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STUDY ON THE DENSITY OF OAK WOOD

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ABSTRACT

The density is assumed to be a complex parameter of quality wood. On the one hand, it depends on the anatomical structure of the wood, the other largely determine all other mechanical properties and influence the processing and use of wood.

Work considered the density of oak wood, sourced from different habitats in the country and its distribution in the radius of the stem. The influence of age, the width of the annual ring, habitat and altitude.

Key words: wood, oak, density, annual ring.

INTRODUCTION

The representatives of the genus Quercus are widespread in our country – 35% of the forested area of Bulgaria are oak, but mostly coppices plants (EFA, 2010). The seminal (plants with high stems) oak forests are mainly distributed in eastern Bulgaria - Strandzha Eastern Balkan Mountains and Ludogorie region, occupying only 20% of the total area of oak forests (1,300,473 ha).

For the rational exploitation of wood, of naturally widespread oaks in Bulgaria, it is necessary to know both its physical and mechanical properties associated with the conditions of the habitat and distribution in the volume of the stem. The complexity of the analysis of the sampled wood is due to several reasons:

1) the wood of oak is heartwood, which means the distribution of juvenile, central and peripheral wood overlaps the location of core and sapwood;

2) the early age of most of the examined trees implies small washers and small number of sample bodies, which have to be properly distributed along the section and to describe the distribution of properties in details.

To improve the accuracy of the analysis, species are grouped into two groups depending on the altitude of habitats (Table 1.). Thus you can see the distribution of the properties of oak wood grown below 250 m asl and over 250 m asl.

The work examines the impact of tree species and habitat on the density of wood.

METHODS AND MATERIALS

The oak wood supplied for research is from 5 habitats in Bulgaria: pubescent oak - Vratsa, Kresna and Sandanski and Hungarian oak – Topolovgrad and Tsarevo. For the purposes of the study, the habitats that were mentioned above were selected as typical of the species in the country. Typical trees are chosen, according to the forest management plan.

Objects of study are two different types of oak – Hungarian oak (*Quercus frainetto* Ten.) and Pubescent oak (*Quercus pubescens* Willd. Sl).

Figure 1: Location of test specimens radius of the stem

The test specimens are non-standard sizes, because they were taken by the diameter of the washers. They were made by splitting radial strip width 40 mm (fig. 1).

The density of each sample was determined by stereochemically method (according to ISO 3131).

RESULTS AND DISCUSSION

Distribution of density by types

According to the research of prof. E. Enchev the average density of Hungarian oak wood in our country is 900 kg.m^{-3} (Enchev, E. 1972). According to Dr. Gramatikov, who carried out researches several years earlier, the value is slightly lower – 867 kg.m^{-3} (Gramatikov, Dr. M. 1970). However, both values are much higher than the value obtained in the current study, Hungarian oak – 705 kg.m^{-3}. It is significantly lower than the values mentioned in the literature. It is difficult to compare these values and to explain the difference (Fig. 2). The reason is that the tested oaks in our work are between 50 and 80 years old. It means that during the years of researching by the authors, the annual rings that are formed are the first for these trees (peripheral wood), where the density is highest.

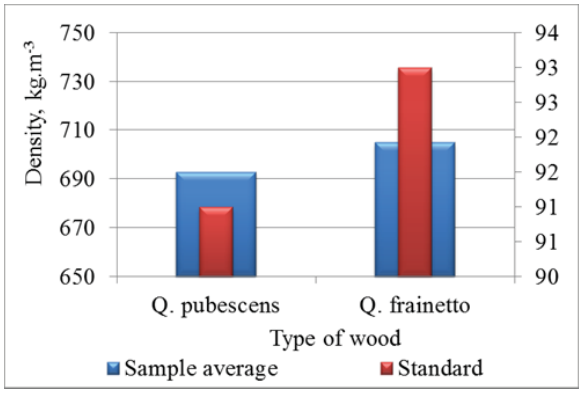

Figure 2: Standard density of oak wood

The average value obtained for the density of wood of Pubescent oak is 693 kg.m^{-3}. However, in our literature there are no published values to compare with (Fig. 2).

The density depends on the structure of wood and the thickness of the cell walls. With the increase of the stenosity of wood, the areas where it could be stored free water reduce.

After soaking and reaching the maximum water content in the wood (W_{max} = 61%), the maximum density of Pubescent oak grew by 300 kg.m^{-3} – 993 kg.m^{-3} (Fig. 3). In Hungarian oak this value (W_{max}=64%) is 1030 kg.m^{-3}, which is close to the maximum density of the Pubescent oak (Fig. 3).

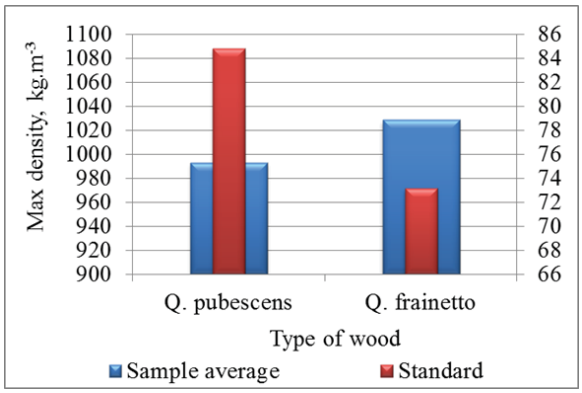

Figure 3: Maximum density of oak wood

The maximum density of wood is more theoretical (checkup value). Here the oak value should be smaller as the standard density is higher, because the role of water is more negligible.

Density distribution according to the habitat

The reason for the difference in the properties can be looked for in the ecotypes. Vihrov V. E., proves that the difference between the values of the density could reach 18% (Vihrov, V. E. 1954). The author identifies three ecotypes and examines both the difference in density values in different habitats and radius of the stem.

The tested wood was obtained from 5 habitats, which generally can be divided into two groups (Table. 1). The aim of this division is to identify and analyze the difference in the values of density and swelling at various altitudes.

Table 1: Division of the tested wood in groups by habitat.

	Habitat	Altitude, m	Type of oak
I Group	Kresna	233	Pubescent oak
	Tsarevo	10	Hungarian oak
II Group	Vratsa	345	Pubescent oak
	Topolovgrad	312	Hungarian oak
	Sandanski	297	Pubescent oak

Each group has representatives from both tree species. It is curious here that despite having similar average, the two tree species form different wood in different habitat conditions (Fig. 4). While Hungarian oak shows a constant value of its density, Pubescent oak density values vary depending on the habitat, although there is a minimum difference in the altitude.

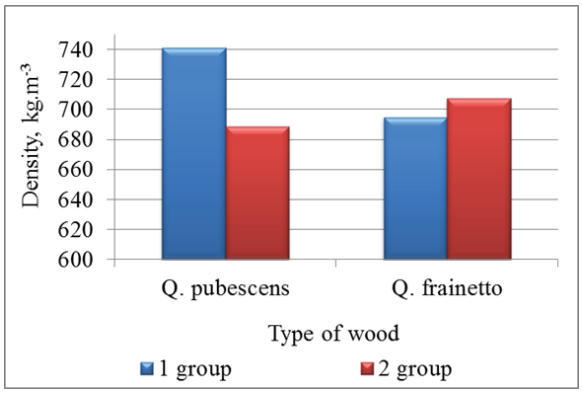

Figure 4: Standard density of oak wood depending on the habitat.

As a result of the research on the influence of the habitat on the density of the wood, it can be concluded that it does not affect the density values.

The distribution of the density in the radius of the stem

It is well known that the properties of wood core and sapwood are very different and these differences should be taken into account in the processing and the usage of wood. Furthermore, there is an overlap of these parts to the areas of juvenile, central and peripheral timber. That is why from the examined properties here is important to indicate the maximum water content. Look at the following figures. It can be easily specified the amount of sapwood – positions 5–7.

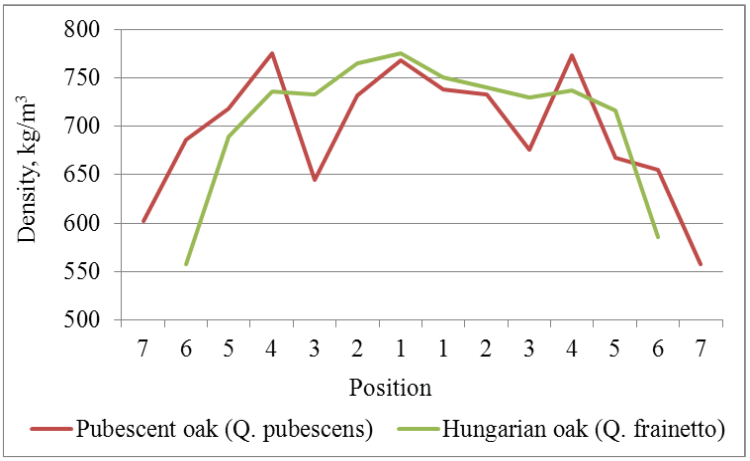

Figure 5: Distribution of the standard density according to the radius of the stem of oak wood

The obtained density values in different oak species are similar (fig. 4). In juvenile and central wood the density is highest, while in the peripheral it is strongly reduced. This difference of nearly 200 kg.m^{-3} can be explained by the participation of the sapwood in this area and by the fact that here the annual rings are the narrowest. Exactly in the annual rings we should seek an explanation for the high variability of the values in Pubescent oak (positions 3–5). The examined oaks are close in age to each other and it is possible to have a period with very narrow annual rings.

CONCLUSION

After the experiment and analysis of the results of the distribution of the density and the swelling we can make the following conclusions and recommendations:

- The obtained average density values in Pubescent oak and Hungarian oak are identical. This is due to the very close wood structure and suggests similar mechanical properties;
- Oak wood, unlike other ring porous species showing higher density values in the juvenile wood than in the center;
- The altitude does not have a significant impact on the density of the tested wood species;
- For better clarification of the trends in the distribution of values of the radius of the stem should be sought correlations between the tested density and the width of the annual rings.

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