WST 112: Properties and Utilization of Forest Products

SORPTION HYSTERESIS OF WOOD

LABORATORY ACTIVITY NO.2

Name: _____ Section:_____
Program: _____ Date:_____

I. INTRODUCTION

Moisture movement in wood is a continuous process that affects its weight, stability, and performance. When wood loses moisture to the surrounding air, it undergoes **desorption**, while gaining moisture from the atmosphere is called **adsorption**. These processes cause changes in the wood's mass as water enters or leaves the cell walls. Understanding these changes is essential because moisture directly influences wood properties such as strength, shrinkage, swelling, and durability.

This laboratory activity measures the differences in moisture content during adsorption and desorption, compares drying and moisture-uptake rates, and identifies the point at which each sample reaches **Equilibrium Moisture Content (EMC)**. Through this, the phenomenon of **sorption hysteresis**—the difference between adsorption and desorption moisture paths—can be observed and explained.

II. OBJECTIVES

By the end of this laboratory activity the student should be able to:

1. Measure the weight changes of wood specimens from green condition to constant weight through desorption.
2. Measure weight gain of oven-dried specimens during adsorption.
3. Calculate the moisture content (MC) of wood from desorption and adsorption;

4. Determine and compare the drying rate and adsorption rate of specimen; 5. Determine the Equilibrium Moisture Content (EMC) of wood for both processes.

III. METHODOLOGY

Equipment and Materials

1. Wood samples
2. Weighing scale
3. Masking tape / sample labels / permanent marker
4. Notebook / data sheets / calculator or spreadsheet
5. Calculator
6. Laptop

Procedure

1. For the adsorption experiment, use the wood sample of the Laboratory exercise 1 in oven-dried condition.
2. For the desorption experiment, use a freshly cut wood of the same dimension and species of the Laboratory exercise 1.
3. Label each specimen with its section and R or D (e.g., *MN1-D*) using masking tape, and record the species and sample ID on the data sheet. WST 112_Laboratory Exercises Records Sheet - Google Sheets 4. Weigh the initial mass of the two wood samples using the digital balance.
5. Place the labeled specimens in a dry place.
6. Weight the specimens every two (2) weeks until the second week of November.
7. Calculate the moisture content of the specimen.
8. Using the computed moisture content, plot the linear regression of each specimen. Insert the “Exponential trendline”, equation of the line and the R value.

Table 1. Bi-weekly Mass and Moisture Content of Wood Species Under Adsorption and Desorption

Species	Moisture Sorption	Initial	Bi-Week 1		Bi-week 2		Bi-week 3		Bi-week 4	
			Mass	MC %	Mass	MC %	Mass	MC %	Mass	MC %
Balobo	Adsorption	136g	130g	–13.91	123g	–18.54	141g	–6.62	151g	0.00
	Desorption	175g	124g	12.73	109g	–0.91	110g	0.00	110g	0.00
Nangka	Adsorption	102 g	115 g	0.00	115 g	0.00	113 g	–1.74	115 g	0.00
	Desorption	125g	112g	53.42	113g	54.79	73g	0.00	73g	0.00

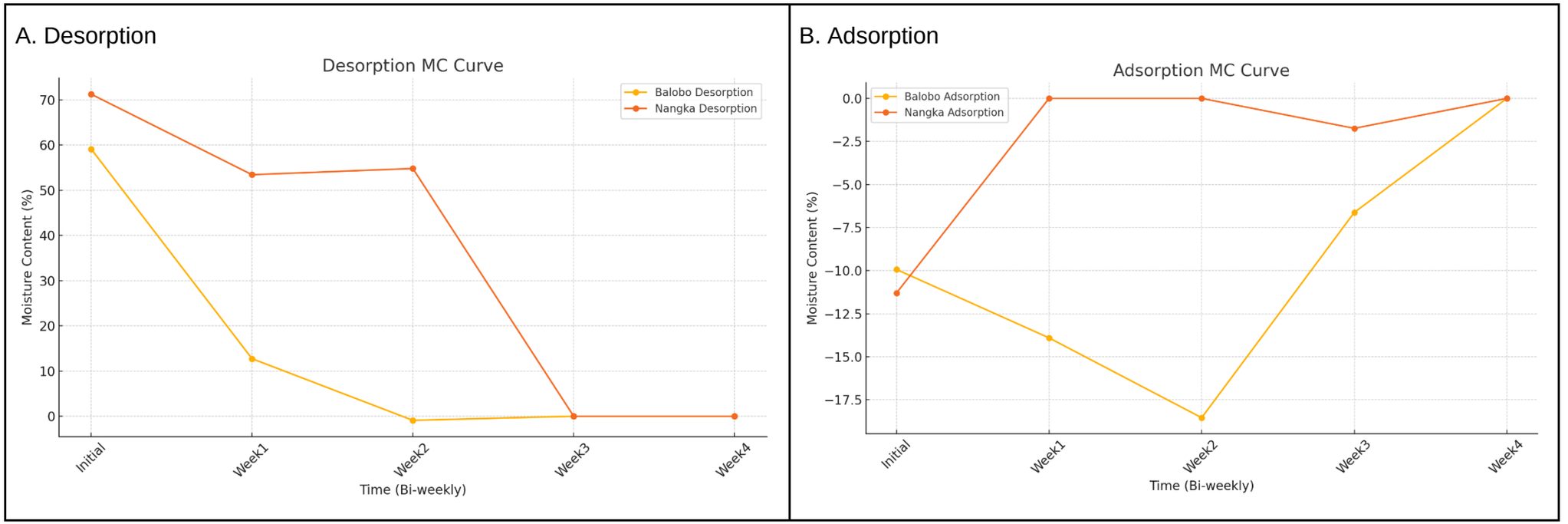

Figure 1. Moisture Sorption Curves of Three Wood Species Under Adsorption and Desorption

IV. GUIDE QUESTIONS

1. What is the difference between absorption, adsorption, and desorption?

- **Absorption** – water penetrates *into* the whole material (bulk).
- **Adsorption** – water attaches *onto* surfaces of cell walls or pores without fully penetrating.
- **Desorption** – release or loss of moisture from the material to the surrounding air.

2. Define sorption hysteresis and discuss its mechanism in wood.

Sorption hysteresis is the difference between moisture content during **adsorption** (gaining moisture) and **desorption** (losing moisture), even at the same relative humidity.

Mechanism in wood:

- Cell walls swell during adsorption but shrink during desorption at different rates.
- Bound water sites in cellulose and hemicellulose open differently when gaining vs. losing water.
- Capillaries trap moisture during desorption, causing slower drying.
- Microfibril angles and lumen size cause uneven movement of water.

3. Based on your moisture content–time graphs, at approximately what day did each specimen reach equilibrium moisture content (EMC) during desorption and during adsorption? What factors might explain why they did not reach EMC at the same time?

Balobo

- **Adsorption:** Stabilized at **151 g**, no MC change → **~Day 28**
- **Desorption:** Flat at **110 g** from Bi-Week 2 onward → **~Day 14**

Nangka

- **Adsorption:** MC returned to stable at **115 g** → **~Day 28**
- **Desorption:** Fully stable at **73 g** from Bi-Week 2 onward → **~Day 14**

Why not the same time?

- Different pore sizes
- Different extractive content
- Different density
- Different drying stresses
- Local RH and temperature fluctuations

5. How did the temperature and relative humidity of your locality influence the desorption rate, adsorption rate, and overall sorption hysteresis observed in your wood samples?

Higher **temperature** → faster desorption (water evaporates faster).
Higher **relative humidity (RH)** → faster adsorption (air holds more moisture).

Effects observed:

- Desorption reached EMC earlier (Day ~14) because local RH was likely lower than fiber saturation.
- Adsorption slower (~Day 28) because it depends on RH increasing enough to re-absorb moisture.
- Hysteresis grew larger in fluctuating RH since wood responds slowly to changes.

6. Compare the sorption hysteresis of your two (2) chosen wood species upon reaching the EMC.

Species	Type	Est. Number of days at EMC
Balobo	Desorption	14 days
	Adsorption	28 days
Nangka	Desorption	14 days
	Adsorption	28 days

7. In wood anatomical perspectives, discuss the possible reasons for the variations in sorption hysteresis between species.

- **Density differences** – denser wood dries slower.
- **Vessel/Tracheid size** – large pores (diffuse-porous) adsorb/desorb differently.
- **Microfibril angle** – affects swelling/shrinkage during moisture change.
- **Extractives** – can block pores and slow moisture movement.
- **Amount of parenchyma** – affects water storage capacity.

These structural differences cause each species to follow a different adsorption/desorption path.

8. List all possible experimental errors and explain how they affect the variations?

Error	Effect
Inconsistent weighing schedule	False MC readings
Scale calibration errors	Wrong initial and final mass
Residual moisture during “oven-dry” stage	Overestimated adsorption MC
Handling moisture contamination	Sudden mass increase
Airflow differences around samples	Uneven drying
Inaccurate labeling	Mixed-up specimen data
Temperature/RH fluctuations	Irregular sorption curves

V. REFERENCES VI. APPENDICES