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MOISTURE ADSORPTION ISOTHERMS OF WOOD USING DYNAMIC VAPOR SORPTION

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INTRODUCTION

▪The use of a dynamic vapor sorption apparatus (DVS) is a relatively new technique developed to collect continuous weight change over time at any desired relative humidity (RH) between 0 and 95% within a short period of time.

MATERIAL AND METHODS

•Five wood species acacia mangium, sesenduk, Sitka spruce,radiata pine and Accoya were used in this study.

•Isotherm analyses were performed using DVS Intrinsic (Figure 1)

•The schedule for the DVS was set to 10 different RHs (0, 10, 20, 30, 40, 50, 60, 70, 80 and 90 percent).

Figure 1: Dynamic vapor sorption Intrinsic

OBJECTIVES

1. **To determine the sorption behaviour of acacia mangium and sesenduk**
2. **To determine the relation between the water molecule in monolayer (HH model) and the primary soprtion site**

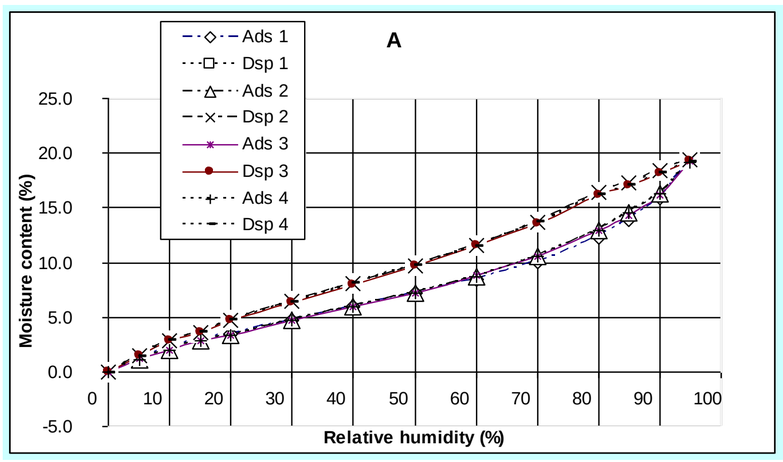

Fig.2: Reproducibility of sorption isotherm of acacia mangium in 4 cycles

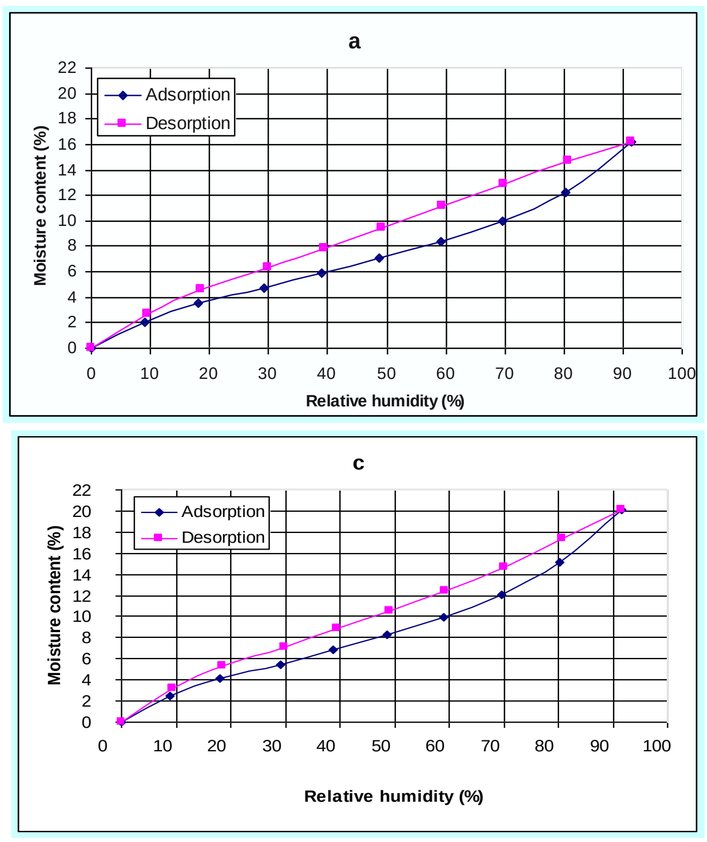

Figure 3: Moisture adsorption and desorption behaviour for Acacia mangium (a), Sesenduk (b), Sitka spruce (c), Radiata pine (d), Accoya (e) at 25 ^{o}C

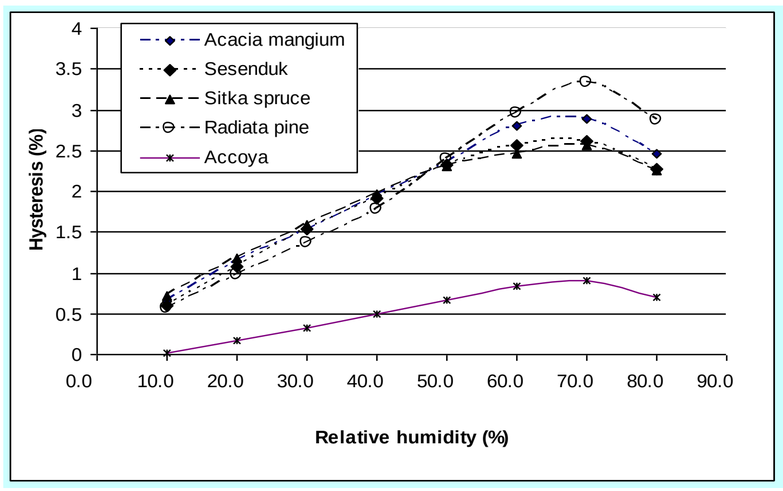

Figure 4: Hysteresis between adsorption and desorption curves (obtained by subtraction of equilibrium moisture contents) at different values of relative humidity

TABLE I
Estimation of OH Concentration (in mmoles per gram) of Dry Cell Wall Substance from Monolayer Water (Mh) Content and the molecular weight (W) at 100% RH Obtained from the Hailwood-Horrobin(HH) fits. Data is Compared with Approximate OH Concentration for Totally Accessible OH Content and for Concentration Based Upon 60% Crystalline (and hence inaccessible) Cellulose OH content

Wood	HH (Mh) OH concentration	HH (W)	Totally accessible calculated OH concentration	OH concentration (60% crystalline cellulose)
Acacia mangium	2.26	419.97	15.2	9.6
Sesenduk	2.34	403.01	14.2	9.5
Sitka spruce	2.59	364.57	14.2	9.7
Radiata pine	2.39	401.53	13.7	8.7

RESULTS

1. Four cycles were applied and the isotherm plots were found to be almost identical indicating that the equipment gave reproducible results and the material is stable (Figure 2)
2. The unmodified woods acacia mangium, sesenduk, Sitka spruce and radiata pine exhibited higher MCs on adsorption, desorption and hysteresis (Figure 3 & Figure 4) compared with the modified wood Accoya.
3. Comparison on the number of accessible OH groups in the monolayer by Hailwood Horrobin theory did not correspond to Rowell's method (Table I).

CONCLUSIONS

1. There are differences in the adsorption/desorption behavior between the two tropical Malaysian hardwoods, two temperate softwoods and Accoya.
2. Acacia mangium showed the lowest hygroscopicity of the unmodified woods.
3. The Accoya showed the lowest levels of hysteresis.
4. Based upon the present study, it is concluded that each water molecule in the monolayer is associated with 3-4 primary sorption sites.

ACKNOWLEDGEMENTS

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