absorption



Conclusion

- Treatment and coating is necessary
- Coating → enhanced influence onto viscosity, Young 's Modulus, toughness and permeation
- Drying is very important
- Young 's Modulus increases more than 150 % (50 wt% filler)
- Oxygen permeation decreases with higher filling degree
- Doping with NaSO_4 increases water absorption
- Next steps:
 - Doping with other agents (oxygen scavenger)
 - Multilayer extrusion with doped compounds
 - Testing of this packaging materials

Acknowledgment

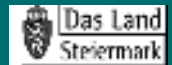
This research work was performed at the Polymer Competence Center Leoben GmbH (PCCL, Austria) within the framework of the K1-program of the Austrian Ministry of Traffic, Innovation and Technology with contributions by the University of Leoben. The PCCL is funded by the Austrian Government and the State Governments of Styria and Upper Austria.

Scientific Partners

- Polymer Processing, Montanuniversitaet Leoben
- Chemistry of Polymeric Materials, Montanuniversitaet Leoben
- Mineral Processing, Montanuniversitaet Leoben

Company Partners

- Paltentaler Minerals GmbH & Co KG
- Greiner Packaging International GmbH



**Thank You
for Your
attention!**