Leather Meal

Crops

Identification

Chemical Name(s): N/A

CAS Number: N/A

Other Names: Hydrolysed leather meal, leather tankage, leather hydrolysate, chrome tanned leather tankage

Other Codes: N/A

Summary Recommendation

Synthetic / Non-Synthetic:	Allowed or Prohibited:	Suggested Annotation:
Synthetic (consensus)	*Prohibited (consensus)*	

Characterization

Composition: Leather wastes from tanneries or leather goods manufacturing.

Properties: Leather meal is a residue product derived from tanned animal hides with organic matter content in the range of 75-85%. Earthy in appearance with slight odor of leather, it contains from 5-13% nitrogen in a slowly available form. Carbon to nitrogen ratio is approximately 4:1, and it contains chromium at approximately 2.5% (25,000 ppm or 50 lbs/ton). Contains 95% solids, 5% moisture, pH is 4.0, and bulk density is rated at 40-45 lbs./cu. ft. (MSDS).

How Made: Leather waste from various sources is ground, treated with steam under pressure, dried, and milled or pelleted. Fertilizer in the U.S. is commonly made from scraps from the manufacturers of leather products or from hide trimmings from the tanning factory (Sachs, Koran). Solid waste residuals from effluent of tanning factories may also be used for fertilizer (McDonnell, Taylor).

Modern leather production is a complex industrial process that involves chemical transformation of its major protein components to separate and stabilize the desirable form, collagen. The largest category of hides tanned is cattle hide. This includes three broad steps (Kirk -Othmer):

(i) Cleaning, curing, removal of hair and all materials not part of the final product.

Curing may be through and air-drying process, more commonly with salt (NaCl), either dry or in a brine. Salt discharge from the curing process can be an environmental problem, with level of 2-4000mg/L in the waste water. Alternative treatments include sodium bisulfite, quaternary amines, potassium chloride, and irradiation, though these are not common.

Hides are further soaked, to remove the salt, then trimmed, fleshed, and dehaired. Sodium sulfide and calcium hydroxide are used to create a strong alkaline reducing condition that destroys the hair. The quantity of sulfide, as Na2 of NaSH, is normally 2-4% of the weight of the hides. Waste from dehairing and affiliated wash water creates the most serious environmental problems for the industry. Flesh and trimmings are then removed and may be discarded as waste or rendering for feed, glue, or gelatin.

Deliming is next, using quaternary ammonium salts to neutralize the lime and form calcium ammonium complexes. Another step involves enzymes and pH adjusters, dispersing the degradation products and further breaking down stiff elastin. Hides are then pickled in salt and acid solutions, usually sulfuric.

(ii) Tanning. Collagen reacts with tanning materials to stabilize the protein to resist chemical, thermal, and biological degradation. Chrome tanning is the most widely used system worldwide, because of advantages of light color, speed, low costs, and good stability of the resulting leather. Prior to the 1900s all leather was tanned by vegetable methods. Tanned leather is so non bio-reactive that centuries old leather has been found in almost usable condition.

The favored tanning agent, chromium sulfate, is produced by the following reaction:

$$Na_2Cr_2O_7 + 3\ SO_2 \text{ -------> } 2\ CrOHSO_4 + Na_2SO_4$$

The chromium sulfate is then reacted with the hides at a low pH, and the chromium attaches to the carboxyl groups in the hide. This significantly raises the chromium content of the hides. The control of chromium penetration is accomplished by increasing the pH with sodium bicarbonate. After this process is complete, the chrome tanned leather is wrung, inspected, and may be trimmed, split, and shaved to the desired thickness. Shavings may be used in fertilizer production.

(iii) Treatment to give desired characteristics. Chrome tanned leather is light blue in color, and requires retanning, coloring, and fatliquoring before it is soft and workable. Retanning may use a combination of vegetable or synthetic tannins, and other "specialty chemicals." Synthetic organic acid and basic dyes are used for coloring, including Acid Blue 2B and Bismarck Brown G. Fatliquoring means oiling of the leather, and may use sulfated or sulfonated animal or fish oils, synthetic oils, and specialty oils developed for this purpose. Final finishing steps include drying, flexing, buffing, and coating with finishes. Finishes are water based latex formulations and contain additional pigments or dyes.

Commercially produced leather is the result of complex and carefully managed chemical alteration of a natural hide using a multitude of synthetic substances. It is also possible to produce leather using salt based curing, mechanical dehairing, and vegetable tanning, in which case a by-product from this type of production could be considered natural and not within the scope of the National List.

Specific Uses: As a soil amendment and fertilizer, and as a source of nitrogen.

Action: A slow release, stable form of nitrogen and supplemental organic matter.

Combinations: This material is variable depending on the source of the ingredients and processes used.

Status

OFPA

Leather meal appears to fall in a prohibited category under section 6508 of the OFPA: "For a farm to be certified under this chapter, producers on such farm shall not (1) use any fertilizers containing synthetic ingredients or any commercially blended fertilizers containing materials prohibited under this chapter or under the applicable State organic certification program . . ." (7 USC 6508(b)(1)).

The substance is considered synthetic. The OFPA, 6517(c)(A) "Guidleines for Prohibitions or exemptions" states that synthetic substances may only be granted an exemption for use only if the Secretary determines, that the use of such subtance (i) would not be harmful to human health or environment and (ii) is necessary to the production or handling of the agricultural products because of unavailability of wholly natural substitute products.

Health and environmental effects are discussed below under the OFPA 6518 criteria. There are many natural alternatives, inclulding compost, animal manures, the use of cover crops to provide added organic matter, and slow release forms of nitrogen in organic systems.

In addition to availability of alternatives, the categories of possible exemption permissable under 6517(c)(1)(B)(i) do not include an option for synthetic fertilizers other than vitamins and minerals (the category that permits the use of synthetic micronutrients). The NOSB recommended that synthetic micronutrients only be permitted based on established record of the specific plant nutrient need.

Regulatory

In the U.S., fertilizers are licensed under the authority of state control officials, with unifying model statutes and definitions provided under the auspices of the Association of American Plant Food Control Officials (AAPFCO). Recently, AAPFCO considered a request by this same petitioner to consider whether this type of leather meal could qualify under the fertilizer term of "natural organic" and be eligible to describe the product as such on its label. This AAPFCO fertilizer term states:

> "Natural Organic Fertilizer – materials derived from either plant or animal products containing one or more elements (other than carbon, hydrogen and oxygen) which are essential for plant growth. These materials may be subjected to biological degradation processes under normal conditions of aging, rainfall, sun-curing, air drying, composting, rotting, enzymatic, or anaerobic/aerobic bacterial action, or any combination of these. These materials shall not be mixed with synthetic materials or changed in any physical or chemical manner from their initial state except by manipulations such as drying cooking, chopping, grinding, shredding, hydrolysis, or pelleting." (Official 1994)

AAPFCO officials decided that this material, which they class as leather tankage or process tankage, is not a natural organic fertilizer, due to the synthetic additives used in production (Breitsman, Koran). They do consider it to meet their definition of organic fertilizer, which currently states:

> "Organic fertilizer – A material containing carbon and one or more elements other than hydrogen and oxygen essential for plant growth." (Official 1973)

Individual states grant approval of labels for fertilizer products sold in each state. Currently, this type of leather meal product (produced by the petitioner) has a label granted by the state of Wisconsin that limits it use to turf, ornamental trees, shrubs, and flowers. It is not permitted for crop use, due to concerns about reports in the literature of chromium phytotoxicity under low pH to crops in the cabbage family (Koran).

Feed use: hydrolyzed leather meal is recognized as a feed additive by FDA at 21CFR Sec. 573.540 for use as a source of protein in swine feeds in an amount not to exceed 1.0 percent by weight of the finished feed. Chromium content of the leather meal used must not exceed 2.75 percent. The Association of American Feed Control Officials (AAFCO) has a similar definition of hydrolyzed leather meal, with an asterisk indicating that as a mammalian product, it is restricted to use for non-ruminants (due to 1997 FDA regulations on transmissible spongiform encephalopathy (TSE) 21 CFR 589.2000).

> 9.55 Hydrolyzed leather meal is produced from leather scraps that are treated with steam for not less than 33 minutes at a pressure of not less than 125 pounds per square inch and further processed to contain not more than 10 percent moisture, not less than 60 percent crude protein, not more than 6% crude fiber, not more than 2.75 % chromium, and with not more than 80% of its crude protein digestible by the pepsin digestibility method. Hydrolyzed leather meal may be utilized in livestock feeds as provided in food additive regulation 573.540. (Adopted 1970)

AAFCO also recognizes a specific definition of leather hydrolysate:

> T9.75 Leather hydrolysate is obtained from chromium tanned unfinished leather shavings, trimmings, and /or lime fleshings that may or may not be pressure cooked with the addition of steam, sodium hydroxide, lime or magnesium oxide. Chromium is precipitated and separated so that only trivalent chromium at less than 1000 ppm on a dry matter basis remains in the hydrolysate. This product is available as liquid ingredient or as a spray dried powder. In either form event, the analysis on a solids basis will not be less than 75% crude protein and not less that 85% of the protein shall be pepsin digestible. (Adopted 1993, Amended 1999)

Cheeke (1999) notes that hydrolyzed leather meal is a poor quality protein, consisting largely of collagen and states that chromium poisoning is a concern, agreeing that chromium levels should not exceed 2.75% for that reason. Earlier reports of successful use at up to 6% in ruminant diets have been superseded by the 1997 FDA ruling prohibiting such use.

Status Among U.S. Certifiers

Prohibited. NOSB recommended prohibition in 1996, and U.S. certifiers adopted this position. Washington State Department of Agriculture had allowed its use, but has recently amended its list effective Oct. 23, 2000 to prohibit.

Historic Use

Prior to 1990, leather meal was more commonly used by some organic producers, but concerns about contaminants and subsequent NOSB recommended prohibition has decreased use by certified producers.

International

CODEX – does not specifically mention. Annex 2 lists "Processed animal products from slaughter houses and fish industries- need recognized by the certification body or authority. " Plant production standards do state that by-products from livestock farming, including manure, should be from organic operations although allowances are granted when such sources are not available.

EU Council Regulation 2092/91 – Does not include on list in Annex II, although blood, hoof, horn, fish, meat, and feather meal are listed. Plant by-products used for fertilizers are restricted to those produced by physical processes, extraction with water or aqueous acid and/or alkaline solution, or fermentation.

IFOAM – Not listed. Basic Standards allow only "By-products from the food and textile industries of biodegradable material of microbial, plant or animal origin without any synthetic additives."

CANADA – Not listed. Fertilizers derived of plant, animal microbial origin may undergo physical, enzymatic, or microbial processes only.

Section 2119 OFPA 7 U.S.C. 6518(m)(1-7) Criteria

1. *The potential of the substance for detrimental chemical interactions with other materials used in organic farming systems.*
   Leather meal is a carbon based material that will increase organic matter and supply nitrogen, and gives a positive crop response. No known interactions with other materials, although adsorption of heavy metals present in the material may have a long-term effect on other materials under different soil conditions.

2. *The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment.*
   Chromium is reported in concentrations ranging from 1-3% in leather meal (10,000 – 30,000 ppm), although it is reported to be found in the insoluble, trivalent form (Cr III) (Ciavetta, and reviewed in Chaney). Hexavalent chromium, Cr (VI), is highly soluble, carcinogenic, and is of serious environmental concern. Studies have shown the soluble forms of Cr (VI) are reduced to Cr (III) when added to soil and generally do not affect the Cr content of the crops, although it is increased in roots. Uptake is greater under high pH conditions (Cary et. al.).

   Some studies have indicated phytotoxicity of excess chromium (Hemphill). Chaney reviewed the literature extensively to argue that the inert nature of Cr (III) in soil chemistry and lack of evidence of health risks justified removal of ceiling limits for chromium originally published in the EPA proposed rules for biosolids (sewage sludge) applications. Chaney does acknowledge the Cr (III) can be oxidized to Cr (VI) is soils under some conditions, particularly the presence of Mn-oxides is oils. Ciavetta found that extractable water soluble chromium in soils after leather meal application varied from being less available immediately after application with a pronounced increase after 40 days, followed by a sharp decrease. He attributes this to a release during decomposition of the organic matter and then subsequent insolubilization. Harrison also notes in the "Case for Caution," (a critique of the EPA biolsolids regulations), that insoluble Cr III is not of concern, but that little information is available on the ionic status of Cr is sludge soils and the potential for chromium oxidation in sludged soils. Chaney also recommends long term studies be done to characterize the fate and transformation of Cr in soils after annual application of leather by products or biosolids. There is no evidence of water contamination or oxidation of Cr III to Cr VI in areas with native high chromium content (areas with serpentine rock parent material).

   Leather meal does contain substantially more chromium than sludge, for example a typical New York sludge contains 50-500 ppm, and typical NY state background soil levels of chromium are found at 52 ppm (Harrison). Soil concentration found in the US range from 1-2000 ppm with a mean of 37 ppm (WSDH). Recently published guidelines for land application of sewage sludge in New Jersey (Krogman et. al, 2000) recommend the use of the original EPA pollutant maximum for chromium (1200 ppm) and molybdenum (18 ppm) due to diverse soil conditions and a large variety of crop species grown that have not been adequately researched. Krogman et. al also note that there is little concern about Cr III, but that "little information is available on the ionic status of Cr in sludged soils and the potential for chromium oxidation in sludged soils."

   Lab analysis submitted with the petition show **lead** levels ranging from 13.6 - 42 ppm (Waters 1997, 1999). Analysis submitted with the initial petition showed levels of lead at 77 ppm and arsenic at 13 ppm (Parker 1989). While this is well under the ceiling limit of 840 ppm set by EPA for sludge, Harrison suggests that a zero increase in soil concentrations should be allowed since negative human impacts continue to be discovered at increasingly low levels. Washington State has adopted metal standards based on Canadian regulations, which allow a maximum of level of 500 mg/kg Pb in products, projecting a total cumulative loading over 45 years to reach a maximal allowed additions to the soil of 100 kg Pb/ha. Washington divides this maximum by 45 to restrict the amount of lead applied to an acre per year to be 1.98 lbs/acre (or 2.22 kg/ha). At the recommended rate of 500 lbs leather meal/acre, if the product contains 42 ppm lead, it would delivers an application of 0.021 lbs. of lead per acre. This rate might be exceeded, for instance if a farmer wanted to apply 150 lbs. of actual Nitrogen, he/she would need 1500 lbs. of leather meal per acre, containing 0.062 lbs. of lead/acre. A product containing 77 ppm lead would deliver 0.0385 lbs. of lead/acre when applied at 500 lbs./acre, or 0.116 lb./acre when applied at a rate of 1500 lbs./acre.

3. *The probability of environmental contamination during manufacture, use, misuse, or disposal of the substance.*

Pollution reduction from tanning factories is a subject of concern and extensive research. In the U.S. almost 56,000 metric tons of chromium containing solid waste is generated by the leather industry each year, and 10 times this amount is generated worldwide. The tanning industry is working to develop alternative techniques and methods to recycle chromium, and reduce its content in waste water (Taylor, Chaney). Kirk Othmer reports that for each metric ton of hides received at the tannery, the tanning process generates waste in the amount of 50-100 kg/T salt, 20-40 kg/T sulfides, 10-20 kg/T of chromium (III), 50-100 kg/T suspended solids, and an increased biochemical oxygen demand of 30-60 kg/T.

4. *The effects of the substance on human health.*
   A search of the website National Institute for Environmental Health Studies found over 100 chemicals listed with uses in leather production, including solvents, dyes, preservatives, and biocides (NIEHS). Many are classed are carcinogens or "as reasonably expected to be carcinogens" [e.g., melamine (1,3,5-triazine-2,5,6-triamine), pentachlorophenol]. The 9th Report on Carcinogens lists as a class "dyes metabolized to benzidine (benzidine dye class)," listed as known carcinogens. Dyes that metabolize to benzidine are mainly used to color textiles, rubber, plastic products, printing inks, paints, lacquers, leathers, and paper product. Approximately 50%of the dyes are applied to textiles, 45%to paper, and 5%to leather. While benzidine use has fallen dramatically in recent years due to its potential carcinogenicity, dyes that metabolize to benzidine are still used. While leather shavings and trimmings used for leather meal production may not be subject to the dyeing and finishing process, they do receive treatment with solvents and preservatives.

   Occupational exposure to chromium occurs in the tanning industries. In the tanning industry, exposure is almost exclusively to soluble chromium (III), typically in the range of 10-50 g/m3 (NIEH, 9th RoC).

   According to the OSHA Material Safety Data Sheet, the primary hazard of leather meal as a product is associated with nuisance dust, with a permissible exposure limit (PEL) of 15 mg/m3 for particulates. The chromium (III) PEL is rated at 0.5mg/m3, with a note that the particulate levels PEL will be exceeded before the chromium permissible levels in a product with 2.5% chromium content.

5. *The effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock.*
   Chaney reports mixed results of studies on earthworms, and attributed a study showing poor survival to massive rates of application. He cites other studies that found addition of up to 46,000 ppm Cr to a sludge and no adverse affects on growth or activity of earthworms. The effect of other residues of the possible synthetic contaminants is not known.

6. *The alternatives to using the substance in terms of practices or other available materials.*
   Many alternatives exist for use as organic matter soil amendments that also supply nitrogen including animal manures, compost, use of leguminous cover crops, plant derived meals such as soybean or cottonseed, etc.

7. *Its compatibility with a system of sustainable agriculture.*
   A goal of sustainability is to encourage the recycling of organic waste products to improve and regenerate soil fertility. Leather meal produced using materials and methods approved in organic crop production or processing would qualify as a natural product that could be a useful complement to a well balanced organic soil building program. However the degree of processing and large numbers of synthetic additives used to produce this material is analogous in scope to the processing of sewage sludge, which was considered synthetic by NOSB, and incompatible with an organic system.

TAP Reviewer Discussion

TAP Reviewer Comments

OMRI's information is enclosed in square brackets in italics. Where a reviewer corrected a technical point (e.g., the word should be "intravenous" rather than "subcutaneous"), these corrections were made in this document and are not listed here in the Reviewer Comments. The rest of the TAP Reviewer's comments are listed here minus any identifying comments and with corrections of typos.

Reviewer #1

[Doctorate in plant pathology, M.S. soil science, expertise in compost managment and waste treatment.]
The characterization of leather meal clearly outlines several issues associated with its production, use, and regulatory status. In the evaluation of leather meal's suitability for organic production there are various aspects to consider. It must be determined if the material is synthetic or not, where it fits in the regulatory framework, if its constituents meet organic standards and what the environmental impacts are.

Chromium
A long-standing concern with leather meal is the chromium used in the tanning process and remaining in the final meal. The TAP review covered this issue and discussed the differences between the trivalent and hexavalent forms of chromium. The latter poses the greater health concern. Studies cited by Chaney (1996) indicate that leather meal contains Cr(lll) and not Cr(Vl). He did indicate however that an important question that remains to be answered is the

potential, in Cr rich soils, to form and leach Cr(Vl). If the leather meal land application rate is high enough, anaerobic soil conditions may exist that could allow the formation of Cr(Vl) (Chaney, 1996). For this reason he felt that longer term studies conducted at agricultural application rates would provide information relevant to soil Cr risk assessment.

An area of concern that was alluded to by Chaney was water quality impacts through potential leaching of Cr. Erosion of Cr containing soil into wetlands and creeks was not addressed, however. Agricultural runoff has an enormous environmental impact on wetlands and water quality today. Chaney mentioned that most plants accumulate little Cr in the foliage. Recent work (Quian et al, 1999; Zhu et al., 1999) indicates that certain wetland plant species do bioaccumulate Cr in both the shoots and the root. Some of these plants meet Chaney's definition of hyperaccumulators (>5mg Cr/Kg leaf tissue). These studies focused on the use of plants for Cr remediation and not potential environmental impacts of Cr in wetland systems.

Regulatory

The TAP review discussed the regulatory status of leather meal among the international and U.S. organic certifying organizations as well as AAFCO (the Association of American Feed Control Officials). U.S. certifiers prohibit the use of leather meal. International organizations do not mention it or specify that only by-products produced without synthetic additives are allowed.

AAFCO does allow leather meal in non-ruminant feed additive but it is specifically not allowed in ruminant feed due to concerns about transmissible spongiform encephalopathy (TSE). The FDA formulated regulations on prohibited feed materials for ruminants in 1997 specifically because of concerns about TSE.

The TAP information did not discuss the opinion of the European Commission Scientific Steering Committee that was adopted September 1998. The Committee addressed the question "Can organic fertilizers derived from materials from mammalian animals naturally or experimentally susceptible to Transmissible Spongiform Encephalopathies, be safely used?"

The Steering Committee's opinion (Scientific Steering Committee, 1998) in part stated that "a) No organic fertilizer should be produced from bovine material originating from countries carrying a high BSE (Bovine Spongiform Encephalopathy) risk. c) Organic fertilizers, derived from mammalian tissues that are known to have the potential to carry the BSE-agent, should always be produced in accordance with the criteria laid down by the SSC for the safe production of MBM (Opinion of the SSC on the safety of MBM, 26-27 March, 1998; Updated Report on the Safety of Meat and bone Meal derived from Mammalian Animals Fed to Non-Ruminant Food-Producing Farm Animals,) or hydrolyzed proteins. They may be used as fertilizer. Ingestion by man or ruminants must be prohibited."

There has also been recent UK regulation that prohibits mammalian meat or bone meal in fertilizer unless certain particle size and pressure temperature requirements are met (Scientific Steering Committee, 1998). These concerns and regulations on mammalian derived fertilizers have arisen from BSE's ability to remain infective even under harsh conditions. One of several hazards is that the infectivity of mammal-derived fertilizers could persist in the environment and potentially accumulate with time. They also expressed concern that humans could accidentally ingest or inhale BSE infected material when it is used as a fertilizer.

It is unclear from the review provided on leather meal if the processing of leather meal meets the temperature and particle size requirements mentioned in the UK regulation. This author found no references on uniform industry or international standards for processing leather meal. Since, increasingly, leather is tanned in developing countries and leather meal is available from these countries, it is doubtful there are standard processes in place to meet the UK requirements.

This author was unable to find references discussing lead, arsenic, mercury, and nickel in leather meal. Previously, cattle dips used arsenic to protect them from parasites. This practice may continue in some countries and could be a source of arsenic in the hides. However this is speculation but might provide an avenue for further investigation.

Based on the TAP review and the author's own review of the tanning process, leather meal should be classified as synthetic due to the chemical changes that occur. The decision to allow or prohibit a synthetic material is based on if non-synthetic materials are available that can be substituted and if the synthetic material is environmentally harmful or not.

In the case of leather meal, there are many non-synthetic materials that provide both organic matter and nitrogen and can be used as a fertilizer. The question of environmental harm if less clear cut. The leather tanning process itself creates environmentally harmful waste products: the wastewater and the leather meal. Both must be disposed of properly.

Although the trivalent form of chromium seems to be relatively unreactive, the tanning process could reduce its environmental impact by reclaiming as much chromium as possible. This would create a leather meal which would be a better agricultural product.

Chaney (1996) outlines research needs to better evaluate chromium's environmental impacts. These include research on the species and transformation of Cr in soils, characterization of Cr uptake by plants, characterization of transformations of Cr in land applied leather by-products, and the development of methods to recover Cr from leather by-products.

The issue of TSEs and specifically BSE is only lightly addressed in the TAP information. However this is an issue that the European Community and the FDA are beginning to address through regulatory means. TSEs impact both human health and environmental health. Environmental health encompasses the potential for long term contamination of land through the application of mammalian products. The TSEs infect not only people but some wild animals such as elk.

The reviewer overall agrees with the information presented in the TAP review. The information in the TAP review should be supplemented with the additional information on TSEs and BSE and bioaccumulation of Cr by wetland plants. Given the environmental and TSE disease concerns leather meal should be classified as a prohibited synthetic.

Reviewer # 2

[Advisor to organic certifiers.]

Natural and synthetic forms:

The very large majority of leather by-products available for use as soil amendments are to be classified as synthetic materials, as the raw hide has undergone a number of chemical transformations via reactions with both natural and synthetic chemicals agents (Kirk-Othmer, AAPFCO, AAFCO).

There are ways of producing leather using only natural curing, tanning, and finishing agents, and the by-products derived from these methods could conceivably be classified as natural products, although additional investigation of all of the reactions pertaining to these processes would need to be investigated further. These processes have qualitatively different environmental impact than their synthetic counterparts, and as such, should receive different evaluation of their suitability in organic farming systems. Because the availability of such naturally produced leathers is so low at the present time, it is presumed that this review is to focus primarily on leather meal produced through use of synthetic chemicals.

Review based on OFPA 7 U.S.C. 6518 (m)(1-7) Criteria:

1. Leather meal is a carbon-based, protein rich material, which is used to increase organic matter and nitrogen content of soil, and has been shown to benefit crop production, at least in the short-term. Based on short-term evaluation, there are no known detrimental interactions with other components of an organic farming system. However, in addition to the carbon and nitrogen content, leather meal also contains amounts of certain metals, most notably chromium, lead, nickel, cobalt, copper, cadmium, and zinc. (Waters, Parker) Studies have been conducted to assess whether these elements appear in the soil in levels toxic to plants or other soil biota, and while certain data does exist, the studies are incomplete, not completely consistent, and as a result, inconclusive. See point (2) below for further discussion.

2. The main concerns that exist relate to the potential toxicity by heavy metals that are found in the leather meal, as an inherent additive in the manufacturing process. Chromium, when introduced to the soil as a component of leather meal, exists almost exclusively in the trivalent form, which has generally not been shown to have deleterious effects on plant growth. Trivalent chromium is insoluble in water, and does not accumulate in most crops, although accumulation in roots of certain species has been shown. Chromium in the trivalent form can be oxidized to the hexavalent form under certain soil conditions; hexavalent chromium is soluble in water and a known carcinogen; how the avoidance and/or monitoring of such potentially hazardous conditions would be done has not been adequately discussed to ensure human and environmental safety. Furthermore, studies have shown mixed results regarding the affect of chromium buildup in soils on earthworms (Chaney et al) - see point (5) below for more discussion on this point. The affect that higher-than-naturally-occurring chromium levels in soils has on other soil organisms has not been well studied.

Other metals commonly associated with leather meal, which are known to be toxic to living organisms, include lead and cadmium. Lead occurs at more significant levels of the two, and this is a cause for concern. Analyses submitted by the petitioner show lead levels between 13.6 – 42.0 ppm (Waters) (and 77 ppm, Parker). While the absolute quantities of lead being deposited (and thereby accumulating) in the soil may be below EPA tolerance limits per application, it is dubious at best to assume that **any** additional deposition of lead (or any other toxic metal) into the soil is compatible with organic production methods, if it is at all avoidable, especially when long-term accumulation is considered.

In any case, it does seem clear that accumulation of metals in soils from single or repeated applications of leather meal will result. The long-term affects of such accumulations will likely vary from farm to farm, but there is no evidence to suggest that the result will be beneficial to the organic farming system, the environment in general, or to human health – the benefits of chromium in the human diet notwithstanding (see point (4) below).

3. Numerous chemicals, both naturally-occurring and synthetic, are involved in commercial leather processing, and much of these end up as part of the solid waste fraction of the manufacturing process. Many of these chemicals are known carcinogens and pose hazards to workers and the environment when being handled. Other materials pose environmental challenges, particularly with regard to waste water discharge, when present in high concentrations, be they salts (e.g., NaCl used in curing), alkalis (e.g., $Ca(OH)_2$ used in unhairing), or chromium-based tanning agents. The finishing of leather often involves the use of dyes, solvents, and other known pollutants and carcinogens (e.g., pentachlorophenol, melamine, and benzidine or dyes metabolizing to benzidine) (NIEH, NTPBDI, USDHHS). Reclamation of toxins and persistence of toxic levels of natural elements in wastewater continue to be a challenge for the leather industry, and although some progress is being made in this regard, the situation still leaves much room for improvement. The solid waste portion of the manufacturing process is generally included as part of the leather meal proposed for use on organic farms. As such, the presence of toxins in the product is certain, although the levels of particular chemicals will vary from one batch or manufacturer to the next.

In summary, the probability of at least some environmental contamination during manufacture, use, misuse, or disposal of the substance during the manufacturing process is high. The probability of environmental contamination during use of leather meal per se as a soil amendment is discussed elsewhere in this review.

4. The use of many of the chemicals handled during commercial leather manufacture is hazardous to human health. Aside from this, handling of the leather meal itself during farming or other operations incurs some hazard from inhalation of dust. This latter risk could be mitigated by use of a simple dust mask by the persons handling or exposed to the goods.

Studies have shown that soils enriched with leather meal can result in corresponding greater accumulation of trivalent chromium in agricultural products (Chaney et al). The amount of research on this issue has not been extensive. The petitioners and other parties in favor of the approval of leather meal have made arguments that trivalent chromium is an essential human nutrient, as it plays a part in normal cellular metabolism of glucose, as part of the oxidation-phosphorylation (Stryer) chain of reactions during glucose metabolism, and as such, should be seen as a beneficial amendment to organic production systems (Krantz). While it is true that the body needs trivalent chromium for normal functioning, the rationale for imparting chromium to the human diet in this manner does not accord with organic production principles. In organic production, micronutrients are generally restricted as soil amendments, being only allowed if there is a documented deficiency in the soil in question, a deficiency that somehow adversely affects the productivity of the field or crop (NOSB, Orlando 1995). Even if leather meal were used to fulfill this purpose, the use would only be allowed as a corrective measure, not as an ongoing practice on any farm, and quantitatively monitored via soil sampling. Vitamin and mineral additions to human food are not conducted in this manner; where known deficiencies in human diets are known, supplementation occurs carefully at the processing level, not in the field. Accumulation in the soil of chromium, accumulation which would be (at least for the foreseeable future) poorly monitored and understood as to its affects on the crops, as a means of augmenting the chromium content of food, is a dubious benefit at best.

5. Studies have produced mixed results as to the effect of high chromium content in soils on earthworm viability (Chaney et al). The studies conducted were taken over the short term, and are inconclusive with respect to longer-term viability. One of the reasons for this is that the effect of chromium accumulation on microorganisms or other organisms in the soil is not known. Organically managed soil is an extremely biodiverse system, the interactions of the species contained therein being relatively poorly understood. Introduction of high levels of chromium, or increasing the levels of lead or synthetic contaminants over time, may or may not have deleterious effects on overall soil health and fertility. Upsetting the balance of biota in the soil can be accomplished by eliminating only a few of the species in the soil. There is no evidence to support the idea that addition of contaminants to the soil via leather meal application will not adversely affect soil health, particularly over the long term. While there also may be little evidence to conclusively show that addition of leather meal actually does adversely affect soil health, it can be safely stated that additions of synthetic materials that are known to be toxins can in and of themselves not be positive. The question becomes more of how negative they are. Without compelling reason to add them to the soil, it is difficult to condone such activity.

6. Organic production is founded on the fact that there are many other alternatives to using off-farm crop amendments to boost carbon and nitrogen content of the soil. Animal manures and/or leguminous and green manure crops offer widespread possibilities for virtually every organic farmer, and indeed at least one of these is often required by certifiers.

Other materials are also readily available to organic farmers, which do not possess the same types of contaminant issues presented by leather meal. In short, leather meal clearly need not be an essential component of any organic production system.

7. It is understandable that leather manufacturers wish to reduce the waste output of their operations. It is admirable that they should try to find a way in which to recycle materials back into the environment in a productive, safe manner. However, leather meal as is generally produced, and as has been discussed in this review, does not satisfy concerns regarding the overall environmental safety or suitability of this material in organic systems. Leather manufacture by these methods is toxic, despite attempts by industry to mitigate the negative effects of the chemicals involved.

Many of the processes involved in this type of leather production have been designed by the manufacturers as a way to make the process more efficient and cost-effective. The cost, however, from a longer-tern environmental standpoint, is great, as the deleterious effects of their operations have been well documented.

There are a variety of natural materials and methods that can be employed to produce comparable products (e.g., Van Grisven et al), although such methods take longer and are less profit-oriented from a purely business standpoint. Organic production systems would benefit from by-products produced using materials and methods already compatible with organic production standards. Such materials could be seen as a natural and sensible recycling of materials through the biosystem, without the inclusion of synthetic toxins. Such a material might or might not need to be included on the National List, depending on the particulars of the processes involved. Such types of production should be encouraged, as ecologically sound alternatives to an industry that otherwise continues to have net negative impact on the environment, despite attempts to mitigate that (e.g., McDonnell).

Recommendation from Reviewer #2:
Leather meal should be PROHIBITED as a synthetic organic production material. This reviewer agrees with the TAP review document as presented.

Reviewer #3

[Soil scientist working in compost quality and laboratory testing.]

Introduction

In reviewing the Hynite Corporation documents, we note that the potential environmental risk of Cr is downplayed. We think it is a poor position to exaggerate the "safeness" of a material that contains such significant levels of potentially harmful ingredients. Their supportive material supplied, allegedly in defense of the use of this product, does not really support it *carte blanche*. Rather, it does raise concerns about the sheer level of Cr in the soil/plant system. Indirectly it raises concerns about how the lax U.S. standards for chromium (that contradict other western standards) have been arrived at, since clearly industry petitioned heavily to have the standards relaxed.

Before starting, let me say there is good reason to evaluate the entire tanning industry- a 'cradle to grave' analysis shows it to be very environmentally unfriendly. We are asked to consider a process that has increasingly become metals oriented (over earlier more natural tanning methods) and that contaminates an amazing volume of water (20 cubic meters water per each ton of raw leather). The huge implications of tanning and the sheer quantity of metals and other chemicals (PCP's, Azo dyes, etc.) that go into the process must cause reasonable people to question how much involvement organic growers should have with it at all. However, as we will show, there are positive alternatives emerging, mostly from Europe, as pressure mounts to change the old-fashioned heavy chemical ways of the industry.

Soil vs Applications:

A normal concentration of total Cr in soil is about 50-100ppm (= 100-200 lb/a). Just one application of 1 ton/a (2000 lb/a) leather tankage will deliver about 100 lb/a or about 50ppm Cr. This alone is excessive. At a rate of 500 lbs/a, it would only take 4 years to exceed normal background Cr levels. Actually, 4 years at this rate would exceed legal loading limits in all EC countries. To argue that Cr is insoluble or unavailable begs the question whether we are dealing with a disposal strategy or protection of our soil resources.

One way to evaluate a product such as the leather tankage is to consider if the contaminant were a "desirable" ingredient, what would the response be? Clearly, if this product had K added as tanning agent instead of Cr, just the fact of the concentration of the addition and the potential huge effects on soils/plants should bar it from acceptance. Tanners would switch to such an agent tomorrow if it were discovered. Naturally the reverse is the case here- we are adding very high levels of a very undesirable element that is fairly inactive, but not totally so, in the soil, and we are unable to identify definitive information, scientific or otherwise, that sets the record straight.

We have shown in the matter of humate/humic-extraction, that it is possible technologically to manufacture an alternative that might be organically acceptable. The problem is always the same: industry will only spend the dollars when sufficient public awareness information amasses in support of a new process. This is beginning to happen with leather, but we are only at the beginning. The talents of many young scientists and new environmentally oriented businesses are available to help move everyone towards cost-effective future options.

<u>Cr(III) vs Cr(VI): Transformation via Mn-oxides present in soil</u>
Data presented along with the leather literature in defense of Cr usage viz. a viz. the Cr(III) vs Cr(VI) issue may be biased. Some of the Cr(III) vs Cr(VI) material put out by EPA and USDA is theoretical-stoichemical in nature. Dr. Richard Bartlett in Vermont has explained how other scientists have gone too far in asserting the safety of Cr(III), in the absence of contrary information. Bartlett discovered one mechanism (possibly others exists) for release of Cr(III) into toxic Cr(VI) form. This discovery surprised the academic community, partly because it was so obvious and commonplace. Virtually all soils and many lower quality soils like the eastern coastal plains contain sufficient levels of active Mn to allow some Cr(III) to be converted to the more toxic Cr(VI) form. Furthermore, the very mechanism that Cheney et al. suggest is an "artifact," whereby for purposes of illustrating the phenomena researchers supplied organic ligands to Cr-amended soil to increase the potential availability of Cr(III) to Mn-induced transformation actually exist normally in high organic matter, organic-enriched soils, which contain natural chelates. It would be ironic and unfortunate that *[NOSB]* should support a chemical strategy that is harmed by presence of organic matter in soil.

A principle reason for objecting to this product being used in organic farming or any farming for that matter is that alternative tanning methods are available to the industry. American industry, however, is reluctant to move towards environmental alternatives so long as it can be prevented. The situation has not been helped by USDA scientists, cited in the literature attached, who have generally taken a position favoring high metal loading to U.S. soils and have removed barriers to land-spreading Cr to soils since it has been considered not dangerous. However, these same scientists do acknowledge Bartlett's work cautioning on probable transformations of Cr(III) (note-Bartlett's work is referenced in Cheney's literature).

It is, however, not just the presence of Cr(III) and its remote potential of transformation into Cr(VI) that is a concern. A recent European sampling of leather products showed Cr(VI) to be present in 63% of samples, in one case as high as 228 ppm (Sharf, 1998, Austrian Environmental Agency, Vienna). The data being provided publicly in the U.S. is in contrast unusually conservative in nature, and may cause one to overlook related dangers. Jürgen Poppe's recent work at Paderborn University showing migration of toxic Cr(VI) directly out of leather products in 50% of samples tested has raised a high level of alarm within Europe. In response to this proven occurrence, Switzerland has now set a test limit of 3 microgram (ug) of Cr(VI) per kg (ppb) of leather (Arztpartner, 2000). Thus, we have stunning evidence that Cr(VI) exists i*n situ* in leather. We do not know to what extent the sludge products would differ from this, but it suggests that immediate damage to soil plants (and to handlers of products!) must exist.

<u>Europe and Leather Fertilizers:</u>
We believe that it not correct as stated by Hynite Corp. that leather tankage is favored in Europe. Metals concentration limits are very strict there and should preclude that the product is used directly as a soil amendment. Additionally, the alternative "organic leather" industry that we refer to has been born in Europe. The concept "Öko-Leder" (Eco-Leather) has been both attacked and defended within Europe (Veslic, 1999; ÖKO-Tex Standard 100). As far as we know, standards for what constitutes organic leather have net yet been developed. Both the Demeter-Bund and the Association of Natural Products and Foods in Germany have issued statements about the potential for eco-leather. It would seem appropriate to wait to decide the entire matter of leather and leather waste usage until this is further investigated.

<u>The Existence of Alternatives:</u>
There are alternatives to chromium/Azo treatment of leathers. The existence of these new environmentally tuned procedures is grounds alone to reject an application for Cr-containing tankage within organic farming.
Examples: In Switzerland, ***fidelioLeather*** in Aarau has an entire plant dedicated to alternative processing. In Germany, new companies manage production of alternative leather under observance of strict environment protection and industrial safety rules. The Schomisch-Ecopell process uses tanning-agents from harvested parts of plants (for example: valonea / tara / rhubarb), uses no post-tanning synthetic covers. Another company (Swewi) in Svendborg Denmark initiated a completely new tanning technology recently to produce leather without chromium, nor do they use the standard cocktail of chemicals and solvents to finish the leather. Instead, the company uses a series of biodegradable polymers and plastics, which they claim mimic the traditional non-metal process used since early times (no information is found yet on the composition of the sludge or tankage). Traditionally, extracts of oak, castanie and Tara-fruits have been successfully used in tanning, but require very large amounts and cause higher BOD in wastewater, which is another environmental concern. According to Swewi literature, carbon dioxide is also used to delime the hides (reducing emissions of nitrogen associated with alkaline nitrogen treatments). Their method they claim poses no environmental

hazard to the local population and does not cause allergies, which are common in the normal old-fashioned tanning process. (In all the discussions about Cr etc., the dangers posed to workers in facilities seems to be overlooked! Cr is very allergenic!)

It is noteworthy that alternative approaches to tanning need public and federal support. For example, the Danish Government actively encouraged Swewi and others to reduce the amount of chromium in its tanning process. Furthermore, the Federal Environment Agency of Vienna, Austria (http://www.ubavie.gv.at) has publicized the high content of PCP's in many leather products and potentially also present in leather waste.

In Europe PCP in leather must not exceed 5ppm and a sampling of 100 leather products recently found as high as 1,400ppm. PCP's are traditionally used in the process to reduce fungal colonization. Finally, the concern of Azo-dies in leather must be addressed. By-products of Azo dyes can be easily formed by chemical, enzymatic, or biological means and consist of numerous carcinogenic aromatic amines.

<u>The need to look to recycling and alternatives:</u>
In any event, the need to consider more appropriate recycling is stressed albeit less strongly in USDA's material where it is stated clearly that "Parties who desire to market tannery by-products rich in Cr should give attention to recycling (and recovery) of Cr which would otherwise end up in agricultural resources" (Cheney et al.).

<u>Summary and Recommendation, Reviewer #3:</u>
This product must be considered to be synthetic, and <u>not allowed</u> on the national list.

[I] reject this as acceptable in organic farming on grounds that 1) it contains unacceptable levels of Cr heavy metal and may also contain unacceptable levels of harmful preservatives and dyes; 2) it has been proven that toxic Cr(VI) migrates directly out of leather; 3) the leather industry has a record of extreme environmental harm; and 4) alternatives now exist such that use of Cr (and azo dyes, etc.) in conventional tanning processes is no longer justifiable unless you are simply not interested in the future of the earth.

Conclusion

The reviewers agree in the determination that leather meal that is a by-product of a chrome tanning process is a synthetic substanceand that it should be prohibited for use in organic agriculture. The reviewers agree that there are many alternatives available to this product. Although reviewers have mixed opinions about the dangers posed by addition of chromium(III) to the soil, they agree that addition of metals not required for plant nutrients is contrary to organic principles and NOSB recommendations. In addition, other metals such as lead, as well as solvents, preservatives, dyes, and other additives from the production process pose concerns.

Concerns about the possibility of TSE (transmissable spongiform encephalopathy) have not been evaluated in the past for other animal byproducts permitted in organic production, but may need to be addressed in future as more information becomes available. This product is not labeled for any food or feed crop use in at least one U. S. state, and while the OFPA acknowledges the precedent of other federal laws in 7USC 6519(f) it would not seem to be wise to permit a material for organic production that is not permitted under state law for conventional agriculture. It also does not meet heavy metals guidelines for land applied sewage sludge in New Jersey.

References

AAFCO - Official Publication of the Association of American Feed Control Officials, 2000.

AAPFCO – Official Publication of the Association of American Plant Food Control Officials, 2000. No. 53.

ArztPartner (2000), Augustenstraße 79, D-80333 Münich Germany. info@almeda.de

Breitsman, John. Pennsylvania Dept of Agriculuuture , pers. communication.

Canada General Standards Board 1999. CAN/CGSB-32.310-99, Organic Agriculture

Carey, EE. W. H. Allaway, O.E. Olson. 1977. Control of Chromium Concentraion in Food Plants. 2. Chemistry of Chromium in soils and its availability to Plants. J Ag. Food Chem. Vol 25(2) p. 305-309.

Chaney, R.L. J.A. Ryan, S.L. Brown. 1996 Development of the US-EPA Limits for Chromium in Land –Applied Biosolids and Applicability of thesse Limits to Tannery By-Product Derived Fertilizers and Other Cr-Rich Soil

Amendments. In Chromium Environmental Issues, edited by S. Canali, F. Tittarelli, and P. Sequi. FrancoAngeli, Milan. pp 230-294.

Cheeke, P.R. 1999. Appplied Animal Nutrition. Prentice Hall. New Jersey.

Ciavetta, C. and P. Sequi. 1989. Evaluation of chromium release during the decomposition of leather meal fertilizers applied to the soil. Fert Reearch 19: 7-11.

Code of Federal Regulations, 21 CFR Part 573--Food Additives Permitted in Feed and Drinking Water of Animals. Last updated April 08, 1998. http://www.fda.gov/cdrh/devadvice/part573.html

Codex Alimentarius Commission, Alinorm 99/22, Draft Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods.

Harrison, E.Z, M.B. McBride, and D.R. Bouuldin. rev. 1999. The Case for Caution, Recommendations for Land Applicaion of Sewage Sludges and An Appraisal of the US EPA's Part 503 Sludge Rules. Cornell University, Ithaca NY.

Hemphill, D.D., Jr. V.V. Volk, P.J. Sheets and C. Wickliff. 1985. Lettuce and Broccoli Response and Soil Properties Resulting from Tannery Waste Applications. *Journal of Environmental Quality*. 14: 159-16.

Kirk-Othemer 1995. Encyclopedia of Chemical Technology 4th Ed. John Wiley and Sons, NY. Vol 15. pp 160-177.

Koran, Michael. Fertilizer Specialist, Wisconsin Dept. of Agriculture, Trade and Consumer Protection. pers. communication 10-11-2000. 608-224-4541.

Krantz, B., Hynite Corporation, Letter to USDA/AMS/TM/NOP, September 22, 2000.

Krogman, U., L. S. Boyles, and J. Heckman, eds. 2000. Guidelines for the Land Application of Sewage Sludge for New Jersey Agriculture. Rutgers Cooperative Extension, NJ Ag. Expt. Station publ. E228. http://www.rce.rutgers.edu/pubs/ag/misc/biosolids.html

MSDS (Material Safety Data Sheet) 1998, US.DOL. Hynite Corporation - hydrolyzed leather meal.

McDonnell, J. 1998 Leather company creates alternative to landfilling. Biocycle 39(6) 32-33.

Meister, R. T. 1999. Farm Chemicals Handbook. vol 85. p B45. Meister Publ. Willoughby, OH.

McEvoy, Miles. Washington State Department of Agriculture. October, 2000. Personal communication.

National Institute of Environmental Health Studies, 2000. Reports on melamine, http://ntp-server.niehs.nih.gov/htdocs/Results_status/ResstatM/10525-W.html and Pentachloraphenol http://ntp-server.niehs.nih.gov/htdocs/Levels/Tr349levels.Html

National Toxicology Program Benzidene Dye Intiative, 2000. Summary at http://ehpnet1.niehs.nih.gov/docs/1994/Suppl-2/morgan-abs.html

ÖKO-Tex Standard 100 - Standards for Cr and Azo dyes in leather products (EU-Belgium).

Parker Laboratory, Inc., 1989 Tankage Analysis Reports for Hynite Corporation.

Poppe, Jürgen. 1999. Paderborn University. Migration of Cr(VI) from leather products. Doctoral Dissertation.

Qian, J., A.M. Zayed, Y.L. Zhu, M. Yu, and N. Terry. 1999. Phyto accumulation of trace elements by wetland plants: III. Uptake and accumulation of ten trace elements by twelve plant species. J. Environ. Quality 28:1448-1455.

Sachs, Paul. 1993. Edaphos, Dynamics of a Natural Soil System. Edaphic Press, VT.

Sharf, S. 1998, Teilweise bedenkliche Pentachlorphenol-, Chromund Azofarbstoffgehalte in Leder und Textilien, Austrian Environmental Agency, Spittelauer Lände 5, A-1090 Wien, Austria. (in German)

<http://www.ubavie.gv.at/publikationen/uba%2Daktuell/archiv/1998/08/tm%5F1998%2D08%2D25%2D2.htm> or see <http://www.ubavie.gv.at> click on "suche" (search), enter "leder" (leather).

Scientific Steering Committee, European Commission. 1998. Scientific opinion on the safety of organic fertilizers derived from mammalian animals. Http://europa.eu.int/comm/food/fs/sc/ssc/out28_en.html.

Stryer, L., Biochemistry 2nd edition. 1981. W.H. Freeman & Co., San Francisco, pp. 307-331.

Taylor, MM., E.J. Diefendorf, C.J. Thompson, E.M Brown, W.N Marmer. 1994. Extraction and characterization of "chrome-free" protein from chromium containing collagenous waste generated in the leather industry. American Chemical Society, ACS symposium series Polymers from agriculutural coproducts: 0097-6156; 575, p. 171-187.

USDHHS - U.S. Department of Health and Human Services, 9th Report on Carcinogens2000,http://ehis.niehs.nih.gov/roc/ninth, Report on chromium: http://ntp-server.niehs.nih.gov/htdocs/8_RoC/KC/Chromium%26compds.html

Veslic. 1999. Association of Swiss Leather Chemists and Technologists (Arbon Switz).

Washington State Department of Health. 1996. Chromium Fact Sheet.

Waters Agricultural Laboratories. 1997, 1999. Tankage Analysis Reports for Hynite Corporation.

Van Grinsven, M., M.L Parkipuny, T. Johns. 1999. Economic Botany, vol. 53, pp. 220-221.

Zhu, Y.L., A.M. Zayed, J.H. Qian, M. de Souza, and N. Terry. 1999. Phyto accumulation of trace elements by wetland plants: II. Water hyacinth. J. Environ. Quality 28:339-344.