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Composite from Leather Waste

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I. INTRODUCTION

Solid waste from Leather industry

Solid wastes from the tanning industry are unavoidable. This is because leather processing primarily associated with purification of a muti-component skin to obtain a single protein,collagen.The intrinsic nature of the leather processing steps and the nature of chemicals employed are also responsible for the generation of certain quantum of solid wastes starts at the first operation namely, desalting the raw hides/skis and prolongs through almost all unit processes and operations till end of the process sequence , namely shaving and buffing operations based on the nature of solid waste generated from the leather processing, they can be categorized into chemical and protein based solid waste.

In India according to the estimated production of hides and skins by CLRI more than 24 million pieces of cattle hides, 22 million of buffalo hides, 106 million of goat skins and 37 million of sheep skins are processed in about 1600 tanneries. Approximately 2 lakh tones of solid waste are generated annually from leather industry.

Reduced cost Quantum of solid wastes produced from processing 1-metric ton of raw material **is**

S.No	Solid Waste	Quantity
1	Salt from Desalting	80 Kgs
2	Salt from solar evaporation Pans	210 Kgs
3	Hair	110 Kgs
4	Lime sludge	65 Kgs
5	Raw trimmings	55 Kgs
6	Fleshing	110 Kgs
7	Wet blue Trimmings	30 Kgs
8	Chrome tanned unusable splits	65 Kgs
9	Chrome Shaving	90 Kgs
10	Buffing dust	60 Kgs
11	Crust trimmings	45 Kgs
12	Dry Sludge from ETP	125 Kgs

II. COMPOSITES

Composite may be defined as material made up of two or more components and consisting of two or more phases. Such material must be heterogeneous at least on a microscopic scale. Composite material may be divided into three classes:

1. Particulate - filled materials consisting of a continuous matrix phase and discontinuous filler phase made up of discrete particles,
2. Fiber – filled composites,
3. Skeletal or interpenetrating network composites consisting of two continuous phase.

A combination of two or more materials (reinforcing elements, fillers, and composite matrix binder) differing in form or composition on a macro scale. The constituents retain their identities, that is, they do not dissolve or merge completely into one another although they act in concert. Normally, the components can be physically identified and exhibit an interface between one another.

There are many reasons for using Leather fiber – polymer composite materials rather than the simpler homogeneous polymers. Some of these reasons are:

- Increased stiffness, strength, and dimensional stability
- Increased toughness or impact strength
- Increased vulcanized properties

III. CURRENT UTILIZATION OF SOLID WASTE

There are so many low value products are developed from leather solid waste .They are listed in the below table

S.No	Solid Waste	Utilization
1	Salt from Desalting	Recovered for curing
2	Salt from solar evaporation Pans	Recovered for curing
3	Hair and wools	Non woven fabrics
4	Lime sludge	Land filling
5	Raw trimmings	Pet treats in food industry
6	Fleshing	Protein meal and Glue & Gelatin
7	Wet blue Trimmings	1.Leather meal making 2.Leather board making 3.parchment like leather making 4.Acoustic building materials
8	Chrome tanned unusable splits	Leather washers, Industrial Gloves etc,

9	Chrome Shaving	1. Leather board making 2.Leather threads making 3.Clothing making 4.preparation of parchment like materials 5.leather like materials 6. Glue and Gelatin 7.Leather fertilizer 8.Fuel for boilers
10	Buffing dust	Leather board making
11	Crust trimmings	Glue and gelatin making
12	Dry Sludge from ETP	Land filling

(i) Leather board from Chrome shavings

Chrome tanned leather wastes are uniformly fibrised and made into a pulp like that of paperboards. The charges of the pulp may be modified suitably and then they are mixed with rubber latex solution and by changing the conditions the coagulated mass is pressed under a plate and dried. The leather board is used in footwear industry as insole.

Generally leather board is made by extracting fibers from shavings and other solid waste using hammer mills, Hollander beaters, treating those fibers with chemicals and binders, Adding copious amounts of water to make a slurry, floating the in surrey on a wire gauze, allowing the water to drain off and then drying out the resulting sheet of matted fibers which is called leather board.

Disadvantages in this utility

1. Leather board are using as low value end products like mid sole, Insoles and reinforcement materials.
2. Poor Physical and chemical properties.
3. No pre treatment for leather waste.

(ii) Preparation of parchment and leather like materials

Preparation of parchment like materials and leather like materials to offer an alternative and better solution for the disposal of chrome shavings. Parchment membranes can be used in the preparation of lampshades, chandeliers, wall hangers, table tops etc. And leather like materials can be used in the preparation of chapel uppers, hand bags, purses etc,

Disadvantages in this utility

1. Restricted usage only.
2. Low value end products

(iii) Glue and gelatin from chrome shavings

Chrome shavings are dechromed with 10% sodium glycolate at pH 8-9 and 40* C for 24 hrs.The extraction is repeated with a fresh solution using the same condition. After dechroming shavings are washed thoroughly with water at room temperature and then they are pre treated with10% NaOH.After 8 hours treatment caustic liquor is drained out and the shavings are allowed to mature for a period of 40hours.The alkali conditioned materials is further treated with 5% hydrogen peroxide in5% sodium carbonate for 24 hours. After a through wash, the pH of the chrome waste is brought to 8.0-8.5 by HCL.Then the shavings are extracted for gelatin at different temperatures.

Disadvantages in this utility

1. Low value end product
2. Limited usage only.
3. Glue bonding strength is moderate only.

(iv) Blended fabrics from chrome shavings

Leather fibers were extracted from these solid wastes and they are mixed with various proportions of natural (cotton) and synthetic (polyester) fibers to prepare composites. These composites were further processed into leather blended yarns and leather blended fabrics. These fabrics have very good physicochemical and mechanical properties, which enable their use in leather and textile industry applications. This concept of fabric manufactures which is energy efficient, eco-friendly and cost effective. In this process 70% the leather shavings can be recycled for the fabrication of cotton blended fabrics.

Disadvantages in this utility

1. Not been commercialized
2. Limited usage only.

IV. OVERALL DRAWBACKS IN CURRENT UTILITIES

There have been mentioned a lot of uses and disposal methods for chrome shavings, however they haven't been taken up or incorporated in the industries due to feasibility concerns and other constrains. Still there is an under-utilization of chrome shavings. They have primarily been used only for recovery of the protein hydrolysate and re-using it in various applications. Also predominantly chrome is recovered and reused for tanning purpose. However this has not been commercialized on a large scale at an industry level. Other utilities of chrome shavings do not find much use and have not been adopted by the industry unfortunately due to feasibility, cost constrains. Conventional leather boards have also been made that are used as insole, packing materials etc.Even parchment-like material has already been made but has restricted usage only.

Present paper deals with chrome shaving and also possible value added products from chrome shaving

Thousands of tones of chrome tanned leather wastes are generated every month by the leather and apparel industries. Currently, in several countries, these kinds of waste are burned, or, even worse, are buried in suburban fields. About 30% of leather substance processed in tanneries is rejected, mainly after the shaving process, in the form of protein wastes containing 3–5% of chromium (III). These wastes are partly utilized, but mainly they are deposited in storage yards, posing a hazard to the environment. The most often proposed technological solution to the problem of waste shavings utilization is the production of secondary or artificial leathers designed for footwear elements, fancy goods or non-woven fabrics as substrates for leather - like materials.

Leather is a natural polymer consisting of collagen fibers cross linked in a three dimensional structure. Chrome leather Tanning results in improved appearance, physical properties and chemical and biological resistance to leather but the process leads to emission of solid and liquid wastes into the environment. The entire leather operations such as trimming, shaving and cutting result with more than 50 % of the raw hide being rejected as waste. Processing of one ton wet salted hide yields only 200 kgs of leather but over 600 kgs is rejected as solid waste. Of the total waste, more than 50 % is considered as potentially hazardous because of the presence of the chromium. An important consideration is the possibility of the oxidation of trivalent chromium to hexavalent chromium, which is considered to be even more hazardous. When waste leather fibers are added to elastomers, the former could function as short fiber reinforcement for the matrix provided the inherent fibrous nature of the former is retained during processing. Since processing of elastomers is carried out relatively at high temperatures, retention of the fibrous nature in leather under such conditions however is very difficult. It is therefore prudent to use and consider the leather waste in the particulate form and study its effectiveness either as filler or as a processing aid in elastomer formulations.

Epoxy resins are outstanding for their easy processing, low coefficient of thermal expansivity, high rigidity, elasticity and resistance to humidity and chemicals. Their more significant shortcomings include only (apart from rather high price) considerable brittleness that might be a hindrance in some industrial applications, and, may be, not overly great burning resistance. The waste has been so far disposed of by land filling, which is not an optimum solution owing to the large content of environmentally controversial compounds of $Cr3+$ in such waste. $Cr3+$ compounds are quite easily eluted from dumped waste by acid rains and in their soluble form pass into ground waters. When these are processed into drinking water, the widely applied oxidizing procedures lead to oxidation of $Cr3+$ compounds to $Cr6+$ compounds which are very potent carcinogens. In addition, the widely discussed problems of renewable raw material sources, for that matter biodegradable polymer, support efforts to utilize the protein fraction of such waste as a secondary industrial raw material.

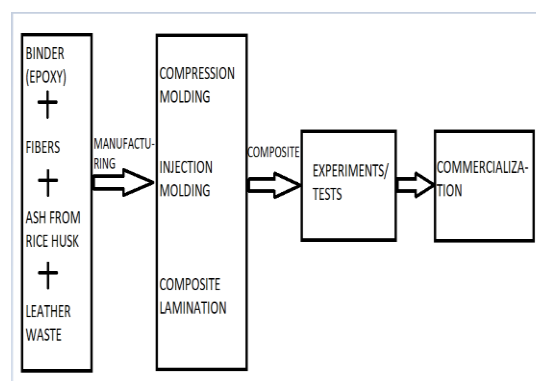
The epoxies used in composites are mainly the glycidyl ethers and amines. The material properties and cure rates can be formulated to meet the required performance. Epoxies are generally found in marine, automotive, electrical and appliance applications. The high viscosity in epoxy resins limits it use to certain processes such as molding, filament winding, and hand lay-up. The right curing agent should be carefully selected because it will affect the type of chemical reaction, pot life and final material properties. Although epoxies can be expensive, it may be worth the cost when high performance is required.

In this work we propose to use the solid waste such as shaving / buffing dust Cr or S. Cr from the leather industry to minimize air and water pollution. They can be quickly disposed from the site by compounding with suitable polymer Binders and conversion into useful Value added products of Engineering and Consumer Applications.

V. PHYSICO – CHEMICAL CHARACTERIZATION OF LEATHER WASTE

Tests	Values
Humidity (wt %)	7.92 ± 0.22
Greases and Oils (wt %)	1.97 ± 0.36
Ash (wt %)	12.86 ± 0.20
Chrome Oxide (wt %)	3.41 ± 0.10
pH in water Extract (wt %)	4.15 ± 0.20
Nitrogen (wt %)	9.71 ± 1.41
Protein (wt %)	54.58 ± 3.80
Decomposition Temperature (°C)	323.0 ± 10.0
Diameter Average (μm)	4.52 ± 0.03
Length Average (μm)	258.5 ± 2.50

VI. PLAN OF WORK



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