Abstract

Sustainability is a global level challenge for tanning industry whose production is based on Cr(III) salts for more than 90%, negatively impacting both biotic and abiotic factors in an ecosystem. Societal challenges are strongly pushing tanning industry to develop a more sustainable leather value chain. In fact, over the past 100 years, a lot of synthetic tannins have been developed for trying to replace chrome and to make the process more sustainable.[1] An alternative tanning system, in fact, should not only satisfy environmental criteria, but should be also able to match the properties of chrome tanned leathers.[2] For this reason, the *wet white* tanning process seems, nowadays, the only alternative to develop a less polluting process obtaining high quality products. In this respect, many efforts have been focused on the design of new environmental friendly and high-performance tanning products for industrial applications.

This industrial PhD project has been developed in collaboration with the *BI-QEM SPECIALTIES S.P.A.*, *Leather and Footwear Research Institute (ICPI*), *Politehnica University of Bucharest,* and *FGL International S.P.A.*

In the first phase of this PhD project, a new supramolecular system based on bisphenol S and β-cyclodextrin was synthesized and used as a tanning agent and as an eco-friendlier and sustainable alternative to tannins currently on the market. Firstly, we investigated the formation of the supramolecular system, using 1D and 2D NMR, FT-IR, and high-resolution mass spectrometry and we studied the different interaction between β-cyclodextrin and the two isomers of bisphenol S. Secondly, we tested the obtained systems on raw hide to evaluate their efficiency in the tanning process on both a laboratory and pilot scale, in collaboration with *FGL International S.P.A.*

In the project phase carried out at the *Leather and Footwear Research Institute* (ICPI), Bucharest, under the supervision of Dr. Elena Badea, the

[1] (a) A. D. Covington*, Chem. Soc. Rev.,* **1997**, *26*, 111. (b) A.D. Covington, W.R. Wise, *Tanning Chemistry The science of Leather,* Ed. Royal Society of Chemistry, Croydon, **2020**.

[2] N. Nishad Fathima, T. Prem Kumar, D. Ravri Kumar, J. Raghava Rao, B. Unni Nair, *J. Am. Leather Chem. Assoc.*, **2005**, *100*, 58-65.

goal was to obtain a fully eco-sustainable re-tanning agent from sodium alginate, a biodegradable, renewable biomass, using the ultrasonic technology. The efficacy of the obtained sodium alginate products (SAD) was evaluated by micro-differential scanning calorimetry (micro-DSC)[3] and attenuated total reflection mode infrared spectroscopy (FTIR-ATR). [4] The results so far obtained have confirmed the suitability of the various SADs as non-toxic and biodegradable re-tanning agents.

[3] C. Carşote, E. Badea, L. Miu, G. Della Gatta, *J. Therm. Anal. Calorim.*, **2016**, *124*, 1255–1266.

[4] C. Sendrea, C. Carsote, E. Badea, A. Adams, M. Niculescu, H. Iovu, *Series Chemistry*, **2016**, *78*, 27-38.