

## **Comparative study of qualitative structure the beech logs sorted by European standard EN 1316-1 and Slovak standard STN 480065**

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**Abstract:** The study analyze the qualitative structure of beech logs sorted according to European standards EN 1316-1 and Slovak national standard STN 480056 from the viewpoint of dimensional log characteristics, frequency, type and size of red heartwood. The results showed that less stricter sorting criteria, in case of Slovak standard have a positive impact on the qualitative structure of beech logs and further yield from the sale of wood assortments. The analysis also showed that by limiting of frequency and size of the red heartwood in beech logs can be achieved favorable qualitative structure and consequently significantly increase yield from sale of produced assortments.

**Keywords:** EN 1316-1, STN 480056, red heartwood, logs, quality classes, hypothetical quality

### INTRODUCTION

Standard EN 1316-1 and Slovak standard STN 480056 classifies beech logs according to dimensional characteristics, as well according to the occurrence and size of wood defects (knots, cracks, sweep, taper, rot, T-disease, red heartwood, etc.).

Qualitative classification of wood according to EN 1316-1 in Slovakia is used for logs where is not known purpose of processing. It includes four grades: F-A - wood of top quality, F-B - wood of normal up to the top quality F-C - wood of lower up to the average quality, F-D - wood which can not be processed to assortments of classes F-A, F-B and F-C.

In contrast, if it is known purpose of processing, for qualitative classification is used standard STN 480056. Contrary to European standard, Slovak standard contains six classes: I. - logs for veneer production, musical instruments and technical needs, II. - logs for the production of peeled veneer, matches, sports equipment and barrels, III. - sawmill logs, III.A - sound logs, III.B - sound logs of standard quality, III.C - sound logs of ordinary quality, less valuable, IV. - mining logs and pole, V. - pulpwood and other industrial wood, VI. - assortments of firewood.

Apart from dimensional characteristics of logs, red heartwood (RHW) appears to be the main phenomena which it has a significant influence on the quality of raw wood and so it significantly decreases to its financial value (Becker et al. 2005). The colour inhomogeneity of "sound" beech RHW, its stability during production and use of the wood products reduces their physical and aesthetic properties. The calculated annual losses caused by the occurrence of RHW were 5.1 million euro in Germany, northern Rhine-Westphalia (Richter 2001).

Both standard classifies the sizes and types of RHWs as one of the major characteristics, limiting their quality. The auxiliary standards (En844-10 1998) distinguishes two types of RHW: "red heart" - red or brown stain affecting the central portion of beech wood, sharply defined and "doty red heart" resp. „star red heart“ (SHW) - unsound red heart of beech which appears at the ends of roundwood in a star-like form.

The aim of the article was compare the quantitative qualitative structure of logs sorted by standard EN 1316-1 and STN 480065 in terms of dimensional characteristics of logs and frequency and size of RHWs and SHWs.

## MATERIAL AND METHODS

Sample material came from standard beech forests of the University Forest Enterprise, Technical University in Zvolen in average age of 112 years. The 57 sampled trees were felled, cut on 12-14 m lengths and transported to timber yard. The cutting of the stem on the logs were made in according to the principles of qualitative evaluation of the standards EN 1316-1 and STN 480056.

Typology and dimensional measurements of heartwoods were evaluated on both ends of the logs. About log classification adjudicated size or less favorable type of heartwood. Mid-log diameters, log length were measured and calculated the volume of each logs. Simultaneously, the maximum width of RHWs and SHWs were measured and calculated the proportion of RHW or SHW (in %). Finally, the logs were graded into the fourth quality classes according to the following criteria European and Slovak standards (Table 1).

**Table 1** Parameters evaluating of the log quality according to (EN 1316-1 2012) and (STN 480056 2007). Average price of logs according to (Anonymous 2013)

Features	Standard / Class							
	EN 1316-1	STN 480056	EN 1316-1	STN 480056	EN 1316-1	STN 480056	EN 1316-1	STN 480056
	F-A	I.	F-B	II.	F-C	III.	F-D	V.
Minimum log length (m)	3	* not specified	3	2.7	2	* not specified	2	* not specified
Minimum mid-log diameter (cm)	40	40	35	<b>30</b>	25	* not specified	20	* not specified
Red heartwood (% of the diameter)-RHW	≤15	≤ <b>20</b>	≤30	≤ <b>33</b>	permitted	III.A - ≤ <b>33</b> III.B - ≤ <b>50</b> III.C - permitted	permitted	permitted
Star red heartwood (% of the diameter)-SHW	not permitted	not permitted	≤10	≤ <b>33</b>	≤40	III.A - not permitted III.B - ≤ <b>33</b> III.C - ≤ <b>50</b>	permitted	permitted
Average prices - excl. VAT (€/m <sup>3</sup> )	150	183	100	100	50	51	41	41

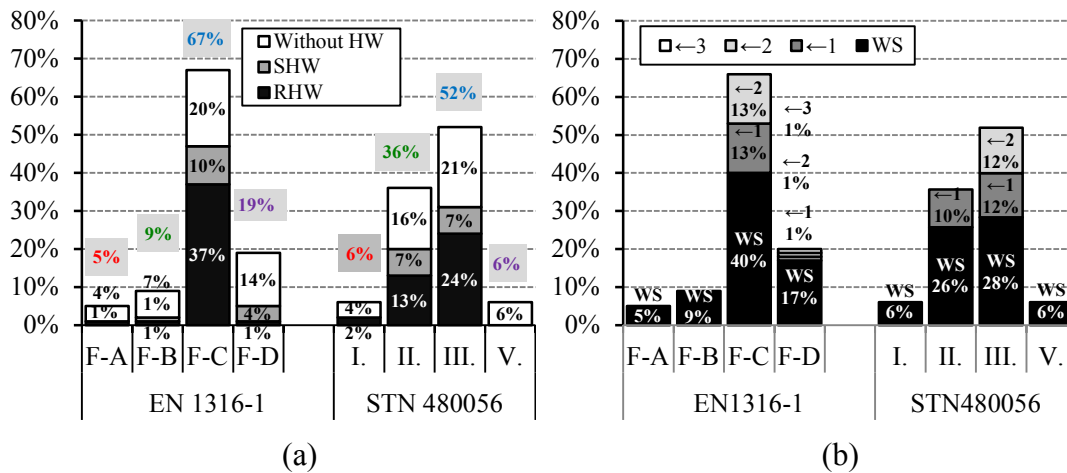
\*according to agreement between supplier and customer

Descriptive statistics of the sampled variables were calculated. Further, there

were compared the percentage of logs with and without RHW or SHW in the individual quality classes. The hypothetical reclassification of logs between qualitative classes was made as a result of the presence or absence of RHW and SHW. Finally, the average yield in €/m<sup>3</sup> and yield proportions (in %) from each class were calculated. The average yield and yield proportions were compared in terms European and Slovak standards. Also, the comparison was made from the viewpoint of a hypothetical classification (if the logs had the RHW or SHW).

## RESULTS AND DISCUSSION

An assortmentation according to EN 1316-1 and STN 480056 is based on similar principles, although the number, label and limiting values of individual classes are quite different (Table 1). However, for purposes of comparison the qualitative structure and yields are between them obvious similarities and the relations. The comparison of the limiting values in different quality classes (Table 1) shows that Slovak standard STN 480056 allows a greater range of permissible wood defects. It caused the transfer of logs from lower grades to higher in comparison with the European standard (Fig. 1a). In the class V. opposite to F-D decreased 3.16-times (from 19% to 6%), in the class III. opposite to F-C decreased 1.29-times (from 67% to 52%). On the other hand, in the class II. opposite to class F-B increased 4-times (from 9% to 36%), in the class I. opposite to class F-A 1.2-times (from 5% to 6%).

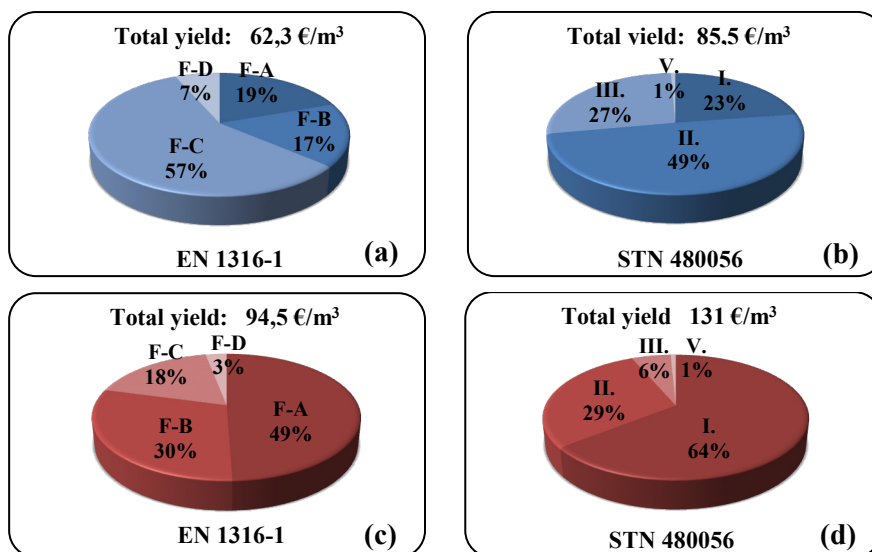


**Fig. 1** (a) - Proportions of logs in the different quality classes, (b) - hypothetical quality of logs and potential of shifts in the quality

Also, different sorting criteria also reflected in the total yield (Fig. 2a, b). Opposite to European standard the total yield was higher by 23.2 €/m<sup>3</sup>. Although, in class F-A and I the difference was not large (only 4%) the higher total yield in the case of Slovakia standards was caused by higher price per m<sup>3</sup> (Table 1). The greatest financial difference was found in class F-B and II. (in class with second highest price per m<sup>3</sup>). While, in the European standards, from the total yield 62.3 €/m<sup>3</sup> had a proportion only 17%, in the Slovak standard, from the higher total yield of 85.5 €/m<sup>3</sup> had until 49%. On the other hand, a significant decrease was observed in class F-C and III. From 57% in the European standards to 27% in the Slovak standard which represents approximately increase of 2.1-times. However, Class F-D and V. had minimal impact on the total yield.

It must be said that the greatest impact on change of qualitative structure, in favour Slovak standard had a change all criteria. But, from this study it is not possible to quantify what proportion plays the change of size of RHW and SHW and what other criteria. But, we can exactly estimate the hypothetical quality if logs do not contain RHW and SHW (or contain RHW by size under 15%). In case of European standard, the greatest shift potential have part of logs from class F-C in favor high quality classes F-A and F-B, proportionally divided between them (13% and 13%) (Fig. 1b). On the other hand, in case of Slovak standard the greatest shift potential has class III. which could allow a shift the 12% logs in favor of class I. and 12% logs in favor of class II. Simultaneously, 10% of logs would be able to shift from II. to I. quality class.

Therefore, we can say that Slovak standard has a higher potential to achieve favorable qualitative structure, in case of limitation frequency and size of RHW and SHW.



**Fig. 2** Average yield and its proportion in the individual quality classes sorted European and Slovak standard– (a,b) real quality, (c,d) hypothetical quality

Also, if the logs did not contain the RHW or SHW, the total yield from logs would be significantly higher too (fig. 2). The total yield for the European standard would be 94.5 €/m<sup>3</sup> which represents an increase of yield, compared to the real quality by 32.2 €/m<sup>3</sup> (fig. 2a,c). In case of Slovak standards, quality could increase up to 131 €/m<sup>3</sup> (fig. 2 b,d) which represents difference in total yield 45.5 €/m<sup>3</sup>.

Due to the fact that SHW and RHW is a facultative colored heartwood (Bosshard 1965), originating from the effects of wounding, it can be reduced by various silvicultural technologies (Račko et al. 2011). Also, a reduction of tree age and maintain a large annual increment can limit the formation and size of RHW and SHW and to achieve the great financial yield (Knoke 2003, Knoke and Moog 2005, Saniga 1996, Seeling and Becker 2002, Zell et al. 2004).

(Hapla and Steinfatt 2002) stated that the use of EN 1316-1 in forestry practice in Germany proved to be problematic. Its use leads to substantial poorer quality classes distribution of graded beech round wood compared to the use of HSK including the grading rules of Lower Saxony. Also Slovakia roundwood market and practice use only the national standard STN 480056. European standard EN 1316-1 is used exclusively in case of export a beech round wood.

## CONCLUSION

Based on the obtained results, we can say that less stricter sorting criteria in the Slovak opposite to European standard leads to movement of logs from class III. (F-C) in favor classes I. (F-A) 1.2-times and II. (F-B) 4-times. Simultaneously, the total financial yield (at current log prices) increased up to 23.2 €/m<sup>3</sup>.

Also, we can achieve significant increase the total yield by elimination the restrictions RHW and SHW. Up to 32.2 €/m<sup>3</sup> in the European standard up to 45.5 €/m<sup>3</sup> in Slovak standard.

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Streszczenie: Studium porównawcze struktury jakościowej kłód bukowych sortowanych zgodnie z normą EU EN 1316-1 i słowacką STN 480065. Praca porównuje wyniki sortowania kłód zgodnie z normami europejskimi i słowackimi odnosząc się do struktury wymiarowej oraz częstości i rozmiarów fałszywej twardzieli. Wykazano że łagodniejsze kryteria sortowania zawarte w normie słowackiej mają pozytywny wpływ na strukturę jakościową kłód i na późniejsze wyniki sprzedaży. Wykazano także że ograniczenie częstości występowania i rozmiaru fałszywej twardzieli polepsza strukturę jakościową i w konsekwencji zwiększa zyski przy sprzedaży.

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