



## IUE 2 - Recommendations for Tannery Solid By-Product Management

2018 updated document

### **Aim of the document:**

The International Union Environment Commission (IUE) is concerned to take into account the technologies currently applied by the most advanced tanneries and not just to consider the latest developments from research units.

The reuse of untanned solid waste is restricted or carefully controlled for human and animal food. The general recommendations collected by the Commission have to be adapted to local conditions and under the supervision of an expert.

### **General remark:**

Please note that any untanned hide by-product (e.g. fleshings, trimmings, splits) from BSE (Bovine Spongiform Encephalopathy) regulated animals must be totally destroyed.

EU regulations for animal by-products do not allow hides and skins from BSE-infected animals in a tannery. It should be clearly noted that from the liming stage the skins are no longer considered an animal by-product by the regulations.

### **1. Dusted salt**

The dusted salts may be reused for pickling after dissolution in water and clarification or filtration. Alternatively, the recovered salts could be used for a number of applications including foundry casting (in the mould), hypochlorite production and de-icing of roads. Dusted salt can be reused for curing but a preliminary heat treatment is required to reduce bacterial impact and to limit the presence of organic matter in recovered salt.

### **2. Green fleshings**

Green fleshings can be used in rendering plants for the recovery of grease and meat meal. These products must be clean, and contain minimal quantities of minerals.

More importantly, green fleshings are a valuable source of high quality tallow, a basic commodity with added value. In contrast to limed fleshings, green fleshings need little pH adjustment prior to enzyme processing. They produce much higher yield and the quality is good, because the fleshings are not previously subjected to prolonged alkaline treatment.

### **3. Trimmings**

The green and limed trimmings can be used with limed splits for tallow or gelatine production (see below).

### **4. Limed fleshings**

#### **4.1 Methane production**

Untanned wastes mixed with farming, domestic and fish wastes can be used for methane production; full-scale plants are in operation in Denmark and Sweden.

Waste fleshings mixed with tannery sludge are digested to produce methane by grinding to 10 mm and warming to allow microbiological activity, with increased fat or grease content resulting in increased methane production. The volume of gas evolved (comprising 75% methane) is estimated to be 615 litres per kg of organic material introduced into the digester, after 25 to 30 days at 35°C. The residual solid phase is suitable for composting according to chromium content and can be applied directly to agricultural land as a soil improver. This technique is especially suited to warmer countries, where the necessary heat input is minimal. The input mix material for this system must have at least 70% of organic matter content to operate successfully. An industrial scale plant is in operation in India.

In Denmark, ferrous metal salts are added directly to the reaction vessel of the bio-gas reactor to avoid the generation of noxious and corrosive gases.

#### **4.2 Grease and protein recovery**

Hydrolysis leading to the recovery of animal grease and proteins can be achieved in two ways; either by a liquid hydrolysis (acid or alkali catalysed), or by enzymatic digestion at 35°C. Following hydrolysis or digestion, the emulsion must be heated to at least 50°C to separate the fat, protein and water components into separate phases. The protein phase contains 5 to 10% protein.

Limed fleshings must be acidified before enzyme treatment. They produce a low yield of tallow, because it is considerably hydrolysed by the liming process; in addition the quality is low because of the high content of free fatty acid from that hydrolytic reaction.

Gaseous by-products of the process are hydrogen sulphide, mercaptans and odour, and it is therefore essential to exhaust these via a water wash or a scrubber system containing sodium hydroxide and sodium hypochlorite. However, in some places, the exhaust gases are passed into the air intakes of the boilers used for energy production, thereby eliminating the need for a scrubber. In some cases, a ferrous metal scrubber may be needed prior to the boiler to capture sulphides.

In respect of the capital and running costs, it is estimated that for economic viability, 10 tonnes of material must be processed per day.

A second process technology involves treatment with hydrogen peroxide and sulphuric acid at 35-40°C. For this, the fleshings must first be chopped to a particle size of 50-200 mm. The process produces two phases that can be separated by mechanical de-watering; grease separates from the liquid phase, the yield being 10 to 12.5% of the original fleshings mass. A

protein phase (20-25% dry solids) is also obtained and this can be used either as animal foodstuff after drying, or as fertiliser. Again, a minimum quantity of 10 tonnes per day needs to be processed for economic viability.

### **4.3 Composting**

A mixture of waste fleshings and an appropriate bulking agent (also carbon source), with aeration, leads to compost production

## **5. Recovered hair**

There are a number of reported promising uses for the recovered hair from hair-save processes. These include: felt production, slow degrading plant containers, keratin hydrolysate, cosmetics and pharmaceutical products (i.e. shampoo, amino acids, etc.)

### **5.1 Composting**

Hair recovered through a hair-save process can be incorporated into existing composting processes, as it is a valuable source of nitrogen and organic carbon.

### **5.2 Fertiliser**

Hair can be directly used as slow release source of organic nitrogen and carbon for fertilising purposes

### **5.3 Recovered hair from pigskins**

Hair from pigskins is a valuable material that is used for brushes and other consumer products.

## **6. Limed splits**

### **6.1 Gelatine production**

Gelatine production by a specialised, purpose built process facility represents a major utilisation opportunity for lime splits, not suitable for tanning. The process involves lime hydrolysis; soluble gelatine is extracted in a series of hot water batches of increasing temperature at controlled pH. Different stages of purification, demineralisation, concentration and sterilisation are then required prior to final drying. The gelatine product is used by the food, photographic and pharmaceutical industries. Lower quality gelatine or glue can be produced by acid hydrolysis and hot water extraction.

### **6.2 Sausage casings**

Specialised manufacturers use limed splits to produce high quality sausage casings. The casing manufacturer will impose restrictions on the process chemicals used in the beamhouse.

### **6.3 Pet chews**

Delimed hide splits can be dried in moulds of various shapes, to produce dog chews.

### **6.4 Composting**

Limed splits, high in nitrogen, low in carbon, will compost readily.

## **7. Grease from degreasing process**

Grease from the degreasing process can be used as a component of low grade fatliquors through a sulphitation process.

## **8. White splittings**

As for lime splits, the wet white process produces splits that can be partially denatured to produce gelatine or collagen additives. However their use in human food production is restricted.

## **9. White shavings**

Wet white chemistry options can create environmentally friendly tanned waste; aldehyde tanned, syntan tanned, marginally vegetable tanned materials have little associated hazard. These shavings are particularly suitable for use as fertiliser or as a source for collagen hydrolysate. Aluminium containing shavings can be applied to non-acidic agricultural land, according to local regulations.

## **10. Blue splits and shavings**

### **10.1 Leatherboard manufacture**

Companies are producing leatherboard from bovine chrome and vegetable shavings and splittings in several countries, although only shavings satisfying strict quality requirements are accepted for processing. The leather fibres are mixed with latex, and after coagulation, the mixture is de-watered, pressed and dried. The final product is obtained either as separated sheets or as a continuous material.

### **10.2 Chemical hydrolysis**

One industrial gelatine manufacturing process blends the shavings with magnesium oxide and subsequently extracts 50% of the gelatine content with boiling water. A chromium containing slurry ('scutch') is generated as a waste.

Protein extraction can be improved with magnesium oxide assisted by enzymes. Liquid proteins can be used for industrial applications. The chrome cake can be recovered for chrome liquor production. Other alkaline agents, such as lime and sodium hydroxide are used industrially.

Acid hydrolysis utilises concentrated sulphuric acid with steam injection. The hydrolysate is neutralised with phosphates and supplemented with organic additives to produce a fertiliser.

The hydrolysate can also be used for different industrial applications, such as in retanning operations in tanneries, as a coagulating agent in the rubber industry, as complementary products for surfactants and as plasticiser in concrete production.

### **10.3 Thermal treatment**

Various laboratory and industrial trials have demonstrated that chromium containing leather waste may be thermally treated to produce an ash containing approximately 50% chrome

oxide, which is similar in nature to the mineral ore feedstock, sodium chromite, used by the chromium chemicals manufacturing industry. Sodium chromite, converted into chromate, is the precursor of most chromium chemicals, including chrome tanning agents.

#### **10.4 Enzymatic treatment**

Enzymatic digestion of shavings results in a high quality and valuable hydrolysate or gelatable protein and a protein contaminated chromium sludge. The hydrolysate can be used in retanning agents, as foam stabilisers, in the chipwood industry and gypsum industry. The chromium sludge can be reused in a dichromate reduction plant for the production of chromium sulphate. Full-scale factories processing shavings have been in operation in the Czech Republic and USA.

#### **10.5 Brick making**

Mixing of limited amounts of chrome shaving into clay for brick making is carried out in South America.

### **11. Vegetable tanned waste**

Vegetable tanned shavings and trimmings may be used in leatherboard or fertiliser production via a roasting or a wet fermentation process.

### **12. Waste water sludge**

Wherever possible, the chromium from spent tanning liquors should be recovered and reused or used in other industry (e.g. steel). Alternatively, high exhaustion chrome tanning systems should be used. Either method will minimise the mass of chromium discharged.

The organic content of a soaking sludge can be reduced by 65 % in a UASB (upflow anaerobic sludge blanket) process.

Usual incineration of sludge (with or without leather waste), although technically feasible, will have limited application due to the economy of scale, and due to associated environmental problems (air pollution and possibility of chromium oxidation).

There is no risk-based justification for banning the application of chromium containing wastes to agricultural land. However, the chromium content of sludge applied to land must be limited in order to comply with existing regulations and requirements.

Mixing the sludge with clay and bricketting, solidification with fly ash and cement would minimise leaching of chromium.

### **13. By-products yet to be utilised**

- Buffing dust
- Crust and finished leather waste
- Finishing resins
- Chrome precipitated from post-tanning operations

Viable uses for all the above wastes need to be established.

## **14. All solid waste**

One option for dealing with all solid waste is incineration, combustion of the organic content of feed material, with controlled availability of oxygen. However, this technology has a bad reputation for producing odour and the possibility of producing dangerous fly ash makes it less environmentally acceptable.

An alternative approach is gasification. Here, the organic content is converted to combustible gas by heat and the gas is in turn burned to maintain the process. The products are heat and stabilised, inert solid. The technology is relatively new, but been established as environmentally sound and has been successfully applied.

While these options are viable, the costs and environmental compliance implications may limit their application.