

Emil Engelund Thybring  
Associate Professor - Promotion Programme  
Forest and Bioresources  
**Postal address:**  
Rolighedsvej 23  
1958  
Frederiksberg C  
**Email:** eet@ign.ku.dk  
**Mobile:** +4561319776  
**Phone:** +4535334433  
**Web address:** <https://ign.ku.dk/forskning/skov-natur-biomasse/>



## Short presentation

My goal is to reveal the mechanisms behind observed physical performance of wood and biomaterials. Central to the performance is interactions with water in the material structure (i.e. cell walls). Therefore, my current primary focus is to expand and renew our knowledge about properties and effects of water inside cell walls as well as how chemical modification alter these.

## CV

### Education

2011: PhD, Technical University of Denmark  
2007: MSc in Civil Engineering, Technical University of Denmark

### Employment

2019- : Associate Professor, University of Copenhagen, Dept. Geosciences and Natural Resource Management  
2015-2019: Postdoc, University of Copenhagen, Dept. Geosciences and Natural Resource Management  
2013-2015: Postdoc, ETH Zürich, Dept. Building Materials and EMPA, Dept. Applied Wood Materials, Switzerland  
2013: Assistant Professor, Technical University of Denmark, Dept. Civil Engineering  
2011-2013: Consultant R&D, Danish Technological Institute  
2008-2011: Industrial PhD candidate, Danish Technological Institute

### Scientific memberships

2015- : Member of the *Marie Curie Alumni Association*  
2013-2015: Member of Management committee, COST Action FP1303 *Performance of biobased building materials*  
2010-2013: Member of Management committee, COST Action FP0904 *Thermo-hydro-mechanical wood behaviour and processing*  
2009-2012: Member of Working group, COST Action FP0802 *Experimental and computational micro-characterization techniques in wood mechanics*

### Leadership

2021- : Scientific reviewer of research applications for the European *Forest Value* programme, European Union, the *NWO Dutch Research Council*, Netherlands, and the *Czech Science Foundation GCAR*, Czech Republic  
2020- : Scientific reviewer of research applications for *Vinnova*, Sweden  
2019- : Scientific reviewer of research applications for the *National Science Centre*, Poland and the *Academy of Finland*  
2019: Guest editor of special issue of the journal *Forests*  
2017- : Member of the Editorial Board at the journal *Wood Materials Science and Engineering*  
2017- : National coordinator for Denmark in the *Northern European Network for Wood Science and Engineering*  
2017- : Co-chair of the National Support Group of Denmark, *Forest-based Sector Technology Platform*, EU

2017-2018: Guest editor of special issue of the journal *International Wood Products Journal*

2017: Main organiser of the conference *13<sup>th</sup> Annual Meeting of the Northern European Network for Wood Science and Engineering (WSE2017)* at the University of Copenhagen

2012- : Scientific reviewer for a range of ISI-journals incl. *Acta Biomaterialia*, *Cellulose*, *International Biodeterioration & Biodegradation*, *Journal of Materials Science*, *Polymer Degradation and Stability*, *Proceedings of the Royal Society A*, and other

2010-2011: Board member in the *Industrial PhD Association*

2007-2011: Board member and board secretary in the *Danish Society for Materials Testing and Research* under the Danish Society of Engineers (IDA)

## Scientific publications

Fredriksson, M, Digaitis, R, Engqvist, J & Thybring, EE 2024, 'Effect of targeted acetylation on wood–water interactions at high moisture states', *Cellulose*, vol. 31, pp. 869–885. <https://doi.org/10.1007/s10570-023-05678-8>

Thybring, EE & Fredriksson, M 2024, 'How accurate are automated sorption balances? An analysis of errors in wood moisture content from uncertainties in the conditioning environment', *Drying Technology*, vol. 42, no. 2, pp. 372-379. <https://doi.org/10.1080/07373937.2023.2294021>

Zelinka, SL, Glass, SV, Lazarcik, EQD, Thybring, EE, Altgen, M, Rautkari, L, Curling, S, Cao, J, Wang, Y, Künniger, T, Nyström, G, Dreimol, CH, Burgert, I, Uyup, MKA, Khadiran, T, Roper, MG, Broom, DP, Schwarzkopf, M, Yudhanto, A, Subah, M, Lubineau, G, Fredriksson, M, Strojecki, M, Olek, W, Majka, J, Pedersen, NB, Burnett, DJ, Garcia, AR, Verdonck, E, Dreisbach, F, Waguespack, L, Schott, J, Esteban, LG, Garcia-Iruela, A, Colinart, T, Rémond, R, Mazian, B, Perre, P, Emmerich, L & Li, L 2024, 'Interlaboratory study of the operational stability of automated sorption balances', *Adsorption*. <https://doi.org/10.1007/s10450-024-00472-9>

Ponzeccchi, A, Alfredsen, G, Fredriksson, M, Thybring, EE & Thygesen, LG 2024, 'Localization and characterisation of brown rot in two types of acetylated wood', *Cellulose*, vol. 31, pp. 1875–1890. <https://doi.org/10.1007/s10570-023-05680-0>

Fredriksson, M, Rüggeberg, M, Nord-Larsen, T, Beck, G & Thybring, EE 2023, 'Water sorption in wood cell walls—data exploration of the influential physicochemical characteristics', *Cellulose*, vol. 30, pp. 1857-1871. <https://doi.org/10.1007/s10570-022-04973-0>

Thybring, EE & Fredriksson, M 2023, Wood and Moisture. in P Niemi, A Teischinger & D Sandberg (eds), *Springer Handbook of Wood Science and Technology*. 1 edn, Springer, Cham, Springer Handbooks, pp. 355-397. [https://doi.org/10.1007/978-3-030-81315-4\\_7](https://doi.org/10.1007/978-3-030-81315-4_7)

De Ligne, LC, Van Acker, J, Baetens, JM, Omar, S, De Baets, B, Thygesen, LG, Van Den Bulcke, J & Thybring, EE 2022, 'Moisture dynamics of wood-based panels and wood fibre insulation materials', *Frontiers in Plant Science*, vol. 13, 951175. <https://doi.org/10.3389/fpls.2022.951175>

Thybring, EE, Thygesen, LG, Alfredsen, G & Fredriksson, M 2022, 'Editorial: Wood decomposition: Mechanisms and prevention strategies', *Frontiers in Plant Science*, vol. 13, 1081131. <https://doi.org/10.3389/fpls.2022.1081131>

Ponzeccchi, A, Thybring, EE, Digaitis, R, Fredriksson, M, Piqueras Solsona, S & Thygesen, LG 2022, 'Raman micro-spectroscopy of two types of acetylated Norway spruce wood at controlled relative humidity', *Frontiers in Plant Science*, vol. 13, 986578. <https://doi.org/10.3389/fpls.2022.986578>

Zelinka, SL, Altgen, M, Emmerich, L, Guigo, N, Keplinger, T, Kymäläinen, M, Thybring, EE & Thygesen, LG 2022, 'Review of Wood Modification and Wood Functionalization Technologies', *Forests*, vol. 13, no. 7, 1004. <https://doi.org/10.3390/f13071004>

- Thybring, EE, Fredriksson, M, Zelinka, SL & Glass, SV 2022, 'Water in Wood: A Review of Current Understanding and Knowledge Gaps', *Forests*, vol. 13, no. 12, 2051. <https://doi.org/10.3390/f13122051>
- Thybring, EE, Boardman, CR, Zelinka, SL & Glass, SV 2021, 'Common sorption isotherm models are not physically valid for water in wood', *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, vol. 627, 127214. <https://doi.org/10.1016/j.colsurfa.2021.127214>
- Kim, I, Thybring, EE, Karlsson, O, Jones, D, Mantanis, GI & Sandberg, D 2021, 'Characterisation of moisture in Scots pine (*Pinus sylvestris* L.) sapwood modified with maleic anhydride and sodium hypophosphite', *Forests*, vol. 12, no. 10, 1333. <https://doi.org/10.3390/f12101333>
- Digaitis, R, Thybring, EE, Thygesen, LG & Fredriksson, M 2021, 'Targeted acetylation of wood: a tool for tuning wood-water interactions', *Cellulose*, vol. 28, no. 12, pp. 8009-8025. <https://doi.org/10.1007/s10570-021-04033-z>
- Gundersen, P, Thybring, EE, Nord-Larsen, T, Vesterdal, L, Nadelhoffer, KJ & Johannsen, VK 2021, 'Old-growth forest carbon sinks overestimated', *Nature*, vol. 591, no. 7851, pp. E21-E23. <https://doi.org/10.1038/s41586-021-03266-z>
- Thybring, EE & Fredriksson, M 2021, 'Wood modification as a tool to understand moisture in wood', *Forests*, vol. 12, no. 3, 372. <https://doi.org/10.3390/f12030372>
- Digaitis, R, Thybring, EE & Thygesen, LG 2021, 'Investigating the role of mechanics in lignocellulosic biomass degradation during hydrolysis: Part II', *Biotechnology Progress*, vol. 37, no. 1, e3083. <https://doi.org/10.1002/btpr.3083>
- Fredriksson, M, Thybring, EE & Zelinka, SL 2021, 'Artifacts in electrical measurements on wood caused by non-uniform moisture distributions', *Holzforschung*, vol. 75, no. 6, pp. 517-525. <https://doi.org/10.1515/hf-2020-0138>
- Glass, SV, Zelinka, SL & Thybring, EE 2021, 'Exponential decay analysis: a flexible, robust, data-driven methodology for analyzing sorption kinetic data', *Cellulose*, vol. 28, pp. 153-174. <https://doi.org/10.1007/s10570-020-03552-5>
- Zelinka, SL, Houtman, CJ, Hirth, K, Lacher, S, Lorenz, L, Thybring, EE & Hunt, CG 2020, 'The Effect of Acetylation on Iron Uptake and Diffusion in Water Saturated Wood Cell Walls and Implications for Decay', *Forests*, vol. 11, no. 10, 1121. <https://doi.org/10.3390/f11101121>
- Yang, T, Thybring, EE, Fredriksson, M, Ma, E, Cao, J, Digaitis, R & Thygesen, LG 2020, 'Effects of changes in biopolymer composition on moisture in acetylated wood', *Forests*, vol. 11, no. 7, 719. <https://doi.org/10.3390/f11070719>
- Zelinka, SL, Glass, SV & Thybring, EE 2020, 'Evaluation of previous measurements of water vapor sorption in wood at multiple temperatures', *Wood Science and Technology*, vol. 54, no. 4, pp. 769-786. <https://doi.org/10.1007/s00226-020-01195-0>
- Thybring, EE, Digaitis, R, Nord-Larsen, T, Beck, G & Fredriksson, M 2020, 'How much water can wood cell walls hold? A triangulation approach to determine the maximum cell wall moisture content', *PLoS ONE*, vol. 15, no. 8, e0238319. <https://doi.org/10.1371/journal.pone.0238319>
- Thybring, EE, Piqueras, S, Tarmian, A & Burgert, I 2020, 'Water accessibility to hydroxyls confined in solid wood cell walls', *Cellulose*, vol. 27, pp. 5617-5627. <https://doi.org/10.1007/s10570-020-03182-x>
- Fredriksson, M & Thybring, EE 2019, 'On sorption hysteresis in wood: Separating hysteresis in cell wall water and capillary water in the full moisture range', *PLOS ONE*, vol. 14, no. 11, e0225111. <https://doi.org/10.1371/journal.pone.0225111>

Thybring, EE, Glass, SV & Zelinka, SL 2019, 'Kinetics of Water Vapor Sorption in Wood Cell Walls: State of the Art and Research Needs', *Forests*, vol. 10, no. 8, 704. <https://doi.org/10.3390/f10080704>

Digaitis, R, Thybring, EE & Thygesen, LG 2019, 'Investigating the role of mechanics in lignocellulosic biomass degradation during hydrolysis', *Biotechnology Progress*, vol. 35, no. 2, e2754. <https://doi.org/10.1002/btpr.2754>

Thybring, EE, Boardman, CR, Glass, SV & Zelinka, SL 2019, 'The parallel exponential kinetics model is unfit to characterize moisture sorption kinetics in cellulosic materials', *Cellulose*, vol. 26, no. 2, pp. 723-735. <https://doi.org/10.1007/s10570-018-2134-3>

Beck, G, Thybring, EE & Thygesen, LG 2018, 'Brown-rot fungal degradation and de-acetylation of acetylated wood', *International Biodeterioration and Biodegradation*, vol. 135, pp. 62-70. <https://doi.org/10.1016/j.ibiod.2018.09.009>

Fredriksson, M & Thybring, EE 2018, 'Scanning or desorption isotherms? Characterising sorption hysteresis of wood', *Cellulose*, vol. 25, no. 8, pp. 4477-4485. <https://doi.org/10.1007/s10570-018-1898-9>

Zelinka, SL, Bourne, KJ, Glass, SV, Boardman, CR, Lorenz, L & Thybring, EE 2018, 'Apparatus for gravimetric measurement of moisture sorption isotherms for 1-100 g samples in parallel', *Wood and Fiber Science*, vol. 50, no. 3, pp. 244-253. <<https://wfs.swst.org/index.php/wfs/article/view/2691>>

Beck, G, Thybring, EE, Thygesen, LG & Hill, C 2018, 'Characterization of moisture in acetylated and propionylated radiata pine using low-field nuclear magnetic resonance (LFNMR) relaxometry', *Holzforschung*, vol. 72, no. 3, pp. 225-233. <https://doi.org/10.1515/hf-2017-0072>

Thybring, EE, Kymäläinen, M & Rautkari, L 2018, 'Experimental techniques for characterising water in wood covering the range from dry to fully water-saturated', *Wood Science and Technology*, vol. 52, no. 2, pp. 297-329. <https://doi.org/10.1007/s00226-017-0977-7>

Thybring, EE, Kymäläinen, M & Rautkari, L 2018, 'Moisture in modified wood and its relevance for fungal decay', *iForest*, vol. 11, pp. 418-422. <https://doi.org/10.3832/ifor2406-011>

Zelinka, SL, Glass, SV & Thybring, EE 2018, 'Myth versus reality: Do parabolic sorption isotherm models reflect actual wood-water thermodynamics?', *Wood Science and Technology*, vol. 52, no. 6, pp. 1701-1706. <https://doi.org/10.1007/s00226-018-1035-9>

Glass, SV, Boardman, CR, Thybring, EE & Zelinka, SL 2018, 'Quantifying and reducing errors in equilibrium moisture content measurements with dynamic vapor sorption (DVS) experiments', *Wood Science and Technology*, vol. 52, no. 4, pp. 909-927. <https://doi.org/10.1007/s00226-018-1007-0>

Tarmian, A, Burgert, I & Thybring, EE 2017, 'Hydroxyl accessibility in wood by deuterium exchange and ATR-FTIR spectroscopy: methodological uncertainties', *Wood Science and Technology*, vol. 51, no. 4, pp. 845-853. <https://doi.org/10.1007/s00226-017-0922-9>

Thybring, EE, Thygesen, LG & Burgert, I 2017, 'Hydroxyl accessibility in wood cell walls as affected by drying and re-wetting procedures', *Cellulose*, vol. 24, no. 6, pp. 2375-2384. <https://doi.org/10.1007/s10570-017-1278-x>

Digaitis, R, Thybring, EE, Kunniger, T & Thygesen, LG 2017, 'Synergistic effects of enzymatic decomposition and mechanical stress in wood degradation', *Wood Science and Technology*, vol. 51, no. 5, pp. 1067-1080. <https://doi.org/10.1007/s00226-017-0939-0>

Thybring, EE 2017, 'Water relations in untreated and modified wood under brown-rot and white-rot decay', *International Biodeterioration & Biodegradation*, vol. 118, pp. 134-142. <https://doi.org/10.1016/j.ibiod.2017.01.034>

Zelinka, SL, Ringman, R, Pilgard, A, Thybring, EE, Jakes, JE & Richter, K 2016, 'The role of chemical transport in the brown-rot decay resistance of modified wood', *International Wood Products Journal*, vol. 7, no. 2, pp. 66-70. <https://doi.org/10.1080/20426445.2016.1161867>

Thybring, EE 2014, 'Explaining the heat capacity of wood constituents by molecular vibrations', *Journal of Materials Science*, vol. 49, no. 3, pp. 1317-1327. <https://doi.org/10.1007/s10853-013-7815-6>

Thygesen, LG, Thybring, EE, Johansen, KS & Felby, C 2014, 'The Mechanisms of Plant Cell Wall Deconstruction during Enzymatic Hydrolysis', *PLoS One*, vol. 9, no. 9, pp. 1-4. <https://doi.org/10.1371/journal.pone.0108313>

Thybring, EE 2013, 'The decay resistance of modified wood influenced by moisture exclusion and swelling reduction', *International Biodeterioration and Biodegradation*, vol. 82, pp. 87-95. <https://doi.org/10.1016/j.ibiod.2013.02.004>

Engelund, ET, Thygesen, LG, Svensson, S & Hill, CAS 2013, 'A critical discussion of the physics of wood-water interactions', *Wood Science and Technology*, vol. 47, no. 1, pp. 141-161. <https://doi.org/10.1007/s00226-012-0514-7>

Engelund, ET & Salmén, L 2012, 'Tensile creep and recovery of Norway spruce influenced by temperature and moisture', *Holzforschung*, vol. 66, no. 8, pp. 959-965. <https://doi.org/10.1515/hf-2011-0172>

Hoffmeyer, P, Engelund, ET & Thygesen, LG 2011, 'Equilibrium moisture content (EMC) in Norway spruce during the first and second desorptions', *Holzforschung*, vol. 65, no. 6, pp. 875-882. <https://doi.org/10.1515/HF.2011.112>

Engelund, ET & Svensson, S 2011, 'Modelling time-dependent mechanical behaviour of softwood using deformation kinetics', *Holzforschung*, vol. 65, no. 2, pp. 231-237. <https://doi.org/10.1515/hf.2011.011>

Thygesen, LG, Engelund, ET & Hoffmeyer, P 2010, 'Water sorption in wood and modified wood at high values of relative humidity. Part I: Results for untreated, acetylated, and furfurylated Norway spruce', *Holzforschung*, vol. 64, pp. 315-323. <https://doi.org/10.1515/hf.2010.044>

Engelund, ET, Thygesen, LG & Hoffmeyer, P 2010, 'Water sorption in wood and modified wood at high values of relative humidity. Part 2: Appendix. Theoretical assessment of the amount of capillary water in wood microvoids', *Holzforschung*, vol. 64, no. 3, pp. 325-330. <https://doi.org/10.1515/hf.2010.061>