TECHNISCHE UNIVERSITÄT DRESDEN

Dendromass4Europe.eu

D4 EU

Effect of storage method and duration on physical properties on poplar wood

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About the project

Dendromass4Europe (2017 – 2022) aims at establishing sustainable, Short Rotation Coppice (SRC)-based, regional cropping systems for woody biomass (dendromass) production on marginal agricultural land. The dendromass produced in SRC (ligneous biomass, bark and wood) is supplied to dedicated bio-based value chains that create additional income and job opportunities in rural areas. The supply chains will be tailored for optimum efficiency of supply logistics and for reducing CO_2 emissions. Innovative bio-based materials will help to replace fossil-based materials.

Fig. 1: Aerial view of the storage side in 2018 for log storage in compact piles and log conservation under oxygen exclusion (green packages)

Task and challenges

Our task is to optimize the method for the storage of poplar trunks over a period of up to 8 months. Three different storage methods

a) Storage in compact pile;

b) Log conservation under oxygen exclusion;

c) Storage in compact pile with water sprinkling

will be evaluated regarding its' impact on wood quality as well as ecological and economical aspects. Furthermore the differences in wood quality and drying of logs stored with and without bark will be evaluated. All parameters of the storage principles will be evaluated and if necessary adapted to the specific industrial process requirement. Wood quality during the storage/conservation period will be monitored and controlled continuously.

Based on the analysis results an operating procedure for the optimum storage method will be created.

Table 2: Storage variants with according analysis and sample strategies applied in 2019
SoS: start of storage, EoS: end of storage, AS: additional sampling after 3/6 Month; number of samples in brackets

Storage Variant	Analysis/Method		Sample strategy
Compact piles (with bark)	Wood moisture content	According to standard	SoS & EoS + monthly AS (22)
		Electric resistance	every 8 h (4)
		Weighing the logs	monthly (22)
	Wood density (12%)		SoS & EoS (22)
	Fungi infection (micro-/macroscopic)		Selected logs EoS
	Shoots (length/diameter/mass)		Selected logs EoS
	pH Value		monthly (22)
Compact piles with water sprinkling (with bark)	Wood moisture content	According to standard	SoS & EoS + monthly AS (18)
		Electric resistance	starting from August, every 8 h (4)
		Weighing the logs	starting from August, monthly (16)
	Wood density (12%)		SoS & EoS (16)
	Fungi infection (micro-/macroscopic)		Selected logs EoS
	Shoots (length/diameter/mass)		Selected logs EoS
	pH Value		starting from August, monthly (16)
Log conservation under oxygen exclusion (with and without bark)	Wood moisture content		SoS & EoS for two packages
	Wood density		SoS & EoS for two packages
	Gas analysis (CO_2/O_2 concentration)		monthly, all packages

Methods

One main objective is to test whether the stored wood undergoes changes in its anatomical, chemical, and physical composition, which may influence the wood processing technique and the characteristics of the end product. In 2018 and 2019 different storage variants were applied which were analyzed with various monitoring approaches and sample strategies (see tables 1 und 2).

Table 1: Storage variants with according analysis and sample strategies applied in 2018
SoS: start of storage, EoS: end of storage, AS: additional sampling after 3/6 Month; number of samples in brackets

Storage Variant	Analysis	Sample strategy
Compact piles (with and without bark)	Wood moisture content	SoS & EoS (300) + 2 AS (19)
	Wood density	SoS & EoS (19)
	Fungi infection (micro-/macroscopic)	Selected logs EoS
	Shoots length/diameter	Selected logs EoS
Compact piles with water sprinkling (with and without bark)	Wood moisture content	SoS & EoS (103) + 2 AS (10)
	Wood density	SoS & EoS (10)
	Fungi infection (micro-/macroscopic)	Selected logs EoS
	Shoots length/diameter	Selected logs EoS
Log conservation under oxygen exclusion (with and without bark)	Wood moisture content	SoS (181) & EoS (35)
	Wood density	SoS & EoS (8)
	Gas analysis (CO_2/O_2 concentration)	monthly, all packages

Fig. 2: Poplar logs after 9 month of storage in 2018 – oxygen exclusion with bark. The stems appear in a very fresh condition. The white mycelium comes from a non-wood-destroying fungus

First Results

Wood moisture content

Storage period 2018: Depending on the storage method significant changes in the wood moisture content (WMC) were found at the end of storage period 2018 (Fig.: 3). With storage under drying conditions the WMC was reduced to 78 % (CPwB) resp. 21 % (CPwob). For storage with water sprinkling the WMC was significantly increased to 179 % (WSwb) resp. 245 % (WSwob). Similar effects were detected for storage under oxygen exclusion (OEwb 154 %; OWwob 161 %).

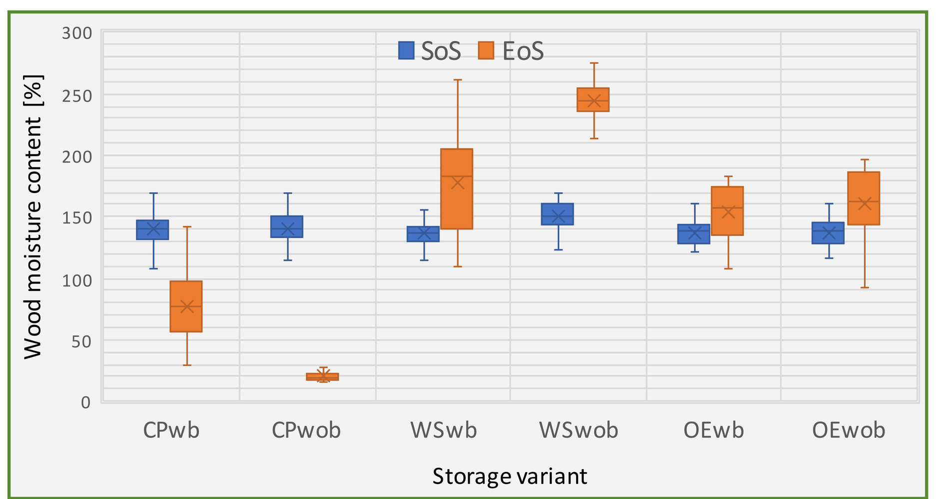

Fig. 3: Changes in moisture content or the 9 month storage period in 2018 (start of storage/SoS vs. end of storage/EoS)
CPwb – compact pile with bark; CPwob – compact pile without bark; WSwb – water sprinkling with bark; WSwob – water sprinkling without bark; OEwb – oxygen exclusion with bark; OEwob – oxygen exclusion without bark

Storage period 2019: In this storage period, the investigations were primarily focused on the use of various analysis and monitoring methods (Fig.: 4). Storage in compact piles and with water sprinkling was tested with logs in bark only. Logs stored in compact piles with bark had a WMC of 52 % after 9 month. Water sprinkling was stopped after 5 Month intentionally. After 4 more month the WMC was 136 % and within the range of fresh poplar wood. No new piles for storage under oxygen exclusion were established in 2019, however remaining piles from 2018 were tested after 20 month of storage. Here, the average WMC was similar to the results for the 9 month storage (OEwb 152 %; OWwob 165 %).

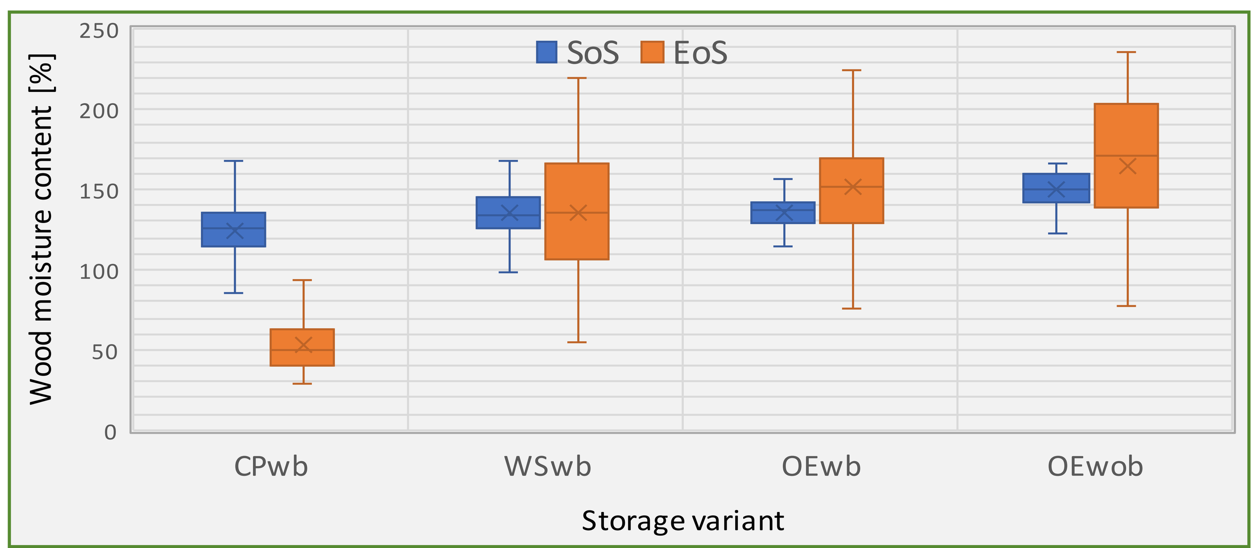

Fig. 4: Changes of moisture content for the 9 month storage period in 2019 – water sprinkling stopped after 6 month (start of storage/SoS vs. end of storage/EoS)
CPwb – compact pile with bark; WSwb – water sprinkling with bark; OEwb – oxygen exclusion with bark; OEwob – oxygen exclusion without bark

Changes in wood density – storage period 2018

The change in wood density resp. mass loss over the storage time is an important criteria to evaluate the storage success. All storage variants are showing a wood density reduction over the time of 9 month (Fig.: 5). The highest mass loss (- 9.6%) was found in logs stored in compact piles with bark (CPwb). A similar loss (- 8.6%) was found for water sprinkling with bark (WSwb). A slightly lower decrease (- 5,9 %) can be found for logs stored under oxygen exclusion in bark (OEwb). The reduction in wood density for the other storage methods is significantly lower (CPwob: -1.78%; WSwob: -1.10%; OEwob: -1.10%).

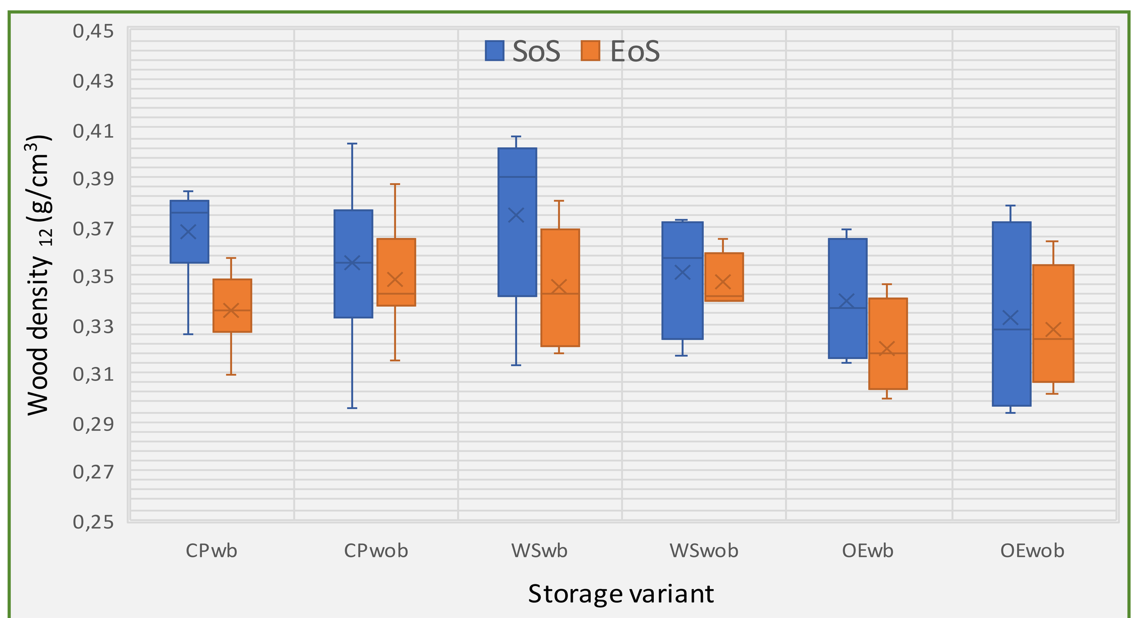

Fig. 5: Changes of Wood density$_{12}$ for the 9 month storage period in 2018 (start of storage/SoS vs. end of storage/EoS)
CPwb – compact pile with bark; CPwob – compact pile without bark; WSwb – water sprinkling with bark; WSwob – water sprinkling without bark; OEwb – oxygen exclusion with bark; OEwob – oxygen exclusion without bark

Fungi infestation – storage period 2018

Fungi infestation is a main risk regarding log storage. Wood quality and mass loss resp. the reduction of wood density are significantly influenced by wood-destroying fungi. Four different fungi species were identified (Tab. 3), especially logs stored in compact piles with bark have been highly infested by white rot.

Table 3: Identified fungi infestation for the storage period 2018

Identified fungi species	Type of rot	Infected piles
Schizophyllum commune	white rot	compact pile with bark
Clylindrobasidium evolvens	white rot	compact pile with bark
Chondrostereum ssp.	white rot	compact pile with bark
Nectria coccinea	bark fungus	water sprinkling with bark

Regardless of economic and ecological aspects, the results so far show that the wood quality is preserved the best through storage under water sprinkling and under oxygen exclusion.

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