



FEDERAL UNIVERSITY OF ESPÍRITO SANTO
CENTER FOR AGRARIAN SCIENCES AND ENGINEERING
GRADUATE PROGRAM IN FOREST SCIENCES
Degrees: Master's and Doctorate



TEACHING PLAN

1) SUBJECT IDENTIFICATION	
Subject	WOOD MODIFICATION: THERMAL AND OTHER PROCESSES
Code	PGCF-2551
Hours per semester	60 hours (Theoretical: 30 h / Practical: 30 h)
Credits:	3
Entry Requirement(s)	-----
Lecturer(s)	Prof. Djeison Cesar Batista, PhD.

2) CONTENTS	
Modifying the properties of wood; thermal modification of wood: processes and their variables; chemical changes; physical changes; biological properties of thermally modified wood; impact of thermal modification on other wood properties; other processes of wood modification.	

3) OBJECTIVES	
<ul style="list-style-type: none">• To teach the importance of wood modification.• To understand the effect of thermal modification on the main properties of wood.• To know other current industrial processes for wood modification.	

4) DETAILED CONTENTS	
DESCRIPTION	HOURS
The current use of wood and the need for its modification	6
Modifying the properties of wood	8
Thermal modification of wood: processes and variables	8
Chemistry of thermally modified wood	8
Physical properties of thermally modified wood	8
Biological properties of thermally modified wood	8
Other properties and performance of thermally modified wood	6
Other processes of wood modification	8

5) METHODOLOGY	
----------------	--

- Synchronous online activities using appropriate tools such as Google Meet. Asynchronous activities using digital tools such as email and Google Classroom.
- Students will be instructed to study specific material from the recommended bibliography. Then there will be face-to-face or online meetings for the lecturer to present the same content, with the main focus on resolving doubts regarding the material previously studied.
- Practical classes will be held in the department's laboratories, according to the available infrastructure and UFES' liberation (pandemic status). The experiments performed will be in accordance with the content studied in each discipline.
- Students will be guided to read current scientific articles on the subject, which will also be discussed in class.

6) EVALUATION (subject to change in agreement with students)

TYPE	NUMBER	PERCENTAGE (%)
Tests	0	0
Exercises	1	25
Presentation of scientific articles (individual or group work)	2	50
Report of laboratory classes	1	25

7) BIBLIOGRAPHY

BASIC

HILL, C. **Wood modification**: chemical, thermal and other processes. West Sussex: John Wiley & Sons, 2006.

JONES, D.; SANDBERG, D.; GOLI, G.; TODARO, L. (Ed.). **Wood modification in Europe**: a state-of-the-art about processes, products, and applications. In: COST Action 1407. Proceedings... Florença, Itália: 123 p., 2019. <https://doi.org/10.36253/978-88-6453-970-6>

MILITZ, H.; ALTGEN, M. Process and properties of thermally modified wood manufactured in Europe. In: SCHULTZ, T. P.; GOODELL, B.; NICHOLAS, D.D. (Org.). **Deterioration and Protection of Sustainable Biomaterials**. Washington, D.C.: American Chemical Society, cap. 16, p. 269-285, 2014.

COMPLEMENTARY

- BATISTA, D.C. **Modificação térmica da madeira de *Eucalyptus grandis* em escala industrial pelo processo brasileiro VAPHolzSysteme®**. 339 f. Tese (Doutorado em Engenharia Florestal)–Universidade Federal do Paraná, Curitiba, 2012. Available at: < <https://acervodigital.ufpr.br/handle/1884/29709>>.
- ESTEVES, B. M.; PEREIRA, H. M. Wood modification by heat treatment: a review. **BioResources**, v. 1, n. 4, p. 370-404, 2009. <http://dx.doi.org/10.15376/biores.4.1.370-404>
- FINNISH THERMOWOOD ASSOCIATION. **ThermoWood® handbook**. Helsinki: Finnish ThermoWood Association, 2003. Available at: < https://asiakas.kotisivukone.com/files/en.thermowood.palvelee.fi/downloads/tw_handbook_080813.pdf>.
- GÉRARDIN, P. New alternatives for wood preservation based on thermal and chemical modification of wood – a review. **Annals of Forest Science**, v. 73, p. 559-570, 2016. <http://doi.org/10.1007/s13595-015-0531-4>
- JONES, D.; SANDBERG, D. A review of wood modification globally: updated findings from COST FP1407. **Interdisciplinary Perspectives on the Building Environment**, v.1, 2020. <https://doi.org/10.37947/ipbe.2020.vol1.1>
- ORMONDROYD, G.; SPEAR, M.; CURLING, S. Modified wood: review of efficacy and service life testing. **Proceedings of the Institution of Civil Engineers - Construction Materials**, v. CM4, p.187-203, 2015. <http://dx.doi.org/10.1680/coma.14.00072>
- RAPP, A. O. (Ed.). Review on heat treatments of wood. In: **COST Action E22**. Proceedings... Antibes, França: 68 p., 2001. Available at: < https://projects.bre.co.uk/ecotan/pdf/Heat_treatment_processes_Andreas_Rapp%20.pdf>.
- SANDBERG, D.; KUTNAR, A. Thermally modified timber: recent developments in Europe and North America. **Wood and Fiber Science**, n. 48 (2015 Convention of the SWST, Special Issue), p. 28-39, 2016. Available at: < <https://wfs.swst.org/index.php/wfs/article/view/2296>>.
- XIE, Y; LIU, Y; SUN, Y. Heat treated wood and its development. **Journal of Forestry Research**, Berlin, v. 13, n. 3, p. 224-230. 2002. <https://doi.org/10.1007/BF02871703>

Jerônimo Monteiro/ES, 20 de julho de 2021.



UNIVERSIDADE FEDERAL DO ESPÍRITO SANTO

PROTOCOLO DE ASSINATURA



O documento acima foi assinado digitalmente com senha eletrônica através do Protocolo Web, conforme Portaria UFES nº 1.269 de 30/08/2018, por
DJEISON CESAR BATISTA - SIAPE 1722127
Departamento de Ciências Florestais e da Madeira - DCFM/CCAE
Em 20/07/2021 às 08:43

Para verificar as assinaturas e visualizar o documento original acesse o link:
<https://api.lepisma.ufes.br/arquivos-assinados/231568?tipoArquivo=O>