The Use of Sawn Timber for Barrel Production from Oak Wood (Quercus Petraea L.)

Muharrem Sejdiu

Agricultural University, Tirana, Albania

Pandeli Marku

Prof. Dr. , Agricultural University, Tirana, Albania

Rrahim Sejdiu

Prof. Ass. Dr., University of Pristina, Pristina, Kosovo

Abstract

The number of firms involved in the production of barrels from white oak (quercus petraea L,) is small. The production of wood barrels is quite complex and with a low exploitation coefficient. We think it is in the interests of firms to know how much the coefficient of use of sawn material for these types of products is. For the study we have chosen the firm "BehaN" in Rahovec, which mainly deals with the production of oak wood barrels. The sawn material taken in the study was of a good quality. To do the tests we used weighing methods, as its volume was difficult to measure since it was half milled. Tests were conducted for the production of barrel details with a volume of 50, 30 and 20 litters, which are most widely used by the costumers. For the realization used by the firm were taken into account the dimensions and technology. From the measurement data it turned out that the weight of the sawn timber was about 250kg. The results of these weights were exchanged in volume and percentage and they are shown in final results.

Keywords: exploitation coefficient, plank, wood pieces, sawdust, barrel

1. Introduction

Barrels were first used for wine by the Romans. They were a big improvement over amphorae (Greek) and goat skins, can be built without metal using pegs and split willow hoops (Barrels & Ageing, 2014).

Traditionally, there are three species of wood used in barrel making: Q. petraea Liebl. and Q. robur L., the most common oak species in French forests, and the American oak Q. alba L. (Mariana Tavares, , Antonio M. Jordao and Jorge M. Ricardo-da-Silva, 2017).

In our country there are few companies that produce oak barrels (quercus petraea L.). But since it is a complicated work and with a small use of wood, we thought it was of interest to see how much it is used.

The production of barrels from wood is not only an interest in the preservation of wine, cognac and other alcoholic drinks, but it is also important for the fact that the physiological process

that occurs due to the passage of oxygen into the air through the stave of barrel directly affects the formation and improves the quality of wine. Storing wine, cognac and other alcoholic drinks in barrels for a long time they become delicious, aromatic and clear. This is also the main reason why these products are stored in wooden barrels.

The study was done at "Beha-N" Company in Rahovec which deals with the production of wooden barrels. It produces barrels of various volumes where the most common are barrels 50, 30, 20 litters (figure 1).

Figure 1. Barrel

2. Aim of the Study

The purpose of this study is to see the percentage of sawdust used for the production of oak wood barrels (quercus petraea L.) and how much is the waste in wood pieces, shavings and sawdust.

3. Methodology

The sawn timber in this firm is dried naturally for the production of barrels. Sawn bands are dried in 12-16% moisture.

The amount of sawdust used is weighed on the scales in kg then the weight is exchanged to m^3. This is because the saw material used in this firm is half milled and it is difficult to draw the correct volume by other methods. In this way the pure stave, wood pieces, shavings and sawdust are measured. In this case specific weight calculation is also required.

3.1 Materials used

- Oak sawn timber with dimensions (31x120-160x1000mm.)
- Wood processing machines as well (saw blade, longitudinal saw, planer machines, milling machine, sanding machine etc.).
- Scale, meters, micrometer, etc.

3.2 Methodology used

Determination of sawn timber use was done by measurements in the field.

The following formulas are used for calculations:

The volume of sawn timber in [m^3] (Ajdinaj D. Marku P., 2014)

$$V = \frac{P_{sh}}{Y_u} \ldots\ldots\ldots\ldots (m) \ldots\ldots\ldots\ldots (1)$$

Where:

$P_{"h}$ - Weight of sawn timber in kg,

Y_u - Specific wood weight in kg/m^3.

Net volume of stave [m^3]

$V = {}^{P}$ ..... (m^3) .....(2)

Yu

Where:

P_d - Weight of stave in kg,

Net yield stave in [%]

$R = EL\,x\,100$ = ... (%).....(**3**)

^{V}l

Net volume of barrel heads [m^3]

V/ = ^{Pf}..... (m^3) .....(4)

Yu

Where:

P

^{f} - Net weight of barrel heads in kg,Net yield of barrel heads [%]

$^{R}\boldsymbol{f = V}$ X^{100} = …..(%) …….. (5)

Wood pieces volume [m^3] (Sejdiu M, 2017)

p

V = ^{p} (m^3) .....(6)

Yu

Where:

^{p}a -Wood pieces weight in kg.

Yield wood pieces [%]

$\boldsymbol{R_a = Vr\,x\,100}$ (%) ..... (**7**)

Sawdust volume in [m^3] (Ajdinaj D. Marku P., 2014)

$V_g = {}^{p}$..... (m^3) ..... (8)

Yu

Where:

p

‘ - Sawdust weight in kg.

Sawdust performance in [%]

$R = V_L$ X100....(%)..... (9)

To calculate the specific weight, there were taken samples of 2x2x2cm and they were taken at the University of Applied Science Lab in Ferizaj. Samples were weighted on scale 0.1 gr. and

measured with micrometer 0.01mm (figure 2).

Figure 2. The view of materials and tools during practical examinations.

Then the samples were dried to oven dry moisture (102±3°C). The measurements are given in chart 1. Chart 1. Sample dimensions, volume, weight and moisture.

2E	Samples dimension in moisture 14%						dry Weight of oven samples in gr.	2E	Samples dimension in moisture 14%						dry Weight of oven samples in gr.
	Longitudinal mm.	Radial mm.	Tangential mm.	Volume in cm^3.	Weight of Samples gr.	Moisture %			Longitudinal mm.	Radial mm.	Tangential mm.	Volume in cm^3	Weight of Samples gr.	Moisture %	
1	19,83	18,65	18,65	6,90	5,60	14%	4,90	39	19,82	18,41	18,41	6,72	5,50	15%	4,80
2	19,85	18,49	18,56	6,81	5,40	15%	4,70	40	19,76	18,52	18,53	6,78	5,50	15%	4,80
3	19,91	18,48	18,69	6,88	5,20	13%	4,60	41	19,83	18,44	18,40	6,73	5,50	15%	4,80
4	19,91	18,49	18,61	6,85	5,60	14%	4,90	42	19,72	18,56	18,54	6,79	5,50	15%	4,80
5	19,84	18,58	18,59	6,85	5,50	15%	4,80	43	19,85	18,69	18,60	6,90	5,40	13%	4,80
6	19,72	18,63	19,10	7,02	5,50	15%	4,80	44	19,80	18,48	18,42	6,74	5,40	13%	4,80
7	19,86	18,58	18,59	6,86	5,50	15%	4,80	45	19,70	18,99	18,51	6,92	5,40	13%	4,80
8	19,73	18,57	18,51	6,78	5,40	15%	4,70	46	19,77	18,52	18,69	6,84	5,50	15%	4,80
9	19,80	18,66	19,10	7,06	5,50	15%	4,80	47	19,87	18,56	18,53	6,83	5,50	15%	4,80
10	19,88	18,41	18,40	6,73	5,40	15%	4,70	48	19,82	18,40	18,39	6,71	5,40	13%	4,80
11	19,90	18,52	18,72	6,90	5,40	15%	4,70	49	19,83	19,57	18,69	7,25	5,50	15%	4,80
12	19,87	18,38	18,57	6,78	5,50	15%	4,80	50	19,77	18,60	18,61	6,84	5,50	15%	4,80
13	19,92	18,53	18,61	6,87	5,50	15%	4,80	51	19,79	18,26	18,59	6,72	5,90	13%	5,20
14	19,38	18,56	18,61	6,69	5,40	15%	4,70	52	19,85	18,49	18,27	6,71	5,90	13%	5,20
15	19,88	18,62	18,67	6,91	5,50	15%	4,80	53	19,81	18,66	18,40	6,80	5,90	13%	5,20
16	19,82	18,58	18,52	6,82	5,50	15%	4,80	54	19,85	18,57	18,45	6,80	5,80	12%	5,20

17	19,80	18,62	18,67	6,88	5,50	12%	4,90	55	19,50	18,41	18,45	6,62	5,80	14%	5,10
18	19,81	18,48	18,51	6,78	5,40	15%	4,70	56	19,88	18,59	18,39	6,80	5,90	13%	5,20
19	19,79	18,66	17,65	6,52	5,50	15%	4,80	57	19,84	18,62	18,18	6,72	5,90	13%	5,20
20	19,85	18,58	18,64	6,87	5,40	13%	4,80	58	19,84	18,62	18,18	6,72	5,80	14%	5,10
21	19,77	18,53	18,64	6,83	5,50	15%	4,80	59	19,82	18,43	18,59	6,79	5,80	14%	5,10
22	19,78	18,55	18,68	6,85	5,40	15%	4,70	60	19,83	18,55	18,32	6,74	5,90	16%	5,10
23	19,81	18,56	18,84	6,93	5,40	13%	4,80	61	19,88	18,45	18,64	6,84	5,80	14%	5,10
24	19,81	18,67	18,68	6,91	5,50	12%	4,90	62	19,85	18,40	18,54	6,77	5,90	13%	5,20
25	19,81	18,64	18,73	6,92	5,40	13%	4,80	63	19,78	18,49	18,21	6,66	5,80	14%	5,10
26	19,93	18,50	18,63	6,87	5,30	13%	4,70	64	19,79	18,22	18,48	6,66	5,90	16%	5,10
27	19,72	18,63	18,58	6,83	5,40	13%	4,80	65	18,78	18,25	18,57	6,36	5,90	16%	5,10
28	19,76	18,62	18,63	6,85	5,50	15%	4,80	66	19,96	18,45	18,18	6,70	5,90	16%	5,10
29	19,83	18,64	18,58	6,87	5,60	14%	4,90	67	19,84	18,40	18,18	6,64	5,90	13%	5,20
30	19,72	18,60	18,66	6,84	5,70	19%	4,80	68	19,92	18,49	18,38	6,77	6,00	15%	5,20
31	19,64	18,55	18,69	6,81	5,30	13%	4,70	69	19,78	18,58	18,29	6,72	5,80	14%	5,10
32	19,85	18,64	18,73	6,93	5,40	13%	4,80	70	19,87	18,63	18,31	6,78	5,90	13%	5,20
33	19,88	18,56	18,52	6,83	5,50	12%	4,90	71	19,84	18,13	18,52	6,67	6,00	15%	5,20
34	19,78	18,56	18,61	6,83	5,50	15%	4,80	72	19,81	18,58	18,30	6,74	5,80	14%	5,10
35	19,80	18,65	18,71	6,91	5,50	15%	4,80	73	19,88	18,56	18,31	6,76	5,90	13%	5,20
36	19,85	18,40	18,51	6,76	5,50	12%	4,90	74	19,85	18,57	18,34	6,76	6,00	13%	5,30
37	19,85	19,28	18,67	7,15	5,60	14%	4,90	75	19,84	18,26	18,52	6,71	5,90	13%	5,20
38	19,68	18,52	18,67	6,81	5,50	15%	4,80								
Average				6,86	5,47	14%	4,79	Average				6,76	5,75	14%	5,04

According to the chart 1, the average moisture of wood was 13.94%, the average volume of samples in this moisture was 6.81 cm^3, the average weight of samples 5.61gr. and the average weight of samples in dry condition 4.92gr.

Specific wood weight calculation was with the formula (Fico S. Marku P. Shqau I., 1998):

$$Yu = {}^{P} \text{..... } S^{r/cm3} \text{.....} \quad (10)$$

$${}^{V}u$$

Where:

Pu- Sample weight in gr.

Vu- Sample volume in m^3

According to these data we see that 1cm^3 in 13.94% moisture weights 0.824gr. or 1m^3 is equal to 824kg.

4. Results

Measurement of sawn timber - The sawn timber in this firm was chosen with small annual rings and large pith wood, as mark is inadequate.

The sawn timber taken in the study weighted 250kg, and then it was exchanged to m^3 by equation 1.

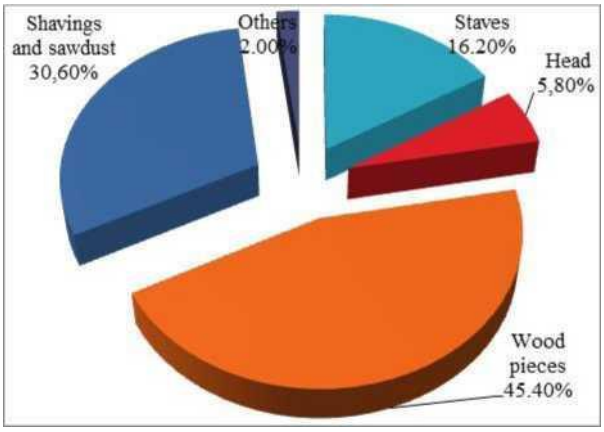
$V = l_j t_L = 250 = 0.3033980\ (m^3)$

Then the final balance of the use of sawn timber for barrels was finalized. The results are presented in tabular form in chart 2.

Chart 2. Performance in volume and percentage

Sawn timber			Clean staves			Clean barrel heads			Wood pieces			Shavings and sawdust			Others		
Weight kg.	Volume m^3		Weight kg.	Volume m^3		Weight kg.	Volume m^3		Weight kg.	Volume m^3		Weight kg.	Volume m^3		Weight kg.	Volume m^3	

Graphically, the data of chart 2. for percentage are shown in graphic 1.



Graphic 2. Efficiency in percentage.

According to the chart it can be seen that the use of sawn timber is very low, about 22%. If we consider the losses of wood during sawing process to make planks and drying boards, then the yield is even lower. This is also, as we said above, for the production of barrels it is used the heartwood.

5. Conclusion and Recommendation

For the production of stave barrels it is used only the heartwood.

From the amount of dry sawn timber of 0.3303m3 used for the production of a barrel is:

Stave takes 16.2%, heads 5.8%.

Others, like wood pieces (45.4%), sawdust and shavings and others (32.6%), are considered losses.

We recommend that:

To be careful during the natural drying of planks, in order to minimize damages.

To be careful during t the wood cutting process of planks, in order to make them radial.

Create mathematical cutting patterns for each type of barrel to achieve maximum utilization of raw material.

Other wood pieces should be used for other products, as there are huge losses.

Shavings and sawdust should be used for briquette or pellet production or for burning.

References

[1] Fico S. Marku P. Shqau I. (1998). *Prodhimi i lendes drusore te sharruar.* Tirane: Pegi.

[2] Ajdinaj D. Marku P. (2014). *Lenda e sharruar.* Tirane: Kumi.

[3] (2014). *Barrels & Ageing.* http://srjcstaff.santarosa.edu/~jhenderson/Barrels.pdf.

[4] Mariana Tavares, , Antonio M. Jordao and Jorge M. Ricardo-da-Silva. (2017). mpact of cherry, acacia and oak chips on red wine phenolic parameters and sensory profile. *OENO, 51* (3), 329-342.

[5] Sejdiu M. (2017). Research on the coefficient of utilization of quercus petraea l. Logs for producing radial planks with a thickness of 33mm. *Knowledge-international journal scientific papers vol 19.4* (p. 1745). Agia Triada, Greece: Institute of Knwledge Menagment.