Possibilities of utilisation polyethylene terephthalate (PET) recycling in particleboard production - mould test

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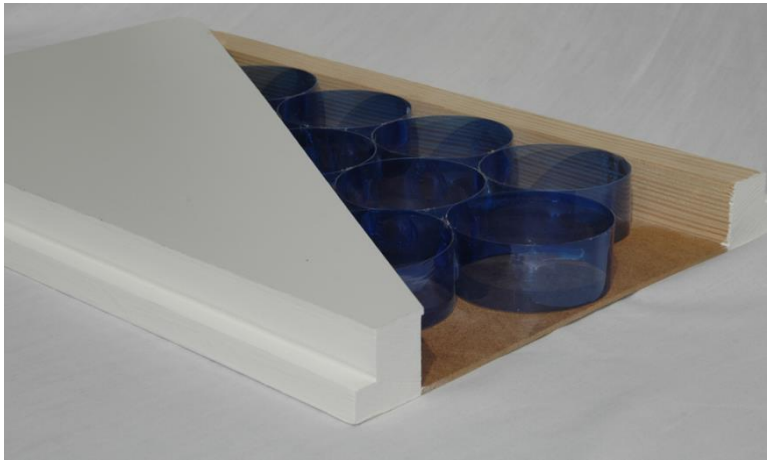
Designing with bio-based building materials - Challenges and opportunities
Madrid, Spain
24 - 25 February 2016

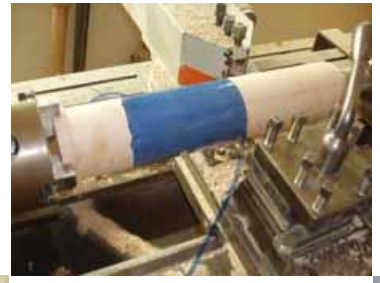
Introduction

Scheme of manufacturing of surface treatment from PET bottles

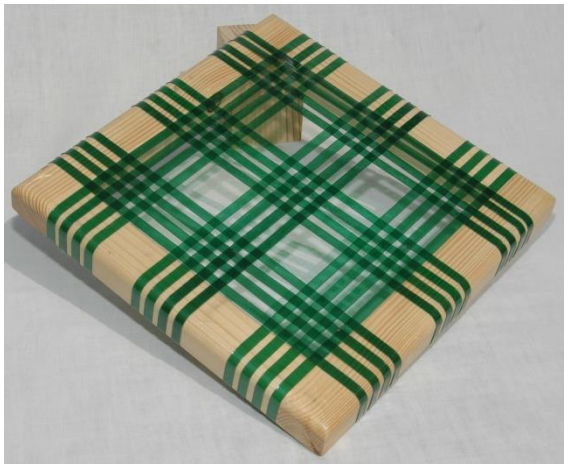
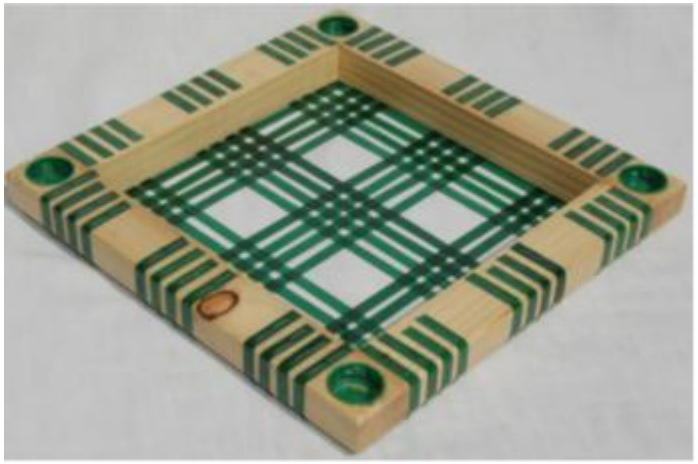


Door filling made out of PET bottles

Introduction

Scheme of production of materials for seat strings

A seat with netting bonding.

Tóth V., Pomikala R., Jerz J. 2012. Patent. Slovak Republic: 287936

Material and methods

In laboratory (of the Faculty of Wood Sciences and Technology, Technical University in Zvolen) conditions - produced boards

- dimensions of 360x360x16 mm
- density 650 kg.m^{-3},
- 5 variants prepared particleboards:

  V1 - without PET admixture - control,

  V2 - PET admixture representing 10 % in the surface layer and 0 % in the core layer,

  V3 - PET admixture representing 0 % in the surface layer and 10 % in the core layer,

  V4 - PET admixture representing 10 % in the surface layer and 10 % in the core layer,

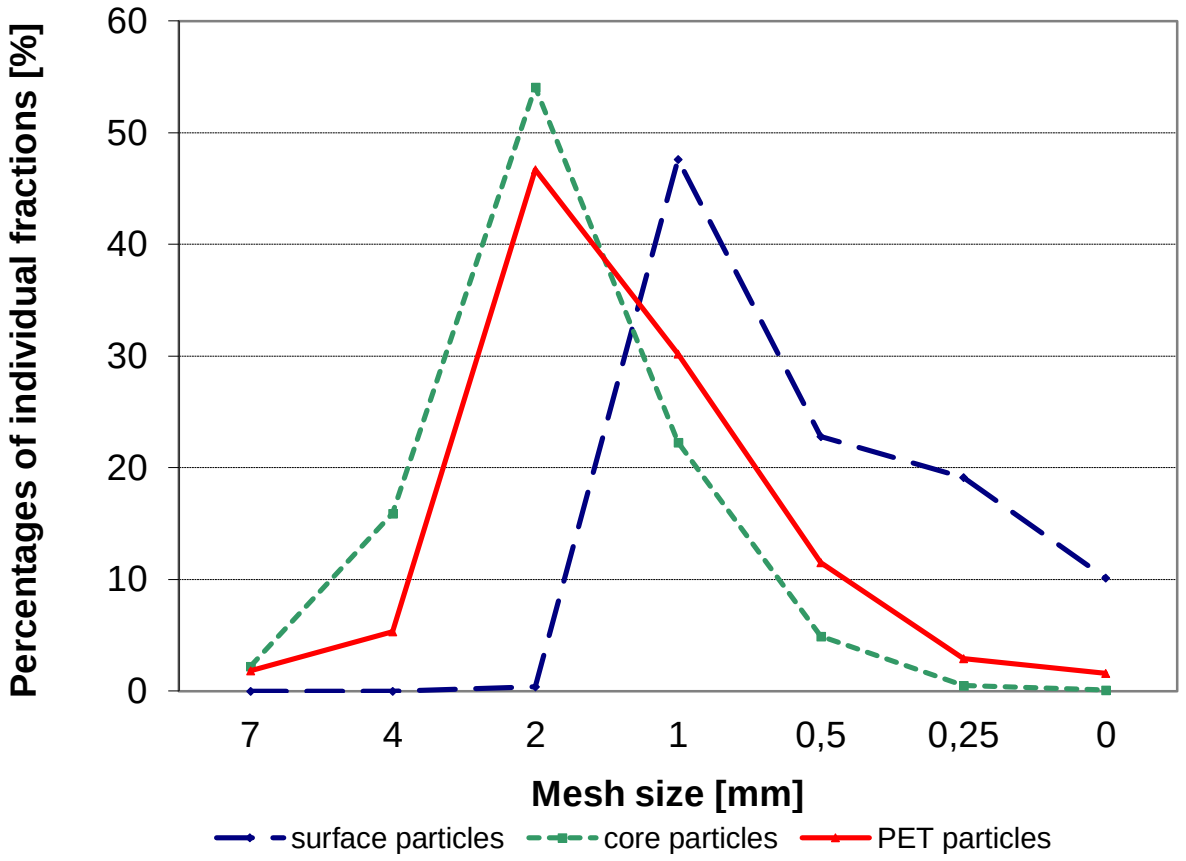
  V5 - PET admixture representing 30 % in the surface layer and 30 % in the core layer.

Material and methods

Particles:

- industrialy produsedparticles from the mixture of softwood species
- MC of softwood - surface particles 5.2 %
  - core particles 3.9 %
- PET particles (addition levels – 0 %, 10 %, 30 %)

Material and methods



Wood particles and PET particles fractions.

Material and methods

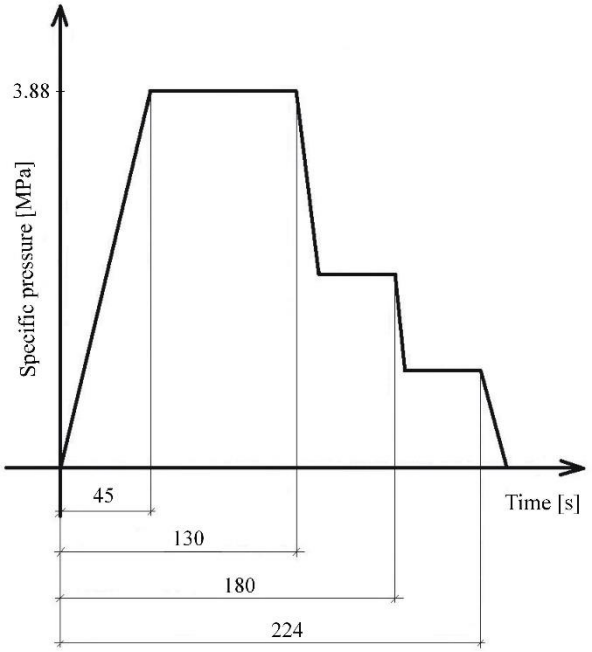
Resin:

- Ureaformaldehyde glue (solids 67 %)
- Glue amount - 11 % for the surface particles
  - 7 % for core particles
- Additional additives - hardener (55 %)
  - paraffine emulsion (35 %)

Material and methods

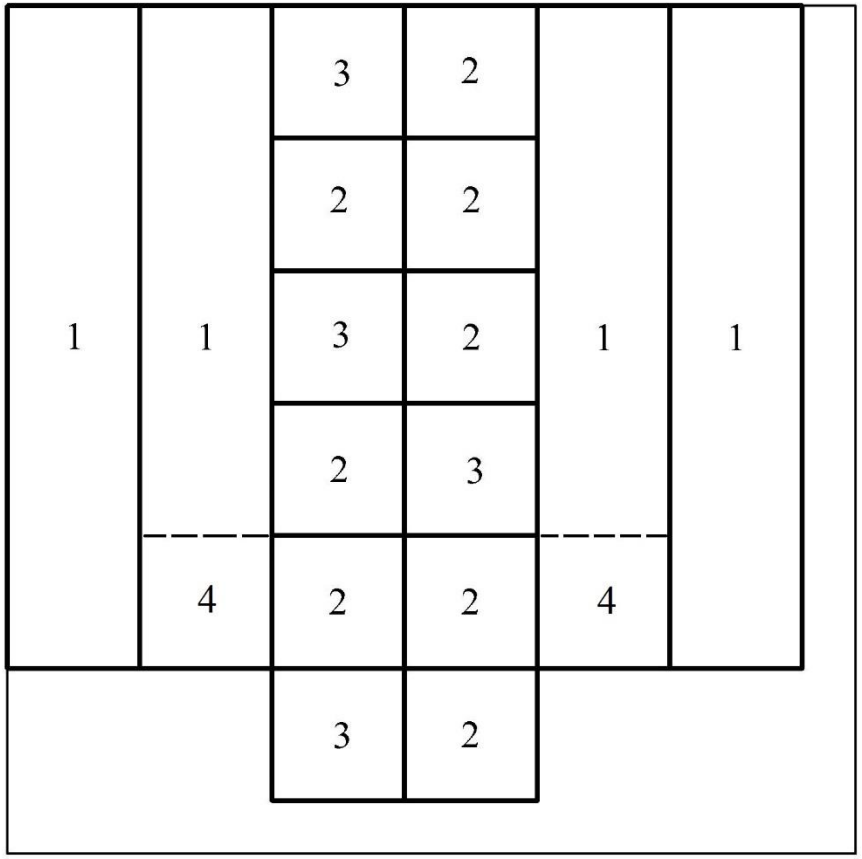
Pressing process:

- by the standard three stage pressing diagram
- temperature of the pressing plates 210 °C
- pressing factor 14 s



Standard three stage pressing diagram

Material and methods



Schedule for preparing test specimens:
1 – bending strength,
2 – tension strength perpendicular to the plane of the board,
3 – thickness swelling and water absorption,
4 – mould test.

The standardized procedures according to EN 310, 319, 317 and 323 were used to determined the physical and mechanical properties of the pressed boards and coating against fungi EN 15457.

Material and methods

Test against moulds (EN 15457)

Biological resistance tests - sterile laboratory conditions (UV lamp)

Specimens - placed into Petri dishes with agar-malt soil and inoculated spore suspension

Fungi - moulds for interior environment:

- *Aspergillus niger* (DSM 12634)
- *Penicillium purpurogenum* (DSM 62866)

Specimens: 50x50x16 mm

Assessment: visually

Evaluation (0 - 4): mould growth after 7, 14 and 21 days

0 - no mycelium on the surface of the specimen

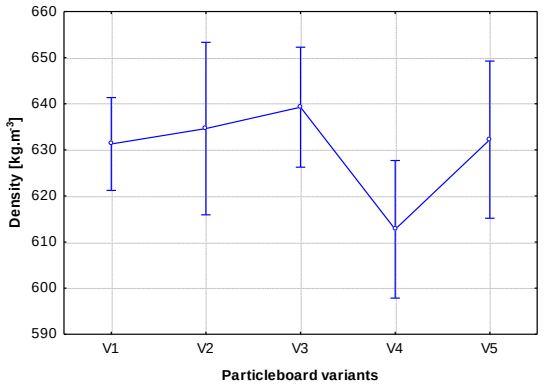
1 - up to 10 % growth on the surface of the specimen

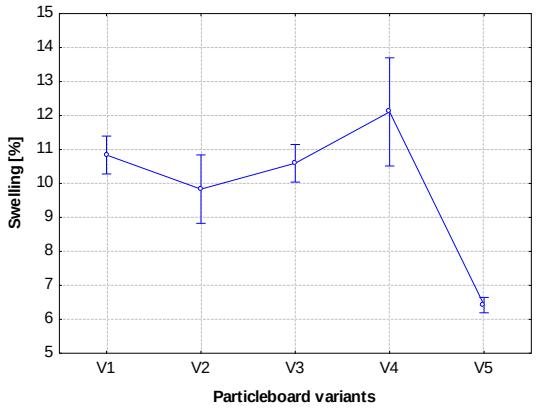
2 - more than 10 % up to 30 % growth on the surface of the specimen

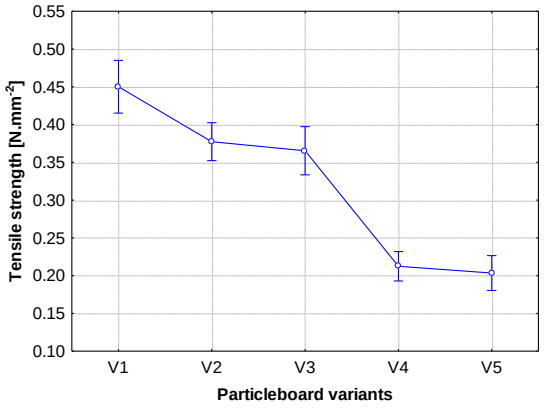
3 - more than 30 % up to 50 % growth on the surface of the specimen

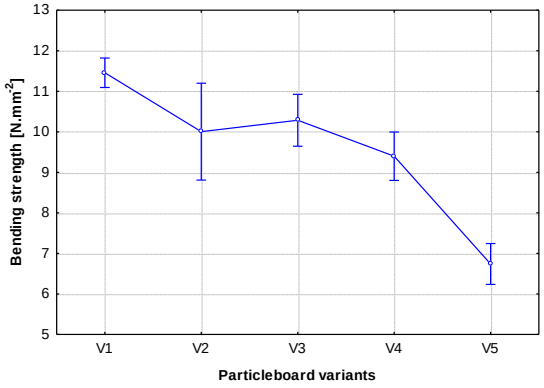
4 - more than 50 % up to 100 % growth on the surface of the specimen

Results: Physical and mechanical properties.









V1 - 0 % PET - control,

V2 - PET 10 % surface layer
0 % core layer,

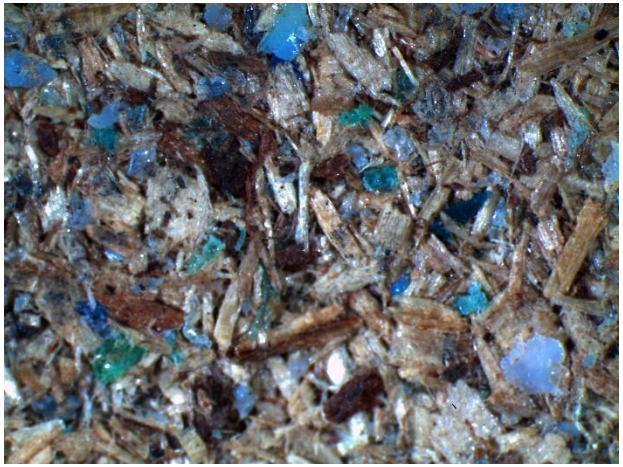
V3 - PET 0 % surface layer
10 % core layer,

V4 - PET 10 % surface layer
10 % core layer,

V5 - PET 30 % surface layer
30 % core layer,

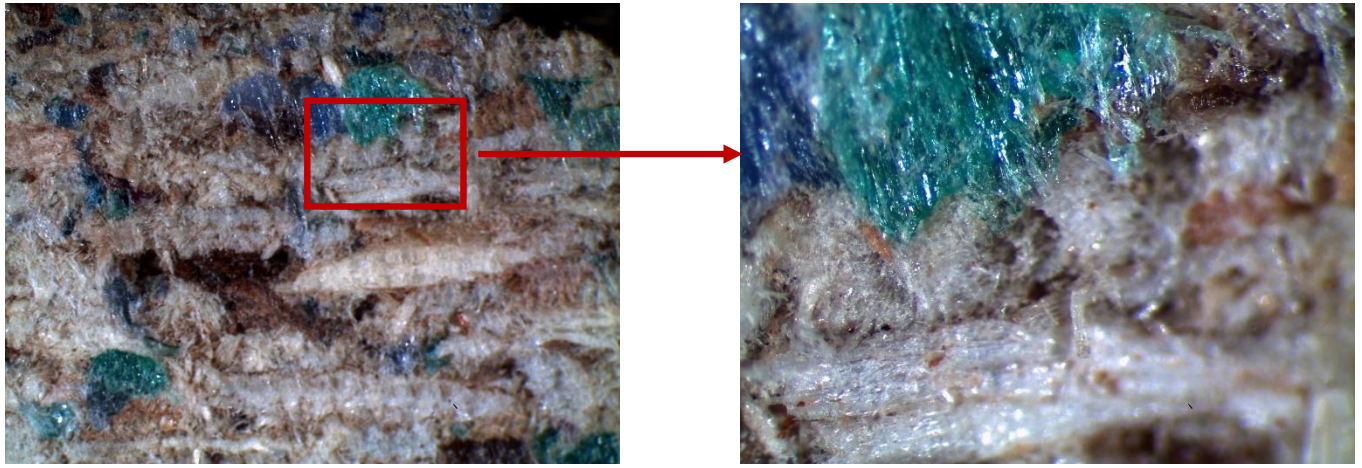
Iždinský J., Tóth V., Kúdela J. 2013. Polyethylene terephthalate recycling in particle board production. In: Wood the best material for mankind, edited by Jozef Kúdela and Marián Babiak. Zvolen : Arbora Publishers: 93-97

Results: Microskopic analysis



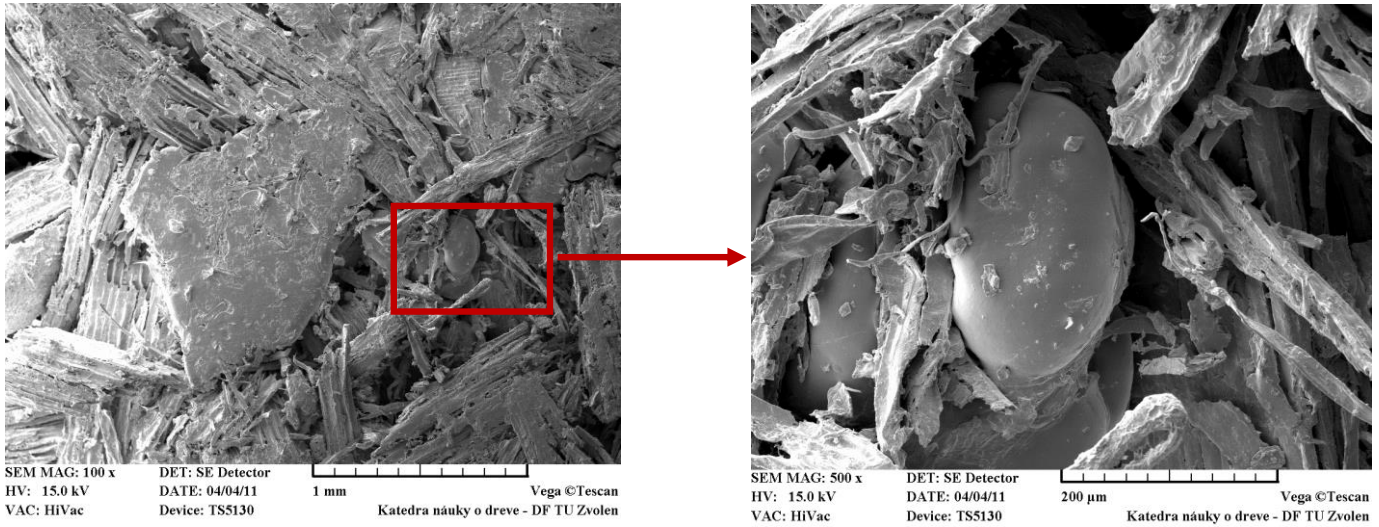
Surface of particleboard containing 30% PET.

Middle layer of particleboard after the tensile strength perpendicular to plane.

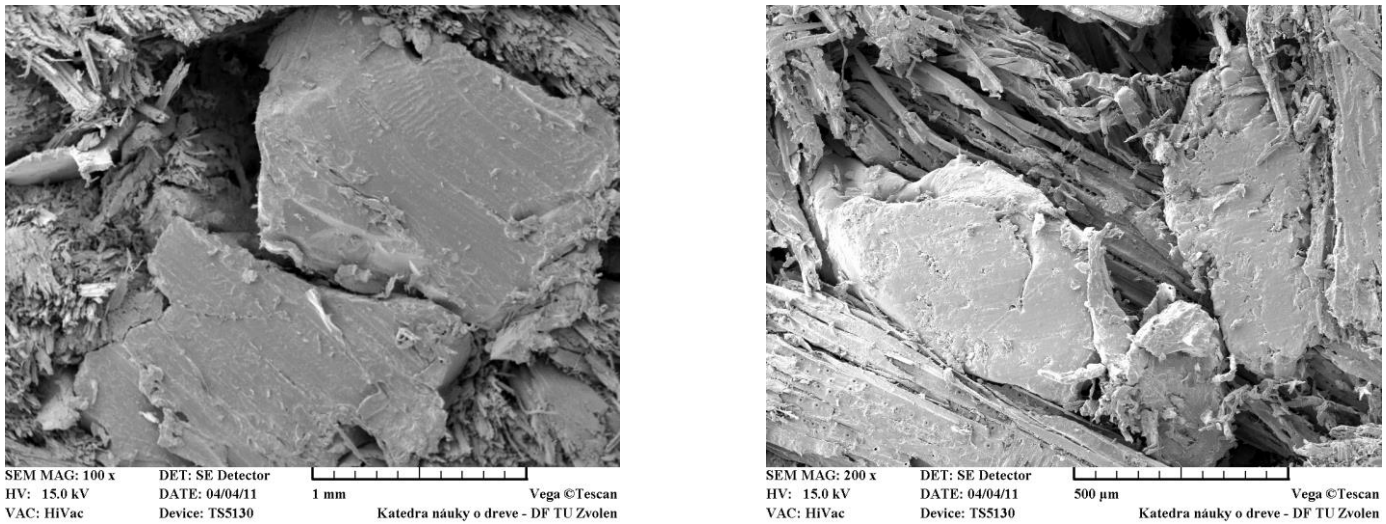


On side particleboard containing 30 % PET.

Results: Microskopic analysis

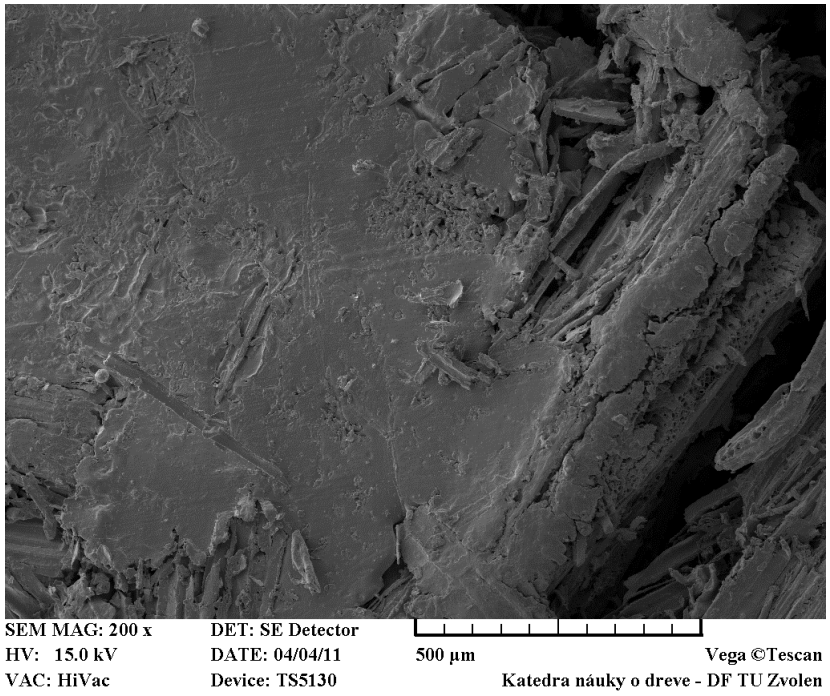


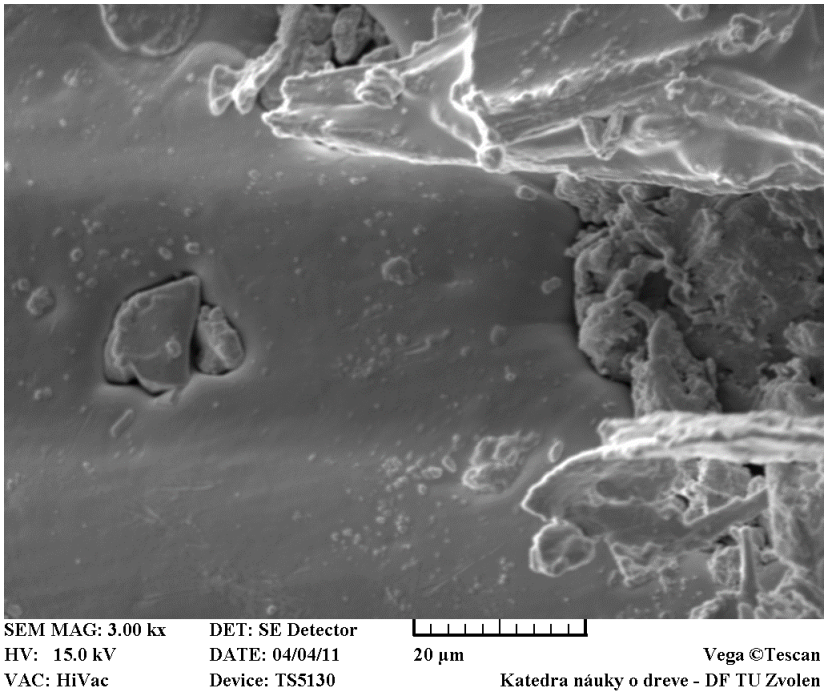
Middle layer of particleboard with occurrence of melted and non-melted PET particles.



PET particles in the middle layer of particleboard.

Results: Microskopic analysis

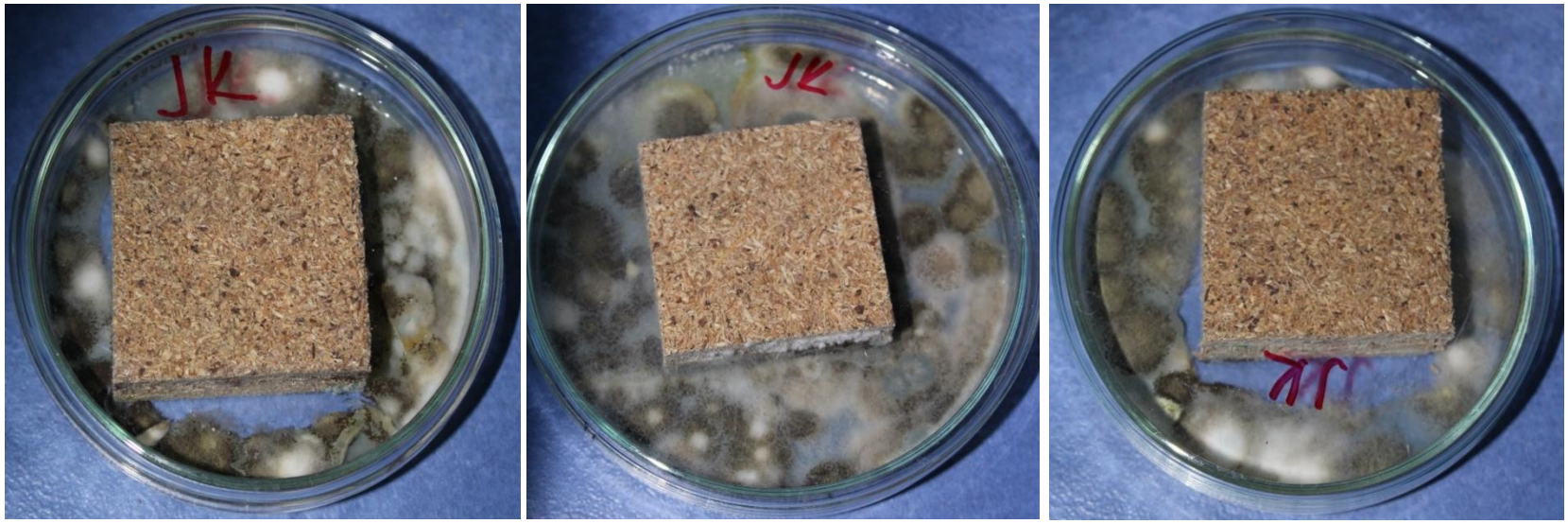




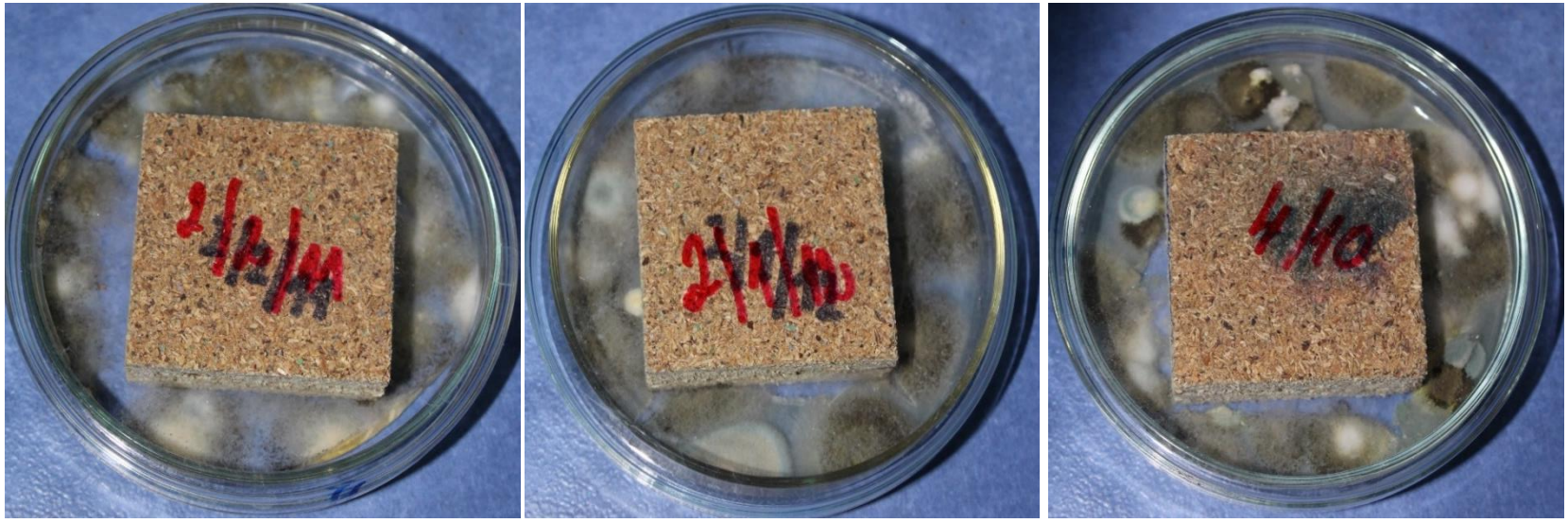
Melted PET particles covering wood particles on particleboard surface.

Results: Moulds / 7 days

Control PB

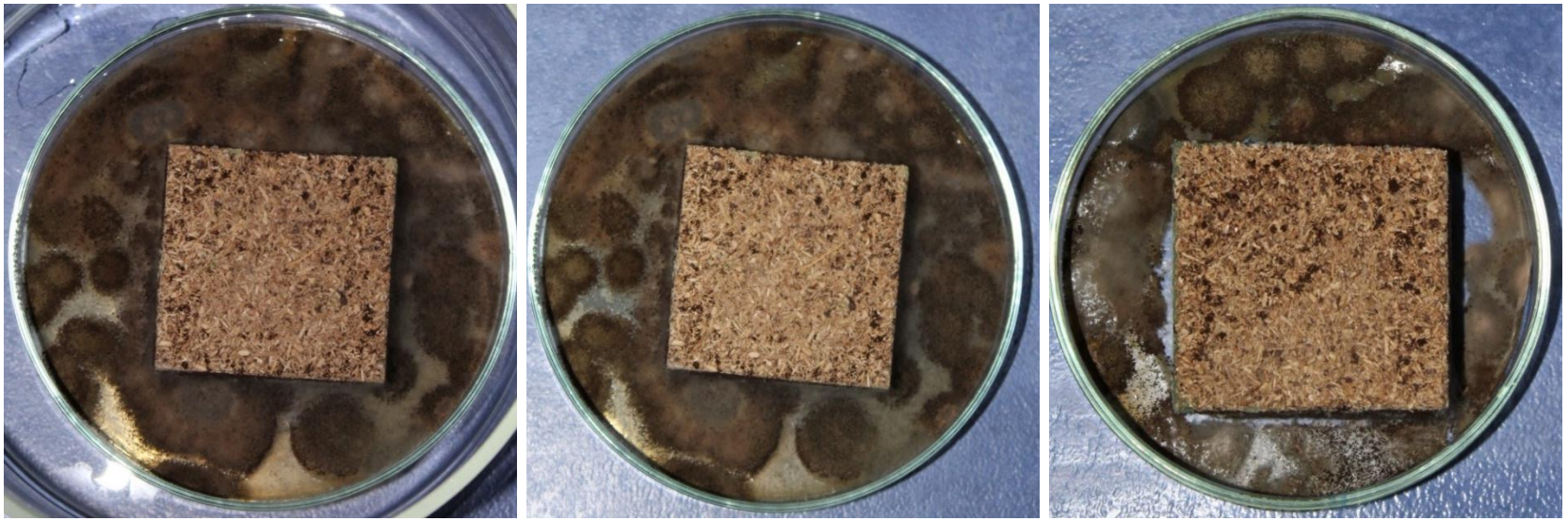


PET PB

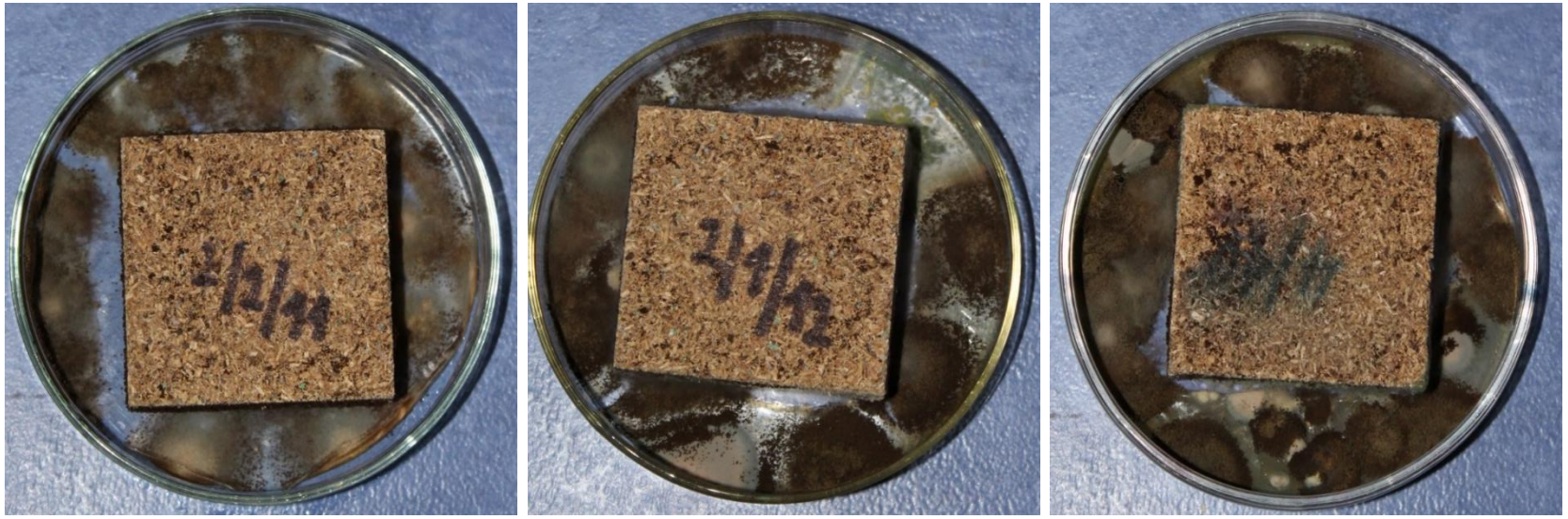


Results: Moulds / 21 days

Control PB



PET PB



Results: Moulds / 7, 14, 21 days

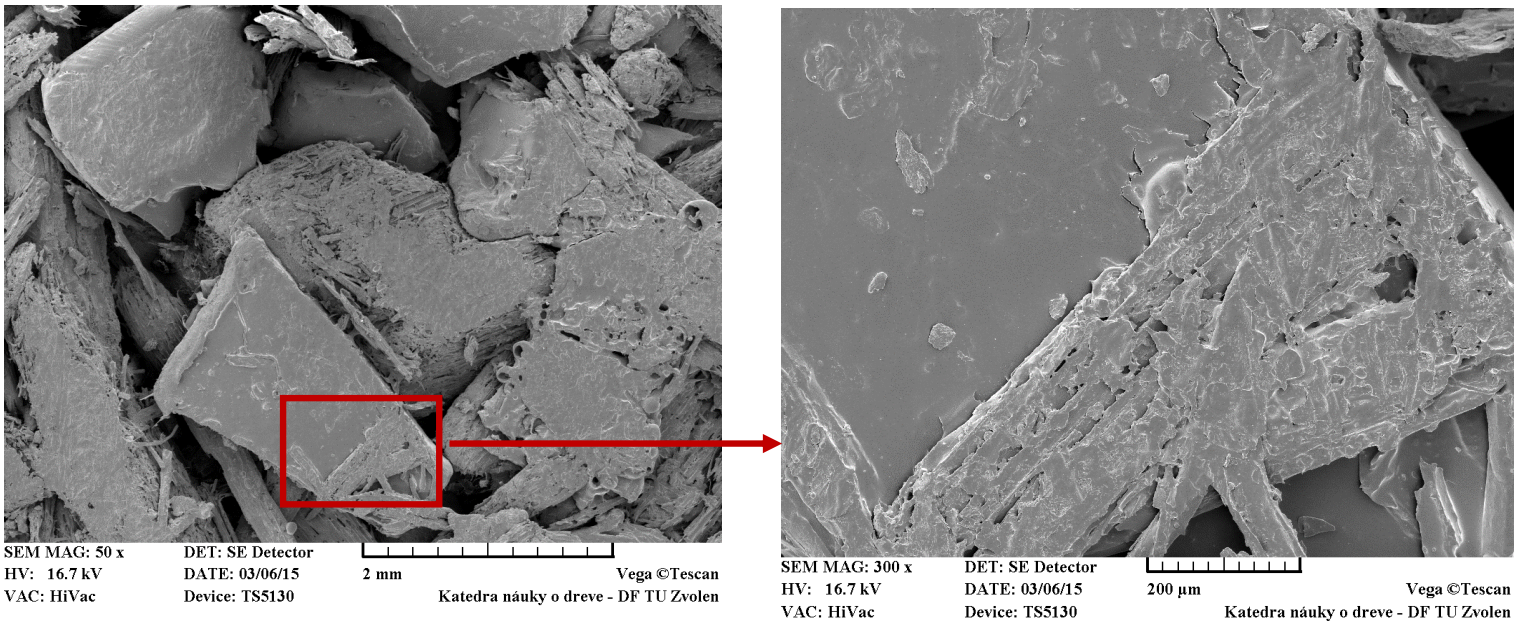
Surface / Days	7	14	21
Control PB	0	1,00	3,00
PET PB	0	1,67	3,00

Conclusions

From the results can be driven the following conclusions:

- recycling of waste from PET packaging material in the particle board production proved to be highly relevant,
- addition of PET particles reduced the mechanical properties but on the other hand improved the water resistance (reduced thickness swelling) of the boards,
- significant impact on the changes in the tested properties had the proportion of PET particles in the particle board,
- moulds were not affected by the addition of PET particles,
- in our opinion, additional research focused on this subject is needed.
- it has been revealed that modification of PET surface with plasma could improve adhesion properties of this material and thus also the properties of wood particle boards with PET admixture

- decline of mechanical properties of composite boards with PET admixture can be considerably mitigated by PET plasma treatment (Klímek et al. 2016).



Klímek P., Morávek T., Ráhel J., Stupavská M., Děcký D., Král P., Kúdela J., Wimmer R. 2016. Utilization of air-plasma treated waste polyethylene terephthalate particles as a raw material for particleboard production. In: Composite Part B 90 (2016) 188-194.

Thank you for your attention

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