

Life+ 2014-2020 @ ENEA



Fourier Transform Infrared Spectroscopy in the leather quality control (LIFE14 ENV/IT/000443 LIFETAN)



LIFE14 ENV/IT/000443 LIFETAN –EU LIFE programme (2014-2020).

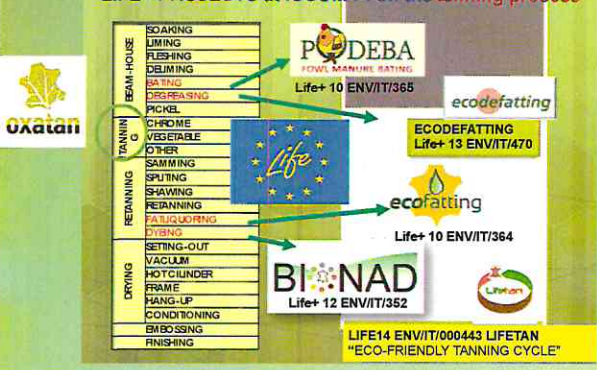
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The project

LIFETAN project is aimed at demonstrating the use of innovative natural products and technologies in the leather tanning process. The current commercial chemicals employed in the tanning process are very toxic and have a big impact on the environment. For this reason EU supports Life+ Program in order to replace products/processes with eco-sustainable and convenient ones to propose "green" industrial cycles. LIFETAN implements the results obtained in five previous Life+ projects and demonstrates the use of new natural products at laboratory, semi-industrial and industrial phase. The goals are to propose products with higher biodegradability and performance to produce high quality leather products better or comparable with those obtained employing traditional ones.



Introduction

Spectroscopic techniques are fundamental in the monitoring actions to characterize the leather samples. In particular FTIR is a valuable useful technique to investigate at molecular level the interaction of new products with the leather proteins. The FTIR analysis of amide I band gives information both in terms of the absorbance ratios at two different wavelengths (e.g. the 1654/1690 cm⁻¹ absorbance ratio to evaluate the collagen cross linking) and the analysis of the single components found by peak fitting (conformational analysis).

B3 demonstration of natural products in the whole tanning cycle at laboratory level

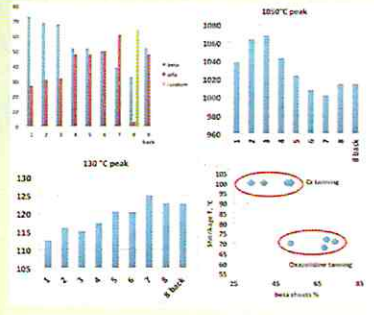
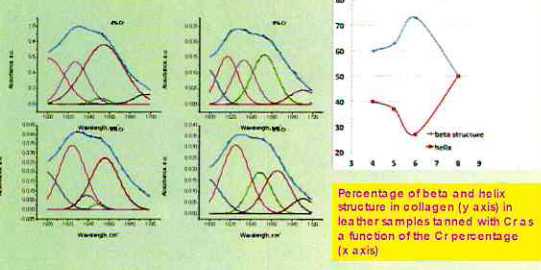
Results

Several LIFETAN leather samples processed with the new tanning formulations (Actions B3 and B4) have been analysed by ATR-FTIR. The results of the peak fitting analysis of these samples have been compared with Scanning Electron Microscopy (SEM) observations, Energy Dispersive X-Ray Spectroscopy (EDS) microanalysis and Thermogravimetric Analysis (TGA).



Sample N.	Defatting	Bathing	Tanning
A series			
1	Commercial product (DG)	Commercial product (enzyme mixture)	Oxazolidine
2	Commercial product (DG)	Amek PODEBA	Oxazolidine
3	EDF20 ECODEFATTING	Commercial product (enzyme mixture)	Oxazolidine
4	EDF20 ECODEFATTING	Amek PODEBA	Oxazolidine
4 rep.	EDF20 ECODEFATTING	Amek PODEBA	Oxazolidine
B series			
5	Commercial product (DG)	Commercial product (enzyme mixture)	Chromium salts
6	Commercial product (DG)	Amek PODEBA	Chromium salts
7	EDF20 ECODEFATTING	Commercial product (enzyme mixture)	Chromium salts
5 rep.	EDF20 ECODEFATTING	Amek PODEBA	Chromium salts
8	EDF20 ECODEFATTING	Amek PODEBA	Chromium salts 4%
8	EDF20 ECODEFATTING	Amek PODEBA	Chromium salts 5%
8	EDF20 ECODEFATTING	Amek PODEBA	Chromium salts 6%
8	EDF20 ECODEFATTING	Amek PODEBA	Chromium salts 8%

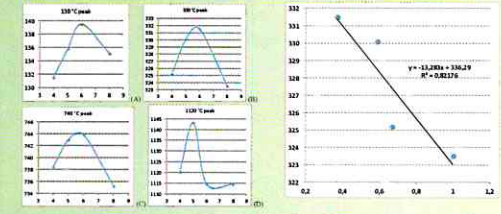
Peak Fitting Analysis of representative FTIR spectra in the amide I region of leather tanned with 4, 5, 6 and 8% Cr, compared with the predicted spectra (bold dotted line)



FTIR spectra of oxazolidine tanned leather samples give low values of AII/AI ratio and high values of 1653/1633 ratio, suggesting high helix percentage in collagen and, thus, high thermal stability.

In the tanning with Chromium salts, despite the Cr(III) concentration employed was the same for samples 5, 6, 7 and 8 the helix percentage in collagen changes depending on the defatting and bathing agent employed. This suggests that the adsorption of Cr(III) ions in the final leather may be different depending on the use of natural or commercial products.

Comparison FTIR/ TGA data: The trend of the 4 significant peaks evidenced by TG analysis as a function of Cr%.



Correlation of the temperature of the main peak of collagen decomposition at about 330°C with the alpha/beta ratio

Conclusions

FTIR is a valuable useful technique to investigate at molecular level the interaction of new products with the leather proteins. The FT-IR analysis of amide I band gives information both in terms of the absorbance ratios at two different wavelengths (e.g. the 1654/1690 cm⁻¹ absorbance ratio to evaluate the collagen cross linking) and the analysis of the single components found by peak fitting (conformational analysis) ^{1,2}

References

1. Monti S; Bramanti E; Della Porta V; Onor M; D'Ulivo A; Barone V Phys. Chem Chem. Phys. 15 (2013) 14736-14747.
2. Pellegrini D.; Corsi, M.; Bonanni, M.; Bianchini, R.; D'Ulivo, A.; Bramanti, E. Dyes and Pigments, 116 (2015) 65-73.