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Report of Research Contract between local distributor and the Institute for the Study of Macromolecules Section of Biella, on Qualitative differentiation between manmade cellulosic textile fibre Lenpur® and other manmade cellulosic textile fibres by near infrared spectroscopy and differential scanning calorimetry.

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The goal of this research is to verify the possibility of qualitative differentiation between the manmade cellulosic fibre named Lenpur® and other manmade cellulosic fibres, and, particularly, lyocell, modal and viscose, by Near Infrared Spectroscopy (NIR) and Differential Scanning Calorimetry (DSC).

Materials.

This is a preliminary report, and it will be amplified by a final report at the end of the contract.

Materials used in the research were supplied by the local distributor to CNRISMAC Section of Biella - C.so Pella 16 13900 Biella.

Materials were obtained in the way shown in the asserted technical valuation performed by industrial textile technician Danilo Mainetti on April 15th 2003.

Materials analysed are:

16 samples of cellulosic bright flock " Lenpur®" Wood Fiber Flock 20 samples of cellulosic bright flock "Viscosa type F" 1,3 dtex, 40 mm, GL lucido 20 samples of cellulosic bright flock "Modal Classic" bright raw white 1,3 dtex, 39 mm. 20 samples of cellulosic bright flock "Lyocell" 1,3 dtex, 38 mm br rw lucido.

The sampling was made directly from 4 bales for each type of cellulosic fibre; the 4 whole bales belong to a single supply owned by Filati Macloadio In this report we have kept the same sample numbers as specified in the referenced technical report.

Differential Scanning Calorimetry DSC.

The thermal analysis of the fibres was carried out employing a Mettler DSC821 calorimeter. The temperature programme was from 30°C to 500 °C with an increment of 20°C/minute. Each sample, cut into short lengths, was sealed into a 40 µ aluminum pan container with a lid. The furnace was saturated with inert gas (N₂). The samples from different type of fibres showed a single endothermic event. The corresponding peak was integrated to obtain the peak temperature and the normalized fusion heat (enthalpy). At this point all 80 samples have been analysed. We are evaluating and comparing the results.

NIR spectroscopy

Before spectra acquisition, fibres were left to condition for at least 24 hours in an environment at a temperature of 20°C and a relative humidity of 65%. Each spectrum was classified according to its category (Lenpur®, viscose, modal, lyocell) using SEMCA (Soft Independent Modeling of Class Analogy) method.

In this classification each spectrum is represented as a point in a region of space. Similar spectra will be placed in a particular region in space and will form a class separated from other classes by a certain distance, called interclass distance. The greater the differences are in the characteristics of each class, the greater the interclass distance. The standard spectra (16 Lenpur® spectra, 20 viscose spectra, 20 modal spectra and 20 lyocell spectra) were processed and calibrated with a chemometric Quant + method. Each group of spectra forms a class (Lenpur® class, viscose class, modal class and lyocell class).

The principle results obtained are shown in the verification diagnostic report. Interclass distance is defined as the measure of the separation between classes. The first table shows the interclass distance

between any two classes.

The interclass distance is 24.27 between Lenpur® and Modal classes, 6.38 between Lenpurland Viscose classes, and 1530.7 between Lenpur and Lyoncell classes.

The second table lists the recognition and rejection rates for each class. The recognition rate is the number of spectra that are assigned to the class as a percentage of the number of spectra that should have been assigned to the class in a specific fibre. The rejection rate is the number of spectra that are rejected as a percentage of the number of spectra that should have been rejected for all the other fibres.

Misclassified samples are also specified and listed in the report.

All Lenpur® samples are recognised as belonging to the Lenpur® class. All viscose samples are recognised as belonging to the viscose class. Three viscose samples (viscose 74, viscose 79 and viscose 69) are recognised as belonging to viscose class, but the same "samples were not rejected from the Lenpur® class."

The figure shows the indicated data plotted on Cartesian axes (x = Modal, y = Lenpur®).

Verification Diagnostic Report

Critical probability level: 0.01 Inter class distances

	LENPUR2	MODAL2	VISCOSA2	LYONCEL2
LENPUR2	/	24.27	6.38	153.07
MODAL2			19.26	59.6
VISCOSA2				113.92

	% Recognition rate	% Rejection rate
LENPUR2	100 (16/16)	95 (57/60)
MODAL2	95 (19/20)	100 (56/56)
VISCOSA2	100 (20/20)	100 (56/56)
LYONCEL2	95 (19/20)	100 (56/56)

Misclassifications - total 5

Class LENPUR2, critical distance = 1.63

Spectrum/Distance	Model	Residual	Combined
VISCOS74	0.14	1.34	1.35
VISCOS79	0	1.47	1.47
VISCOS69	0	1.50	1.5

Class MODAL2, critical distance = 1.52

Spectrum/Distance	Model	Residual	Combined
MODAL44	0	1.88	1.88

Class LYOCEL2, critical distance = 1.55

Spectrum/Distance	Model	Residual	Combined
LYOCEL22	0	1.58	1.58



