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Data Article

# Characterization data of pulp fibres performance in tissue papers applications

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ABSTRACT

The data presented in this article are related to the original research paper entitled “Comparative characterization of eucalyptus fibres and softwood fibres for tissue papers applications” available in Materials Letter: X Journal [1]. In this article, six eucalyptus hardwood pulps and six softwood pulps were characterized in terms of morphological, chemical and water-related (by drainability and water retention index) properties. In addition, using these pulps, unpressed laboratory isotropic handsheets were produced with a basis weight of approximately 20 g/m$^2$, similarly to tissue papers. The key properties of tissue papers, namely structural properties, tensile index, absorption, and handfeel softness were analysed in these handsheets.



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Specifications Table

| | |
|---|---|
| Subject | Materials Science |
| Specific subject area | Tissue Paper Materials |
| Type of data | Table and Figures |
| How data were acquired | MorFi® analysis, SCAN standard, TAPPI standard, ISO standard, Water Retention method, TSA analysis |
| Data format | Raw and Analysed |
| Parameters for data collection | Hardwood and softwood pulps suspension were obtained in standards conditions. Low basis weight and unpressed isotropic laboratory handsheet were obtained with an adaptation to an ISO standard. |
| Description of data collection | MorFi® were performed to analyse morphology fibres of hardwood and softwood pulps. SCAN and TAPPI standards were performed to analyse chemical hardwood and softwood pulps (viscosity, pentosan content and carboxyl group content). Water retention method was performed to analyse water retention value of the pulp's suspension. ISO standard and TSA analysis were performed to analyse pulps suspension and isotropic handsheets (Schöpper-Riegler degree, thickness, bulk, tensile index, water absorption capacity, handfeel softness). |
| Data source location | FibEnTech-UBI, University of Beira Interior, Covilhã, Portugal<br>RAIZ- Forest and Paper Research Institute, Eixo, Aveiro, Portugal |
| Data accessibility | With the article and in supplementary material |
| Related research article | F.P. Morais, R.A.C. Bértolo, J.M.R. Curto, M.E.C.C. Amaral, A.M.M.S. Carta, D.V. Evtyugin, Comparative characterization of eucalyptus fibers and softwood fibers for tissue papers applications, Mater. Lett. X 4 (2019) 100028. https://doi.org/10.1016/j.mlblux.2019.100028 |

**Value of the Data**

- This data is useful to demonstrate and understand the effect of fibres morphological and chemical analysis on tissue paper properties.
- This data can be useful to the paper tissue industry and from the point of view of the researcher.
- This data can be used in future studies as comparison of different eucalyptus hardwood and softwood pulps in the market and looking for the most suitability pulp for each tissue paper (toilet paper, towel paper, napkins, facial paper, etc).
- To the best of our knowledge, this is the first published vast amount of characterization techniques used that justify the suitable of different fibres pulps for tissue papers application.
- Our data will be the starting point for optimized formulations of eucalyptus pulps modified to produce premium tissue papers.

## 1. Data

Here we report experimental characterization data on six eucalyptus hardwood and six softwood pulps and un-pressed laboratory isotropic handsheets with a basis weight of approximately 20 g/m$^2$ [1]. Analysis of fibres morphology, chemical properties, drainability (Schöpper-Riegler degree - °SR), water retention value (WRV), structural, tensile, absorption and handfeel (HF) softness tissue properties are shown (Table 1). Some correlations found about these properties also are shown, namely tensile index *versus* curl and kinked fibres (Fig. 1) and tensile index *versus* softness (Fig. 2).

## 2. Experimental design, materials, and methods

### 2.1. Pulp samples

Twelve industrial kraft pulps (six eucalyptus hardwood and six softwood pulps), with different bleaching sequences, were analysed. For all samples, the dry matter content was determined by placing the samples on an infrared scale at 105 °C for 30 minutes, following an adaptation of ISO 638 standard.

**Table 1**
Fibers morphology, chemical composition, and tissue paper properties characterization for hardwood and softwood pulps.

| Pulp samples | H_A | H_B | H_C | H_D | H_E | H_F | S_A | S_B | S_C | S_D | S_E | S_F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fiber length[a], mm | 0.84 ± 0.00 | 0.76 ± 0.00 | 0.77 ± 0.00 | 0.80 ± 0.00 | 0.71 ± 0.00 | 0.70 ± 0.00 | 1.96 ± 0.03 | 1.75 ± 0.03 | 1.73 ± 0.03 | 1.76 ± 0.02 | 1.69 ± 0.08 | 1.57 ± 0.02 |
| Fiber width, μm | 19.1 ± 0.2 | 18.2 ± 0.0 | 18.0 ± 0.2 | 18.8 ± 0.0 | 18.0 ± 0.1 | 18.3 ± 0.1 | 30.3 ± 0.5 | 29.4 ± 0.1 | 30.4 ± 0.2 | 30.8 ± 0.2 | 30.9 ± 0.3 | 29.9 ± 0.4 |
| Coarseness, mg/100 m | 8.44 ± 0.14 | 9.36 ± 0.18 | 6.71 ± 0.06 | 9.56 ± 0.15 | 8.22 ± 1.07 | 7.02 ± 0.63 | 19.66 ± 2.01 | 19.13 ± 2.88 | 16.81 ± 2.07 | 16.77 ± 1.72 | 18.83 ± 4.78 | 17.37 ± 1.71 |
| Kinked fibers, % | 43.7 ± 0.5 | 45.4 ± 0.5 | 50.4 ± 0.3 | 37.2 ± 0.1 | 51.6 ± 0.4 | 53.4 ± 0.5 | 55.1 ± 1.0 | 50.5 ± 0.8 | 51.7 ± 1.3 | 45.2 ± 0.7 | 47.1 ± 0.2 | 45.0 ± 1.0 |
| Curl, % | 10.4 ± 0.1 | 10.7 ± 0.2 | 12.3 ± 0.1 | 8.6 ± 0.0 | 12.5 ± 0.2 | 13.7 ± 0.2 | 14.4 ± 0.1 | 12.5 ± 0.2 | 13.2 ± 0.1 | 12.5 ± 0.2 | 12.7 ± 0.1 | 11.8 ± 0.2 |
| Fines elements[b], % | 45.6 ± 0.6 | 44.9 ± 0.2 | 40.0 ± 0.3 | 44.1 ± 0.9 | 43.7 ± 2.5 | 42.0 ± 1.6 | 34.1 ± 1.7 | 33.6 ± 3.2 | 29.9 ± 2.9 | 31.6 ± 2.8 | 30.4 ± 3.8 | 31.6 ± 1.4 |
| Viscosity, mL/g | 814 ± 0 | 790 ± 0 | 630 ± 0 | 915 ± 4 | 453 ± 0 | 973 ± 0 | 683 ± 9 | 699 ± 14 | 865 ± 4 | 844 ± 2 | 808 ± 0 | 656 ± 0 |
| Pentosan content, % | 19.5 ± 0.2 | 17.4 ± 0.0 | 16.4 ± 0.0 | 19.6 ± 0.3 | 21.1 ± 0.2 | 6.3 ± 0.0 | 8.6 ± 0.1 | 8.1 ± 0.0 | 8.3 ± 0.1 | 7.6 ± 0.1 | 10.3 ± 0.2 | 9.7 ± 0.5 |
| Carboxylic groups content, mmol/100 g | 5.05 ± 0.03 | 9.61 ± 0.18 | 9.26 ± 0.12 | 7.03 ± 0.05 | 5.02 ± 0.01 | 4.36 ± 0.05 | 10.60 ± 0.42 | 8.92 ± 0.32 | 8.73 ± 0.10 | 7.27 ± 0.04 | 1.89 ± 0.16 | 2.98 ± 0.04 |
| °SR | 18 ± 0 | 18 ± 0 | 21 ± 1 | 20 ± 0 | 20 ± 0 | 18 ± 0 | 12 ± 1 | 12 ± 1 | 13 ± 1 | 14 ± 1 | 14 ± 0 | 15 ± 0 |
| WRV index, % | 73.7 ± 1.9 | 76.9 ± 2.8 | 72.2 ± 2.1 | 76.3 ± 2.8 | 60.6 ± 2.6 | 63.1 ± 1.9 | 75.0 ± 1.5 | 63.7 ± 1.1 | 64.2 ± 3.9 | 70.1 ± 1.2 | 69.0 ± 2.4 | 72.5 ± 3.6 |
| Bulk, $cm^3/g$ | 3.61 ± 0.03 | 5.68 ± 0.02 | 5.83 ± 0.02 | 3.55 ± 0.03 | 3.71 ± 0.02 | 3.55 ± 0.00 | 8.04 ± 0.03 | 7.49 ± 0.02 | 6.43 ± 0.02 | 6.53 ± 0.01 | 3.46 ± 0.03 | 3.54 ± 0.03 |
| Tensile Index, N.m/g | 5.67 ± 0.38 | 4.03 ± 0.19 | 4.29 ± 0.21 | 9.96 ± 0.21 | 2.73 ± 0.41 | 2.00 ± 0.35 | 4.49 ± 0.80 | 5.43 ± 0.58 | 8.36 ± 0.17 | 11.45 ± 0.99 | 6.12 ± 0.70 | 9.31 ± 0.34 |
| Softness (HF) | 76.0 ± 1.5 | 75.2 ± 2.5 | 79.6 ± 1.7 | 65.7 ± 2.1 | 81.7 ± 2.5 | 86.9 ± 3.7 | 71.7 ± 1.8 | 73.1 ± 2.0 | 68.1 ± 2.1 | 63.8 ± 3.0 | 75.8 ± 2.6 | 69.3 ± 2.7 |
| Water Absorption Capacity, g/g | 8.83 ± 0.05 | 8.19 ± 0.02 | 8.17 ± 0.02 | 8.08 ± 0.28 | 8.59 ± 0.37 | 8.45 ± 0.02 | 9.48 ± 0.19 | 9.03 ± 0.29 | 8.82 ± 0.36 | 8.34 ± 0.20 | 8.64 ± 0.22 | 8.42 ± 0.09 |

[a] Length weighted in length.
[b] % in length; Values reported are the mean ± standard variation. Raw data available in supplementary material.

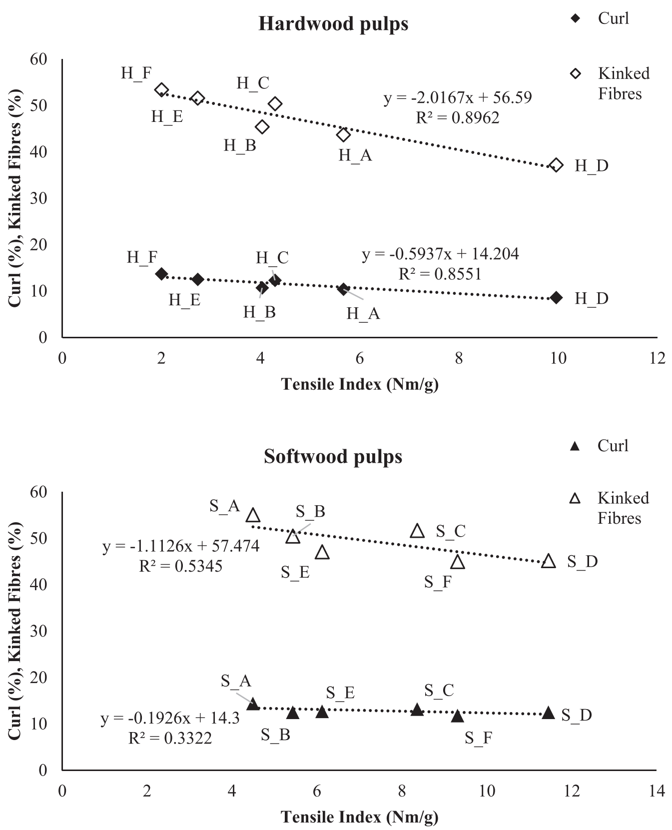


**Fig. 1.** Correlation of tensile index and curl and kinked fibres for hardwood and softwood pulps.

### *2.2. Fibres morphological properties and pulps composition*

The pulps morphological analysis was performed using a system based on image analysis, namely MorFi® (TECHPAP, Grenoble, France) equipment. The equipment integrates a digital camera and image analysis software for the automatic measurement of suspended fibres. Parameters such as length, width, coarseness, curl, kinks and fines were analysed. All assays were done in triplicate.

### *2.3. Chemical characterization*

The pulp's viscosity, the pentosan content and the carboxyl group content was determined according to SCAN-CM 15:88, TAPPI T 223 cm-10, TAPPI T 237 om-97 standard, respectively.

### *2.4. Pulps suspension characterization*

The pulps drainability was evaluated considering the measurement of the Schopper-Riegler degree according to ISO 5267/1 standard. For each sample, triplicate assays were performed.

The Water Retention Value (WRV) was determined according to the method described by Jayme [2]. This method is based on centrifugation at 7000 revolutions per minute, about 2 g of wet pulp for 10 minutes. Thereafter, the already centrifuged pulp was removed and weighed exactly to

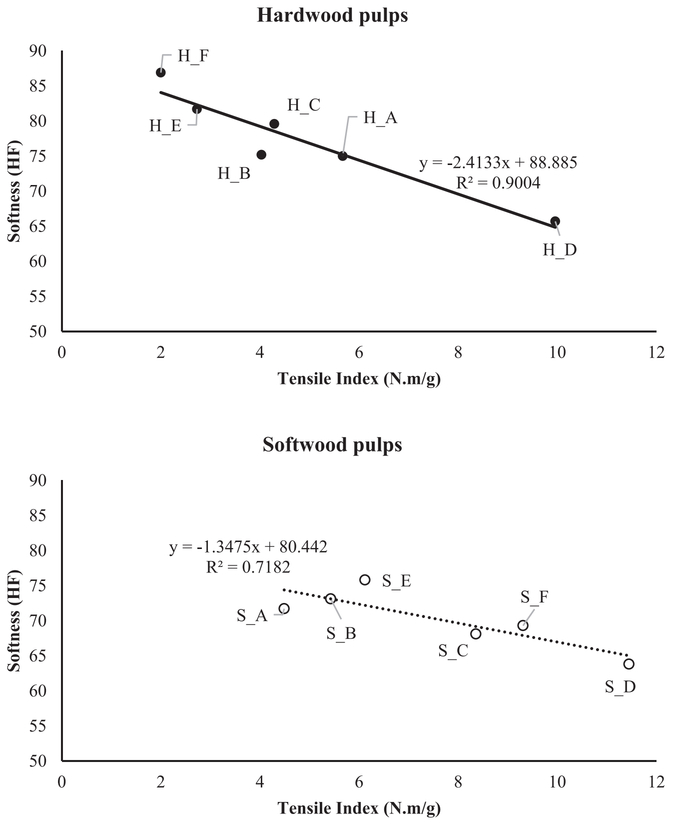


**Fig. 2.** Correlation of tensile index and softness for hardwood and softwood pulps.

the tenth of a milligram. Finally, centrifuged pulp samples were dried in the oven (105 ± 2 °C) for further determination of the sample dry weight. For each sample, triplicate assays were performed.

### *2.5. Laboratory isotropic handsheets preparation and testing*

The handsheets of each pulp were produced according to an adaptation of ISO 5269-1 standard. Handsheets with a basis weight of approximately 20 g/m$^2$ and unpressed were produced to approximate more tissue paper, using a laboratory handsheet former according to the respective standard. Finally, the handsheets were removed from the former web with a blotting paper and placed in a conditioned room (temperature of 23.0 ± 1.0 °C and relative humidity of 50.0 ± 2.0%). For each assay, 10 replicates were carried out for each sample.

The handsheets produced were tested for various tissue paper properties like, thickness and bulk (ISO 12625-3), basis weight (ISO 12625-6), tensile index (ISO 12625-4), water absorption capacity (ISO 12625-8), and softness using a TSA - Tissue Softness Analyzer (Emtec) equipment. The handsheets porosity was also determined by the Henriksson et al. [3] equation:

$$\text{Porosity}\ (\%) = 1 - (\rho_{\text{handsheets}} / \rho_{\text{cellulose}}) * 100$$

where $\rho_{\text{handsheets}}$ corresponds to the handsheet's apparent density and $\rho_{\text{cellulose}}$ corresponds to the cellulose density (1.5 g/cm$^3$).

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## Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2020.105253.

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