Scots Pine (Pinus sylvestris L.) Stem Wood and Bark Moisture and Density Influencing Factors

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Topicality

- It was clarified by several researchers in Norway, Sweden, Scotland and France how wood density depends on the geographical growing position. It has been observed that wood density increases the more southwards the tree grows (Hedenberg, 2003).
- Latvia uses average density indexes obtained in Russia or European countries, but they are mutually different, and there is no knowing of the most suitable one for conditions in Latvia.
- Therefore, it is necessary to carry out a research in Latvia.



Methods

- Wood and bark moisture and density were analysed in 21 sampling plots, arranged in middle-aged and cutting-aged reached forest stands, depending on tree age, cutting time and location place in the tree stem.
- Sampling plots are located in commercial thinning forest stands, and in the final felling forest stands, once for every month.
- Ten sample trees, with a certain step, and by regular arrangement, are chosen in the established sampling plot, for obtaining sample discs (every disc thickness equals to 5 cm). Sample trees are taken proportionally to the distribution of tree amount in diameter classes. Sample discs are taken during the harvesting, starting from tree stem butt end and farther, from every log, sawn by tree harvester.





Subsequently diameter of sample disk in mm is measured in two mutually perpendicular directions both over and under bark. Then each sample disk is divided in four pieces, and one sample is chosen for further processing from each peace and sawn out in 30 degree angle clockwise . Each sample is marked with tree numbers, for example 1-2-3,where:

- 1 sample tree number;
- 2 sample disk sequence in growth direction.;
- 3 piece number





Weight and volume of wood and bark samples is measured in fresh cut condition right after sawing. Weight is obtained by electronic scales, but volume is measured by immersing method. Volume equals to the amount of water, displaced by the sample. Volume of the bark samples is calculated on the basis of measuring the length, width and thickness.

Afterwards samples are placed into the drying oven at 103°C until samples are absolutely dry. Weight and volume is measured again when samples are dry.





Moisture content of Scotch pine, depending on the age of the tree

Part of the cross- section	37 – 70 years	Std. Deviation	71 – 146 years	Std. Deviation
Heartwood	37.3	4.4	32.0	2.9
Sapwood	121.3	11.9	122.4	13.1
Wood, average	108.4	11.9	90.6	10.1
Crust bark	141.2	38.5	99.4	33.8
Flaky bark	194.7	36.9	181.0	36.7
Bark average	156.0	32.3	119.4	27.4
Wood and bark	110.5	13.8	92.9	11.8

Following to t-test results the moisture content of sapwood has no significant differences according to age, but for other parts of the tree stem cross section has significant effect according to the age of the tree.



Average wood moisture content depending

on tree age



With an increase of tree age, average wood moisture content value decreases from 111% (40 years old trees) to 79% (140 years old trees).

Average wood moisture content changes, depending on tree age,
could be explained by the heartwood part proportion.

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Wood moisture content yearly fluctuation

Moisture content of pine heartwood varies little for a year-long period :

- 37 till 70 years old trees reveals that moisture content varies from 34% till 41%;
- 71 146 years old trees the value of this index is between 30 and 34%

Yearly fluctuations of sapwood moisture content are higher :

- 37-70 years old trees varies between 113% (in August) up to 130% (in April);
- 71-146 years old trees sapwood moisture content varies between 116% (in September) up to 130% (in February).



Wood and bark density depending on the

moisture content

	Wood and bark moisture content, g cm ⁻³							
Data source	Oven dry condition			Basic moisture		Freshly cut condition		
	Wood	Crust bark	Flaky bark	Wood	Bark	Wood	Crust bark	Flaky bark
Reasreach	0.501	0.412	0.532	0.529	-	0.848	0.651	0.844
B. N. Ugolev (Б. H. Уголев)	0.470	0.650		0.500	0.680	0.863	0.8	50

The research findings difference from B. N. Ugolev (Б. Н. Уголев) data could be explained by the fact that B. N. Ugolev (Б. Н. Уголев) density parameters are obtained in Russia where the climate is continental.



Pine wood and bark density in oven dry condition depending on tree age

Part of the cross- section	37 – 70 years	Std. Deviation	71 – 146 years	Std. Deviation
Heartwood	0.421	0.056	0.492	0.052
Sapwood	0.490	0.033	0.504	0.042
Wood average	0.478	0.032	0.501	0.040
Crust bark	0.413	0.070	0.412	0.081
Flaky bark	0.539	0.074	0.532	0.091
Bark average	0.424	0.052	0.421	0.052
Wood and bark	0.470	0.032	0.497	0.041

Wood density depends not only on tree species, but also on tree age. Pine wood density of absolutely dry wood increases by increasing of tree age.

Following t-test results for sapwood, crust bark, flaky bark and bark average density of oven dry condition has no significant differences according to the tree age.



Pine wood and bark density in freshly-cut condition that depends on tree age

Part of the cross- section	37 – 70 years	Std. Deviation	71 – 146 years	Std. Deviation
Heartwood	0.516	0.069	0.585	0.059
Sapwood	0.956	0.047	0.988	0.055
Wood average	0.881	0.064	0.848	0.062
Crust bark	0.697	0.074	0.604	0.082
Flaky bark	0.864	0.093	0.844	0.095
Bark average	0.730	0.097	0.651	0.071
Wood and bark	0.873	0.051	0.846	0.053

Following t-test results for flaky bark density of oven dry condition has no significant differences according to the tree age



Conclusions

- 1. Average wood moisture content changes, depending on tree age, could be explained by the heartwood part proportion.
- 2. Moisture content of pine heartwood varies little for a year-long period. A study conducted for pine of age from 37 till 70 years reveals that moisture content varies from 34% till 41%, but for 71 146 years old trees the value of this index is between 30 and 34%. Yearly fluctuations of sapwood moisture content are higher. Sapwood moisture content of 37-70 years old trees varies between 113% (in August) up to 130% (in April), but for 71-146 years old trees sapwood moisture content varies between 116% (in September) up to 130% (in February).
- 3. pine wood density of absolutely dry wood increases by increasing of tree age, especially heartwood, density by 14.5%. Bark both flaky and crust type, regarding to tree age, density remains practically unchanged.
- By increasing of tree age, wood density in freshly-cut condition is increasing heartwood density increases by 11.8%, sapwood density increases by 3.2%, but in average wood density decreases by 3.7%. Higher average wood density for younger trees (37-70 years old) can be explained by small proportion of heartwood. Crust bark for younger trees is by 13.3% denser and flaky bark is by 2.3 % denser.



Thank you for attention!

