CALORIMETRIC CHARACTERIZATION OF THE SURFACE PROPERTIES OF CELLULOSE

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The thin-layer wicking technique was used to determine the surface free energy components and the surface character of cellulose, using an appropriate form of the Washburn equation (1). For this purpose, the penetration rates of probe liquids into a thin porous layer of the celluloses deposited on horizontal glass plates were measured. The results are shown in Table 1.

Table 1 - Surface tension components of the celluloses and work of water spreading (mJ/m^2)

Cellulose	γ_s^{LW}	γ_s^+	γ_s^-	γ_s^{AB}	γ_s^{TOT}	W_s
Sigmacell 101	54.49	0.11	47.83	4.49	58.98	-3.54
Sigmacell 20	52.94	0.11	41.70	4.24	57.18	-9.11
Avicel pH 101	51.82	0.00	50.14	0.00	51.82	-8.15

The surface properties were also evaluated by calorimetric means. The specific enthalpy of dehydration and the amount of adsorbed water for each type of cellulose were determined by differential scanning calorimetry and thermogravimetry. For this purpose, the cellulose samples were preconditioned in a 100% relative humidity (RH) chamber, for 7 days, at room temperature. The results obtained from the calorimetric assays are consistent with the ones obtained from thin-layer wicking. Sigmacell 101, which is stable in aqueous media, is the less hydrophobic of the analysed celluloses (Ws), and has the highest specific heat of dehydration. The other celluloses show less affinity for water molecules, as assessed by the two independent techniques (2).

Table 2 -Amount of adsorbed water and enthalpy of dehydration.

	$\frac{mg\ H_2O}{mg\ dry\ solid}$	ΔH (j/g H_2O)
Sigmacell 101	0.365 ± 0.031	1577.48 ± 115.07
Sigmacell 20	0.243 ± 0.014	1444.95 ± 95.05
Avicel pH 101	0.233 ± 0.013	1464.30 ± 83.98
Whatman CF-11	0.214 ± 0.016	1360.56 ± 69.46

(1) Chibowski, E., Holysz, L. (1992) Use of the Washburn Equation for Surface Free Energy Determination. *Langmuir*, 8, 710-716

(2) Dourado, F., Gama, F. M., Chibowski, E., Mota, M. (*in press*) Characterisation of cellulose surface free energy. *Journal of Adhesion Science and Technology*