Study of the physico-mechanical properties and the durability of thermally modified wood

NINANE Maxime[1], HEBERT Jacques[1] and JOUREZ Benoit[2]

1 Forest and Landscape Management, Gembloux Agro-Bio Tech, University of Liège, B-5030 Gembloux
2 Laboratory of Wood Technology, Department of Natural and Agricultural Environment Studies, Public Service of Wallonia, B-5030 Gembloux

1. Introduction

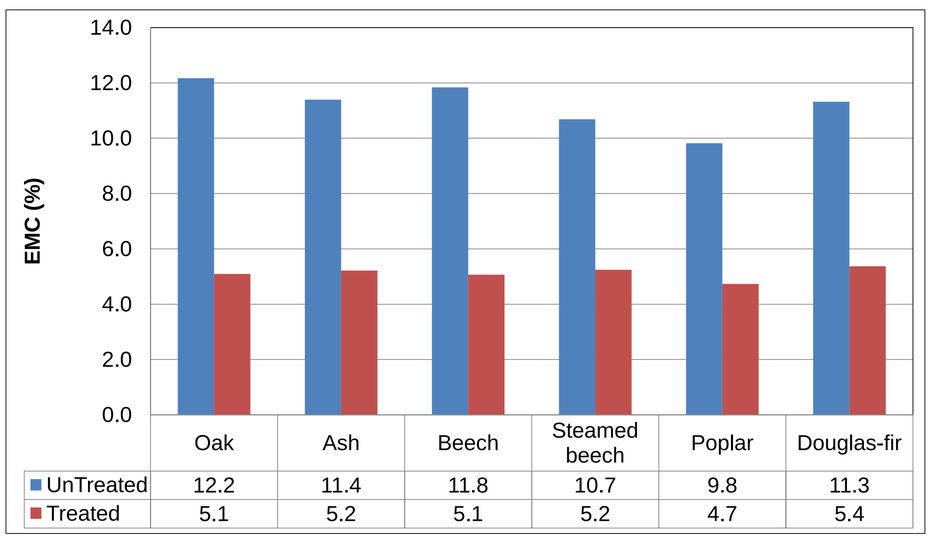
Wood is increasingly being used as building material appreciated both as a biological product as well as for its carbon fixation properties. However, many methods to preserve wood have negative environmental effects and the use of tropical timber may lead to overexploitation of forests and biodiversity loss. Thermal treatment, by hemicelluloses degradation, improves the biological durability and the dimensional stability of wood. This study aims to determine the changes in physico-mechanical properties and durability of thermally modified wood.

2. Methodology

We studied five species (oak, ash, natural beech and a variant known as steamed beech, poplar, douglas-fir). For each species, 15 treated and 15 un-treated associated samples were analized and compared.

3. Results

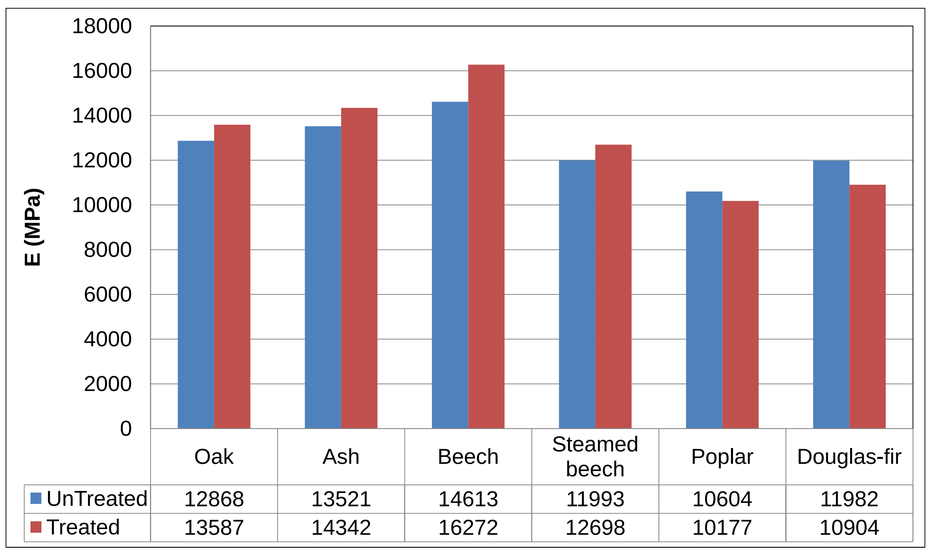
A. Physical properties



	Oak	Ash	Beech	Steamed beech	Poplar	Douglas-fir
UnTreated	12.2	11.4	11.8	10.7	9.8	11.3
Treated	5.1	5.2	5.1	5.2	4.7	5.4

Figure 1. Equilibrium Moisture Content (EMC) for each species with and without thermal treatment all conditioned in the same climate chamber at 65% RH and 25°C.

B. Mechanical properties

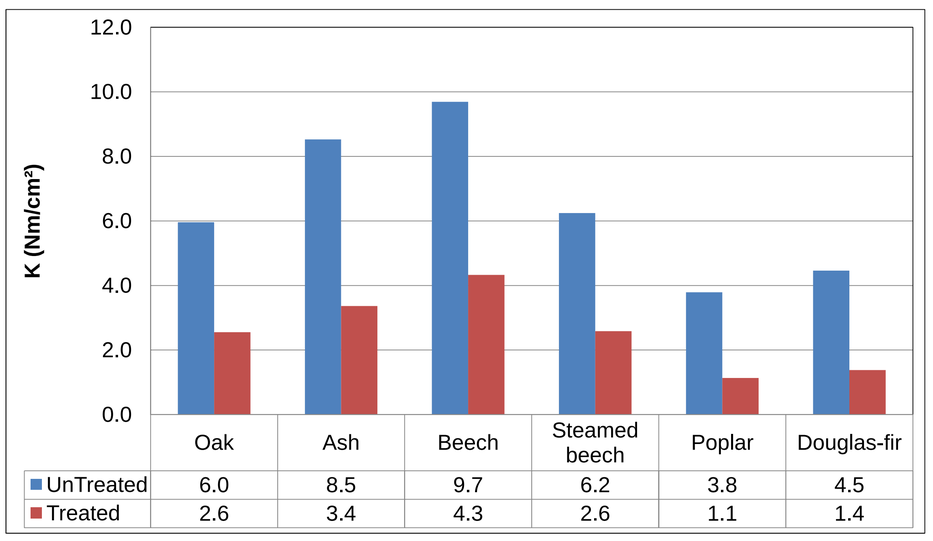


	Oak	Ash	Beech	Steamed beech	Poplar	Douglas-fir
UnTreated	12868	13521	14613	11993	10604	11982
Treated	13587	14342	16272	12698	10177	10904

Figure 2. Stiffness (E) for each species with and without thermal treatment.

	Oak	Ash	Beech	Steamed beech	Poplar	Douglas-fir
UnTreated	94	108	112	100	69	90
Treated	48	80	77	63	43	46

Figure 3. Static bending strenght (σ_f) for each species with and without thermal treatment.



	Oak	Ash	Beech	Steamed beech	Poplar	Douglas-fir
UnTreated	6.0	8.5	9.7	6.2	3.8	4.5
Treated	2.6	3.4	4.3	2.6	1.1	1.4

Figure 4. Impact Bending Strength (K) for each species with and without thermal treatment.

C. Durability

Species	Durability Class	
	UnTreated	Treated
Oak	3	1
Ash	5	1
Beech	5	3
Steamed beech	5	3
Poplar	5	4
Douglas-fir	4	3

Table 1. Durability class for each species with and without thermal treatment.

4. Conclusion

The results show a decrease in the hygroscopicity and an increase in dimensional stability of heat-treated wood in relation to the degradation of hemicelluloses. The durability of thermally modified wood against wood-destroying fungi increases. The mechanical properties are influenced variously; heat-treated wood is lightly stiffer for some species but above all more brittle.

Thermally treated wood is a credible alternative for some tropical timbers and for timbers treated with unwanted preservatives.