

A hundred years of sustainability within the leather industry

Dr Anne Lama

Scope and Limitation

- World-wide differences were not addressed in this study
 - Only papers published in English were reviewed
 - Results from similar articles were amalgamated
-

Sustainability

- Buzz word
- Integral part of leather making processes
- Driving forces
 - Environmental concern
 - Limited resources
 - Tighter legislation
 - Customer awareness
 - Social, cultural and economic issues
- Dated back to 1879 (over 135 years) in “*Progress and Poverty*” by Henry George¹
- Concern regarding deforestation within the leather industry was raised as early as 1918



Early 1900

- Literature predominantly focused on
 - Analysis
 - Scientific underpinning
 - Experimental trials
- Anthrax appeared to be a major issue
- Use of double-bath chromium tanning system
 - Reduction of Cr(VI) to Cr(III)
- Introduction of the single-bath chromium tanning system
- Concern regarding public health raised due to the pollution from tanneries
- Conditions of English rivers by the large manufacturing area's were described as extremely bad¹



1. Morrison, J. A. S (1911) The Treatment of Tannery Effluent. *J AM LEATHER CHEM AS*, 6: 326.
2. Photo: Pittards (1826-1976) (Courtesy of the Museum of Leathercraft)

Early 1900 - Effluent

- Legislation (UK)¹
 - Public Health Act 1875 and River Pollution Prevention Act 1876, prohibited discharging of
 - ‘*Solid matter*’ to stream or any interference of flow
 - ‘*Sewage*’ to river
 - ‘*Harmful, toxic or polluting*’ liquid
 - 1899 Navigation act: to prevent deposition of waste to the navigable water (except from liquid from streets and sewers)²
- Main issue - solid waste (oxygen demand due to the presence of organic matter)¹
- Presence of arsenic

“Opinion is still being held that without the aid of arsenic a certain quality of leather cannot be obtained”³

1. Bailey, D. A. (1969) A Review of the Legislation Affecting the Discharge of Trade Effluent. *J SOC LEATH TECH CH*, 53: 251

2. Morrison, J. A. S (1911) The Treatment of Tannery Effluent. *J AM LEATHER CHEM AS*, 6: 326.

3. Eitner. W. (1907) *J AM LEATHER CHEM AS*, 2: 146

Early 1900 - Effluent Treatment

- Passing effluents through bed of coke before discharging¹
- Admission of effluent to the public sewers¹
- Treatment option researched^{1,2}
 - Precipitation of lime and tanning liquor
 - Biological treatment of sludge using bacteria
 - Purification of liquid tannery waste by forced oxidation
- Patents
 - *Treatment of waste leather, hoofs, horns etc. of animals. U. S Patent No. 892, 840*
 - *Process of detanning chromium leather. U.S Patent No 967,215*
 - *Production of a nitrogenous fertiliser from leather waste U. S. Patent 1,255, 643*

1. Morrison, J. A. S (1911) The Treatment of Tannery Effluent. *J AM LEATHER CHEM AS*, **6**: 326.

2. Alsop, E. C (1912) Purification of Liquid Tannery Waste by Forced Oxidation. *J AM LEATHER CHEM AS*, **7**: 72.

Early Concerns - Chromium

- Double bath system
 - Development of acute sores in contact of skin wound^{1, 2}
 - Persistent if the handling was not stopped^{1, 2}
 - Stomach and kidney disease¹
- Affected personal working in chromium manufacture and personal using chromium such as dyers, tanners, textile printers and printers¹



1. Lewin (1908) Poisoning by Chromium in Industrial Operations. *J AM LEATHER CHEM AS*, **3**: 315.

2. Bateson, M. (1917) The Prevention of Chrome Sores. *Journal of the Society of Leather Trades' and Chemists*, **1**:157

Photo: The Ohio Leather Co (1935) Tanning Drums and Chrome Room (Courtesy of the Museum of Leathercraft)

Early Suggestions - Chromium

- Limited contact time¹
- All workmen should be made aware of the toxic effect of chromium and the transmission routes¹
- Application of sodium bisulphite solution^{1,2}
- Avoid direct contact whenever possible¹
 - Use of gloves
 - Application of Vaseline or vegetable oils
- Avoid eating and drinking on the premises¹
- Avoid dust formation while working with chromium powder¹
- Regular urine test by a physician¹

1. Lewin (1908) Poisoning by Chromium in Industrial Operations. *J AM LEATHER CHEM AS*, **3**: 315.

2. Bateson, M. (1917) The Prevention of Chrome Sores. *Journal of the Society of Leather Trades' and Chemists*, **1**:157

Prediction Made - Blockey (1915)

Blockey, J. R. (1915): The tannery of fifty years hence? *J AM LEATHER CHEM AS*, **10**: 488.

- Substitution of manual labour with machines
- Reduce raw material waste and conversion of waste to by product
 - Raw material quality (animal husbandry, flaying, preservation)
 - Process efficiency
 - Conversion of waste to energy
- New chemicals
 - Enzyme
 - Tanning agents (e.g., chromium, syntans)
- Scientific approach



Mid - 1900

- Pollution issues within leather industry was evident
 - *“Large in volume, extremely putrescible and difficult to treat in a satisfactory and economical manner”¹*
- 85-95% of the total waste generated from beamhouse
- Toxic effect of Cr(VI) was clear
- Double bath was still mentioned, but limited application^{1,2}
 - Glazed/glacé kid from goat skins
- Single bath was popular
 - Efficiency of chromium uptake and
 - No yellowing effect
 - Low labour and material cost



1. Eye (1962) The Chemistry and Technology of Leather, Volume III, Editors: O’Flaherty, F. Roddy, W. T. Lollar, R. M. Robert E. Krieger Publishing Co., Inc. New York, p 462

2. Progress in Leather Science 1920-1945 (1948) Volume 3, British Leather Manufacturers’ Research Association, London

Photo credit: Axel Landmann (courtesy of the Museum of Leathercraft)

Mid - 1900

- Typical tannery waste may contain:
 - Flesh, raw trimmings, hair, blood, manure, earth, salt, soluble proteins, suspended lime, sulfites, sulfides, amines, chromiums, arsenic, tannin, soda ash, sugars, starches, oils, fats, greases, surfactants and/or inorganic acids
- Pollution Potentials
 - BOD, solids (total, dissolved, suspended and settleable), pH, turbidity, colour, toxicity, chlorides, sulfides, nitrogenous compound and grease
- Environment pollution due to gas lighting
 - Deterioration of vegetable-tanned leather



Eye (1962) The Chemistry and Technology of Leather, Volume III, Editors: O'Flaherty, F. Roddy, W. T. Lollar, R. M. Robert E. Krieger Publishing Co., Inc. New York

Photo: Courtesy of the Leather Conservation centre

Mid - 1900

- Lot more focus on effluent treatment
 - Most textbooks contained a chapter on effluent treatment
- Proposed suggestion to deal with effluent¹
 - Change of process
 - Chemical substitution
 - Good housekeeping
 - Personnel training
 - Monitoring of effluent discharge
 - Recycling and reuse
 - Recovery of usable materials from the effluents before treatments and final disposal

1. Eye (1962) The Chemistry and Technology of Leather, Volume III, Editors: O'Flaherty, F. Roddy, W. T. Lollar, R. M. Robert E. Krieger Publishing Co., Inc. New York

Late - 1900

- Effluent concern increased in this period
- Chromium (VI) was well understood
 - Hazardous impact ¹
 - Issues with disposal of chromium-tanned leather waste and control^{2,3}
- Beamhouse and liming were still an issue (75 to 80% pollution load)
- Pollution potential: COD, BOD, solids (total suspended), oil and grease, nitrogen, sulfide, chromium, phenols, pH



1. Gibson, R. S. and Randall, J. A. (1987) The Assessment of Chromium Status of Workers Exposed to Industrial Chromium. *J AM LEATHER CHEM AS*, **82**: 15.

2. Feikes, L. (1986): The 1986 John Arthur Wilson Memorial Lecture: Leather Manufacture and Ecology. *J AM LEATHER CHEM AS*, **81**: 233.

3. Fearheller, S. H (1985) John Arthur Wilson Memorial Lecture: The Next Major Changes in Leather Manufacturing Technology - What is likely to be and how close are we to it? *J AM LEATHER CHEM AS*, **80**: 311.

Photo credit: Axel Landmann (courtesy of the Museum of Leathercraft)

Late - 1900

- Continuous evaluation of regulation¹
 - The Rivers (Prevention and Pollution) Act 1961
 - The Public Health Act 1971
- Publication of guidelines
 - U. S. Environment Protection Agency (1974): Effluent guideline on *pre-treatment standard of leather tanning and finishing*²
 - U. K. The Department of the Environment (1978): Wastes from Tanning, Leather Dressing and Fellmongering

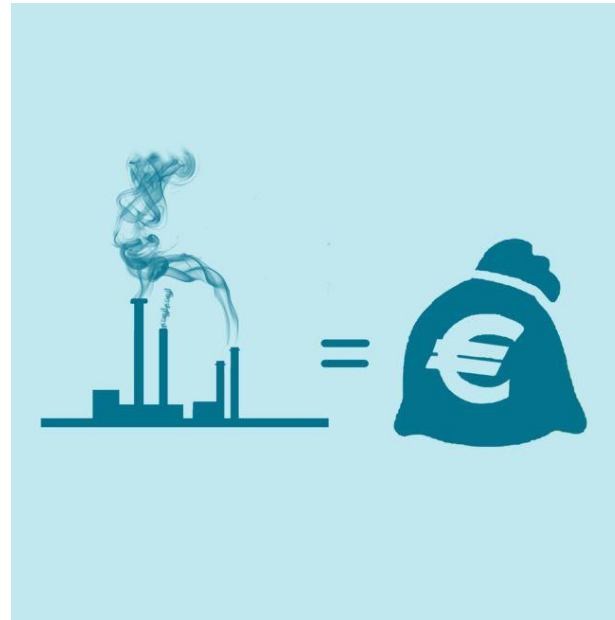


1. Bailey, D. A. (1969) A Review of the Legislation Affecting the Discharge of Trade Effluent. *Journal of the Society of Leather Trades' and Chemists*, **53**: 251.

2. EPA (1984) Guidance Manual for Leather Tanning and Finishing Pretreatment Standards, <https://www3.epa.gov/npdes/pubs/owm0405.pdf>

Late - 1900

- Introduction of Waste Framework Directive (1975/442/EEC; 1991/156/EEC)¹
 - Polluter pays principle
 - Waste hierarchy model



1. DEFRA (2011) The Waste Framework Directive,
<http://adlib.eversite.co.uk/adlib/defra/content.aspx?doc=19433&id=19435>
Photo credit: <http://www.eesc.europa.eu/?i=glossaries.en.sustainable-terms.21630>

IULTCS Effluent Commission

- First meeting: 7-9 September 1970, Holland¹
- Reduction in the amount and degree of pollution
 - Low float
 - Reuse water
 - Oxidative unhairing
 - Enzyme assisted unhairing
 - Reduction of the quantity of lime and vegetable tanning agents
- Treatment of tannery effluent
 - Mechanical treatment
 - Sedimentation
 - Chemical treatment
 - Biological treatment
- Sludge disposal
 - Mechanical dehydration
 - Agricultural disposal

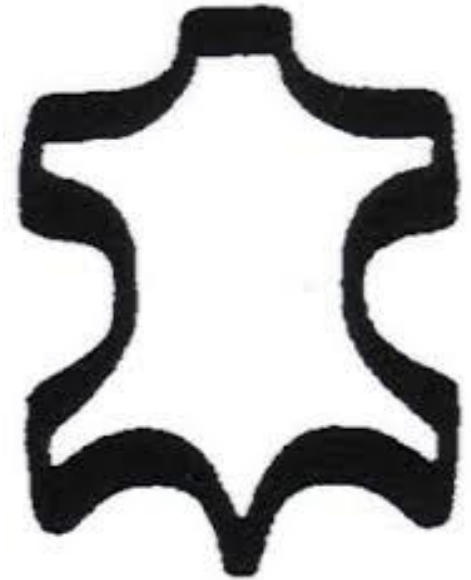
Late 1900 - Pressure Groups

Sykes, R. L. (1973) A Positive approach to the new pressure groups - the consumerists and the environmentalists, *J SOC LEATH TECH CH*, **57**: 123.

- Emerging pressure groups
 - Environmentalists
 - Consumerists
 - Sunday Times, 5th March 1972: *“Chromium is fifty times more toxic than cyanide”*
 - Which - Magazine of the Consumers’ Association, January 1973: *“We also tested all our samples for arsenic, cadmium and chromium – other poisons”*
-

Sykes, R. L. (1973)

- Actions taken by the pressure groups driven by emotion rather than logic
- Responsibilities
 - Product quality and performance
 - Employees and stakeholders
- Importance of certification



Prediction Made

- Fearheller, S. H (1985) John Arthur Wilson memorial lecture on The next major changes in leather manufacturing technology- what is likely to be and how close are we to it? *J AM LEATHER CHEM AS*, **80**: 311
 - Pit, paddle to drums
 - Application of chromium(III) as tanning agent still strong - no alternatives were found
 - Development of synthetic retanning, fatliquor, finishing agents
 - New machinery to replace manual labour
 - Siegler, M. (1987) Contribution towards a tanning procedure - free of chrome. *J AM LEATHER CHEM AS*, **82**: 117
 - “free of chrome - which I believe will be the basis of the tanning procedure for the 21st century”
-

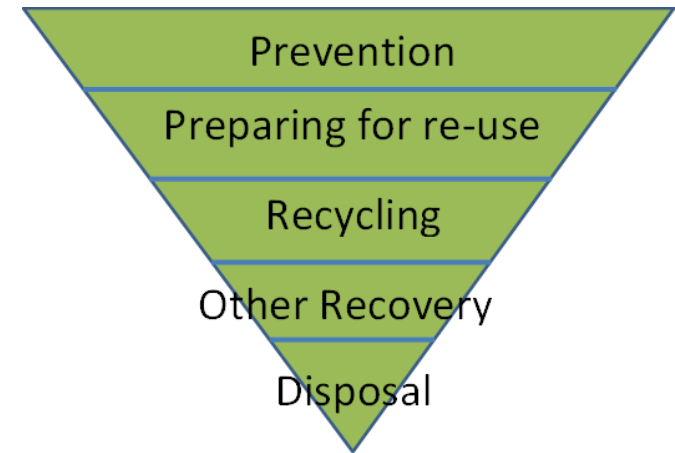
Late - 1900

- Thorstensen (1969) (Practical Leather Technology) have also included a chapter on leather substitute materials

“The management people who can anticipate these changes, and innovate rather than follow, will advance a great industry”¹

21st Century

- REACH (**R**egistration, **E**valuation, **A**uthorisation, and restriction of **C**hemicals)
 - Reach regulation (EC) No 1907/2006
- Best Available Technologies
 - Waste Hierarchy¹
 - Revised Waste Framework Directive 2008/98/EC
- Pressure groups
 - Environmentalist
 - Consumerist
 - Animal right activist
- Footprint concept²
- Corporate Social Responsibility (CSR)
 - Economy/social/environment



1. DEFRA (2011) Guidance on Applying Waste Hierarchy. <https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs>

2. Wegner, B. and Paczkowski, N. (2014) Reducing the Carbon Footprint of Leather, *World Leather*, **27**: 34

United Nations Sustainable Development Goals

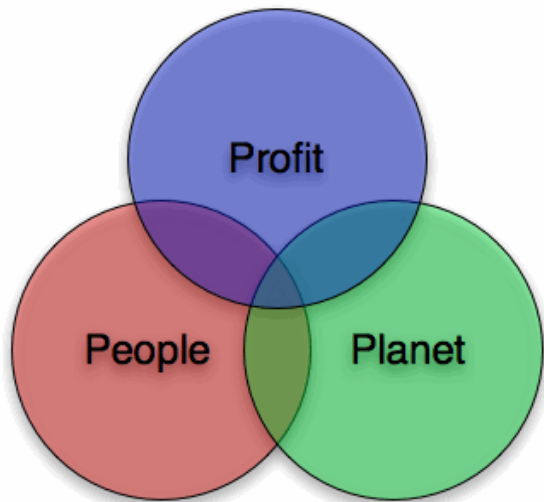
- Sustainable development goals - Transforming our World: The 2030 Agenda for Sustainable Development , launched in 2015 by the United Nations¹



1. UN (2015) Transforming Our World: The 2030 Agenda for Sustainable Development, <https://sustainabledevelopment.un.org/?menu=1300>

Sustainability

- Triple bottom line
 - Economy
 - Social
 - Environmental



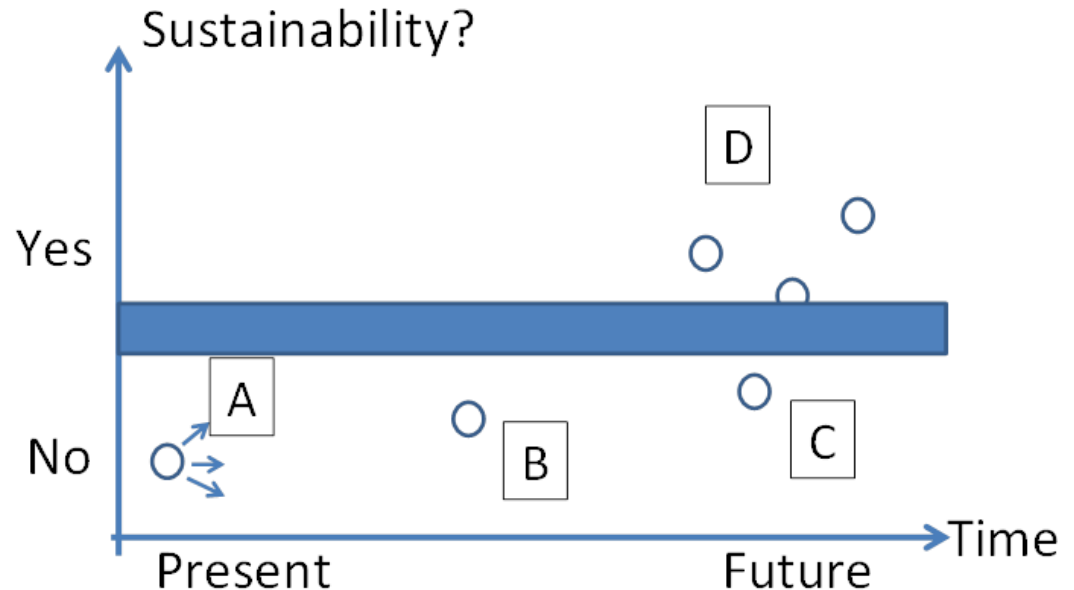
- Influencing factors (2050)¹
 - Population growth
 - Resource depilation
 - Climate change



1. Rahimifard, S. Sheldrick, L. Woolley, E. Colwill, J. Sachidanada, M. (2013) How to Manufacture a Sustainable Future for Billion People in 2050. "20th CIRP International Conference on Life Cycle Engineering, Singapore, 2013

Sustainability

- Backcasting¹
 - Visioning
 - Scenario planning
 - Not relying on forecast



- A. Directional studies
- B. Short-term studies to achieve goals
- C. Forecasting studies
- D. Other alternatives and visions

-
1. Nicholas Head (2015) PhD thesis: Development of a Multi-Criteria, GIS-based, Backcasting Framework Model (G-BFM) for Progression Towards Zero Waste Futures, for Holistic Resource Management Policy and Practice in Northamptonshire by 2050.
 2. Dreborg, K. H. (1996) Essence of Backcasting, *Futures*, **28**: 813

A Very 21th Century Issue

- Disposal of end of life goods
 - How much we throw away?
 - Clothes
 - Shoes (estimation 20 billion pairs/year)
 - Food
 - Energy
- Can we recover resources?
 - End of Life Vehicle Directive 2000/53/EC
 - 95% (Reuse and recovery)
- Producers responsibility?



Acknowledgements

- Axel Landmann
- Christin Zingelmann
- Jeanette Casey
- Jon Loxston
- Matthew Abbott
- Nicholas Head
- Paul Evans
- Richard Daniels
- Steve Trantum
- Ken Moakes
- Museum of Leathercraft

