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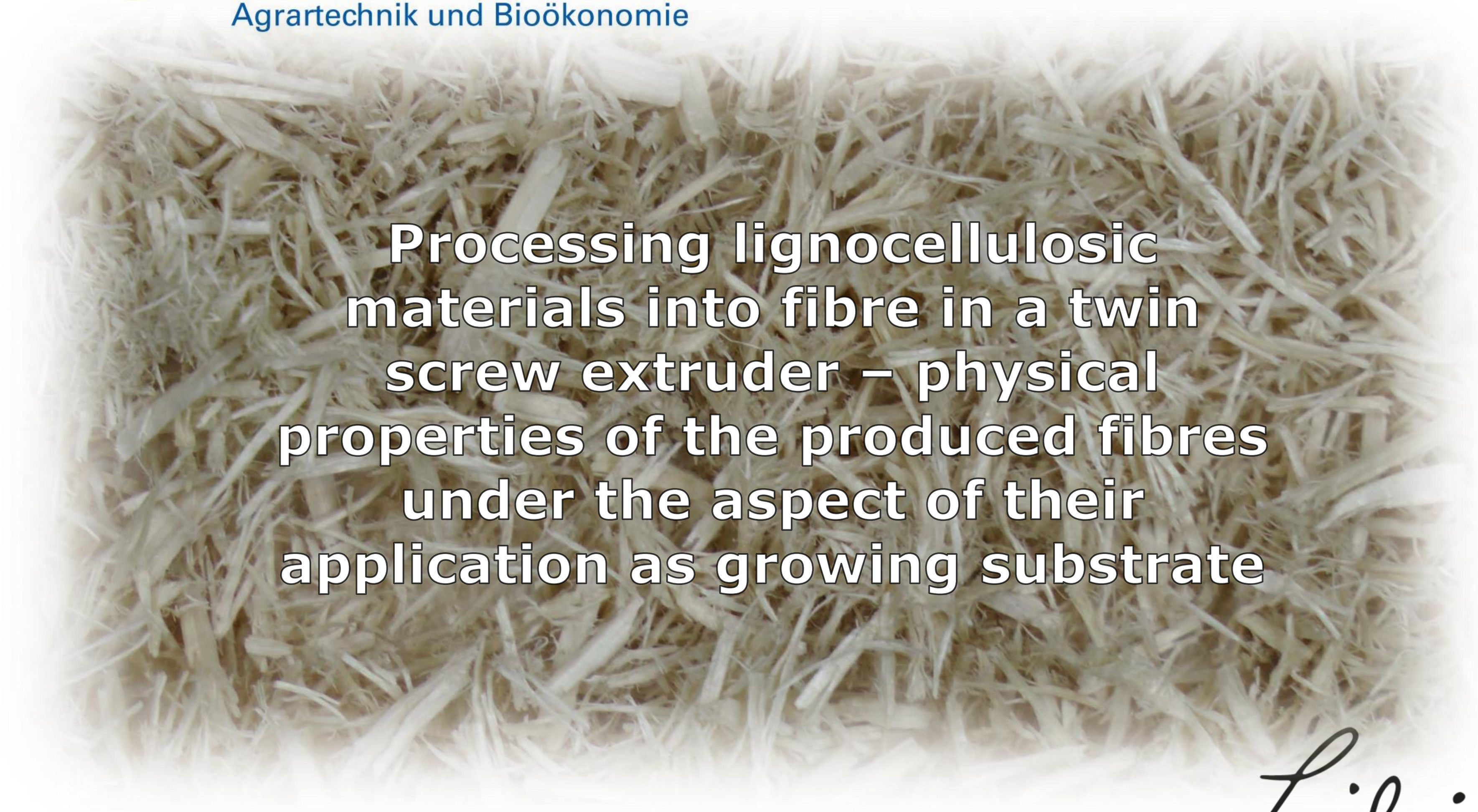
Leibniz-Institut für
Agrartechnik und Bioökonomie

ORGANIC PLUS



Processing lignocellulosic materials into fibre in a twin screw extruder – physical properties of the produced fibres under the aspect of their application as growing substrate

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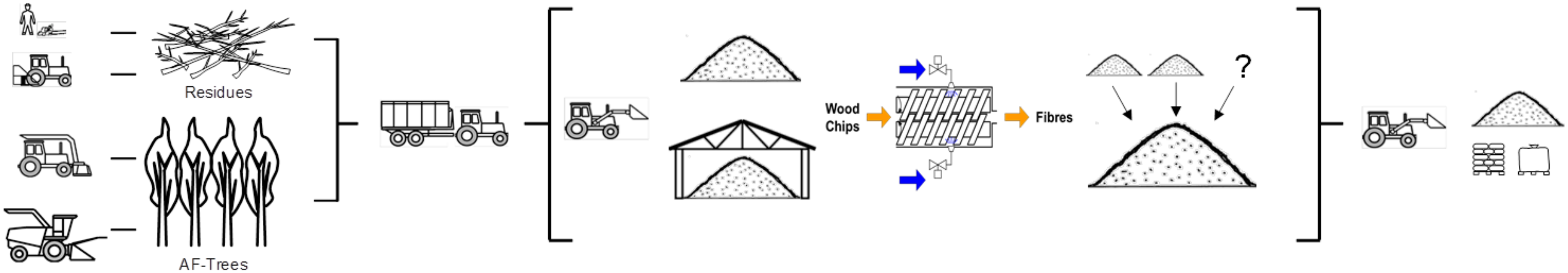
Leibniz Association

Process Chain

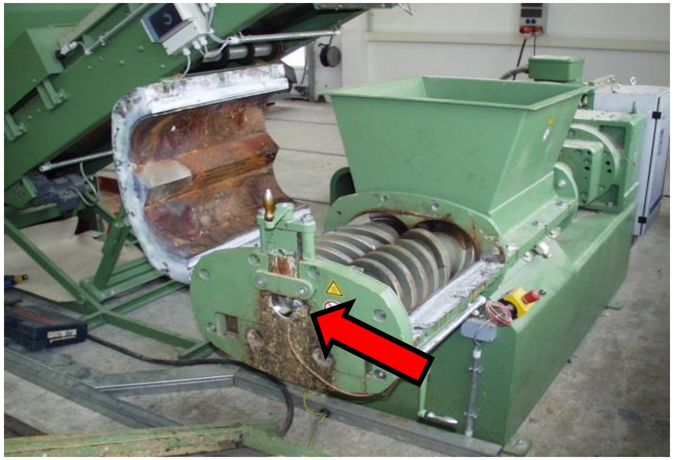


- Harvest of woodchips from short rotation coppice by mower chipper or modified forage harvester
- Residues from landscape management harvested manually, chipper fed manually
- Transport to storage location
- Drying of woodchips in big piles
  - Self heating due to microbiological activity
- Extruding
- Drying → storage

Twin-Screw-Extruder

Defibration of wood chips by:

- Pressure, shear and squeeze comminution
- Relaxation comminution due to steam explosion
- Temperature up to 120 °C
- Swelling of wood
- Partial release of wood ingredients (extracts and lignin)



Influence on fibre properties

- Aperture setting:
  - small aperture → more fines
- Water content of raw material:
  - high water content coarser fibre

Processing Lignocellulosic Material

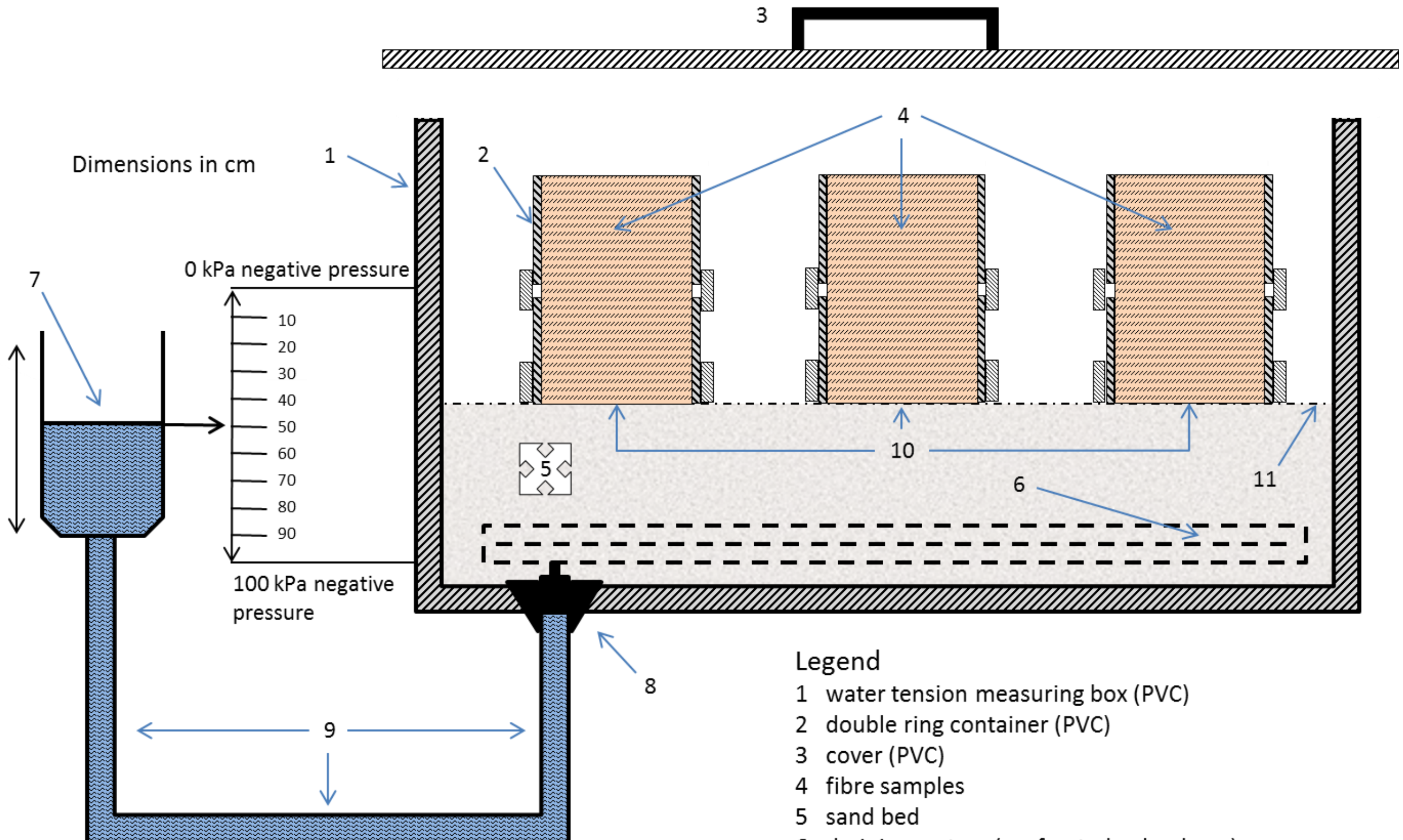
- Olive

- Poplar

Requirements of Fibre Quality

- High water holding capacity
- High air volume (even at full water saturation)
- Stable → porosity
- Chemically inert
- Free of microbiological contamination
- High focus on following materials due to high availability: ***Black Locust, Poplar, Sea Buckthorn, Hop, Grape Vine, Forest Biomass***
- With standard DIN EN 13041 Soil improvers and growing media, physical properties were determined

Experimental design water tension measuring box

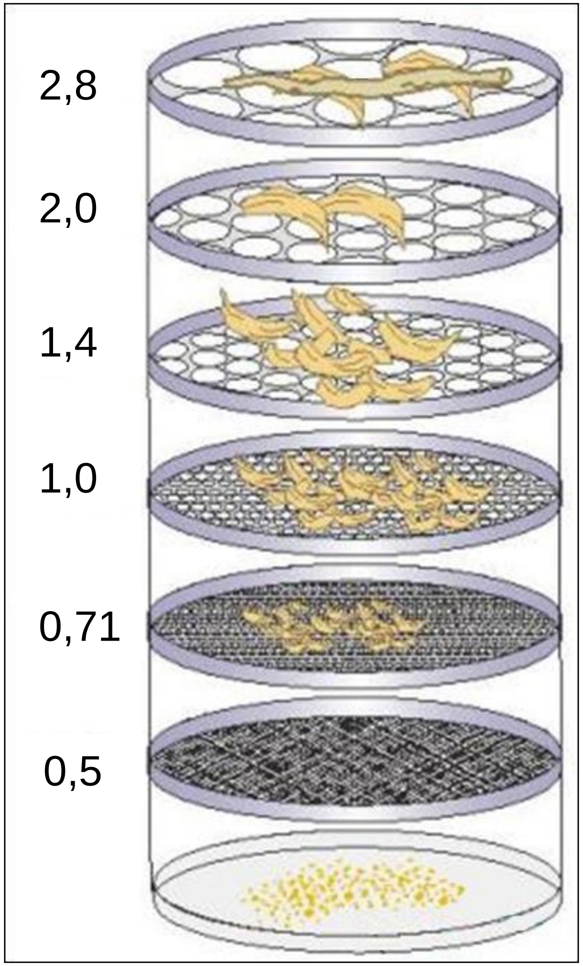


Legend
1 water tension measuring box (PVC)
2 double ring container (PVC)
3 cover (PVC)
4 fibre samples
5 sand bed
6 draining system (perforated nylon hose)
7 water tension regulator adjustable 10 -100 cm
8 outlet
9 flexible hose (nylon)
10 perforated fine fabric
11 synthetic filter paper

Standard DIN EN ISO 13041

Sieving Tower

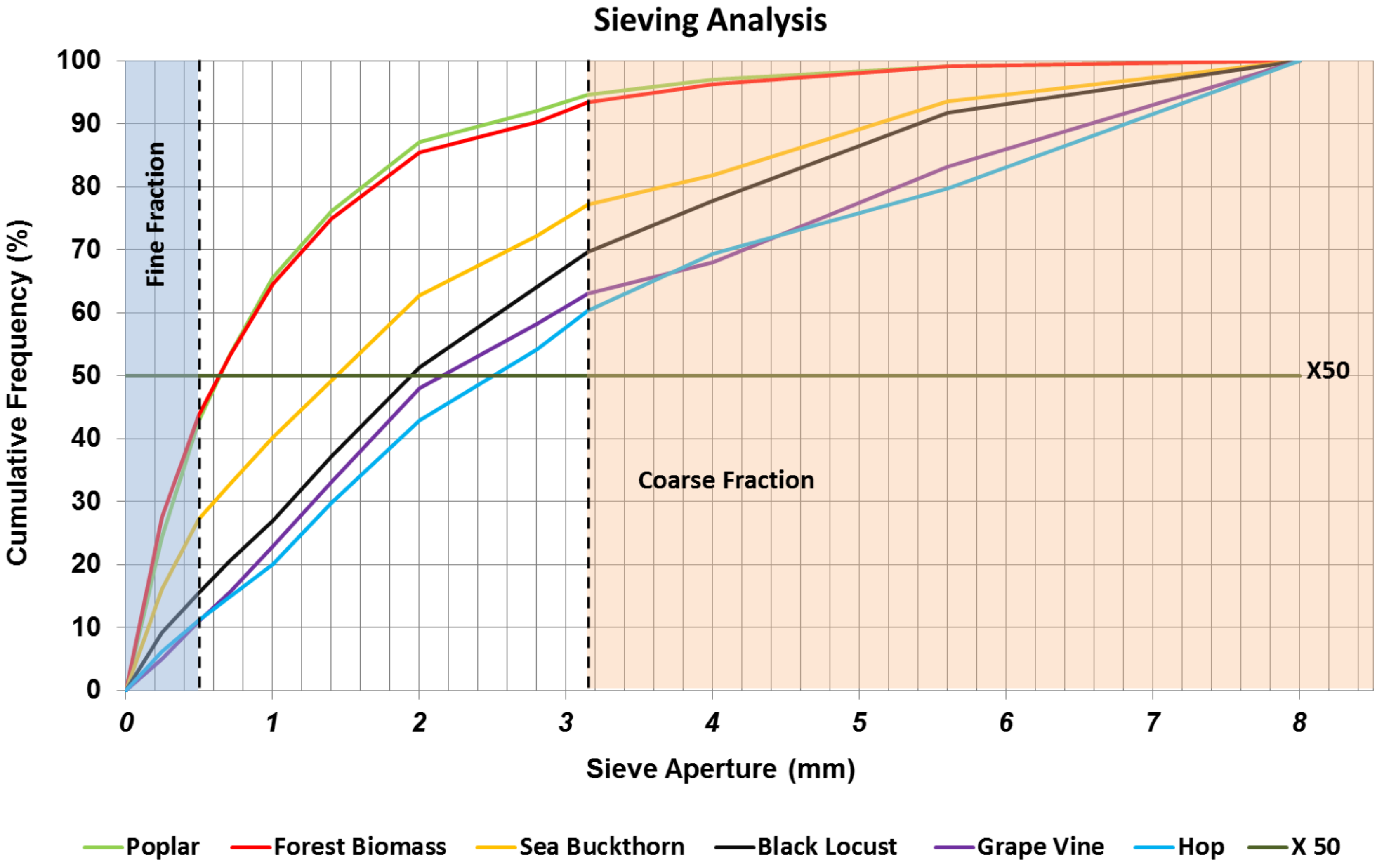
Coarse Fraction > 3,15 mm



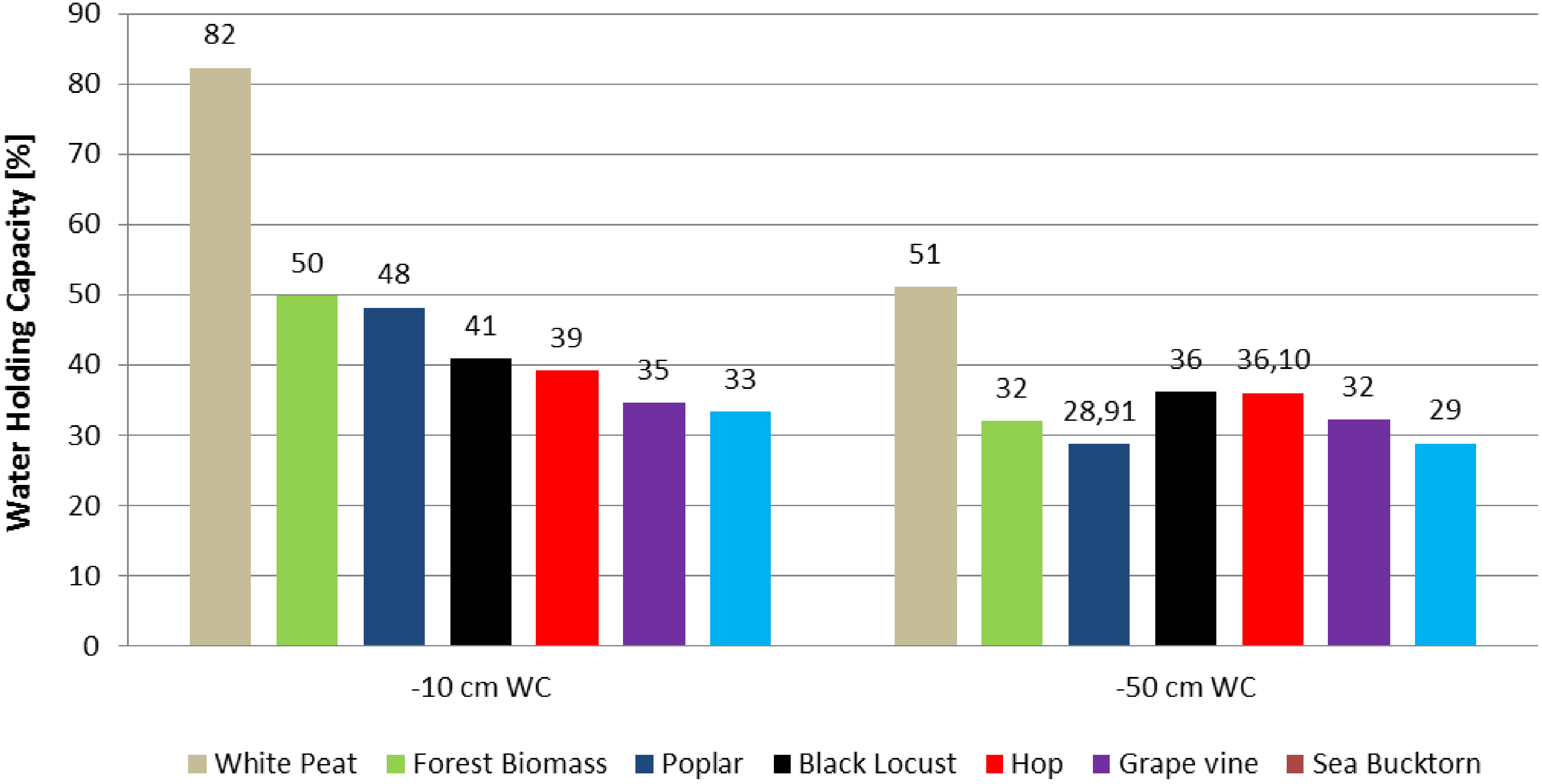
Fine Fraction < 0,5 mm

Source:https://www.seegen.at/uploads/media/Waldhackgutnorm_OENORM_C_4005.pdf

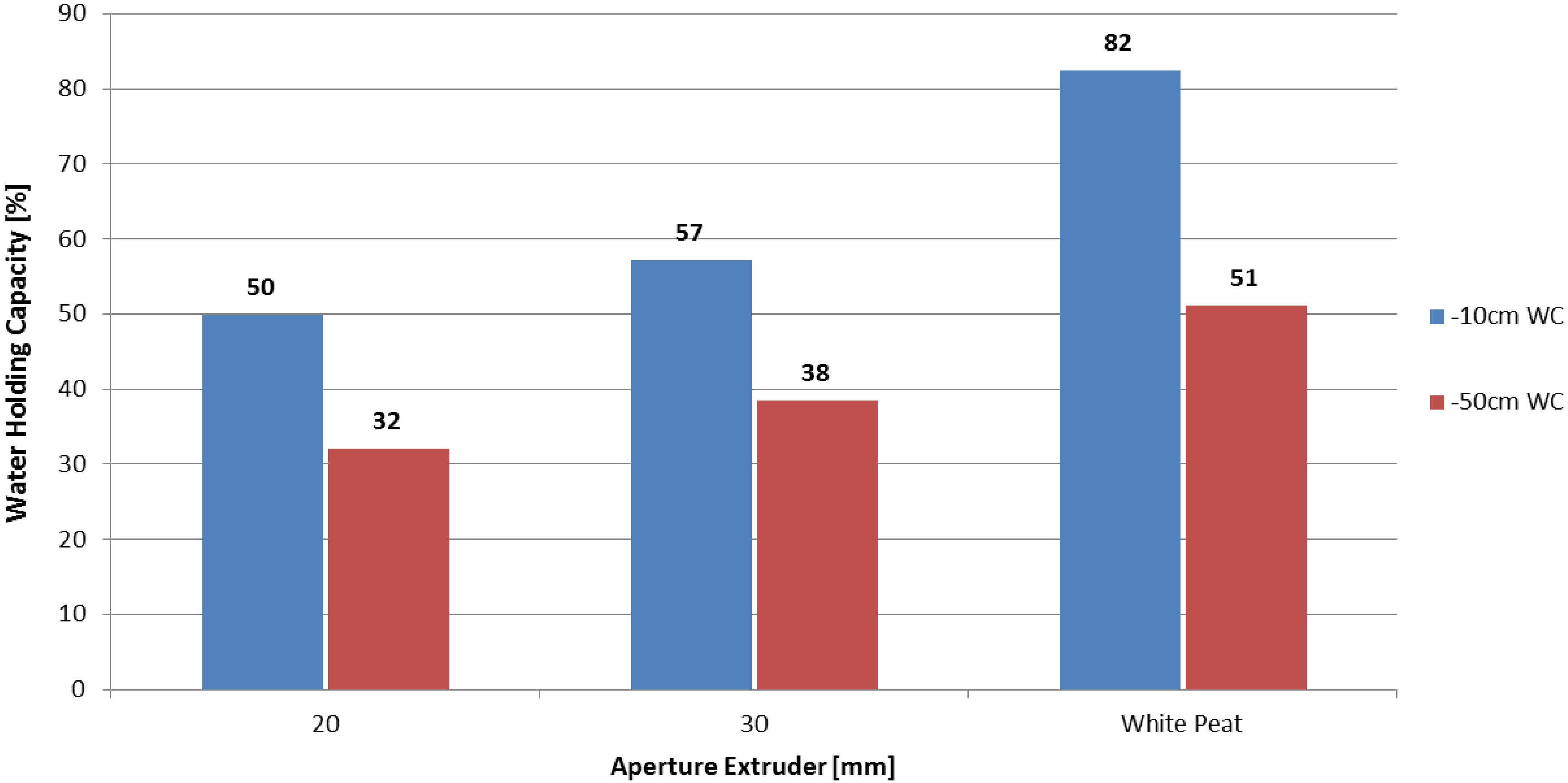
Particle-Size-Distribution at 20 mm Extruder Setting



Water Holding Capacity as a Funktion of Raw Material at 20 mm Apertue



Forest Biomass,
Water Holding Capacity as a Function of Aperture



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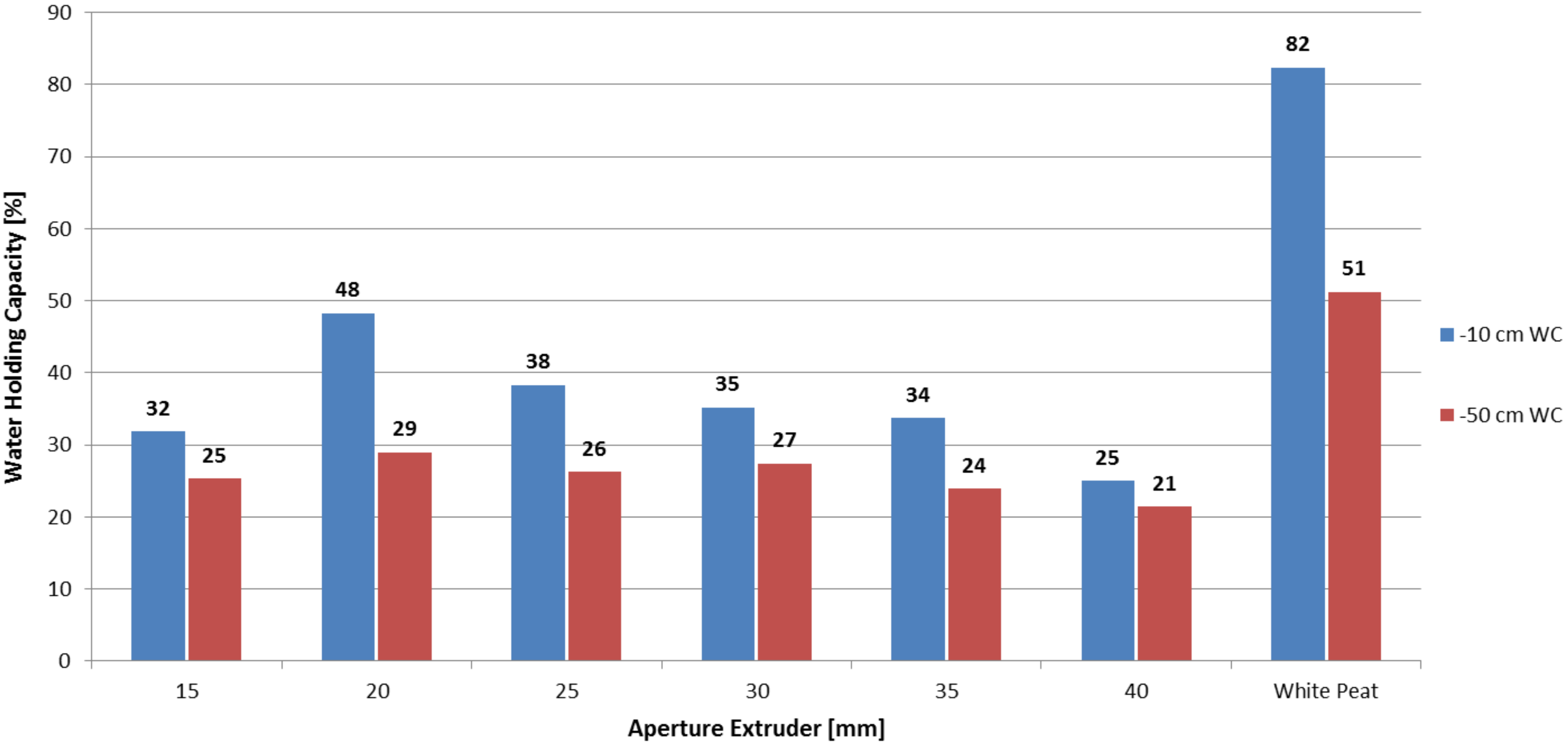
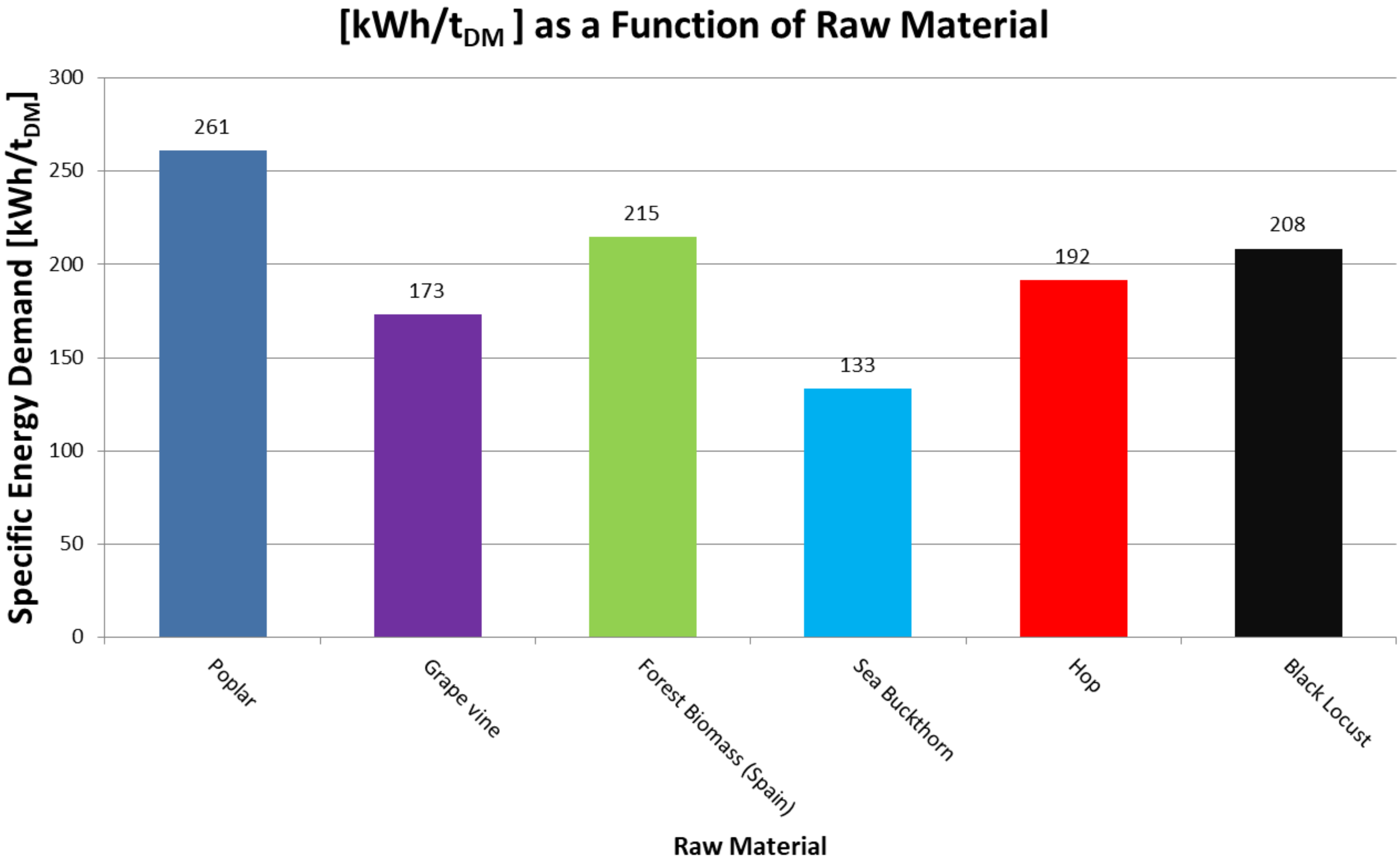
Poplar,
Water Holding Capacity as a Function of Aperture y achse ganze zahlen



Energy Consumption During Extrusion at 20 mm Aperture



Comparison of different extruded material

Material extruded at 20 mm Aperture	Fine fraction [%] (<0,5mm)	X 50	Coarse Fraction[%] (>3,15 mm)	Water holding capacity [%] at 10 cm Water column	Specific Energy Demand [kWh/t_{DM}]
Poplar	43	0,64	3	48	260
Forest Biomass	44	0,67	3,7	50	215
Grape Vine	11	2,15	32	35	173
Sea Buckthorn	27	1,43	18,2	34	134
White Peat	23	1,9	21,5	82	not extruded
Black locust	16	1,95	22,2	41	208
Hop	11	2,5	30,7	39	192

Conclusions

- High number of tentative tests
- Getting fibre with a specific quality is difficult
- Different settings of the extruder affect physical properties (Water Holding capacity, Particle size distribution etc...)
- Raw material and raw material water content have an influence on physical properties
- No fibre produced reaches the water holding capacity of peat
- Water holding capacity of all produced fibre is smaller than peat
- Distance between WHC-values within each fibre are all smaller than WHC-values within peat
- Promising fibre was sent to IRTA (Spain) for growing tests
- Statistical analysis in progress


Thank you for your attention