Perspective and challenges for chromium-tanned leather in a circular economy

Interview with Dr. Mike Redwood, Consultant to the leather and associated industries

Dr. Mike Redwood

Mike Redwood studied leather science at Leeds University and spent his working life in the leather industry running tanneries throughout the world. He helped establish the Leather Naturally programme through which the world's top tanneries are starting to promote leather as a high quality sustainable material and still acts as a spokesperson for it. He is a Visiting Professor for Leather at the University of Northampton and has been a Teaching Fellow in Marketing at Bath University where he still gives occasional lectures.

In September 2019, Emmanuel Pommier, Managing Director at the Artisanal Leather Goods and Saddlery section of the French luxury fashion house Hermès said "Leather is recycling. It is the beginning of the circular economy", stressing commitment to leather as a renewable material. What makes leather a choice material in a sustainable environment?

The circular economy too often gets corralled into talk of end of life of products, mostly as a result of the book Cradle to Cradle. *This puts focus on design for disassembly and procedures to separate out the organic and chemical elements for re-use as original material.*

In fact, the circular economy was first conceived by Walter Stahel with his Mitchell Prize winning paper in 1982 – "The Product Life Factor[1]". Here he shows that longevity followed by the circles of reuse, repair and reconditioning are the most important and he went on to argue that not only does this avoid depletion of the planet's resources, it could employ large numbers in the repair and reconditioning work not likely to be replaced by robots.

Hermès fits into this in two ways. First as with all leather the raw material is a by-product, or non-determining product, from the meat and dairy industry, exactly as you say in your question. Some argue that it is even a waste material from those industries. So companies like Hermès take the view that leather is the ultimate circular material because of this alone. It is certainly natural, renewable and not depleting resources in the way fossil fuels do.

Secondly a Hermès bag is intended to last, and is designed to be suited for repair and refurbishment should that be necessary and they employ staff specially trained for this work. The thought process that goes into their products includes consideration of the implications of an article that will not be used for months or years, but decades. For me this is the true circular value of nearly all leather products. Longevity allied with minimal care and ease of repair or eventual reconditioning if required, with Hermès being a supreme example.

Consumers do now expect leather articles to last a long time. The pricing of leather means that it is not suited to the fast fashion, disposable economy which has created so much overconsumption, waste and landfill. From belts, to wallets and so on leather items are kept in regular use for many years. Tanners are now actively trying to encourage consumers.

This does not mean end of life should be ignored, only that it should not be the main feature of leather, however the leather has been made. For larger items like bags and furniture, increasingly new social businesses are working on innovative designs to use smaller pieces and organizations are springing up throughout the world. This recognizes that leather rarely wears out, it is usually threads and zips.

Where collection and separation work, chromium can be removed from the leather with acid treatment and the remainder, which is protein, put on the land as a fertiliser. This was done extensively at the end of last century by the tanners and shoemakers in the Milwaukee area.

Another route is high temperature incineration, or pyrolytic burning, which produces energy via gas and effectively smelts any chromium which ends as the only solid output. This avoids any issues with chromium six or other uncomfortable emissions.
Ground leather fibres have for a long time been used in leatherboard for shoe linings and for what is sometimes called "bonded leather". There are also newer materials such as e-leather which builds the fibres around a plastic skeleton. I am sure more such materials and hybrids will be developed in the future. ➤

[1] *Stahel, Walter R. «The product life factor.» An Inquiry into the Nature of Sustainable Societies: The Role of the Private Sector (Series: 1982 Mitchell Prize Papers), NARC (1982).* http://www.product-life.org/en/major-publications/the-product-life-factor

Humankind has been using leather since its early days, but today there is a rise of anti-leather activism motivated by diverse reasons. Is it due to certain confusion between fur and leather industries? Leather is clearly a by-product of the meat industry and even though some encourage less meat product consumption as part of a healthy lifestyle there will still be hides for leather production, how can you explain this anti-leather feeling?

I do not see confusion as an issue here, but I am uncomfortable that, with accelerating urbanisation around the world, newer generations are becoming disconnected from our sources of food and materials.

At the turn of the century animal rights groups only attacked the fur trade, quite successfully, but the change came in 2006 when the FAO published Livestock's Long Shadow. *This was publicised with statements that livestock was worse for the planet than transportation and was immediately recognised as highly inaccurate; but the damage had been done. The calculation had effectively compared the cost of running vehicles – without any figures for manufacturing them, the roads, etc. – with livestock figures which covered Amazon forest loss and all other capital aspects on a worst-case basis. The actual figures in the US are 28% for transport and 9% for all agriculture, with 3.9% being animal related. In the UK transport is 27% and all agriculture is 10%. Despite this, the 2006 paper is frequently still quoted as scientific evidence of the need for vegan diets.*

The animal rights and vegan groups have taken the opportunity to attack meat and leather based on health and environmental grounds. They cherry pick the science, and mix in ancient history and untruths, to create a powerful narrative. The leather industry has been surprised how powerful some of these bodies are and how much money they have, with a number of passionate billionaires involved.

I started pushing the leather industry to do some more generic marketing and position itself strongly back in the early nineties, but the industry has been characterized by small and medium sized family businesses with low margins, and by very strong national feelings. This has meant that extracting meaningful funds is difficult and avoiding them being trapped in silos almost impossible. We have now got a Leather Naturally campaign working globally but it is smaller than needed and while most organisations are now consumer facing, the silos throughout the industry seem stronger than ever.

With the development of bio-fabrication technologies, do you think we will see the leather industry using hides grown from cell cultures in laboratories in the near future?

This is controversial and it is hard to judge whether the concern comes from the abuse of terminology we are seeing or for a fear of loss of market share. Both things are apparent at this time. None of the leather alternates are as good as leather in terms of durability and aesthetics so the industry is angry when they see consumers becoming confused by inferior materials passing themselves off as leather.

On the other hand, tanneries understand the nature of non-woven materials very well, and are good at manipulating collagen. So it would make sense for them to become involved in these new materials in some way. Towards the end of the 20th century some tanneries in Italy certainly gave a lot of assistance to non-woven materials – mostly from nylon 66 – greatly improving its handle. It is clear that the future supply of hides cannot keep the per capita availability of leather matching the growth in population so becoming involved in compatible materials could make strategic sense.

At the same time all the bio-fabricated articles have taken much longer to come market than expected and only one or two are sold in commercial volumes. There is a considerable interest and further development is likely to quicken but to date we see considerable limitations in handle and durability, while some are far from proven environmentally in their production. At the moment quite a few have significant amounts of polyurethane and other plastics incorporated to stabilise the structure.

We can identify three types of leather: chromium-tanned leather, chrome-free leather and vegan leather (the most resistant being made of polyvinyl chloride or polyurethane which also have their environmental issues). How do these 3 compete in terms of overall footprint from sourcing to processing and recycling? Which type of leather is the most durable?

The industry actually recognizes three main types – chromium, vegetable and chrome free leather. Vegan leather is not leather at all but a quite different material, usually plastic. The definition of leather is that it must come from the hide or skin of an animal, essentially intact, and there is a clear ISO standard associated with that. While both plastic and textile are umbrella terms that cover a very wide range of materials, since the first legal definitions were laid down in the British Law in 1603, leather has been a much more precise term around ➤

the world. As you indicate currently nearly all the "vegan" category is fossil-fuel-based plastic, thus from a non-renewable resource, with a short life and a difficult after life. Some of them, such as one called Pleather when initially sold in the US and was a PU coated textile, involved very dangerous solvents, and it is well recorded in Whenzhou that it shortened life and caused childbirth issues.

Chromium quickly became the dominant tanning material after it was introduced at the start of the 20th century and is well understood. Relatively small amounts are needed to create a stable fibre structure so a lot of active sites remain in the collagen for the addition of other chemicals to improve the performance of the leather. Areas such as water, perspiration and fireproofing are typical although chrome tanning itself is better in these areas than the alternates.

The main historic tannage is vegetable and this remains excellent for article like handbags and other leather goods, as the patina develops nicely when handled. There are many instances, though, when a chrome tanned leather is given an extra "retan" with vegetable in order to combine the characteristics. There are some very traditional leathers, mostly in the equine sector, where vegetable tanning remains preferred as well as for hand crafted products where vegetable leathers can be outstanding. However, given the large amounts of vegetable tannin required to make vegetable leather, supplies of sustainable material would inevitably go beyond the availability. Historically when vegetable tanning was dominant there were complaints about damage to forest and mangrove swamps by bark collectors.

During the 1990s there was a push to replace chromium with other materials on the grounds that it was too easy for the chrome in the leather to convert to the hexavalent form. As far as I could observe at the time this was mostly pushed by the chemical suppliers and the only customer group they really persuaded were the automobile sector in Europe who were worried about a recycling directive being discusses in Brussels for 2000. The leathers they made were found to have better hydro-thermal stability for cars – cut chrome tanned pieces can change size if left for a time or overnight. This is connected to humidity and temperature but is not fully understood – but it aided these chrome free leathers to access and remain dominant in this sector. So far chrome free leathers have not been good enough to establish a big hold in other sectors.

Durability of all three types is very similar, the main differences are in characteristics etc. Vegetable tanned leather is distinct but is generally thicker and less flexible, so suited only in a limited number of areas.

However, the bad image of hexavalent chromium associated with leather adds to a list of reasons why some brands consider leather quite a difficult material to handle, something the leather industry will have to work hard to overcome.

We understand that chrome-tanned processes are safe for workers, our environment and the final consumer provided the application of the strictest HSE standards. Nevertheless, in some countries those standards are not respected which in turn causing damage to our sector, what kind of actions would you recommend?

Most of the industry consider chromium to be the best way to tan leather currently available, when done responsibly. Difficulties arise when workers are not trained in handling chemicals, not provided with PPE, the plant and drainage inadequate and there is no provision from handling effluents.

The structure of the leather industry involves a significant number of major factories, some very large indeed, with outstanding facilities and engaging with all the best auditing and compliance arrangements. These produce by far the majority of the world's leather but have behind them a very long tail of smaller and medium sized units around the world right that extend right down to the micro units found in places such as Morocco and the subcontinent. Many of these smaller units leave a lot to be desired and in some cases the behaviour of the management and the authorities is separately or together quite disgraceful.

In India for example, the legislative framework is quite good but enforcement in some areas is very weak or corrupt and not applied at all to the micro tannery sector where illiteracy is additionally identified as a major issue. Similarly, in the traditional, and very ancient, pit tanning areas of Morocco a detailed inspection will uncover bags of chromium powder in various back rooms being used to make a few special leathers. Health and safety provision is generally poor here, and the facilities are totally unacceptable for using chromium powders. It is these sectors where the photos are so easily taken that provide the images used against the industry as a whole.

When the Chinese decided earlier this century to deal with effluent in the leather industry, they imposed tighter enforcement of the laws and then systematically started closing smaller tanneries or requiring them to move to zones that have a functioning common effluent plant. They argue, correctly, that small tanneries standing alone will not be able to fund meeting modern effluent standards. ➤

It is my belief that our national, regional and global trade bodies have to combine and pressure countries that have failing sectors or areas to make similar changes. In most countries closure is needed but, in some places, a central effluent plant plus training and PPE might be adequate and save a lot of needed employment. Brundtland's definition of sustainability includes an expectation that society will pull people out of poverty, and the leather industry has been outstanding at this. The main employment in terms of numbers comes in making articles from leather, for which it is important that the tanning is safely and efficiently done.

Most of these poor plants do not trade in the international system, but a few like those in Bangladesh do in order to achieve low selling prices through avoiding investment, health and safety and any environmental controls. We should be pressurising the brands that buy these leathers to get involved in correcting matters.

Do you see any other challenges for the chrome-tanning industry?

Tightening legislation related to CrVI is the clear current threat, with the recent start to aggressive enforcement of California's Proposition 65. Enforcement orders have recently been handed out to a number of companies in the glove industry and footwear brands and retailers look like they are next in line. The lawyers involved have a strong history of success and the law appears to be written to their advantage. While this might appear as a money seeking exercise, settling out of court apparently involves pulling product from the shelves, ensuring no further infringement and the likely application of labelling identifying the contents as dangerous. This is in addition to paying sizeable reparation.

It is hard to assess the full implications of this while the industry is grappling to come to terms with it. So far, they have been unable to stop the use of an adapted test procedure carried out in a US lab which is a subsidiary of an Indian company, rather than using the international standard as used by the EU. This is significant because of the ease of obtaining false positives even with the best test method in top laboratories. Thus, the leather being challenged has nearly all, as far as I know, been certified as within limits by the normal international standards.

What it means is that many producers are urgently trying to find acceptable process methods which do not use chromium. For gloving leather and garment leather this is much harder than with the heavier substance bovine material.

For gloves the likelihood is an increase in the use of plastic based materials in the sports glove area, and a similar approach might well be the outcome in some other product areas where chrome free leathers do not work well.

There is another point here which is that the leather industry, myself included, should have responded with greater clarity in the 1990s to the foolish attacks on chromium in leather and the wave of industry greenwash for non-chrome processes that accompanied it. The outcome has been that many key influencers amongst brands, designers, environmentalists and consumer groups now believe that chromium is dangerous to use and handle. It is not clear whether the leather industry can successfully fight this or whether it will eventually be forced to concede, find an alternate and move on.

The recent sale of its chrome division by Lanxess has also created a surprise as they have actively and successfully promoted leather as an outstanding material and their approach has integrated chrome tanning with their other offers to the industry. The divestment was not very clearly explained and has unsettled the industry.

What is, in your opinion, the outlook for the chrome-tanning industry and leather industry in general?

The best description for the future of leather would have to be mixed. The industry has been slow to realise a need for marketing – or to understand that marketing is more than a brochure, a press release and an advert – so for much of the middle and lower priced leathers they are engaged in a difficult battle with much cheaper plastics which are easier to handle through mechanised and automated equipment. To the industry's surprise some hides and skins in these sectors are not being bought by tanners and abattoirs are having to dispose of them, mostly by burying. This is a first in history for all available hides and skins not to be used for leather.

Good marketing and innovation should recover this situation as leather is essentially one of the most sustainable materials. The industry acknowledges and respects those not wanting to use animal products but does not accept the arguments. The leather trade is pleased to use this by-product and to cooperate with the livestock sector to ensure the highest level of husbandry and animal welfare.

For high quality areas the appetite for leather remains strong and although there are challenges, for example in the automobile sector, the prospects look good. ➤

Do you have any advice for chromium chemicals producers?

If you are interested in the sector then Leather needs more help to explain the nature and value of chromium, its chemistry and all the aspects of CrIII and Cr VI. Tanners have found that few sustainability directors at retailers or brands have any chemistry knowledge and so feed on perceived views. The tanners do not have good enough documentation, well written and referenced, to fight for chrome tanning.

It would also be good to help the leather industry find a good test for chrome six, as the problem of false positives remains ongoing. There is a project underway related to this but it has a false start and its current status is unclear.

Provide some better peer reviewed papers on the dermatological aspects of CrIII and CrVI. Similarly, for the absorption and ingestion of CrVI – through the nose membrane, touching etc. The leather industry is clearly nervous about challenging claims in these areas and the differences between allergies and developing cancer through contact with CrVI.

A final area where I personally believe could offer significant benefit is to consider helping fight against the use of loose terminology and weasel words such as toxic, heavy metal, sustainability, natural, organic, biodegradable. I have long tried to persuade the leather industry to be more careful with its language, but have not been very successful. ◆

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