Innovation

Part 2: Co-products and solids management

Twenty world-standard tanneries have opened their doors for in-depth study as part of the Tannery of the Year Awards 2009 and 2011 programme. Considerable technical information has been published following these visits.

Recycling and regeneration practices employed to minimise water and chemicals consumed in leather manufacture have been described in Part 1 (October/November 2011).

Part 2 continues this analysis of good practice with a broad overview of how co-products associated with leather manufacture, and other solids are managed.

Losses of hide material in leather manufacture are inevitable due to the needs of the conversion processes and operations, and vary according to the type of hide and skin and the target final leather. There is also waste stemming from the various processes used in leather manufacture.

At one time this loss was simply accepted as solid waste for disposal, but times change, and the solids once perceived as waste are now finding new outlets as co-products. The properties and outlets for these very different solids are detailed in this article:

Limed and tanned splits

The major co-products from leathermaking are splits from lime splitting and from splitting full substance hides after tanning. Tanned splits are often sold to other tanners who specialise in this type of leather production, but many tanners process these in-house.

Limed splits are mainly sold for high quality gelatine manufacture or sausage skins/casings, but they are also converted into dog-chew products. In addition, they are being subjected to anaerobic digestion with organic waste to generate biogas.

Collagen fibres are also being produced for use in the food processing industry, and this is described in *Panel 1*.

Panel 1: Collagen fibres - Hulshof, Lichtenvoorde, The Netherlands

Collagen fibres are a major co-product manufactured on site, and are used in the food processing industry. The standards of hygiene required are very high, and the conditions are under audit and inspection by government bodies according to Directives 852 and 853 Food Standards for the EU. This is unlike technical gelatine manufacture where by-products are chemically destructured, which does not require such high standards.

The production process relies on fresh hides free of preservatives, and uses limed splits that are processed in a building adjacent the tannery. All personnel operating the machinery in these initial leather and food processing stages have to meet the standards of cleanliness and hygiene demanded by food manufacture.

This operation produces a white dry fibrous product, and this can be added to sausages, beef burgers, prepared meats and similar products. Different fibre lengths produce different textures and tastes, while the product allows an increase in water content up to x25 the weight of the product. It can be mixed with soya and gelatine, and produces a quality texture that these products cannot achieve.

Fleshings, trimmings and grease

Fleshings from raw and salted hides after a short soak, and after liming/unhairing processes, are being macerated and heat treated on output from the fleshing operation. This produces granuals of cooked protein and skin-grease which can be used as boiler fuel. On a larger scale, commercial rendering is taking place to extract tallow and oils of different grades and cooked/sterilised protein granules as described in *Panel 2*.

Another common treatment is to heat-treat fleshings to form commercial glue. This processing is normally performed by external contractors, although there are in-house examples in tanneries. Fleshings are also being used in the manufacture of fertilisers.

Where grease is not fully removed from hides in beam house operations there is some release on washing after tanning, or in the case of purchased wet blue, released on wetting back. In this event, the wash waters are being held for a short time before discharge to effluent treatment *(or recycling)*, so that the grease/oil separates. This recovered oil is being burned as an additive to boiler fuel.

Recovered hair

Many tanners operate hair recovery systems. The main objective is to reduce the load on the effluent treatment plant in terms of suspended solids, COD and nitrogen. Ultimately this means a smaller effluent treatment plant, reduced energy in-put and reduced solids for disposal/alternative use.

These hair recovery systems operate by recirculation of the unhairing float from the processing vessel, then screening the float through external screens to remove the hair. Often a single screen serves several vessels, and this might include compression of the recovered hair although there are examples where each vessel is served by an individual screening arrangement. This recovered hair is badly degraded, matted, and contaminated with grease.

It is possible to compost this hair with other waste, with the final product used for land conditioning. There are examples where the hair is heat sterilised, then mixed with other organic waste and used as part of land recovery or cover at landfill locations. Investigations are also taking place to create a colourless hair-hydrolysate.

However, hair recovered from hair-sheep manufacture is collected, washed and used for blanket and garment manufacture.

Shavings, tanned trimmings and leather dust

Chrome shavings are mainly compressed on collection from shaving operations into dense cubes of about 30 cm sides. An outlet for chrome shaving that is long established is conversion

Panel 2: The rendering of fleshings - Coming Industria e Comercio de Couros, Brazil

All of the fleshings are rendered on site to produce oils and protein. This treatment is in conjunction with bones from the abattoirs that supply the tannery, as previously these were deposited to landfill. First, the solids as received are delivered by augers to a macerating plant where they are chopped into small pieces. These pieces are then screw-fed into an autoclave where they are rendered at 125°C, to form liquid tallow and cooked recovered protein. These products are separated by gravity, with tallow flowing from the separator base, and extruded from the recovered protein by screw pressing. This tallow is blended with the previously separated tallow, and then pumped to a centrifuge for clarification.

The recovered oil is used for pharmaceutical purposes and personal care, food additives, chocolate and ice cream manufacture, shampoo and soap manufacture. The lower grades are used in tyres for cars and bio-diesel, and can be used as boiler fuel. The sterilised bone/protein meal product is used as feed for chickens, pigs and fish.

Fleshings and bones are first macerated, then heat rendered under pressure in the series of autoclaves.

into leather board. This also applies to leather trimmings, but this requires extra operations as these pieces need maceration.

In addition, the breakdown of shavings to form hydrolysate by processing under alkaline conditions for several hours at high temperature is well established. This is taking place both at tanneries, and also by external companies. The uses for these hydrolysates are considerable. Products are being manufactured that serve as fillers in retannage, there are uses as fertilisers, and possibilities of conversion into floor tiling. The adhesive properties are being exploited so that they are being used as additives to commercial water-based paints; biodegradable paints are also being made based on hydrolysate, the colourants including white overspray from leather finishing.

The ability of hydrolysates to degrade rapidly when in solution has led to their use in creating biogas using anaerobic digestion, coupled with energy reuse within the tannery.

Recovered chrome from this hydrolysis is also being regenerated to form chrome tanning products.

There are also chrome-free shavings to take into account. These are not as stable as chrome shavings, thus can be biodegraded or composted often together with other waste. There are also examples of chrome-free leather board manufacture.

Leather trimmings and off-cuts

These are used extensively in a variety of outlets. Trimmings from tanned skins are being softened with oils and coloured, and then turned into small leather hand craft goods. Finished leather trimming are often used for small leather goods such as small cases for memory sticks, mobile phones, key fobs, etc.

Solids from effluent treatment

Screenings from separated waste streams *(chrome free)*, and precipitates from chemical dosing using ferrous salts are being used for land conditioning.

If the sludges from effluent treatment after dewatering contain chromium, then these are being deposited to landfill. Alternatively, these solids may be used with other wastes under carefully controlled conditions as a source of thermal energy.

Chrome-containing ash from thermal treatment, and dried chrome precipitates from separate treatment of segregated used chrome liquors, are being thermally treated and incorporated in brick and cement manufacture.

Where the solids are free of chrome, then there are other opportunities. These include composting with other organic wastes, controlled anaerobic digestion to produce biogas/energy or after heat treatment used with other wastes as top cover for landfill sites.

Segregation of miscellaneous solid waste

Solids wastes generated within the plant tend to be segregated in each department, collected at source, and then delivered to a management centre at the tannery site. These wastes typically include sheet plastic, paper and cardboard and bags made from plastic and paper. There are also polycrates and barrels that have contained chemicals, wood and various metals, dried sludges from effluent treatment, bricks and rubble.

Where appropriate these materials are cleaned and stacked, and then where possible sold, or are given away for reuse/recycling. Hazardous products such as electrical goods that might contain mercury, oils and heavily contaminated wastes are held in a secure store for collection and reuse/deposit by licensed companies. Revenues generated from these items are often used for social purposes within the company or for various social projects that the company supports. RD

Panel 3: These beautiful animal horns are a co-product from the processing of exotic skins.