ASSESSING THE PARTICLE STRUCTURE OF WOOD BASED PANELS THROUGH MODE I FRACTURE TEST

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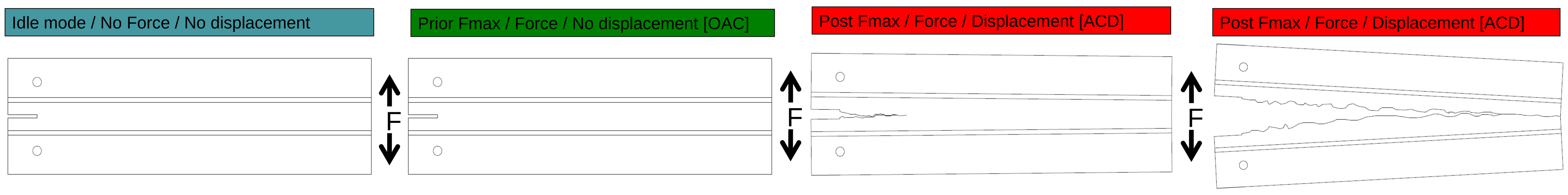
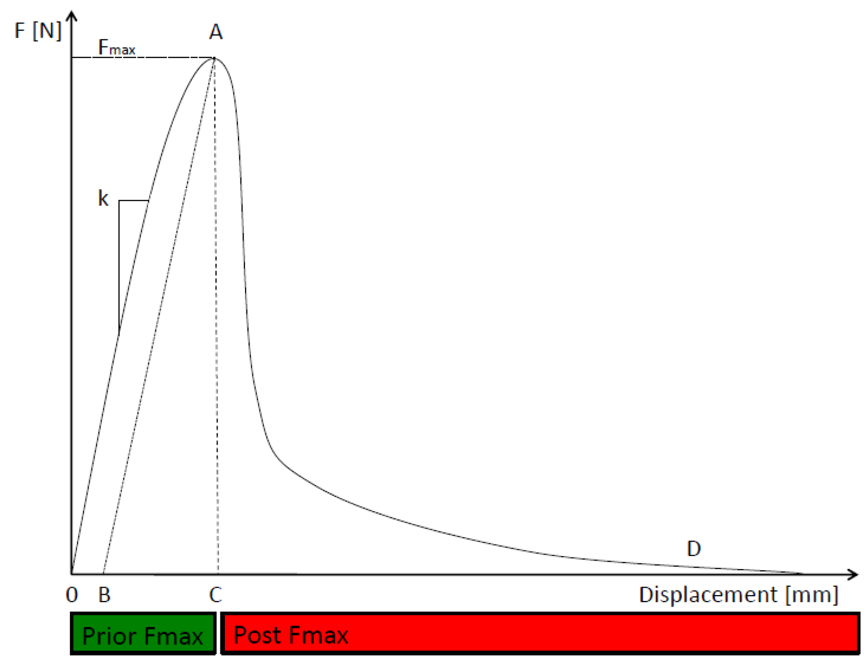
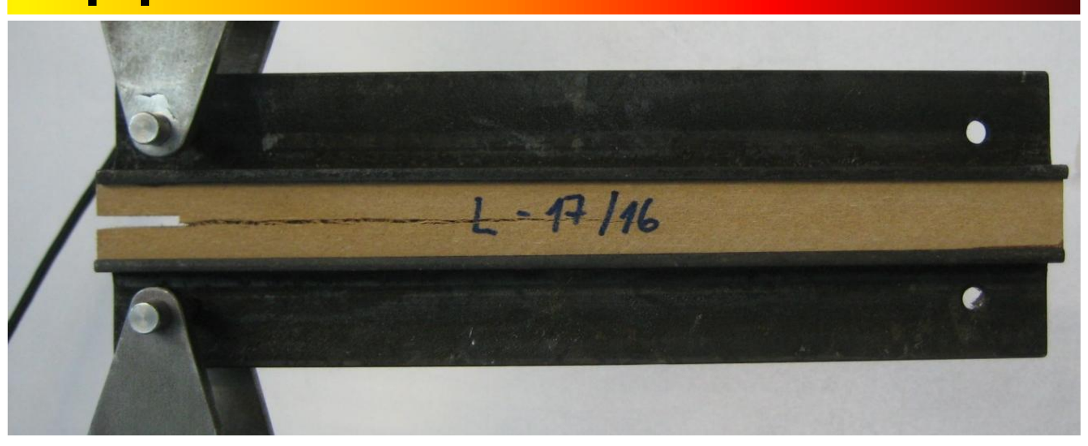
Background

A major characteristic of wood based panels and construction materials is the resistance against fracture. Assuming that wood based materials contain propagable fracture structures, mainly the adhesive bond strength dictates the fracture behaviour. On the other hand the density of the board, adhesive content and particle size and geometry determine the bond area between the particles. Due to the low density the weakest area of fracture resistance can be found in the core layer. The new developed fracture resistance testing method is optimized to observe effects of the particles, adhesive content and density on bonding strength of the board.





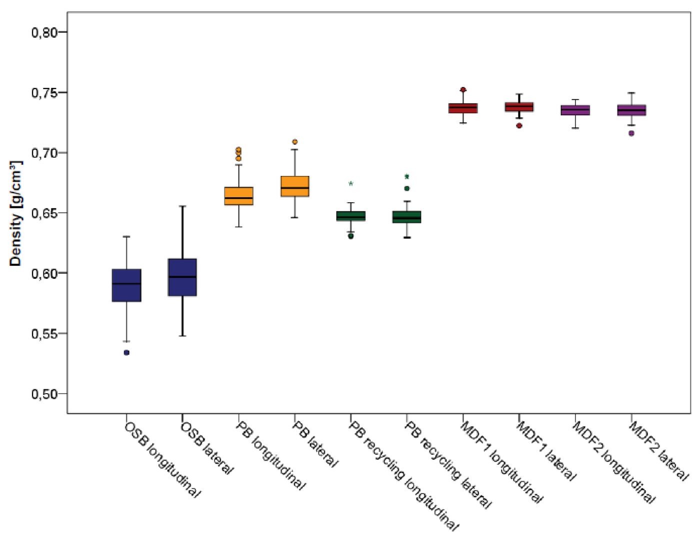
Approach

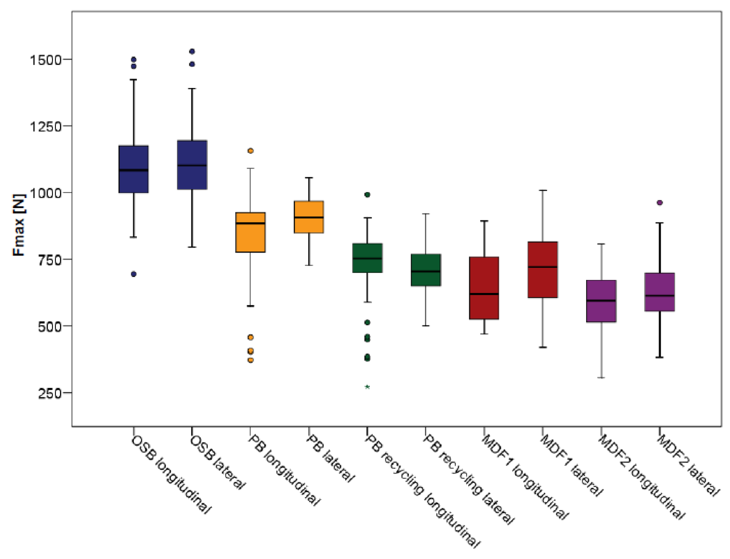


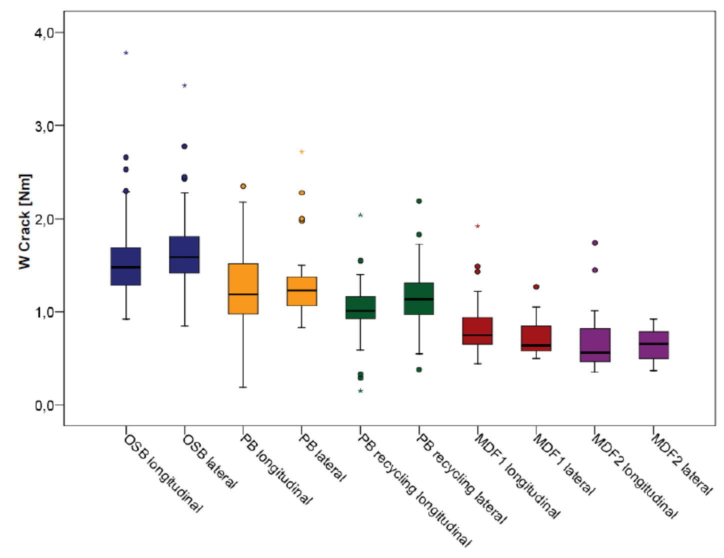
In total 660 fracture energy test samples, i.e. OSB, particleboard, particleboard recycling and MDF with two subtypes, were tested. Each group is divided in two subgroups with first axial orientation and second transverse orientation. All boards showed a nominal thickness of 19 mm. Rectangular specimen of 25 mm width and 250 mm length were cut off the boards gaining 100 to 200 specimens for each group. In order to initiate the crack within the core layer, specimen were cut in the core layer to a depth of 20 mm. The samples were glued with a rapidly curing cyanoacrylate adhesive between two stiff, metallic T-beam braces which guarantee the force application mainly into the core layer. Fracture tests were performed on a Zwick/Roell Z100 universal testing machine equipped with a 2.5 kN load cell. The cross head speed was 1 mm/min until the remaining force dropped to one third of the maximum. These settings guarantee fracture within 60 ± 30 sec similar as for the internal bond test. By implication, cross head speed increases progressively up to 10 mm/min and the test ends with a remaining force of 5 N or after a maximum displacement of 50 mm. For the evaluation of the force – displacement curve maximum and minimum values are measured, while the fracture energy is calculated by integrals using the area under the curve.

Density/Fmax/W[crack]

- Inverse correlation between density and F_{max}
- Coherence of F_{max} and W [crack]
- Link between F_{max} and W [crack] with particle size and degree of resination





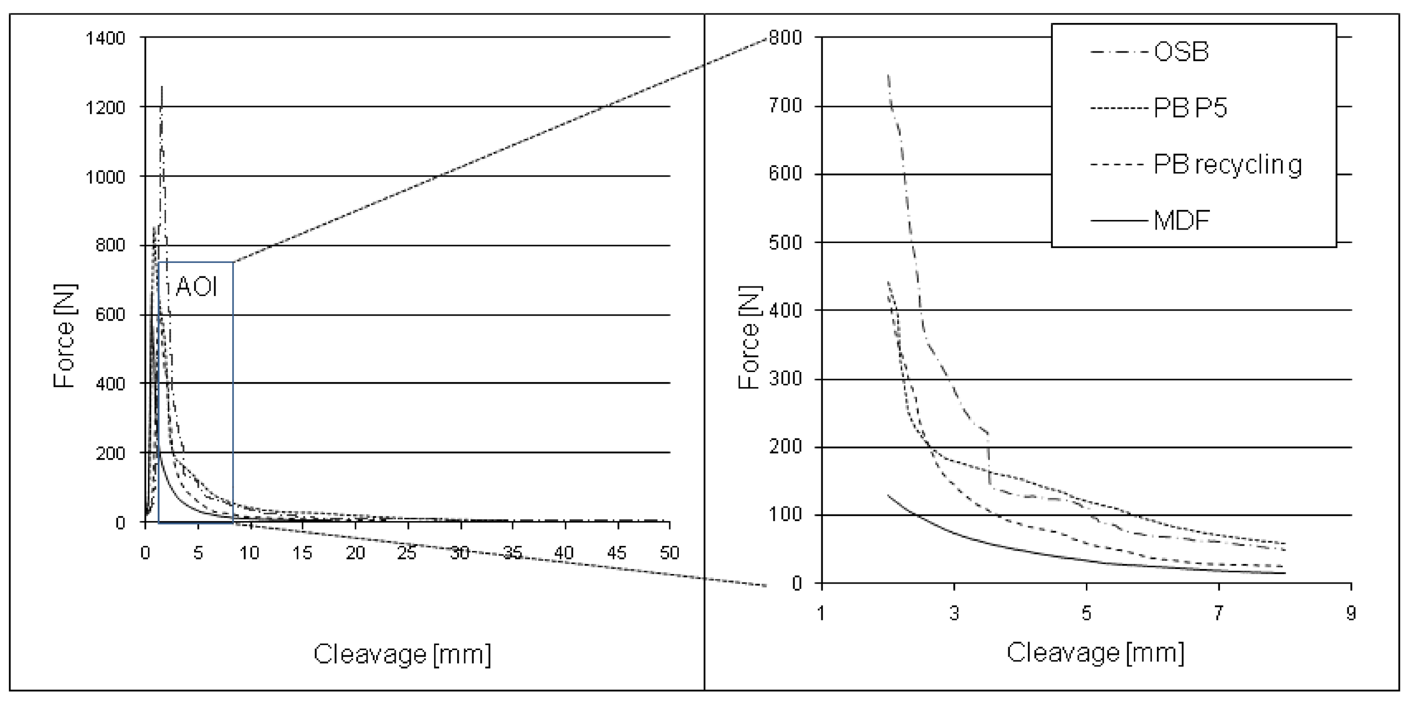


Visual Curve Analysis

- Characteristic force-displacement curves for each board type are shown on the right
- Maximum load for OSB at 1263 N, PB P5 at 850 N, PB recycling at 628 N and MDF at 604 N
- Post Fmax Area of the force-displacement curve is strongly influenced by particle geometry
- With the force drop after the maximum load the curve follows a more or less asymptotic progression

- OSB curve shows an irregular pattern with several abrupt force drops due to the large particles
- MDF illustrates a very smooth curve and low energy absorption, which can be seen in the out fading zone
- PB P5 absorbs much more energy than PB recycling which can be attributed to the higher particle quality
- PB recycling shows in comparison to PB P5 more irregularities after Fmax due to particle geometry

From the fracture energy curves it is assumed that greater particles lead to irregularities and abrupt force drops in the coasting part of the curve, whereas the prior Fmax part of the curve is more attributed to the bond strength of the board.



CONCLUSION:

- easy handling & accurate process
- wide range of collected data
- sensitive to analysis of board characteristics

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