

SHRINKAGE OF BEECH (*Fagus sylvatica*) AND OAK (*Quercus robur*) VENEER SHEETS DURING THE DRYING PROCESS

Artur Castro¹, Constantino Mituca², Ofélia Anjos^{1,3}

¹Superior Agrarian School of Castelo Branco, Quinta da Senhora de Mércules, Apartado 119 – 6001
Castelo Branco – Portugal.

²S.C. Company – Lósan Romania SRL – Brasov Romania.

³Forestry study research center – Instituto Superior de Agronomia – 1300 Lisboa, Portugal

SUMMARY

In this paper we studied the retraction of veneer sheets of a diffuse-porous specie (beech) and a ring-porous specie (oak) during the drying process. For each specie we analysed radial and tangential sections, since the differences obtained relate to vessel distribution across the axial or non axial section. Thus, we studied the following parameters: thickness, moisture content, retraction of axial and non axial (radial or tangential) direction.

We used 10 beech logs, from which we took 30 samples with a radial cut and 30 samples with a tangential cut. From each log we took 6 veneer sheets. We applied the same procedure to the oak logs. All our veneer sheets were 0,6mm thick. Immediately after cutting, we measured the thickness, moisture content, length and width of each veneer sheet. We measured the same parameters again after the drying process.

The two species behaved differently, which we attribute to their distinct anatomical structure, even though both are hardwoods. Variance analyses showed that the species is the main responsible for the variation, and that beech has a higher shrinkage variation. Higher shrinkage results from the tangential cuts, compared to radial cuts

Key words: veneer sheets, oak, beech, shrinkage, drying

INTRODUCTION

The growth of our world's population has resulted in a rapid increase of wood use. In global terms, industrial use of wood is close to that of steel and cement, and is much greater than that of plastic (Haygreen Bowyer, 1996).

Among the range of uses that we can attribute to wood are: non industrial uses (e.g. fuel wood); industrial uses (e.g. pulp mills, particle and fibre boards); and construction (e.g. saw wood, veneer sheets and plywood).

The production of veneer sheets requires boles with very high quality geometric configuration, even grained, with no knots nor stains, etc. This is why, in order to maximize

resource use efficiency, the higher quality wood should be allocated to more demanding uses, such as plywood, furniture and carpentry (Pires, 2001).

Veneer sheets are industrial products made from solid wood, with a maximum thickness of 6 mm, which can be found in various colours, textures and patterns, depending on the wood used and the section that is cut (radial, tangential). They are frequently used to decorate surfaces, using the wood grain to create patterns. They can be applied over wood boards or, more frequently, a lower quality substrate such as particle boards, as long as these surfaces are clean and dry. Another common application is on car interiors, namely on doors and front panels (Chefneux *et al.*, 2000).

Our study aimed to assess the retraction of veneer sheets (in both axial and non axial directions) during the drying process. We studied two tree species: *Quercus robur* (English oak) and *Fagus sylvatica* (beech), chosen because they were the most commonly used by the company involved. For each species, we analysed two types of cuts: radial and tangential.

MATERIALS AND METHODS

We used 10 logs of beech, from which we took 30 samples with a radial cut and 30 samples with a tangential cut. From each log we took 6 veneer sheets, cut while moist. We applied the same procedure to the oak logs, so studied 120 samples in total. All our veneer sheets were 0,6mm thick. Immediately after cutting, we measured the thickness, moisture content, length and width of each veneer sheet. We seasoned them in a kiln dry using a high-temperature drying method, and then measured the same parameters again.

Figures 1 and 2 show the patterns of the oak and beech sheets, respectively, resulting from radial and tangential cuts.



Figure 1: English oak veneer sheets, in radial (a) and tangential cuts (b).

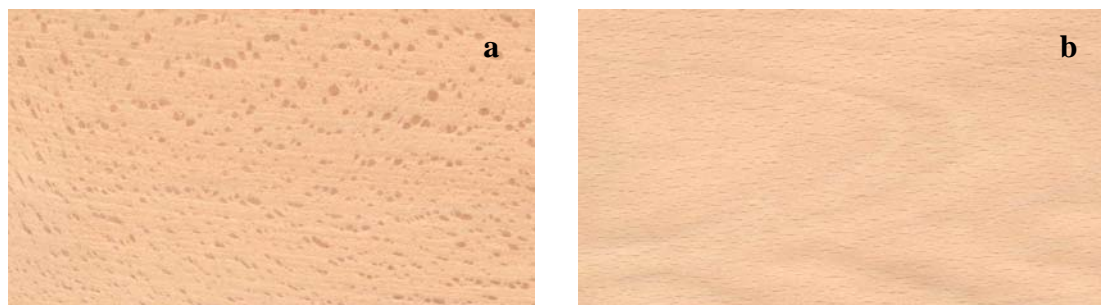


Figure 2: Beech veneer sheets, in radial (a) and tangential cuts (b).

For these two cuts, we measured variations in dimensions and shrinkage in both radial and tangential (non axial) directions. In both cases, axial or longitudinal shrinkage is a result of variation of the largest sheet dimension, i.e., its length. For sheets processed in a radial cut, the direction of radial shrinkage corresponds to the smallest sheet dimension, i.e., its width (Figure 3). For sheets resulting from tangential cuts, the direction of radial shrinkage corresponds to the smallest sheet dimension, i.e., its width (Figure 3).

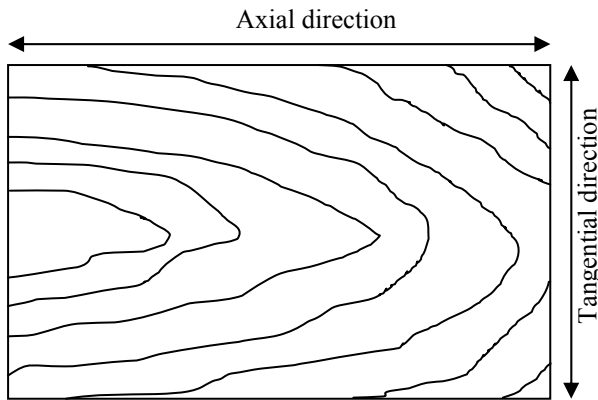


Figure 3: Shrinkage directions for a veneer sheet laminated by a radial cut

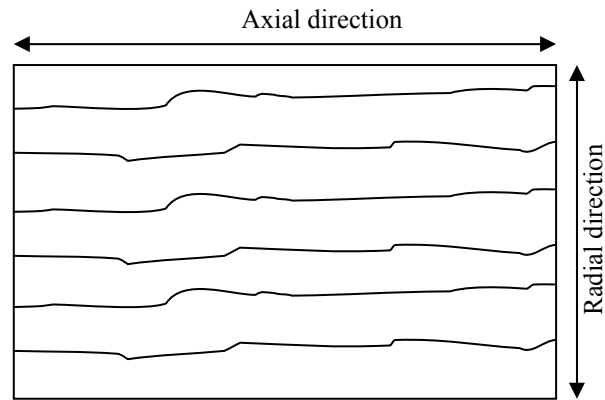


Figure 4: Shrinkage directions for a veneer sheet laminated by a tangential cut

RESULTS AND DISCUSSION

Beech sheets showed higher average variation of thickness compared with oak sheets, independently from the type of cut. The largest variation was found in tangentially cut beech sheets, followed by the radially cut sheets of the same species.

Axial shrinkage

Axial shrinkage was higher in beech than in oak sheets, independently from the type of cut. This is due to the fact that the first species contains more vessel elements, and so has higher water content. Besides, the percent moisture content at fibre saturation point is higher in beech (32-35%) than in oak (22-28%), so beech starts to retract first.

As to the type of cut, tangential cuts suffer more axial retraction than radial cuts, essentially due to the ring arrangement. When a piece of wood suffers a tangential cut it includes more vessel elements than if the cut is radial, and therefore has a higher water volume and thus retracts more when dried.

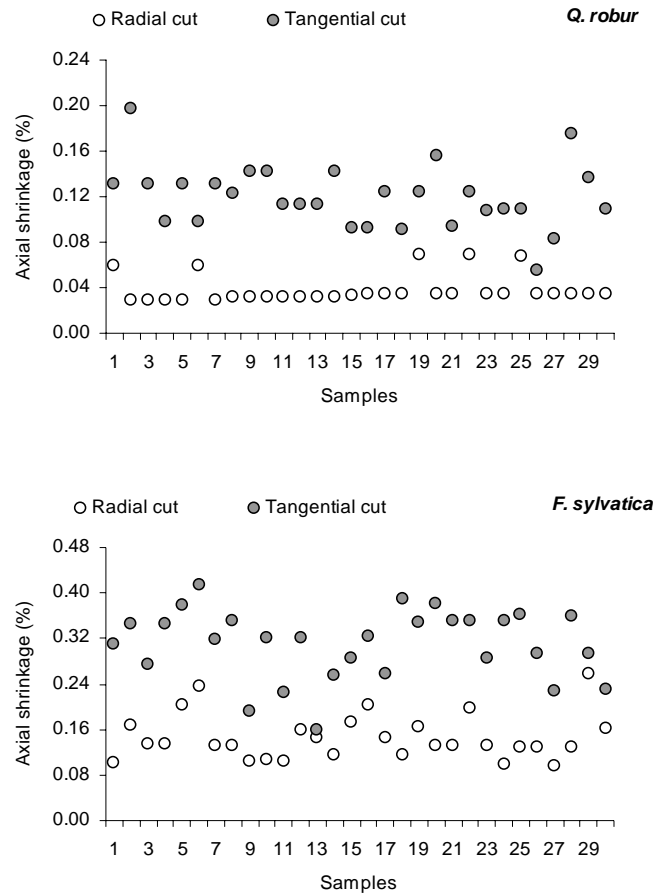


Figure 5: Axial shrinkage of oak and beech sheets, resulting from radial and tangential cuts.

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Table 1 shows the axial shrinkage values of oak and beech sheets.

Table 1: Axial shrinkage of oak and beech sheets.

Species	Cut Seccion	Average± Std. Dev.	V.C. (%)	Max – Min (mm)
<i>Q. robur</i>	Radial	0.038±0.012	32.8	0.069 - 0.029
	Tangential	0.172±0.299	173.9	1.751 - 0.028
<i>F. sylvatica</i>	Radial	0.146±0.040	27.8	0.257 - 0.096
	Tangential	0.31±0.061	19.7	0.414 - 0.16

Std. Dev.: Standard deviation, V.C.: variation coefficient, Max – Min: maximum – minimum

We carried out variance analysis for the factors species and cut section: 26% of total variation was due to the cut section and 17% to differences between species. Natural wood has great natural variation, which explains most of the residual error (57%).

Non-axial shrinkage

Beech sheets retracted more, on average, than oak sheets, mainly because their vessel elements are more numerous and thinner. In each square centimetre of beech wood, 40% of the surface is composed of vessels elements with diameters below 100µm, while in the same area of oak wood, 20% is occupied by vessels elements with diameters of 400µm. This means that beech has four times as much water than oak, and so when dried suffers more retraction (Constatin, 2005 personal communication). Another reason lies in the different densities of heartwood and sapwood. Beech wood has false heartwood while oak doesn't, and false heartwood is denser and thus more difficult to dry (Carvalho, 1997).

Different cut sections also have different retractions: sheets resulting from tangential cuts suffer more non-axial contraction. This is largely due to the different way the rings are arranged in each section: tangential cuts produce surfaces with more vessel elements and thus with higher water content. Beech sheets processed by tangential cuts show the highest shrinkage, followed by sheets of the same species but processed by radial cuts. In third place are oak sheets processed by tangential cuts. It is therefore clear that both species and both types of cuts suffer variations, but of different intensity.

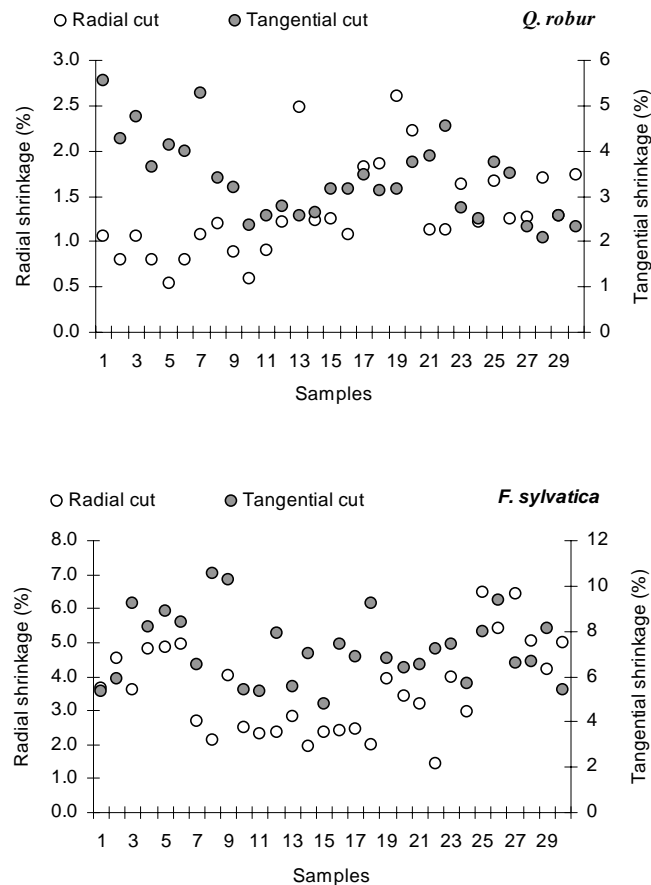


Figure 6: Radial and tangential (non axial) shrinkage of English oak and beech sheets, processed by radial and tangential cuts.

Table 2 shows the non axial shrinkage values of oak and beech sheets.

Table 2: Non axial shrinkage of oak and beech sheets.

Species	Cut Seccion	Average±Std.dev.	V.C. (%)	Max – Min (mm)
<i>Q. robur</i>	Radial	1.32±0.511	38.8	2.593 - 0.532
	Tangencial	3.37±0.893	26.5	5.536 - 0.888
<i>F. sylvatica</i>	Radial	3.60±1.351	37.6	6.466 - 1.449
	Tangencial	7.23±2.546	21.4	17.714 - 4.762

Std. Dev.: Standard deviation, V.C.: variation coefficient, Max – Min: maximum – minimum

We carried out variance analysis for the factors “species” and “cut section”: 38% of total variation was due to the cut section and 44% to differences between species. The residual error was 12%, which shows that non axial retraction is mainly due to the species and cut section, and not as dependent on the material’s natural variability.

CONCLUSIONS

The two species behaved differently, which we attribute to their distinct anatomical structure, even though both are hardwoods. Variance analyses showed that the species is the main responsible for the variation, and that beech has a higher shrinkage variation. Higher shrinkage results from the tangential cuts, compared to radial cuts.

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