Sustainable Leather

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Introduction

Sustainability and climate change are critical issues facing the world leather industry. Energy, chemicals, salt, water and waste will all become more critical for tanners and all industries. The damaging effects of climate change are accelerating and it is crucial that scientists emphasise a more realistic, more desperate, account of the global-warming problem and the need for the world to take immediate action. The climate change sceptics, deniers and the fossil fuel industry were wrong and have delayed action for far too long. Renewable energy and energy savings are essential. Oil, coal and also gas must be phased out as quickly as possible for us to have a liveable world.

The International Energy Agency, the UN, the World Bank, and the World Meteorological Office (WMO) in November 2012 all produced reports documenting how the world is not achieving its climate targets and highlighting the impacts of delay: an unrecognisable planet. We are on track for a 4-6°C warmer world this century, marked by extreme heat-waves, droughts, floods, declining global food stocks, loss of ecosystems and biodiversity, and life-threatening sea level rise: the latest predictions on climate change should shock us into action.

The UN report about melting Arctic permafrost makes it clear yet again: the need to cut the pollution that drives warming is more urgent than ever. The current forecasts do not include the warming which will be caused by the methane from the permafrost! The WMO says greenhouse gases, which are closely linked to the use of fossil fuels and to deforestation, have increased the warming effect on the climate by 30 per cent between 1990 and 2011, with CO_2 accounting for around four-fifths of this rise.

In spite of this, almost 1,200 new coal-fired power plants are planned worldwide. This would be disastrous. It is worse than a smoker with lung cancer increasing the number of cigarettes each day; it is the whole world that is threatened. Fortunately, coal-fired plants around the world are now being shut down. Brazil, Germany, Spain, Italy and China are among the leaders in renewable energy and the rest of us must quickly follow them. Great advances have been made in the last year and renewable energy can be stored.

Some tanneries are already achieving lower environmental impact by using clean technologies and some are using renewable energy. Scientifically based and appropriate requirements and regulations are essential for true sustainability. Far more action and research is needed.

Environmental Audits

Over the last few years the Leather Working Group (LWG) has achieved considerable improvements in tannery environmental performance in many countries through its Audit Protocol. Protocol 6 is being developed; it will be more demanding and in use by 2014. It will be more rigorous for salt and energy use but it will soon need updating again to ensure tanneries continue to become more sustainable. It is important that the LWG develops one Restricted Substances List that is scientifically based (Money 2010). At present Brands have different lists.

Zero Discharge

A number of companies using leather have announced that they are working toward a 2020 goal of zero discharge of hazardous chemicals for all products in their supply chain. This is unrealistic, unreasonable and unnecessary.

Greenpeace in Argentina has campaigned for tanneries to adopt a clean production program having a goal of no chromium in the effluents and waste. This goal cannot be achieved, is unnecessary, and is being contested. The world must have scientifically based restrictions and NGOs must review the science and their requirements. Practical wisdom is required.

Carbon Footprints

Carbon Footprints (CF) and Life Cycle Analyses (LCA) are being introduced for leather and footwear but they can be misused and very misleading. For example, Puma has compared suede and cotton/canvas sneakers and publicized that the suede has higher carbon emissions. World Leather (August/September, December 2012) found a number of significant flaws in Puma's analysis which invalidated the results. Another flaw in the Puma comparison that was not mentioned is that the difference between the durability of suede and cotton/canvas was not considered.

Durability should be an essential component of any Life Cycle Analysis for footwear and for all leather products. Sneakers that children wear every day would last much longer if they were made of leather. Leather shoes are comfortable and can be worn for many years; the leather is often in perfect condition when some non-leather soles crumble. In a constrained future, fashion is likely to become far less important; durability and comfort will be critical as we evolve from our throwaway society.

UNIDO Life Cycle Assessment/Carbon Footprint in Leather Processing (F. Brugnoli 2012)
The comprehensive November 2012 version of the UNIDO technical report opened the way for the development of practical guidelines to obtain reliable Leather Product Carbon Footprint (PCF) data. It produced proposals for convergence and harmonization of the most important elements related to finished leather LCA and PCF studies. It has been important to determine the system boundaries for leather. Leather is derived from hides and skins from animals which have been raised mainly for milk and/or meat production. Therefore the LCA and PCF for leathers start in the slaughterhouse, where activities and treatments are carried out in order to prepare the hides for tanning, and end at the exit gate of the tannery.

The transportation of hides and skins from the slaughterhouse to the tannery and transport of wet blue, wet white and crust must be included in any Leather PCF. A shipping container holds about 700 salted hides, 2,000 wet blue or 4,000 crust leathers. This indicates the large energy saving and CF advantages of tanning hides near their source.

Meat Production

Hides and skins are by-products: the Leather Industry is dependent on the meat industry for its raw material. In the future we will eat less meat but we will still farm animals for meat, milk and fibre. However, we must waste less food and utilise the whole animal as is done in developing countries: offal is high in protein, low in fat and nutritious. To be sustainable, all hides and skins produced by the meat industry must be utilised.

Grass fed animals have a far lower carbon footprint than grain fed animals. Modest levels of grazing cause much less ecological damage than growing crops. From an environmental standpoint, grazing is sometimes erroneously viewed as less desirable than leaving land which cannot be cropped unused. However, this causes a number of problems including the need for herbicides to control weeds. If

growers manage livestock so that pastures are grazed moderately, they are fertilising the soil, restoring soil quality and cutting greenhouse gases by keeping carbon in the soil as organic matter rather than releasing it into the atmosphere as carbon dioxide.

Over many years, Alan Savory of The Savory Institute has developed Holistic Management of livestock to address desertification and climate change. He has demonstrated in Africa, Australia and North and South America that properly managed grazing animals are essential for land restoration. Holistic Management involves intensive grazing of seasonal rainfall grasslands with a high stock density for short graze periods followed by long rest periods. The high physical impact of cattle trampling, dunging and urinating on the land for a few days is interspersed with resting for months for plant and soil-life recovery. It is now recognized that seasonal rainfall grasslands require periodic disturbance for overall health. Fertilisers are either not necessary, or application rates are greatly reduced. Plant growth is lush, the water table is higher, wildlife thrives, soil carbon increases and up to four times as many cattle can be kept. Livestock are being used to mimic the role that large herds of wild herbivores once played in maintaining ecosystem health (Savory, 2013).

Tannages

Chromium

Chromium III (Cr III) is usually a more environmentally acceptable tannage than alternatives. Chromium VI (Cr VI) can be formed during fatliquoring of wet blue and in finished leathers during manufacture of articles, exposure to heat, low humidity, daylight and UV light. Although antioxidants can lower the Cr VI content in leathers, they increase the soluble chromium which could cause skin reactions. Also, Cr VI can increase again during manufacture and storage. Misconceptions about the properties of Cr III and Cr VI continue to threaten the tanning industry and recent publications have attempted to counter these errors (Money 2012a, b).

Chromium tanning is not toxic and Cr VI carcinogenicity is not associated with tanneries or leather: it is respiratory and due to inhalation, mainly in the welding industry. A very small percentage of the population is allergic to Cr VI and Cr III but chrome tanned leather has been worn for over 100 years and the contact dermatitis can be managed. Tanners and others who are allergic to chromium control dermatitis by using barrier creams containing ascorbic acid and EDTA, and cortisone ointments. People allergic to shoes can wear barrier socks and those allergic to chromium can wear synthetics if necessary. Chrome allergy must be kept in perspective; there are many far worse allergens that are not banned.

The problem of Chromium VI allergic contact dermatitis in perspective

The proposed ECHA (European Chemicals Agency) 2012 restrictions on leather containing Cr VI cannot be justified. Danish authorities proposed a restriction on leather articles containing Cr VI, in concentrations above 3mg/kg, which come into contact with the skin. The Danish proposal was seriously flawed and a document, Consequences of Banning Chromium VI in Leather Articles (Money 2012b), was submitted to ECHA in September 2012. The submission discussed how the Danish proposal had misinterpreted the referenced literature. In a study of particular relevance, chromium-allergic patients were patch tested with leather samples and 50% of the allergic reactions were caused by leathers with Cr VI < 3 mg/kg (Hansen et al 2006a, b). It had previously been demonstrated that both Cr III and Cr VI are capable of eliciting eczema at low concentrations (Hanson et al 2003).

The submission concluded:

- The proposed restriction on Cr VI should not be introduced.
- Better management of chrome allergies to leather items should be investigated.
- Cr III and Cr VI are both capable of eliciting dermatitis at low concentrations.

- It has not been demonstrated that the restriction will reduce chromium sensitivity to leather items: an important study found that 30% of chrome-allergic patients reacted to leathers which contained less than 3mg Cr VI/kg.
- Control of Cr VI formation in finished leather is an unsolved problem and there is no viable substitute for chrome containing shoe leathers.
- The range of consequences of the restriction throughout the global leather industry must be considered.

However, on 12 March 2013 the ECHA Committee for Socio-economic Analysis (SEAC) decided that the proposed restriction would be the most appropriate EU-wide measure to address risks of chromium (VI) in leather articles. This unreasonable restriction could enter into force in the first part of 2015. IULTCS, REACH and COTANCE should contest this SEAC decision. Any chrome tanned product, whether produced in Europe or elsewhere, could generate Cr VI during storage and wear, even after an antioxidant treatment. If Europe introduces this regulation then the world leather industry will be severely threatened. Leather and shoes imported into Europe will need to contain < 3mg Cr VI/kg, even after manufacture, storage and display. Ageing tests are available but do not simulate the real ageing of leather over months rather than days. There is, at present, no viable alternative to chrome in shoe leather and there is no viable way to ensure elimination of Cr VI from chrome tanned leather articles.

Alternative Tannages

Vegetable/syntan, aldehyde, and other white tannages are being widely promoted but cannot realistically replace much chrome leather and there is no sound environmental reason for this to occur. Wet white serves a niche market but currently available processes will not replace chrome tannage. Many of the syntans originate from fossil fuels and more chemical is required than in chrome tannage. Some of the new tannages claim to need no pickle salt but total effluent salt is the critical issue.

Some of the newly developed alternative tannages include aluminium which can be toxic to fish and plants, particularly at low pH. In some countries aluminium tanning could be more of a problem than chromium. Australia regulates that the total aluminium in fresh waters should be < 5 µg/L, if pH < 6.5, and < 100 µg/L, if pH > 6.5. Aluminium in irrigation water should be < 5mg/L. In Australia, chrome liquors are recycled and excess chrome is precipitated and reused; tannery effluent can be irrigated with little treatment. Any aluminium tannage would need to be fully recyclable to replace chromium.

Salt Issues and Green Processing

By processing fresh/green, unsalted hides and skins, the cost of salting is eliminated and the salinity (Total Dissolved Solids, TDS) of the effluent is greatly reduced. Salinity is the build-up of salt in soil and water. For many tanneries, salinity is a far greater environmental problem than chromium; salt use must be lowered. Salinity is also a problem at the sites where hides and skins are salted; in Africa, salting is causing land degradation.

High salinity in water causes high osmotic pressure. This causes both reduced water availability to plants, and retarded plant growth of crops which are not salt tolerant. In addition, high concentrations of sodium ions in water can adversely affect soil structure by causing dispersion of clay. However, the presence of calcium and magnesium ions in tannery effluent ameliorates this effect by stabilising the soils.

Preservation salt contributes 60-70% of the total salt in tannery wastewater. Ocean discharge is the environmentally sustainable disposal method for effluents from tanneries using salted raw materials but this is often not possible. Also, with water shortages and droughts, sewage and other authorities

are replacing ocean discharge with reuse and land irrigation and salinity is a major concern. Even for tanneries processing green hides, other salt inputs must be minimised to allow irrigation of effluent.

In 2007, about 56.8 million bovine hides were salted in China and about 43.2 million in India (Source: FAO via ICT) resulting in over 400,000 tonnes of salt being distributed in the environment. In addition to this, enormous amounts of salt are generated from local skins and imported hides and skins. In comparison, Brazil produced about 37.6 million bovine hides and USA 34.4 million but both countries processed large proportions of green rather than salted hides.

India

Unsustainable Zero Liquid Discharge (ZLD)

For many years salinity has been a major problem for tanneries in Tamil Nadu. To meet TDS discharge limits, tannery effluents must now undergo costly and energy demanding treatments including Reverse Osmosis (RO) and multi effect evaporation to achieve zero liquid discharge (ZLD). Requirements for ZLD (Sahasranaman 2012):

- Tertiary treatment of effluent
- RO system: Pre-treatment filtration, organic scavenger, ultra-filtration (UF), two stage reverse osmosis, automated control system.
- Mechanical Evaporation of RO reject: Five effect evaporation with thermal vapour re-compression system and pusher centrifuge for separation of salts.
- Recovered salt storage facilities

The government is subsidising this ZLD. The system does generate clean water but the massive energy use (65% for evaporation) plus the enormous quantities of unwanted mixed salts being generated makes this ZLD unsustainable. One Common Effluent Treatment Plant (CETP) includes a disposal unit with capacity to store salt generated for two years. It is hoped that a use for the mixed salt can be found but this is unlikely. For years solar evaporated, tannery mixed salt has been collected in India and it usually ends up back in the environment during the monsoon. An exception is the use of recovered salt on coconut palms in Kerala.

This is a desperate attempt to solve the tannery salt problems in Tamil Nadu. It is short-termism and should not continue. Another solution must be found.

This unsustainable ZLD technology should be heavily penalised in LWG Audits. The LWG Protocol Version 6 is expected to assess effluent sodium, chloride or TDS, unless discharge is to coastal waters. Also, treatment at a CETP, or equivalent, is to be assessed to fully audit energy use and waste produced in leather production.

China

Changes aimed at reducing pollution from tanneries:

- Pingyang County, Zhejiang Province, planned to eliminate beamhouse processing in the county by the end of 2012 and to eliminate tannery processing altogether by 2014.
- Coastal tanneries are being relocated inland, for example to Fuxin, in Liaoning Province. However this is likely to create salinity problems where beamhouses processing salted hides will discharge high salt effluent into inland rather than coastal waters.
- It is proposed to issue new Discharge Standards of Water Pollutants for Tanneries. There will be a limit for Chloride of 3000 mg/L for surface discharge and 4000 mg/L for sewer discharge. However, chloride will not be restricted if the treated water is discharged to the sea directly.

It will be difficult for tanneries using salted hides to meet these chloride limits. Green processing and importing wet blue will be better options than RO.

Australia

Australian wet blue tanneries process green, full-thickness hides. Chilling or chemical short term preservation, usually using low levels of sodium chlorite, are sometimes used to facilitate green processing (Money 1991). High quality tallow and gelatine are produced from fleshings and trimmings. Well fleshed and trimmed, often heavy, green hides (loads of 10 tonnes or more) are loaded into a large recycling drum. All processes from unhairing to tanning are carried out in the same drum and the wet blue is then unloaded and sammed. Processes must ensure that thick necks and butts are penetrated by lime and later chromium. The tanned hides are split. Water consumption is very low, less than 10 kL per tonne of fleshed green hide processed.

These tanneries use cleaner, low salt, low sodium tannery processes which enable beneficial irrigation of all wastewater. Effluent volumes and loads are being minimised in many ways including:

- processing well fleshed green hides which do not require re-fleshing
- reducing floats and chemical consumption
- hair-saving unhairing
- carbon dioxide deliming usually with low levels of ammonium salts
- direct recycling of chrome liquors to reuse salt and chromium
- total reuse of chromium
- the use of magnesium oxide for basification
- minimised washing. This requires good drum drainage.

These tanneries are able to sustainably use the effluent for irrigation even though, because water use is very low, the Total Dissolved Solids (TDS) can be over 10,000 mg/L. For an Australian tannery beneficially irrigating effluent, the chloride content can be as low as 200 ppm, the sodium 1,200 ppm and TDS 10,000 ppm (Money, 2005). Hair is used as a fertiliser.

Some components of the TDS are beneficial and the application rate is critical. The tannery effluent is replacing fertilisers. Many tannery effluent components are also components of fertilisers including ammonium sulphate, lime, gypsum (calcium sulphate), magnesium, manganese, and slow-release, high organic nitrogen products (hair). Also, calcium and magnesium ions in tannery effluent ameliorate the adverse effect of sodium ions on soil structure.

Conclusion

In a sustainable future:
Grass fed meat will be a major food source and hides and skins will be produced sustainably in large numbers. Tanners must take action to become more sustainable; LWG Audits can assist in continuous improvement. Green hide processing reduces water, chemical and energy use and can be sustainable. The ultimate goal should be to process green hides and skins only and to irrigate land with the effluent. Countries with salt problems should import wet blue rather than salted hides. In future, more tanners throughout the world, and their customers, will realise the benefits of tanning green hides near their source as is done increasingly in Australia, USA, Brazil, Europe and other countries. Many salted hides are still exported from Australia and USA to China and other countries. This must change.

Scientifically based and appropriate requirements and regulations are essential. The most recent unreasonable regulation is the 2013 ECHA restriction on leather articles containing Cr VI in concentrations above 3mg/kg. There is, at present, no viable alternative to chrome in shoe leather and there is no viable way to ensure elimination of Cr VI from chrome tanned leather articles. Practical wisdom is necessary.

Renewable energy and energy saving are vital.

In his book 2052 - A Global Forecast for the Next Forty Years, published 40 years after The Limits to Growth, Jorgen Randers (2012) says "Something is needed to temper the short-termism of the nation state, probably something at the supranational level. For example a global central bank for climate gas emissions, introduced through democratic means – like the normal central banks. Otherwise, I predict, it will be the Chinese who solve the global climate challenge – through a sequence of 5-year plans established with a clear long term vision, and executed without asking regular support from the Chinese."

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