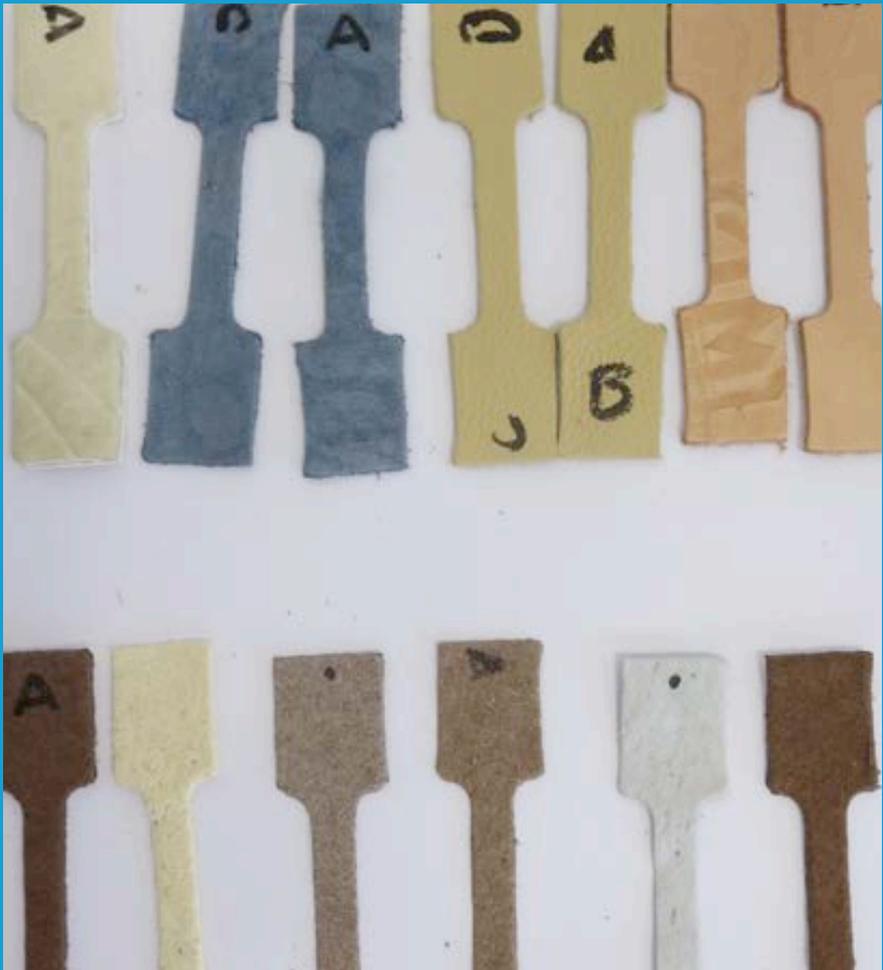


Circular Taxidermia

Friedemann Schaber



Title	2
Background and Motivation	2
Submission Details	3
Aims and Objectives	4
Submission Details	5
Additional Statement	5
Research Context	7
Research Questions	7
Research Methodology	9
Research Outcomes	11
Insights	44
Dissemination	48
Bibliography	50

Figure 1. (cover)
Tensile testing of leather and
collagenic fibres at ICLT

Title

Circular Taxidermia, or a new approach in the arrangement of skin τάξις (táxis, "arrangement", "order") + δέρμα (derma, "skin"); circular = systems thinking in line with UN Sustainable Development Goals

Background and Motivation

Leather is a natural, sustainable material with unique properties when properly made and sourced. The research sets out to explore and evaluate innovative uses of leather, whilst being based in the East Midlands of England in an industrial town with a tradition in leather processing and the making of footwear, which provided a supportive environment to undertake the prototyping of artefacts that will showcase new possibilities. At the same time, the research interrogates knowledge transfer with communities of practice associated with a particular material, probing the interplay between craft traditions and innovation, and demonstrating the scope for 'New Product Development'. Working closely aligned with a cluster, the research aims to shed light on the contribution of design and networks to give a future to the British leather industry. It does this principally by mapping the interactions of emerging design talent and established RCA alumni with Northampton shoemakers, apparel, the Leathersellers Company and Scottish tanneries producing automotive leather.

Submission Details

Researcher	Friedemann Schaber
Collaborators	Staff and facilities at The School of Design, Royal College of Art London (RCA) where part-time PhD Research was conducted and situated. Staff and facilities at the Institute for Creative Leather Technologies (ICLT) at the University of Northampton, where prototypes were made and tested. Staff and facilities at D-Lab, Kyoto Institute of Technology where material experiments were undertaken and a handbook was created; during a scholarship and fieldwork in Japan.
Title	Circular Taxidermia
Output Type	Artefact
Output Component(s)	Body of work, including artefacts, diagrams and glossaries
Dates	2012-2020
ORCID	https://orcid.org/0000-0002-9479-706X
DOI	https://doi.org/10.24339/m0ad-hv43

Aims and Objectives

The Aims and Objectives for this project by practice include future applied design capabilities for leather as a material within the circular economy, and with the upcycling and recycling potential, focusing on gaps in understanding leather and the technology of leathermaking. The application of leather and collagenic fibres in the design process were shown as artefacts as part of the practice. The research “demonstrates how tacit knowledge can be employed, observed and created in a methodical way, with new artefacts playing a role in provoking insights based on tacit understanding” (Rust 2007).

The situated learning has been captured through material experiments, photographic records and a handbook of terms and processes, which has become central to the research. The focus is about a systematic and contextual study of leather material, and its application and intersection with the automotive industry, looked at through case studies and exploration via practice. The end prototypes, ranging from chrome-based, zirconium tanned, vegetable tanned, and engineered composites material will be as an exemplar of what could be done going forward to innovate the material and to safeguard this ancient community of practice.

Submission Details

Application of leather and collagenic fibres developed in practice, that led to a curated display of artefacts as part of the practice including handbooks, models, test rigs, experiments, tableaus, swatch books, and photographic output.

Exhibition of artefacts

2018 Schaber, F. Conductive Leather. Work in Progress Show. Henry Moore Gallery, Royal College of Art, London

2019 Schaber, F. collagenic fibres. Work in Progress Show. Henry Moore Gallery, Royal College of Art, London

Talk at a symposium

2018 Schaber, F. Advanced Textiles for Health and Wellbeing Symposium. Royal College of Art, London

Leather glossary - handbook of terms and processes.

Japan Handbook

Additional Statement

The purpose of this research by practice determines how leather can be used as a sustainable material of choice for the future. Using a design-led methodology, this research develops knowledge for guidelines for sustainable practice in this traditional industry, to make leather a material of choice for sustainable future consumer experiences and manufacturing. This investigation updates and re-evaluates old practices of handling leather and presents modern practices using alternative tanning methods, digital manufacturing and upcycling leather wastes into bonded collagenic fibres which address the end-of-life directive in the automotive industry. This portfolio entails the practice of my research. Through the means of curated artefacts, handbooks and diagrams; it proposes leather as an eco-informed material choice (Ashby 2009), and it introduces new practices to the

catalogue of working with leather (Waterer 1946, Amberg 2018).

My methods address the future of leather by undertaking detailed observations of practice through fieldwork in the UK, Italy and Japan. Also, by prototyping circular practices using leather through hands-on investigation in a design laboratory and tannery environment.

My findings identified collaborative communities which were drawn out in three areas: an actor network map, a leather processing diagram with closed loops and an atlas of locations of leathermaking. I produced a framework and an accompanying glossary to inform future practice with leather, including composite fabrication and digital manufacturing. In the practice part of this research, several artefacts have been created, demonstrating a potential process for undertaking 'circular' product design. A body of findings resulting from this research were categorised and presented in guidelines aimed at supporting future practice. Physical leather samples and upcycled composite materials from leather shaving waste tested the validity of the guidelines. Here, the studies demonstrate circular systems for production and reclaiming production by-products, through experiment and prototyping. An outcome of this research highlights the relevance of leather as a material for the circular economy – this is communicated through a handbook that illustrates terms and processes, which it is hoped will inspire makers and users.

Research Context

The value of this research for design practice is in its exploration of sustainable manufacturing methods and uses of leather, exemplified by providing samples, as well as the creation of the illustrated handbook.

For the academic community, its consideration lies in developing design and reframing the position of leather and its by-products in the circular economy, which unlocks value from the reuse, repair, remanufacture, retrieval and recycling of products, components and materials.

Research Questions

How can leather be used as a sustainable material of choice for the future?

How can design thinking create an impact and make an ageing industry like leather relevant once more?

And, asking a question related to Experiential Knowledge (Nidderer 2015; Fisher 2017), how will emerging technologies affect practices (around leather products) from the designer and the user perspective? Which led me to experiment with digital techniques, composites fabrication and alternative tannages.

The research questions emerged from previous iterations: Can leathers be produced to respond to increasing or changing usage? Is there a future for leather in the circular economy? What can the leather industry do to avoid becoming just another commodity? Leather and sustainable communities – can we empower communities through 'making' and participating in the leather value chain? The research illustrates the need for the UK to exploit its creative capabilities – as identified by The Cox Review of Creativity in Business (2005). There is a lack of interrogation of how emerging technology affect leather practices from the designer and the user perspective.

Research Methodology

The methodology employed to answer the research question of how leather can be used as a sustainable material of choice for the future. The methods will address the future of leather through 1) observations (fieldwork) in the UK, Italy and Japan. 2) Development of a circular practice of using leather through the prototyping of leather through action research situated in a design laboratory and tannery setting.

Research methods include ethnography, participant observation in a fieldwork context, prototyping and curation. Links between the textual and practical components of this research are discussed in the context of my PhD by Project that presents the research phases, including data collection and analysis methods.

In the research, I devised projects to find solutions to systemic environmental challenges, as outlined in the UN's Sustainable Development Goals. Other projects around defined applications such as 'cutting out waste' led to the experimental use of digital fabrication, laser engraving and cutting, digital nesting and tessellating, embossing and debossing with rapid prototyped dyes and pattern stamps, screen printing circuitry onto substrate and a wide range of artefacts.

Participant-observation provides 'Ethnography', that describes the findings from several field work undertaken in locations both in the U.K. and in Japan amongst leather manufacturers, in some cases by interacting with practitioners. In Japan I undertook observations in districts where tanneries cluster and two locations relating to manufacturing, design and retail. Following Bound (1999), I undertook photographic recording and some observations of practitioners. Furthermore, field work was undertaken in locations of leather manufacture and interacting with practitioners, so to shed light on the contribution of design and networks in the transformation of the shoe and leather industry.



Figure 2.
Goatskin. Deep 3D
effect through calcium
chloride applied in a
screenprinting process

Developing circular practices of using leather through prototyping, my early investigation led to the creation of artefacts from leather off-cuts and waste, using techniques of nesting and tessellation. Considerations were taken of scars and defects of the animal skin and processes to conceal or to enhance these characteristics with techniques such as pull-up effect and distressing. There was a focus on user perception of a sustainable material that mellows and ages gracefully.

Observation of the practice of designers from the Royal College of Art led to the subsequent exploration of smart material properties through the introduction of sensory and conductive capabilities into leather. This was initiated by participating in the 'Bare Conductive' workshop (Johnson 2013). Through practice-led research, exemplary prototypes were presented using recently developed technologies such as rapid prototyping and artefacts, that when used and tested, reveal new ideas and research opportunities. I developed through practice a knowledge base for leather and requirements for potential applications and explained this through diagrams. These are included in a glossary / handbook where research and practice converge. The illustrated handbook codifies my tacit practice.

Research Outcomes

1. Processes

Gaining subject knowledge (leather craft, processing, collagenic materials chemistry) through 'leather appreciation' courses at ICLT in 2012 and 2017. Undertake material testing and scanning electron microscopy of collagenic fibres

2. The field study

Qualitative survey of leather industry and supply chain, initially Northampton and Walsall based leather goods manufacture, then global tanners, manufacturers and educational research institutes, as follows:

UK: Northamptonshire archives and companies 2011-2020

Investigation based in the East Midlands of England in an industrial district with a tradition in leather processing and the making of footwear, which provided a supportive environment to undertake the prototyping of artefacts. Museum of Leathercraft, Northampton Shoe Museum, ICLT, and Shoe manufacturers Churchs, John Lobb, Doc Martens, Crockett-Jones, Trickers. Findings resulted in book chapter for Springer 2019

UK: London based designers and makers, Leathersellers Hall St Helens, City of London

2009-2018 Recorded in conferences and exhibitions section, some of which precede Ph D studies. Photo record

UK: West Country leather manufacturers

August 2016 – fieldwork; site visit to Pittards Tannery in Yeovil and Baker Tannery in Colyton.

January 2018 – fieldwork; site visit to Thomas Ware tannery in Bristol.

India: Chennai

In February 2012, attending the Intl. Leather Fair in Chennai, India and building links with Indian and Italian manufacturers, designers and education institutes; followed by visit to footwear manufacturers with discussion on new product lines, diabetic podiatry and socially responsible design. Workshop and UG assignment on Breadline shoes, presented at conference. Recipient of Chancellors Fellowship and Santander Universities grant to conduct field work in India.

Brazil: Sao Paulo and Novo Hamburgo, Rio Grande do Sul

August - 8 September 2012 - Visit to the Brazilian footwear cluster in Rio Grande do Sul, National Footwear Museum, Courovisao leather trade fair, sustainability forum and various universities in Novo Hamburgo, Sao Paulo and Porto Alegre.

3-6 September 2013 - I C D H S, 8th Conference of the International Committee for Design History and Design Studies DESIGN | FRONTIERS in Sao Paulo with paper presentation titled: History, Design and Technology in the Leather Trade - Case Studies from India and Britain. Published in the conference proceedings. Photo record

Italy: Arzignano, Torino

Fieldwork to Europe's foremost leather district, including several factory visits and a leather finishing training course in Arzignano, a tannery cluster in Veneto Province, Italy (13-18 May 2012) Visit to the National Automotive Museum in Turin and a manufacturer of vegetable tannin agents in Piedmont. Photo record

Netherlands: Waalwijk and Dongen

June 2017 visit to leather conference (Freiberger Ledertage) and Dutch cluster of leather and chemicals companies. ECCO, Stahl, and leather education Boxtel and SLEM Waalwijk. Photo record

Japan 1: Tokyo, Himeji, Kyoto

September 2013 – Fieldwork in Japan with visit to leather cluster and Hyogo Prefectural Museum; visited tanners in Himeji including Mr. Kashiwa and the tanneries of Jun Kawaguchi, Sayonan Co and the Kyoshin Co. Excursion facilitated by Photographer Prof Katsushi Hasegawa and Prof Yuko Nishimura. Kyoto Museum of Traditional Crafts "FUREAIKAN", meeting place of industry, culture, people and traditional techniques

Japan 2 Kyoto, Tatsuno, Nara, Nagoya, Gifu

31 January - 31 March 2018 - Scholarship at Kyoto Institute of Technology. At the materials science department I undertook composites fabrication with shavings from leather production waste, appropriating the Washi Japanese paper making process and recorded initial results and adhesion achieved. Optimised fibre composition and fibre size in collaboration with materials scientists and technicians.

Summary:

- * Gained knowledge of research methodologies, current and future trends in product, automotive and interior design, fashion and accessories, by attending relevant trade fairs and conferences.
- * Investigated the conceptual ideas necessary for prototypes.

3. Objects**4. Diagrams****5. Handbook**



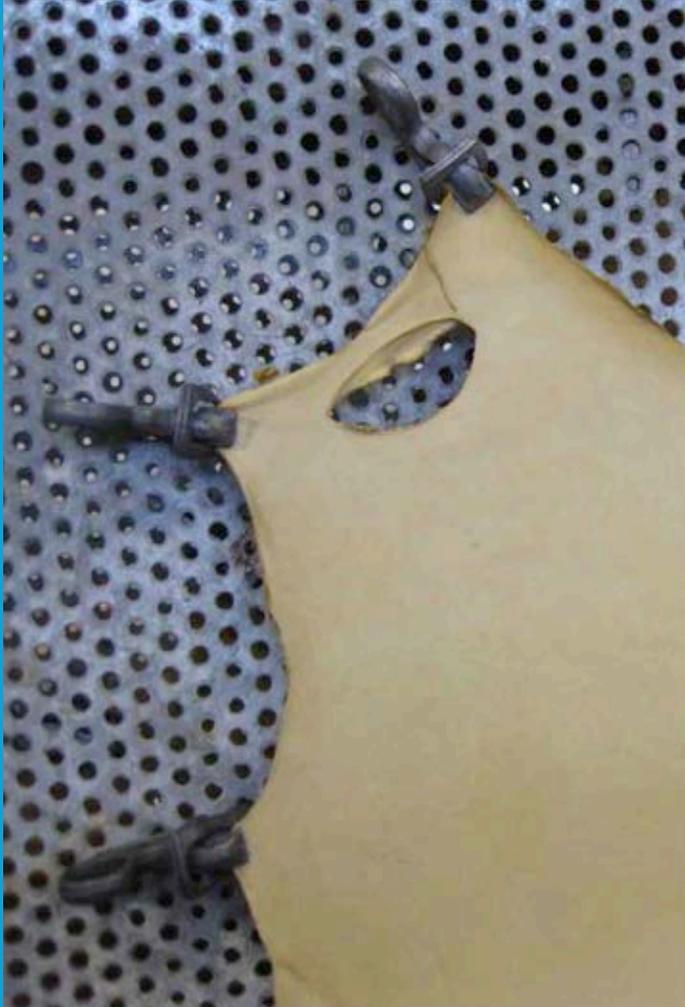
3

Figure 3.
Coating and stabilising of sample
from leather waste fibres



4

Figure 4.
Processing and application of foil to
sample from leather waste fibres



5

Figure 5.
Leather finishing processes. Rawhide
in a toggle frame. Cover image for
Handbook of Processes and Practices.



6

Figure 6.
Plant Matter (Waste) as Tannins. Tanning
experiments at ICLT on the reuse of plant
waste - Alternative tannages from plant
matter, farm and forestry waste that
contain phenolic tannins.



Figure 7.
Experimental tanning of rawhide with apple pulp, alder tree and foliage, chestnut and cherry tree shavings and bark, hop plant waste and mulberry.

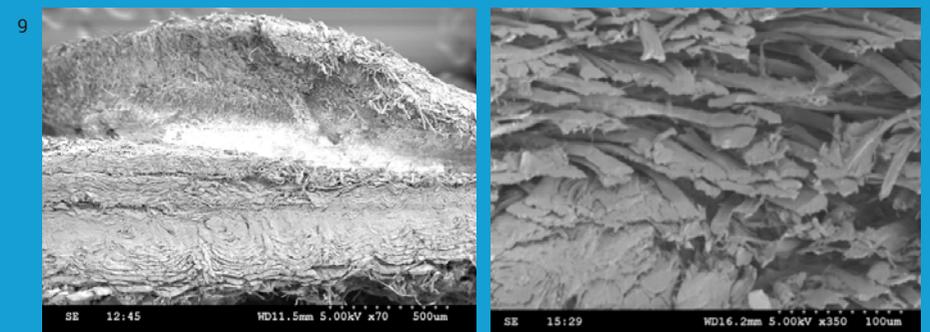


Figure 8. Scanning Electron Microscopy at ICLT.

Figure 9. Fish skin sample

Figure 10. Sample made from leather shaving waste fibres



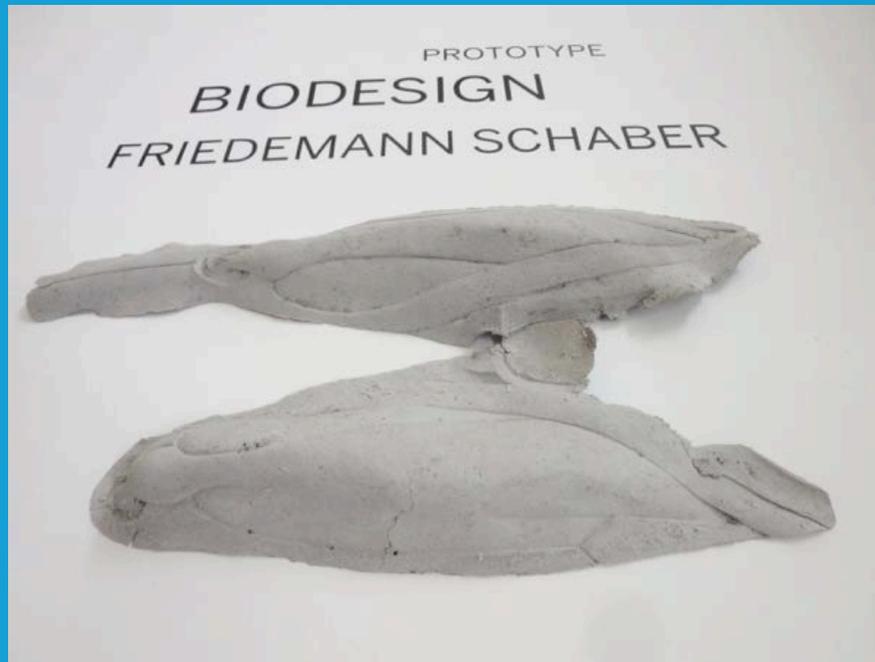
11



12

Figure 11.
Experimental application of calcium
chloride through screenprinting process

Figure 12.
Goatskin. Deep 3D effect through calcium
chloride applied in a screenprinting process



13

Figure 13.

Fabrication from leather fibres. Mouldmaking and spray coating application of collagenous fibres with and without resins, binders and foils for upscaling of production, on display at RCA WIP 2019.

14

**Figure 14.**

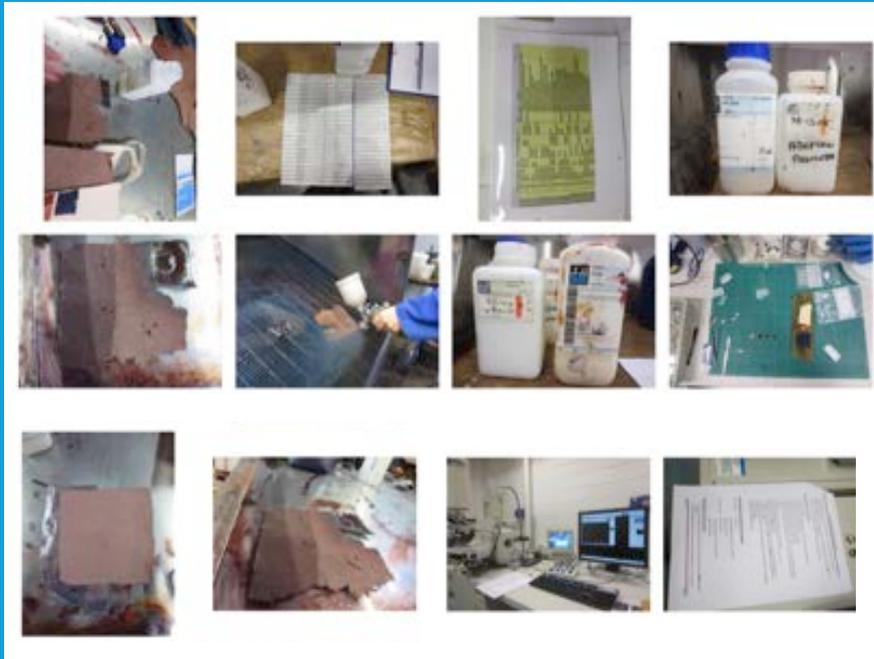
Material experiments in Japan

a) A prototype of composite material from collagenic fibres and mulberry (koko) fibres. The processes including the blending of leather fibres from production waste with a plant fibre Japanese koko, optimising fibre composition towards a bio-composite,
b) A prototype of composite material from collagenic fibres with palm oil fibres, from another waste stream, investigating the

creative and commercial potential of blended natural fibres.

c) A prototype of collagenic fibres laminated with biodegradable polylactide, experiment to strengthen the fibres, towards new systems that I have devised to use leather waste and offcuts.

d) A prototype of collagenic composite materials using plant-based starches experiment to use biodegradable binders.



15

Figure 15.

Material experiments in Northampton
 Creation and coating of composite
 material from collagenic fibres
 including the blending of leather fibres
 from production waste. Application of
 films, foils and biodegradable resins
 to strengthen the fibres, towards new
 systems that I have devised to use leather
 waste and offcuts

16



17

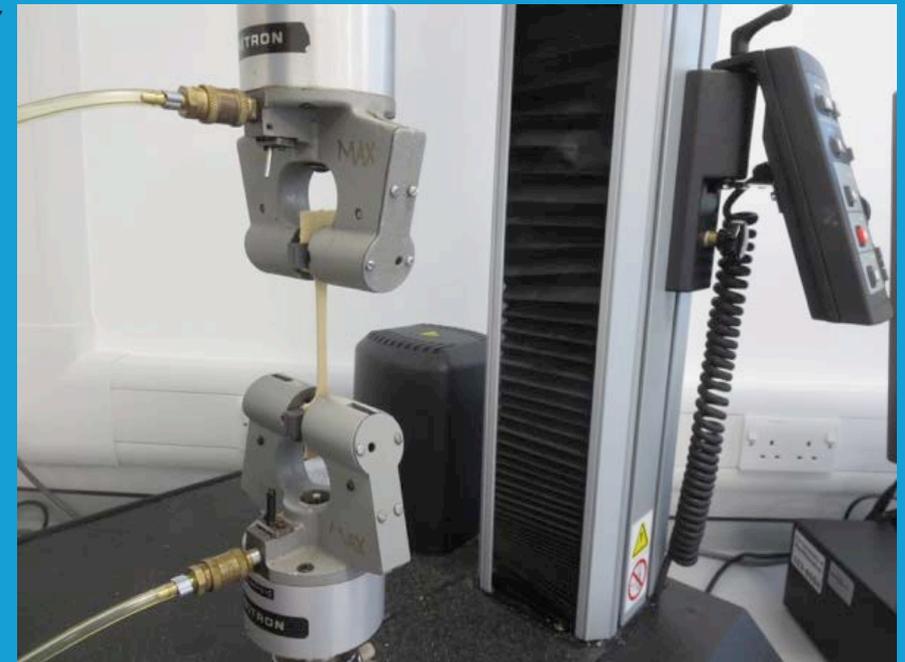


Figure 16 & 17.

Tensile testing of leather and collagenic
 fibres at ICLT



18



19

20

**Figure 18.**

Off-cuts from Walsall saddleries. Designing waste out. The practice is reframing the position of leather and its by-products in the circular economy, which unlocks value from the reuse, repair, remanufacture, retrieval and recycling of products, components and materials.

Figure 19.

Artefact. Laminated off-cuts from Walsall saddleries.

Figure 20.

Fieldwork in Japan. Urushi manufacture in Kyoto. A natural resin traditionally used for the coating of leathersgoods

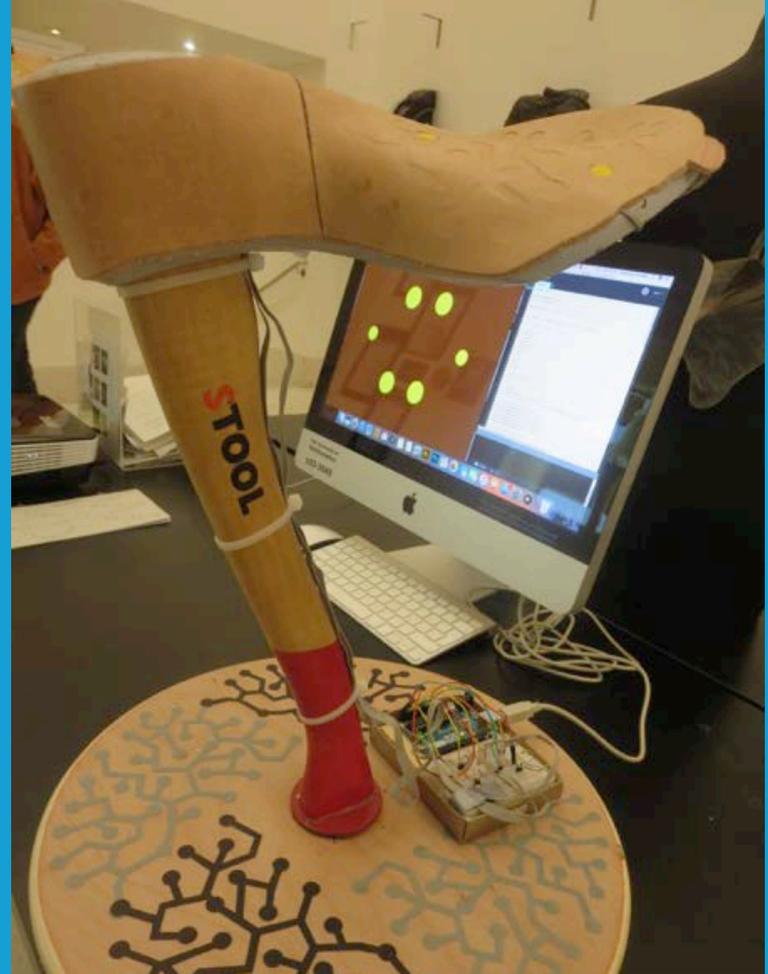


21

Figure 21. Prototype of a Despatch Box (300x240x120) featuring a distressed finish, scars and surface defects; demonstrating leather material that ages gracefully. RCA Design Biennale Exhibition 2013



22



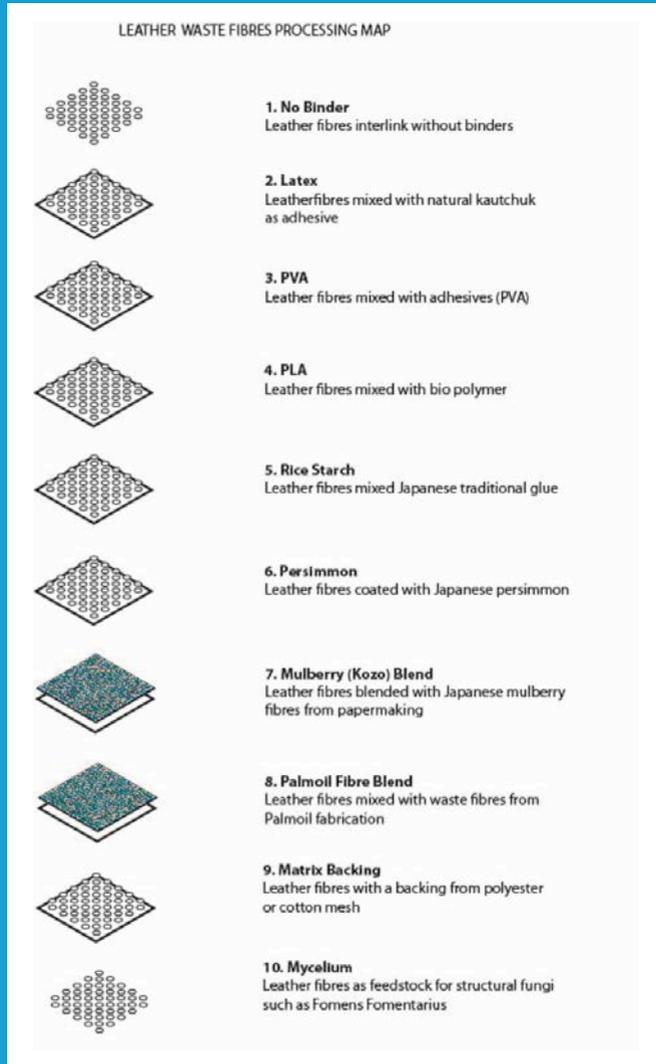
23

Figure 22. Saddle covered in alternative tanned leather from plant matter. Physical leather samples and upcycled composite materials from leather shaving waste tested the validity of guidelines of how leather can be used as a material of choice. Here, the final projects demonstrate circular systems for production and reclaiming production by-products, through experiment and prototyping.

Figure 23. Saddle/Seat with force sensors embedded in vegetable tanned embossed cowhide and wired to Arduino Micro Controller, displaying pressure distribution, with potential benefits for posture and health. RCA WIP Show.

Figure 24. (next page) RCA WIP Show.

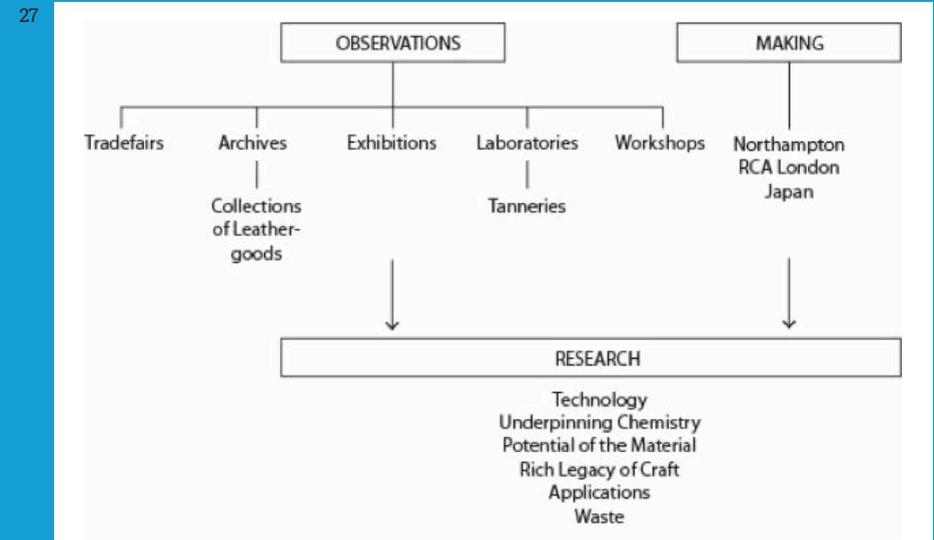




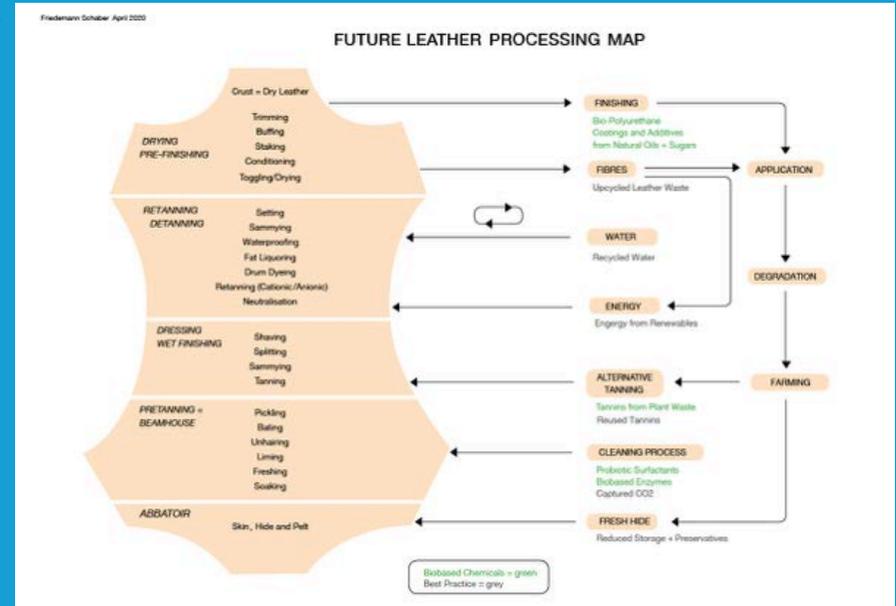
26

Figure 26. Creation of Bonded Fibres from Leather Waste

There are considerable environmental benefits by using leather, by-products and waste efficiently, with material samples created at the Fibro Science Lab at Kyoto Institute of Technology,



27



28

Figure 27. Design research methods employed in the study

Figure 28. Leather processing map towards closed loops and the circular economy

Hop & Coffee Leather

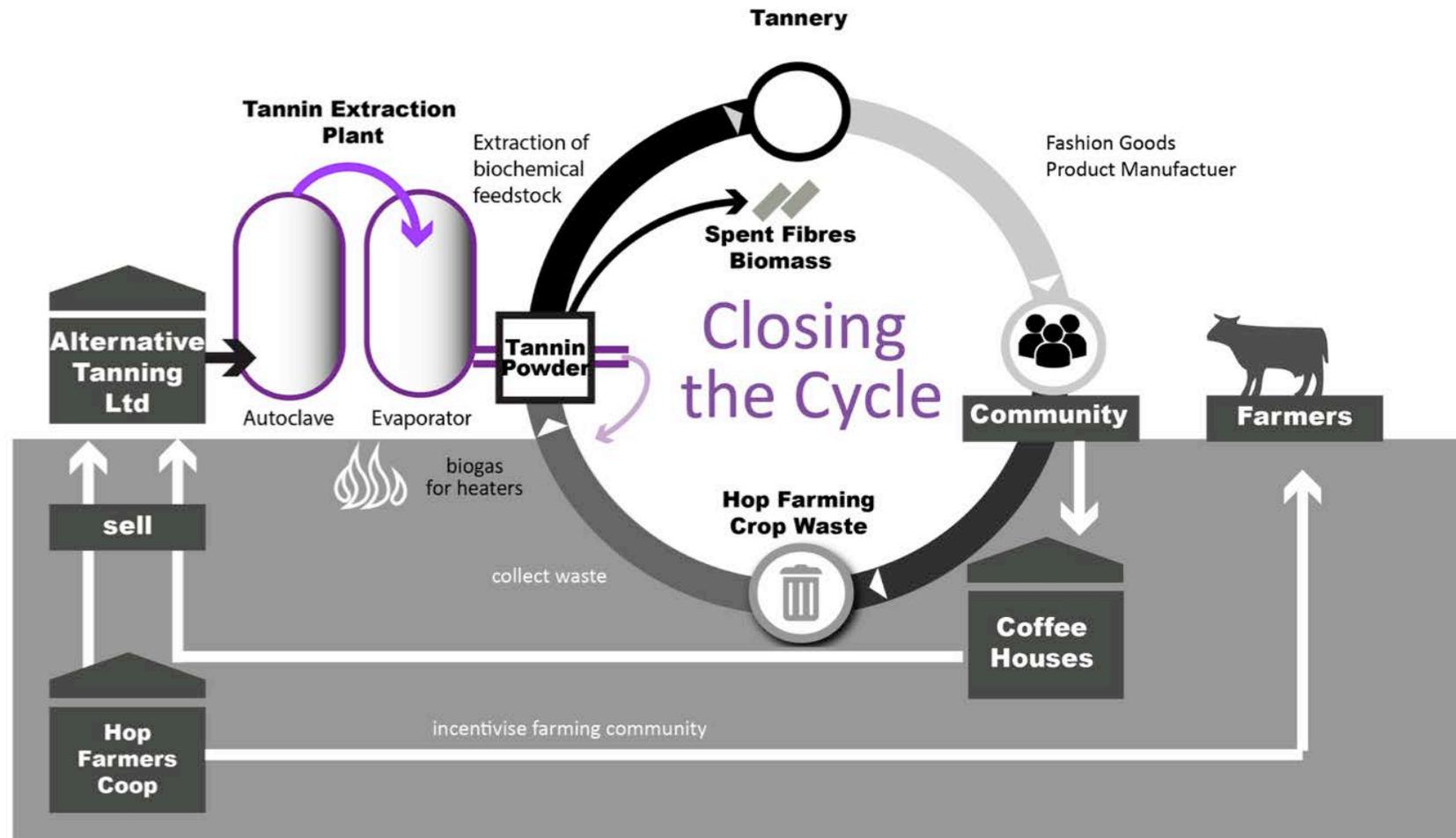


Figure 30. Valorisation of waste from beverage industries (coffee ground and hop for brewing) as vegetable tanning agent

Contents

001.	Accessories	042.	Exotics	085.	Suede
002.	Aldehyde	043.	Fat liquors	086.	Supply chain, OEM, Tier One, Tier Two
003.	Alternative tannages	044.	Finishing	087.	Sustainability
004.	Alum, Aluminium tannage	045.	Footwear	088.	Tanning, tannins
005.	Aniline leather	046.	Fur	089.	Testing, tear strength, tensile strength, elongation
006.	Animal	047.	Garment: Cationic finishing of fashion articles	090.	Titanium tannage
007.	Animal Welfare	048.	Genotyping	091.	Topcoat
008.	Anionic pigments	049.	Glazing	092.	Traceability
009.	Artico leather	050.	Glove	093.	Trade Organisations and Regulatory Bodies
010.	Authenticity	051.	Grain	094.	Trend forecasting
011.	Automotive leather	052.	Handle	095.	Vegetable tanning
012.	Bead tanning, water free	053.	Hide	096.	Wet blue
013.	Beam house	054.	Imitation, faux	097.	Wet white
014.	Biofabrication	055.	Injection moulding	098.	Yield
015.	Biopolymers	056.	Innovation,	099.	Zirconium
016.	Boarding	057.	Intellectual property IP		
017.	Brand	058.	Knowledge transfer		
018.	Bycast	059.	Leather		
019.	Chamois	060.	Leather manufacturing		
020.	Chrome tanning	061.	Light fastness		
021.	Collagen	062.	Luxury goods		
022.	Collagen Silicate	063.	Nappa		
	Composites	064.	Nubuck		
023.	Color and Trim	065.	Olive tannage		
024.	Composites, e-leather	066.	Panel sizes		
025.	Conductivity	067.	Parchment, vellum		
026.	Connollisation	068.	Performance properties		
027.	Corium, Corium Club	069.	PETA		
028.	Corrected grain	070.	Pickle		
029.	Craft, skills	071.	Pigment		
030.	CSR Corporate Social Responsibility	072.	Polyurethane resins		
031.	Cuir Bulli	073.	Proof of Concept		
032.	Design	074.	Pull-up		
033.	DNA labelling	075.	Rawskin		
034.	Drum	076.	REACH		
035.	Dye	077.	Retanning		
036.	Eco Label	078.	Semi aniline		
037.	Effluence, Common Effluent Treatment Plant	079.	Sewing and stitching		
038.	Embossing	080.	Smart material, research		
039.	End-of-life regulations	081.	Smell		
040.	Enzyme	082.	Snuffing		
041.	Epidermis	083.	Specification		
		084.	Split leather		

Figure 31.
Handbook of Processes and Practices.

Glossary list of contents. 99 terms and processes from Accessories to Zirconium

Introduction and scope

This illustrated glossary contains 99 entries of relevant terms and processes from Accessories to Zirconium Tannage. It contains a small working vocabulary and definitions in alphabetical order. It also covers a list of leather trade locations where fieldwork has been undertaken and introduces communities of practice, i.e. practitioners. It is an outcome of research undertaken on new and innovative uses of leather. It is also an output of doctoral studies undertaken at the Royal College of Art and workshops participated at the University of Northampton from 2011 to 2012. The glossary handbook defines terms, conventions and processes for a non-expert community that appreciates, works with and uses leather. The glossary aims to guide designers and help them to disseminate this knowledge to consumers. In doing so, the author is engaging with the leather trade and is negotiating/claritying somewhat different use of terms and conventions by various communities of practice. Illustrations such as photographic images, diagrams and graphics are visualising data, giving insights and communicating specific manufacturing and chemical processes. In an exhibition, material swatches will accompany the glossary. The glossary is envisaged in other languages: Italian, French, German, Chinese and Spanish, with the glossary acting as a dictionary. Previously, the 'International Glossary of Leather Terms' has been prepared by the International Council of Tanners to serve the needs of the leather producing industry, of all users of leather and the public using leather throughout the world. The scope of the glossary is governed by the following principles: The terms included are all of potential interest to tanners, and/or their customers, and/or the general public. Terms, the meaning of which is self-evident (eg. football leather, upholstery leather etc.) are not included. In the 'International Glossary of Leather Terms' processing terms are not included, except for a very few terms which it was necessary to define in order to clarify the definition of a type of leather. Primarily this glossary will include and illustrate processes and terms to do with leather in mobility and design led applications. The larger section with around 100 entries in alphabetical order features key concepts and processes in the leather trade. The author encountered these

32

34

Animal

The source of skins, commonly from mammals, as opposed to birds, reptiles, fish, or insects. An animal is a living organism which feeds on organic matter. Typically being distinguished from algae and certain forms of plants and fungi. The term is used to describe any animal and leather is a by-product. With exception to insects, they are generally of low value to the farmer. They are domesticated for a range of the main sources of skins. There are further specified and listed as rabbits, wild, cow, pig, dog, sheep, horses, beaver, birds, etc. and also kangaroo or deer, which is often used as a synonym for the leather industry word used as cattle, sheep and goats, which are usually specified by the product of most used and dairy products. Typically, the value of cattle hides, sheep and goat skins represents in the region of 5-15% of the market value of an animal. The leather industry values hides and skins which would, if the industry did not exist to process them, create a waste disposal problem for the abattoir health hazards. Sustainability of production is fundamental value for the global leather industry of Europe as stated by the International Council of Tanners (ICTI). The source of animal skins from which the industry raw material derives, in every continent of the world is conducted on a large scale. Production of Animals on Farms, Pesticides during transportation of animals, Production of animals at the time of slaughter and killing of animals for their skins, etc.

Artico leather

A new generation of evanescent leather used by Mercedes is called 'Artico leather' with the added content of 'nanomaterials'. The material description does not appear to be in compliance with EU standards. <https://www.mercedes.com/artico>

Authenticity

The quality of being authentic. Spontaneous, genuine, original, reliability, dependability, trustworthiness, truth, sincerity, faithfulness, loyalty, authenticity, credibility. Oxford dictionaries, Walter Benjamin (1936) states that the presence of the original in the process by the concept of authenticity, and that work of art is, in principle, has always been 'unavailable' and 'irreproducible'. Authenticity is a concept that is often used to describe the quality of being authentic. In the context of emerging digital practice, 'how can we authenticate the digital and how might we address guarantees, the ownership of data, design and claims to uniqueness, in a world of instant copying, sampling, and the total program of images?'

Antionic Pigments

Dispersion mechanisms: Ionic dispersing agents act by coating the surface of the pigments particles as the result of an attraction to the positive charges that develop on particles when in contact with water; a process known as adsorption. Adsorption results in net negative charges to the particle surface so that the particles are repelled from each other. When a mineral is dispersed in water using Dispersing products, the negative charges on the dispersed particles, thus lowering the viscosity of the mineral slurry for a given time. This slurry is then used to build up a very high viscosity of the mineral but has added 0.01-0.02% of Dispersing. Dispersing addition gives the slurry better flow

32

35

Accessories

A small article or item of clothing carried or worn to complement a garment or outfit, such as hats, gloves, bags or shoes. These items are normally made from leather and described as leather goods. In the mid 20th century the term leather fairs goods was used by the trade and designers such as John Walton. <https://www.oxforddictionaries.com/define/leather-accessories>

Aldehyde

Waxes like leather which in its natural state is white, tanned with tannin pigments or other aldehydes, a term in Chemistry, is an organic compound containing the group -CHO, formed by the oxidation of alcohols. Typical aldehydes include methanal, formaldehyde and ethanal (acetaldehyde). Origin in Mid 19th century derived from Latin aldehydum: generum, alcoholis, alcoholis, aldehydum.

Alum, aluminium salts

Tanning is a method that uses alum and aluminium salts, generally in conjunction with other products such as egg yolk, fat, and other salts. The leather becomes based by tanning in a water-potash alum and salt solution. The process increases the leather's pliability, stretchability, and quality. Adding egg yolk and fat is to the standard tanning solution for its emulsified emulsion to help the emulsion in its tanning characteristics. Then, the leather is air-dried (tanned) for several weeks, which allows it to stabilise

Alternative Tannages

Alternative tannages: Olive oil residues have high performance, chrome, chrome substituted tannages.

Aniline

A colourless oily liquid present in coal tar. It is used in the manufacture of dyes, drugs, and plastics, and was the base of the synthetic dye. Origin Mid 19th century from an 'oil' (oil) from which was originally obtained: see French and Portuguese from Arabic anīl (Iran, Spanish anil), from the Sanskrit anīl (China) (originally referring to the thickness of the applied pigment layer, anilī/halī or related to anīl-ānīl). Aniline leather has no pigment based top coloration. Only pigmentation, but has pores still well recognizable. Some aniline <https://www.oxforddictionaries.com/define/aniline>



Figure 32–25. Handbook of Processes and Practices.

An illustrated glossary that sets out to define relevant terms and processes. It adds new practices and clarifies responsible usage of leather for the benefit of designers and users.

Communities of Practice, Informants

Balazs Borzsi, Riccardo Caronzo, David Reisch, Mounir Meghazzeni, Guido Galante, Roberto Caronzo, Roberto Molteni, Yoko Nakamura, Katsuhiko Hasegawa, Paolo Antonio, Wei Wang, Tony Chongbin, Kai-Flavien, Miss Robinson, Dave Sherwood, Paul Evans, Michael van Duynhoven, Jesse, Chris Bernard, Simon Hooper, Julia Lohmann, John Bell, Nick Cooper, Carmen, Hana, Bj Arberg, Mike Hallowell, Stephen J. Johnson, Clara Gonzalez, Steven Dale, Joseph Marshall, Jeffy Lutzke, Stephen, M. Phil, Youssef Flemer, Paul Richardson, Mark Williams, Hans-Joachim, Romy, Nankkula, Jonathan McCoy, George Yin, Peter, Sandra Nelson, Steven Maki, Patrick, Sara, Giles Taylor, Martin Bester, Dakota Paul, Corey Chisell, Henry, William, and Astarik Lattig, Paul Pearson, Franz von der Haese, Sebastian, Basil Karakostas, Chris Laffer, Zoe McLaughlin, Kristine Halderson, Helen Peter Garmann, Peter, Harrie, Michael Barren, Ulla Steiner, Lisa Andreev, Cheong, Pina, Wang.






Insights

Revisiting the research question of *How can leather be used as a sustainable material of choice for the future?*

Through my research, I found traditional practices of making and working with leather, and applied eco strategies of durability, reparability and longevity. Through prototyping I explored and tested modern practices of processing and handling leather.

Through observation, I found that designer's network with leathermakers and leather education and through a collaborative process innovate by way of experimental making and prototyping. Leather chemists devise and follow scientific methods, the technologists apply these. Innovation happened in multiple ways, not only within leather making but through brands that develop a vertical supply chain and integrate leather factories. Through observer participation, it became evident to notice that:

1. The leather industry is affected by developments and movements in the global supply chain, including automotive and luxury goods / apparel.
2. Skills gap; whilst there are country-specific education routes such as work based learning, apprenticeship models are scarce, with few institutions offering access courses, top-up or degrees. It was noted that tannery staff are trained and upskilled by chemical suppliers.
3. The emergence of design 'hothouses and 'appreciation' courses for creatives and opinion makers provided by leather consortia, chemical companies and brands.
4. And leather makers are under an ongoing challenge to respond to environmental pressures and regulations in many locations, with certification processes and consortia to change perceptions of the trade and product, exemplified by Tuscany Vegetable Tanners in Italy, Leather Naturally in the UK, and Hyogo Leather and Tatsuno Leather Corporation in Japan.

Collaborative practice has been demonstrated by me with leather technologists, fibre science and papermaking; it demonstrates the role of leather knowhow. Through the making of prototypes, I have accessed tacit knowledge and I have come to an understanding of how that knowledge has been accessed by material research and creatives.

The prototypes created by me, ranging from chrome-based, zirconium tanned, vegetable tanned and engineered composites material, will be exemplars of what could be done going forward with the research outcomes:

- * Development of a Handbook/Glossary
- * New material and sustainable design solutions of leather and its by-products
- * Extending an understanding of leather in the circular economy

To summarise, I investigated the conceptual ideas necessary for prototypes, questioned social and cultural histories of the material, and perceptions of existing alternatives. I mapped processes of leather making, the usage and outlet, and asked: can new leathers be produced to respond to increasing or changing usage?

The research question posed earlier, entitled as *How will emerging leather materials affect practices (around products) from the designer and the user perspective?* has been explored, and it led to a novel utilisation of waste fibres and leather by-products.

The research aligns with, and critically evaluates an increasing interest in creating, tinkering and designing with new materials (Karana et al. 2015; Rognoli et al. 2015). Of note here is the growing of materials from living organisms (Collett 2017; Myers 2012) and creating active composites by embedding electronics into materials (Vallgård et al. 2016). My contribution to the practices of design is to contribute to a positive social environmental and to economic and political change (Drazin and Küchler 2015).

Overall, the scope of my research is “Leather Futures”, and I have extended the practice of leather processing into “Collagenic Fabrication”. My model includes the terms 3D printing, composites, digital manufacture, smart materials and bio fabrication. In my research, the model has been described through a diagram.

Leather making is a traditional industry and has its own jargon (Covington 2009). Some of the terms are set out in glossaries and more can be found in the British Standards Glossary of Leather Terms. Through review, I have identified a knowledge gap. A contribution to knowledge is the handbook, which is presented as illustrated glossary of terms of leather processing, trade locations and practitioners. The handbook adds glossary terms and updates expressions and practices of leather making. This handbook is a useful resource to a diverse group of stakeholders who are engaged in creating, fabricating, trading and consuming the material.

An output is the creation of a design tool. The handbook, accompanied by physical leather samples, will be a guide for users, designers and manufacturers engaging with the material.

A contribution of this research for design practice is the exploration of sustainable manufacturing methods of leather, exemplified by providing samples. For the academic community, its value lies in developing design considerations and reframing the position of leather and its by-products in the circular economy.

My research offers prototype creation. I investigated several processes including chrome tanned, and vegetable tanned bovine fibres from production waste, optimising fibre composition in collaboration with the materials scientist at Kyoto Institute of Technology and technologists at Northampton. This resulted in:

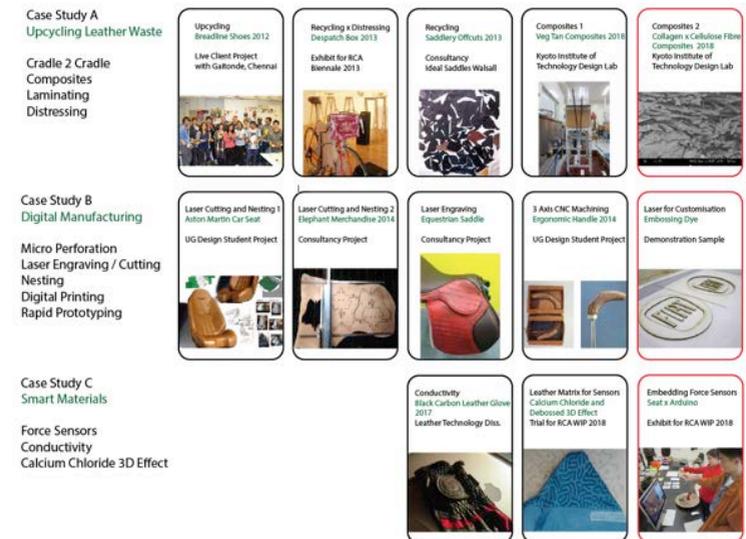
Figure 36.
Structure of Practice.
Upcycling Leather Waste.
Digital Manufacture
and Smart Materials
Investigation.

New materials:

- * A prototype of composite materials from collagenic fibres and mulberry fibres
- * A prototype of composite material from collagenic fibres with fibres from another waste stream, palm oil, investigating the creative and commercial potential of blended natural fibres.

The research investigated transferrable fabrication processes:

- * A prototype of collagenic fibres laminated with biodegradable polylactide
- * A prototype of collagenic composite materials using plant-based starches
- * Mouldmaking and spray coating application of collagenous fibres with and without resins, binders and foils for upscaling of production



Dissemination

1. Leather: Practice and Innovation in Japan. Fieldwork report, guide, manual. Kyoto Institute of Technology [KYOTO Design Lab] JASSO Visiting Scholar from 31 January - 31 March 2018. Creative material investigation and innovative applications of leather within craft, product and automotive design practice. PDF 74 pages.
2. Smart leather - Perceived Quality and User Acceptance of sensors and structural biomaterials. RCA Work in Progress Show. Henry Moore Gallery 24/01/18 – 27/01/18 London, United Kingdom. Smart material exploration and embedding of force pressure sensors in vegetable tanned saddle hide. Research output: Non-Textual Output › Design
3. Collagenic Fabrication: Darwin Entrance Gallery, Royal College of Art, Work-in-Progress Show Schaber, F., 24 Jan 2019 Research output: Non-Textual Output › Design
4. RCA Research Biennale
5. Super-i-fabrics, 8 April 2016- Horizon20:20 bid submission (unsuccessful) Led by Iannis Ioannides, UoL, Will Wise and T. Covington UoN 14 strong Consortium. multi-partner project, H2020-ICT-2016-2017. Proposal acronym: SUPERiFABRICS aimed at ...enabling design-driven disruptive market-creating solutions for reliable, safe and secure, direct active monitoring smart capabilities development in cross cut Weartech, wellbeing, comfort, safety and security, as well as Health applications. The 3-year research programme will lead to the de novo 3D- architecture modeling and co-design of universal intelligent generic collagenic biomaterials/ composites, building blocks enabling mass customization, 3D-fusion, biosynthetic and additive manufacturing of smart heterogeneous fabrics and systems. Turnkey enabling technologies for the lab scale prototyping of conducting, thermo-regulating, energy harvesting and functionalized smart materials

comprise in: surface micro/nano-treatments, 3D-chemical modification with deep eutectic solvents, as well as 3D-fusion with polymers, nano-fibers and –composites.

Objects

- * Thesis excerpt: 4.3. sustainable Future leather Use 4.3.1. curated Artefacts on Display (the diagrams, the handbook)
- * Scholarship and fieldwork with a JASSO grant to Kyoto Institute of Technology, examining creative usage of leather and related hybrid materials in broader cultural contexts such as Japanese white leather, fish skin, lamination and parchment manufacture. Some of these processes have been preserved in Himeji, Japan.
- * Academic paper at the 8th Conference of the International Committee for Design History and Design Studies from 3 – 6 September 2012 in São Paulo – Brazil.

Bibliography

Key Topics are eco-informed material choice and material experience. I have engaged with the theory of the Circular Economy and innovation for sustainable development. The process of Design Thinking and some of its concepts such as collaboration, visualisation and an emphasis on creative research tools used during the creative exploration of 'leather futures' together with literature on new materials in design (Stattmann 2000), (Howes and Laughlin 2012), **eco informed material choices** (Ashby 2009), **materials experience** (Pedgley 2010), (Parisi and Rognoli 2017) and **fundamentals of materials and design**, (Covington 2009; Heidemann 1993). It was found that leather is a complex material with issues, but also with unique aesthetics and performance properties that – when responsibly processed – will positively address changing user demand the growing concern for leather's sustainability credentials (Redwood, 2017).

Aldersey-Williams, H., Bound, J. and Coleman, R., 1999.

The methods lab: user research for design. London: Helen Hamlyn Research Centre.

Amberg, B., 2018. Leather - then and now. [Catalogue of an exhibition held at Leathersellers Hall, 9-13 May 2018] London: Worshipful Company of Leathersellers.

Ashby, M., 2009. Materials and the environment: eco-informed material choice. Oxford: Butterworth-Heinemann.

Brundtland, G.H. and Khalid, M., 1987. World commission on environment and development: our common future. New York: Oxford University Press.

Buljan, J. and Král, I., 2019. The framework for sustainable leather manufacture, 2nd ed. Vienna: The United Nations Industrial Development Organization.

Charter, M., 2018, ed., Designing for the circular economy. Oxford: Routledge.

Covington, A.D., 2009. Tanning chemistry: the science of leather. London: The Royal Society of Chemistry.

Covington, A.D. and Wise, W.R., 2020. Tanning chemistry: the science of leather, 2nd ed. London: The Royal Society of Chemistry.

Daniels, R. and Landmann, W., 2013. The framework for leather manufacture. Liverpool: World Trades Publishing Limited.

Earley, R., 2017. Circular design futures. The Design Journal, 20(4), pp.421-34.

Ellen MacArthur Foundation, 2017 & 2018. Ideo circular design guide. [online] Available at: <https://www.circulardesignguide.com> [Accessed 30 March 2020].

Franklin, K. and Till, C., 2018. Radical matter: rethinking materials for a sustainable future. London: Thames & Hudson.

Fuad, L.A., 2009. The eco design handbook. London: Thames and Hudson.

Heidemann, E., 1993. Fundamentals of leather manufacture. Darmstadt: Roether.

Howes, P. and Laughlin, Z., 2012. Material matters: new materials in design. London: Black Dog Publishing.

Karana, E., Pedgley, O. and Rognoli, V. eds., 2014. Materials experience: fundamentals of materials and design. Oxford: Butterworth-Heinemann.

Karana, E., Barati, B., Rognoli, V., & Zeeuw Van Der Laan, A., 2015. Material driven design (MDD): A method to design for material experiences. International Journal of Design, 19(2).

Laurenti, R., Redwood, M., Puig, R. and Frostell, B., 2016. Measuring the environmental footprint of leather processing technologies. Journal of Industrial Ecology, [e-journal] October. <https://doi.org/10.1111/jjec.12504>.

MacGregor, N. ed., 1992. A catalogue of: Leather in life, art and industry - a centenary exhibition John W. Waterer RDI 1892-1977. Northampton: Museum of Leathercraft.

McDonough, W. and Braungart, M., 2002. Cradle to cradle: remaking the way we make things. New York: North Point Press.

Nidderer, K. and Fisher, T., 2015. Special issue of craft research: real or unreal? – crafting authenticity in the digital age. *Journal of Craft Research*.

Papanek, V., 1984. *Design for the real world*. London: Thames and Hudson.

Redwood, M., 1990. Nature's high performance, breathable material. [blog] Adapted from a lecture given to the Survival - 90 Conference at the University of Leeds. Available at: <<http://www.mikeredwood.com/>> [Accessed 9 January 2009].

Redwood, M., 2012. Leather manufacture glossary. [blog] Available at: <<http://www.michaelredwood.com>> [Accessed 1 September 2012].

Rust, C., 2007. Unstated Contributions - How Artistic Inquiry Can Inform Interdisciplinary Research. *International Journal of Design*, 1(3), December 2007.

Rust, C., Mottram, J. and Till, J., 2007. Review of practice-led research in art design & architecture. Bristol: Arts and Humanities Research Council.

Solanki, S., 2018. *Why materials matter: responsible design for a better world*. New York: Prestel publishing.

Stahel, W., 2019. *The circular economy. A user's guide*. London: Routledge.

Stattmann, N., 2000. *Handbuch Material Technologie*. Ludwigsburg: Avedition.

Waterer, J., 1946. *Leather in life, art and industry*. London: Faber and Faber.

Woolley, M. and Niedderer, K. eds., 2016. Real or unreal? – crafting authenticity in the digital age. *Craft Research*, 7(2), pp.159-64.

COLOPHON

Project Editor **Andrew Hewitt**
 Proofreaders **Andrew Hewitt, Mel Jordan**
 Graphic Design **James Smith**
 Publisher **The University of Northampton**
 DOI **10.24339/m0ad-hv43**



