BioReCer

Biological Resources Certifications Schemes

The analysis of bio-based fashion materials towards SCAR spectrometry:

A weapon against green-washing

Gustavo Adrián Defeo FSLTC, CTC Ars Tinctoria SRL, March 25th, 2025

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DISCRIMINATING BIO-BASED / FOSSIL CARBON PROPORTIONS ALLOWS TO VERIFY THE INTRINSIC CIRCULARITY OF MATERIAL

Bio-based materials ensure intrinsic carbon neutrality and circularity

100% COTTON

PURA LANA VERGINE

^{14}C / ^{12}C proportions allows to understand the fossil / renewable carbon content in any organic material

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Bio-based standards - Communication

EN 16935 – Requirements for Business to Consumer communication and claims

Communication — It must be clear which sustainability information is refered to the product and which to the packaging

Bio-based content

- Minimum verifiable bio-based carbon in relation to the total carbon (EN 16640)
- Minimum verifiable biomass in relation to the total mass of the product (EN 16785-1/2)

Sustainability criteria — in accordance with EN 16751

End of life — Disposal alternatives and impact

Additional informations — LCA and other claims must be scientifically proved

Bio-based standards - Communication

EN 16848 – Requirements for Business to Business communication of characteristics using a Data Sheet

Biomass type (Plants trees, algae, marine organisms, microorganisms, animals)

Biomass origin Geographic origin

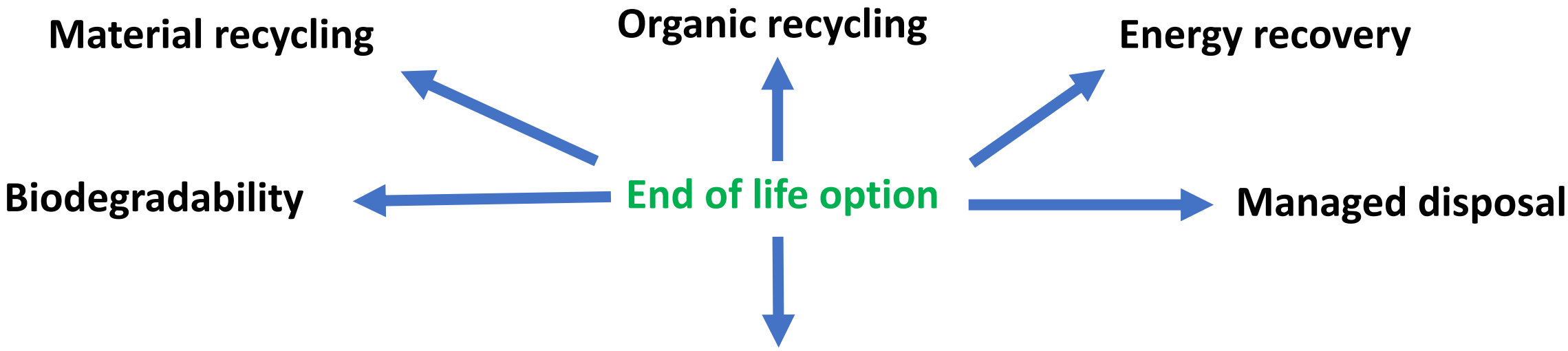
Bio-based carbon content

- Minimum verifiable bio-based carbon in relation to the total carbon (EN 16640)
- Minimum verifiable biomass in relation to the total mass of the product (EN 16785-1/2)

Bio-based norms - Communication

EN 16848 – Requirements for Business to Business communication of characteristics using a Data Sheet

Biomass sustainability — Information on aspects of Biomass sustainability (EN 16751)



What is SCAR?

SCAR: Saturated-Absorption Cavity Ring-Down Spectrometry

System developed by CNR-INO (Istituto Nazionale di Ottica) Florence

Alternative method to AMS (Accelerator Mass Spectrometry) and LSC (Liquid Scintillation Counting) to determine ^{14}C / ^{12}C proportions – Biobased Carbon

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Our research on MDPI Coatings

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coatings MDPI

Article

Material Circularity: A Novel Method for Biobased Carbon Quantification of Leather, Artificial Leather, and Trendy Alternatives

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Abstract: In the past, climate change led the United Nations to define the Sustainable Development Goals Statement "blueprint to achieve a better and more sustainable future" and the European Commission to promote the "bioeconomy" concept and to launch the Green Deal Policy. Accordingly, the COP26 conference proposed a drastic reduction of fossil-based fuels and materials, in favor of biobased materials which should ensure intrinsic carbon neutrality. Contextually, many startups and established materials suppliers proposed new, trendy materials claiming sustainability advantages but, in many cases, without robust scientific backing. The need for transparency in terms of circularity led us to exploit a fast, reliable and easily deployable analytical method for assessing the biogenic carbon fraction in a variety of industrial materials. Our research team identified a radiocarbon analysis based on Saturated-absorption CAvity Ring-down (SCAR) spectroscopy as a quick and effective method for such a scope. Here we demonstrate its use for the determination of biogenic/fossil carbon proportions of polymeric and coated materials such as leather, coated textiles and trendy alternatives used in the fashion industry, with the scope of defining their intrinsic renewable content. The reliability of the SCAR method is validated through a comparison with the results obtained by the benchmark technique.

Keywords: radiocarbon quantification; infrared spectroscopy; leather alternatives; SCAR spectroscopy

check for updates

Citation: Carcione, F.; Defeo, G.A.; Galli, I.; Bartalini, S.; Mazzotti, D. Material Circularity: A Novel Method for Biobased Carbon Quantification of Leather, Artificial Leather, and Trendy Alternatives. *Coatings* **2023**, *13*, 892. https://doi.org/10.3390/coatings13050892

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1. Introduction

Global warming was internationally recognized under the Kyoto treaty protocol signed in December 1997 urging state parties to commit to the reduction of greenhouse gasses. This imposed on all sectors the need for a net CO_2 reduction, so as to achieve the goal of keeping a global temperature rise under control. Specifically, during COP21 the Paris agreement was adopted, establishing the goal to limit global warming to "well below 2 degrees Celsius, preferably 1.5 degrees Celsius below pre-industrial levels" [1]. During the COP26 conference in Glasgow, the Paris agreement parameters were strengthened, while recognizing that "limiting global warming to 1.5 °C requires rapid, deep, and sustained reductions in global greenhouse gas emissions, including reducing global carbon dioxide emissions by 45 per cent by 2030 relative to the 2010 level and to achieve net zero around mid-century, as well as deep reductions in other greenhouse gasses" [2]. These targets can only be reached by a net limitation of fossil carbon, such as petrol, natural gas and coal, not only as energy resources but as raw materials for each industrial sector. Among the many emerging concepts, the "bioeconomy" is perfectly aligned to the net zero scope. In 2012 it was defined by the European Commission as "the production of renewable biological resources and their conversion and waste into products with high added value,

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Bio-based content on fashion materials

“Vegetarian”

“Plant-based”

“Eco-sustainable / cruelty free”

“Biocircular”

Bio-based content on fashion materials

“Circular – by product of food industry”

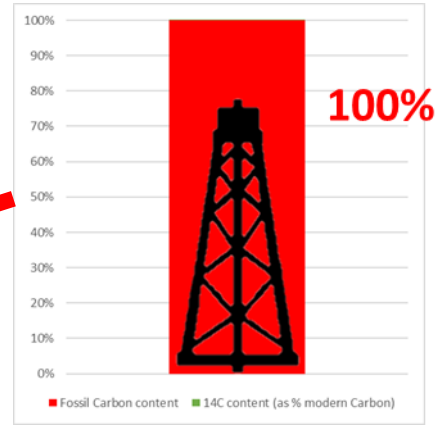
“Vacchetta produced with traditional Veg tanning”

“XVII century Leather process”

Bio-based content on fashion materials

“Vegetarian”

*No leather, feathers, fur or skins. We are a vegetarian company, which means no animals are killed for our products. None of our products contain leather, feathers, fur or exotic skins – and none of the glues used in our shoes or bags come from animals… **



100% Fossil carbon ≡ 0% Bio-based

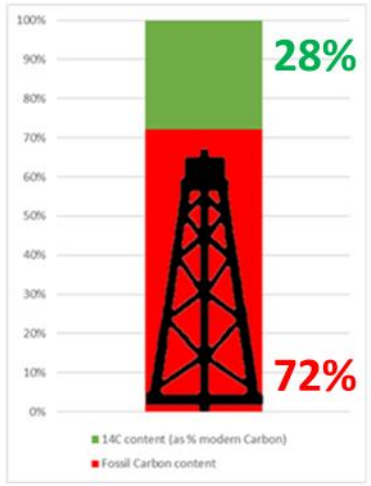
* From the manufacturer's website.

Bio-based content on fashion materials

“Plant-based”

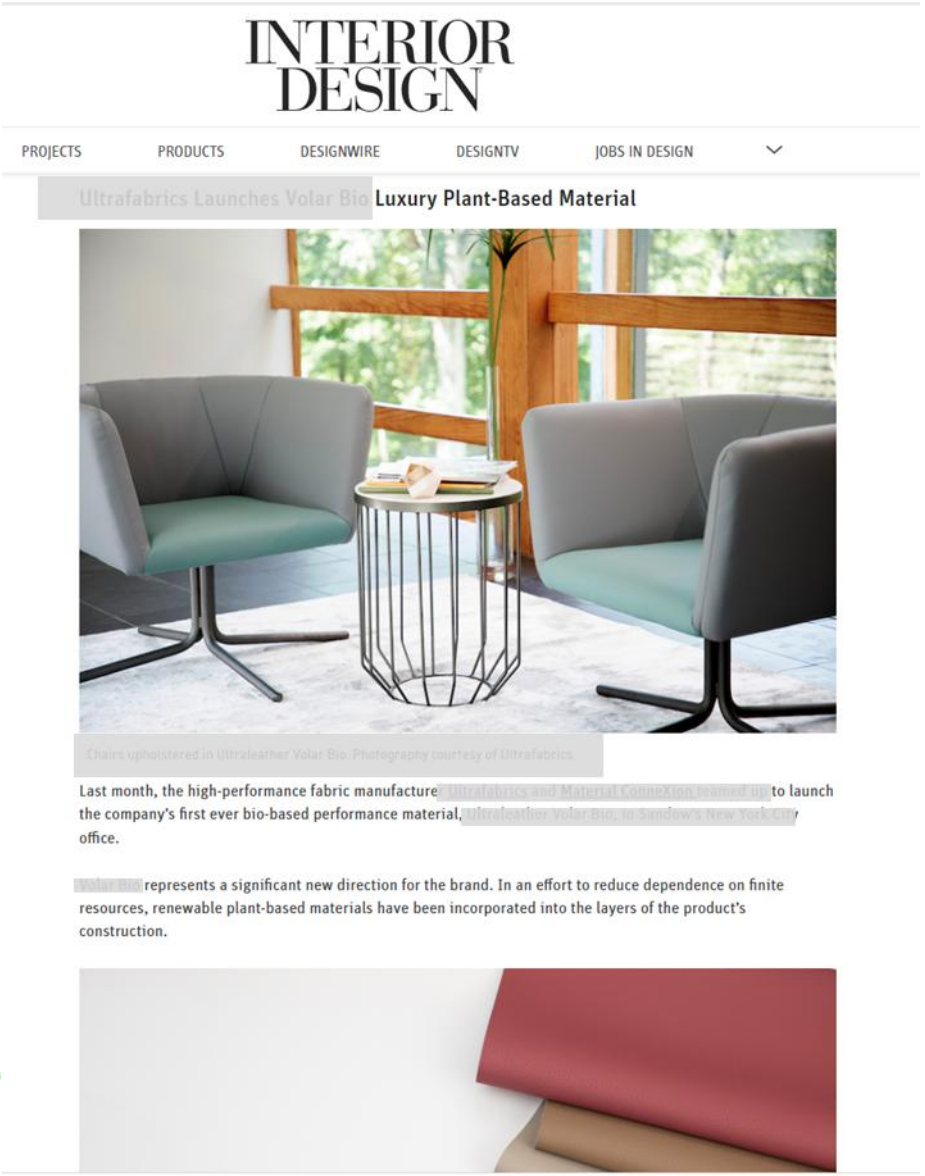
This material is called a luxury plant-based material.

Our analysis reported that the material contains 28% bio-based carbon (i.e. 72% fossil carbon).



This data is confirmed by the certification of the USDA BioPreferred® program on the producers’ website.

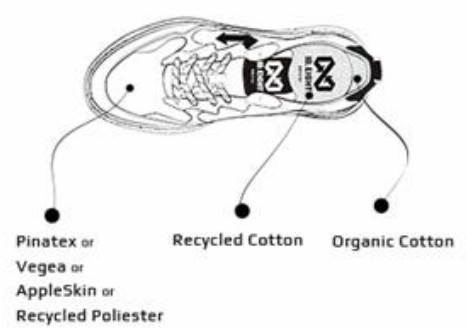
72% Fossil carbon ≡ 28% Bio-base

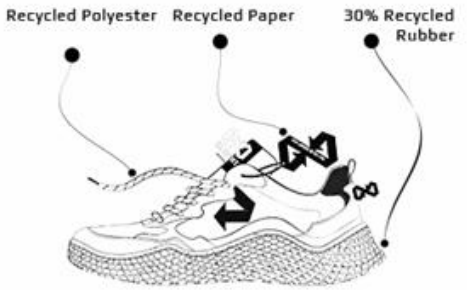


Bio-based content on fashion materials

“Eco-sustainable / cruelty free”

*...the project of eco-sustainable sneakers, made with waste from the food industry and recycled materials. The goal is to launch on the market a footwear with low environmental impact, made in Italy, made with innovative and eco-sustainable materials...**





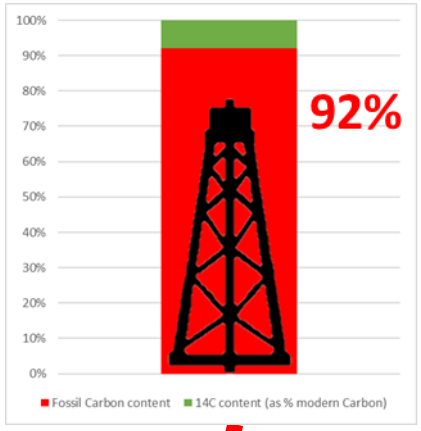
Why do we use recycled polyester and appleskin?

In recent years, the amount of agri-food waste used to make sustainable products has increased from 0 to over 30 tons per month. **Appleskin is one of them, derived from the polymerization of apple peels and cores.**

* From the manufacturer's website.

Bio-based content on fashion materials

"Eco-sustainable / cruelty free"



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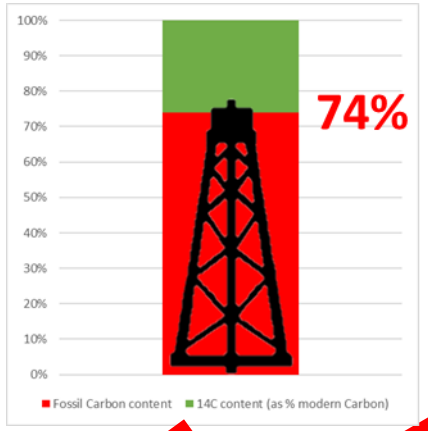

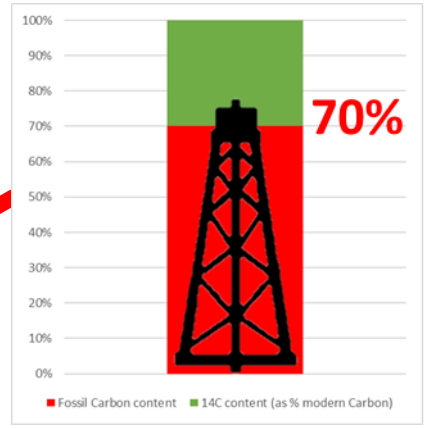

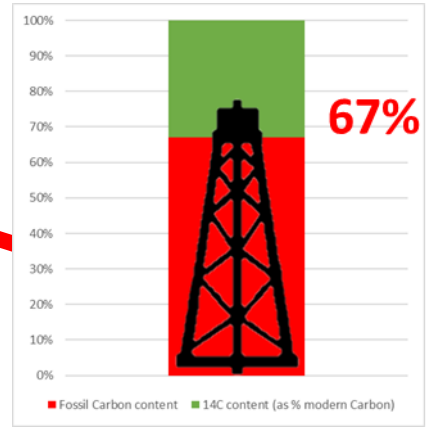

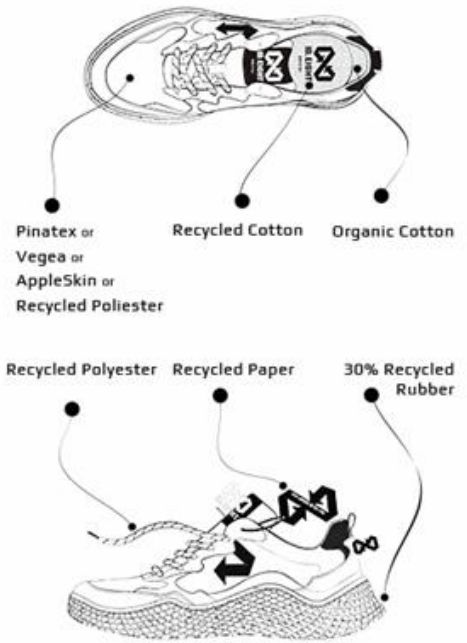

92% Fossil carbon ≡ 8% Bio-based
74% Fossil carbon ≡ 26% Bio-based
70% Fossil carbon ≡ 30% Bio-based
67% Fossil carbon ≡ 33% Bio-based

* Non homogeneous material

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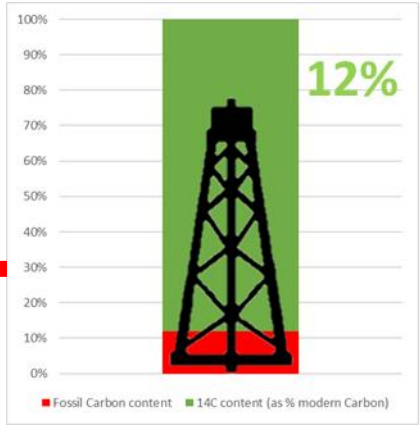
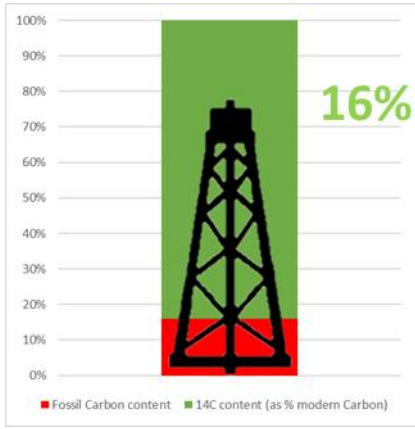
Bio-based content on fashion materials

"Biocircular"

Leather processed with plant-based chemicals



12% Fossil carbon ≡ 88% Bio-based
16% Fossil carbon ≡ 84% Bio-based



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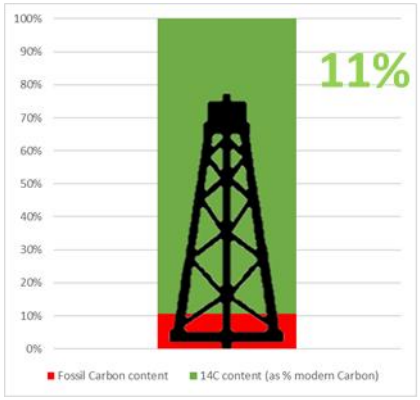
“Circular – by product of food industry”



11% Fossil carbon ≡ 89% Bio-based

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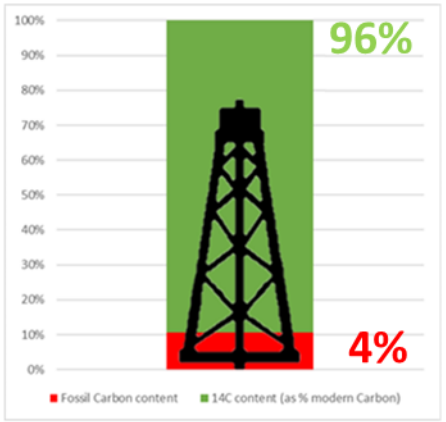
“Vacchetta produced with traditional Veg tanning”



4% Fossil carbon ≡ 96% Bio-based

«Vacchetta Toiano" produced according to the regulations of the "Consorzio Vera Pelle Italiana Conciata al Vegetale"

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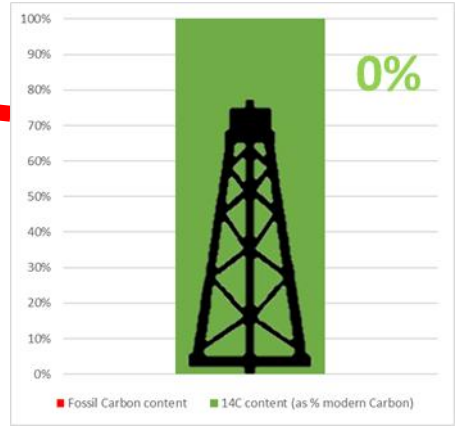
"XVII century Leather process"

XVIIth Century process Chestnut tanned tallow / degràs fatliquored leather prepared for a museum…



0% Fossil carbon ≡ 100% Bio-based

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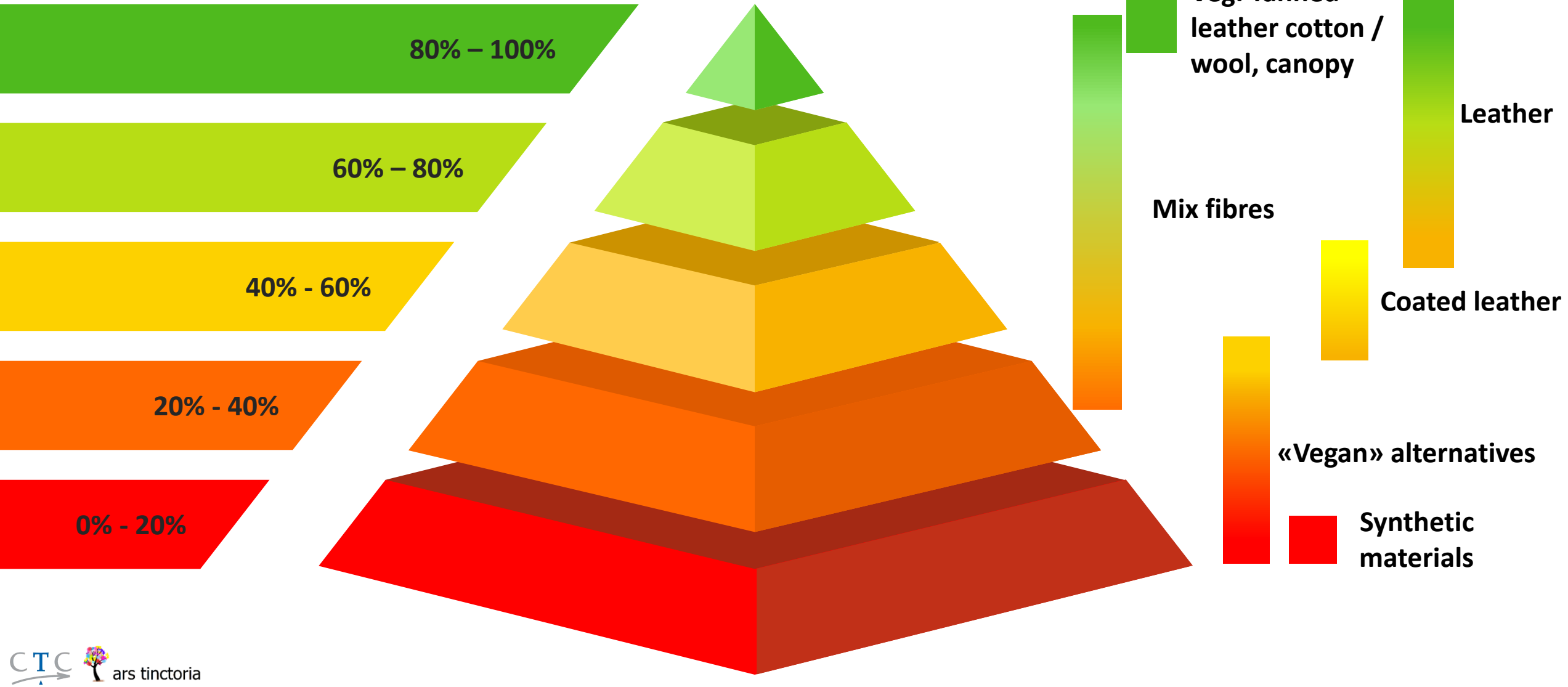

Thank you for your attention

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