

Eco-Friendly Leather: Durable and Crack-Resistant Shoe Uppers

¹Loganathan.T; ²K.Elajaraja ; ³M.Vishva kumar

¹Faculty, ^{2,3}Sr. Faculty

Department of FDP in Footwear Design and Development Institute
Ministry of Commerce and Industry, Govt of India.

Abstract:- Today in this developing world we always want something new or an advanced product and technology. In this daily life we use shoes everyday as office wear, formalwear, casualwear, nightwear etc. It should be comfortable from inside even from outside too, it will have significant work efficiency of the product. This invention is related to development of new crack free leather for shoe upper. It may upgrade the quality of leather and also helps to resolve the finishing operation to make leather more pliable, durable, breathable and comfortable for a long time. Aqueous finishing ageing time and its durability will be increased; it could sustain the leather for a longer period. It will provide a brilliant texture as well as smooth and uniform grain structure. Also it has a tendency till a certain level to protect leather from UV rays. It will have high thermal resistance. Zinc Oxide (ZnO), the element of the bottom layer of leather serves protection from UV rays, also gives shine to the leather which can perform better bondage with collagen (protein peptide). Cowhides last very long due to their greater strength properties and it is widely available in the market due to its constant demand in the market. Cowhide a bovine leather is mostly used for shoe upper and outsole of the shoe as per its high air permeability and water permeability as well as its comfort and durability. It also maintains its shape with chrome tanned. This invention may change the quality of leather and also helps to become environmentally friendly.

Keywords:-

- BCS - Basic Chromium Sulphate
- Shoe Upper Leather
- Finishing
- Crack free leather

I. INTRODUCTION

Upper made up the bulk of the processed leather for shoes. The variety of processed leathers is unlimited, including skins and hides from many species. It is common for uppers to be made from cowhide and calfskin at a premium price. Depending on the desired look and finish, leather can be coarse or fine-grained, matt or glossy, metallic or luminous.

Most shoe upper leather is chrome-tanned. Here we will make upper leather with chrome tanned leather with aqueous finish.

A. Introduction to Leather Industry

Leather is one of the most widely used products globally. The growth in demand for leather is driven by the fashion industry, especially footwear. The leather industry has a prominence in the Indian economy due to substantial export earnings and growth. The Indian leather industry accounts for around 12.93% of the world's leather production of hides/skins (as per 2019 data).¹ Development of a new sustainable crack free shoe upper of cow hides. It will be more prominent to an environment and effective as a resultant of smooth and supple cow (shoe upper) leather production. Cowhides are a product of the food industry. Cowhides have versatile use due to its greater strength properties and availability also it is widely used for shoe making, around 52% shoe production is done by cow hide due to its comfort and durability. It has smaller hair follicles and fiber bundles. Its collagen structure is compact from which it can easily bond with the skin matrix and link stronger bonds with the protein.

B. Introduction to Footwear Industry

The footwear sector is a very significant segment of the leather industry in India; rather it is the engine of growth for the entire Indian leather industry.

- India is the second largest global producer of footwear after China, accounting for 13% of global footwear production of 16 billion pairs.
- India produces 2065 million pairs of different categories of footwear (leather footwear - 909 million pairs, leather shoe uppers - 100 million pairs and non-leather footwear - 1056 million pairs).
- India exports about 115 million pairs.
- Thus, nearly 95% of its production goes to meet its own domestic demand.²
- The major production centers in India are Chennai, Ranipet, Ambur in Tamil Nadu, Mumbai in Maharashtra, Kanpur in U.P., Jalandhar in Punjab, Agra, Delhi, Karnal, Ludhiana, Sonapat, Faridabad, Pune, Kolkata, Calicut and Ernakulam.

- Footwear exported from India are Dress Shoes, Casuals, Moccasins, Sport Shoes, Horrachies, Sandals, Ballerinas, Boots, Sandals and Chappals made of rubber, plastic, P.V.C. and other materials.

II. MATERIAL

Material Required for Crack Free Leather;

➤ *Base Coat*

- Polymer Binder
- Water
- Casein Binder
- Hydroxyphenyl Triazine (provides protection from UV rays)
- Heavy coat of Hybrid (Butadiene) Resin and Acrylic Binder (gives smoothness and flexibility to leather and resist from minor cracks)

➤ *Pigment Coat*

- Water
- Zinc Oxide (ZnO protect leather from UV rays and link with peptides also give shine to leather)
- Pigment colour
- Polymer Binder

➤ *Top Coat (Done Twice for Crack Free Leather Requirement)*

- Wax Emulsion
- Stabilizer
- Penetrator
- Butadiene Resin
- Emulsion

This finish for shoe upper of cow leather will give a luxurious and natural look and it is done with spraying technique, it is a method of application by atomizing from fine jet spray gun and applied on leather which is finely dispersed on the leather.³ After finishing, ironing and packaging is done and ready for manufacturing leather shoe upper for the footwear industry.

III. PROCESS & METHOD

- Firstly, an important step before starting pre-tanning operations. Curing (preservation of hide) it will be done by a chilling method which is an alternative of salt curing (NaCl) common salt is popularly used for preservation of hides and skins of the animals in Indian leather industry. In other countries like Australia, France, U.S.A and etc are using chilling methods for preservation of hides and skins of the animals. Chilling is a short-term curing method of hides and skins. The study says that in chilling method we store the cow hides at optimum temperature level of 4°C and treated with 10% Buffered Formalin for first 24 hours then set at 2°C next 6 days (for cow hides) and has no bad odor, no hair fall and hides remains fresh and wet.⁴ After 7

days preservation ready for pre tanning operations. Chilling method is better than Salt-Curing method, it cut-off excess cost of the salts, and salt waste after curing method as well as in sludge waste.

- Soaking operation is necessary for rehydrating hides after preservation of hides in a blast chiller, and also helps to remove blood stains, insoluble protein, dirt and other unwanted waste. Soaking method for chilled hides need 3 stocks done with a chemical constitution of 200% of Water (H₂O), 0.5 - 1% chemical enhancers like Wetting agent and Enzyme in a drum.
- Liming operation also known as Unhairing operation which is done after Soaking operation to disrupt the hairs or epidermal layer also loosen the hair follicles and open-up the fiber bundles of the collagen with paste of 20% of Water (H₂O), 8% mixture of Lime powder (CaOH) + Sodium Hydrosulfide (NaHS) apply on flesh side and process it for 8-10 hours in paddle.
- After Liming operation, Deliming operation is an essential process for removing excessive lime from the limed pelt and maintaining the pH level of the pelt as well as osmotic swelling. We use buffered Ammonium Chloride (NH₄Cl), 100% of Water (H₂O) + 4% of Lime (CaOH). The final pH value after completion of process must be around 8.5 pH.
- Bating operation is treatment of pelt with 1% of enzymatic agents to prepare the pelt for tanning. In order to achieve wet-blue, acid bating with ambient temperature of 37°C in drum for Copper (II) Sulphate tanning. The optimal pH value should be 3.5-4.
- Last pre-tanning operation is Pickling operation by which pH level of bated pelt has to be changed to desired pH level according to requirement for the tanning process. It also prevents pelt from several microorganisms and bacterial attacks and can be stored for about months. 100% of Water (H₂O), 10% of Common Salt (NaCl), 1% of Inorganic acid (H₂SO₄) to prevent acid osmotic swelling. The final pH value of pickled pelt is 2.8-3 pH.
- Tanning process is done with pickled pelts for required properties like softness, suppleness, flexibility and durability. After pickling we removed 50% of pickled water, now we will add Tanning agent 5% of (BCS) Basic Chromium Sulphate (Cr₂(SO₄)₃) salt. Rotate drum at shrinkage temperature (T_s) 90-100°C for 30 minutes. After, rotate the drum for another 30 min in fresh water (H₂O) with 4% of Pentahydrate Basic Chromium Sulphate (Cr₂(SO₄)₃) salt at optimum temperature 37°C.
- Here Post-Tanning operation takes place after tanning, Sammying operation is removal of excess water of the

leather has been reduced so we can execute all post-tanning operations easily.

- Shaving operation we reduce thickness and uniform the grain structure for suppleness, for garment thickness will be 0.5-0.9 mm. After we perform Washing operation for removal of shaved dust from the wet-blue.
- Basification operation to raise pH value of wet-blue for that chemicals we need 50% of Water (H₂O), 0.75% of Sodium Formate (HCOO⁻Na⁺), 1% of Sodium Bicarbonate (NaHCO₃) runs in drum for 60 minutes. Check for pH 4 - 5.
- Neutralizing operation is done for softness and uniformly fat liquoring throughout cross-section of wet-blue and reduces the positive charge to level the pH. Add 0.5% of Neutrigan (a mixture of organic and inorganic compounds), 0.5% of Sodium Formate (HCOO⁻Na⁺), 0.5% of Sodium Bicarbonate (NaHCO₃). It will adjust acidic nature; to a pH level of 5.8-6.5 at the end of the operation.
- Retanning operation is continuous process with Dyeing and Fat-Liquoring operations, it is an addition of chemicals to make leather soft, stretchy and water repellent after dyeing the wet-blue, also improves the dyeability by 4-6% of Aqueous Poly-acrylic Dispersion Agent and 5% of Protein filler (rotate in drum for 60 minutes).
- Dyeing operation is to color the leather as per fashion demand. We use Acid dye 1:1 Metal complex dye for mineral tanning, 3% of dyes, 0.5% of Neutrigan, 0.5% Liquor Ammonia (it improves the grain lubrication). Dyeing is done for 2 hours. Fat-Liquoring is the operation in which oils and fats are converted into emulsion by a process of sulfonation, to make leather smooth, stretchy and waterproof. 10% of FOSFOL-SCS (Sulphochlorinated Oil) and Hot Water (H₂O).
- Fixing operation is done to enable dyes to penetrate the leather and fix the chemicals before incorporating Formic acid (HCOOH). It needs 3% of Formic acid (HCOOH) and 300 ml Water (H₂O). After fixing operation, Setting operation is performed to make the leather flat (removal of wrinkles and folds) and this operation is carried out with a setting machine. Water content should be 15-20%.
- Then, Drying operation is done to dry the leather for other subsequent mechanical operations. After all the drumming operation, wet-blue are left overnight for ageing. Next day, Staking operation which provides softness to the leather by separating the opening fibers.
- Toggling operation is method leather dried finally and removes excessive water content from it, approx 10% of

water is observed. Edge-Trimming operation is to trim well round the area, give proper shape to the leather.

- Buffing operation is performed before the finishing; making sure the flesh side should be smooth and uniform for garment production. It can be achieved by rubbing emery paper on the flesh side (280,300,320 Grade).
- Finishing is the last and crucial operation of the tanning process for final appearance and enhancing surface properties of the leather. It is an art by itself to give finishing to the leather (crust). Manufacturing of the cow crack free (shoe upper) leather using Basic Chromium Sulphate (Cr₂(SO₄)₃) tanning, Aqueous finishing is preferred for production of cow shoe upper leather.
- It is a best and most suitable finish for shoe upper of cow leather and gives a luxurious and natural look. It requires 1ltr of Water (H₂O), 10gm/ltr of Pigment dye, 15gm/ltr of Polymer Binder (BRILLO SUPER TR), 15gm/ltr of (STAHL Melio® Top 285) Casein Binder one heavy coat of STAHL Hybrid (Butadiene) Resin and Acrylic Resin, 10gm/ltr of Zinc Oxide (ZnO) for basecoat to make leather crack resistance for long duration and 20gm/ltr of Wax Emulsion (CERAUBINA 212), 1ltr of Water (H₂O), 10gm/ltr of Penetrator (RODA® Penetrator 4019), 10gm/ltr of Stabilizer (INSPIRA® FFSS)⁵ for topcoat finishing (2 coats required for top coating) done with spraying technique, it is a method of application by atomizing from fine jet spray gun and applied on leather which is finely dispersed on the leather.

IV. ENVIRONMENTAL IMPACT

➤ BCS – Basic Chromium Sulphate

Chromium is a corrosive, health hazardous, harmful and environmental hazardous element.

It is banned by (USHD) Universal Sustainable Habitat Development,

- (IARC) International Agency for Research on Cancer,
- (WHO) World Health Organization,
- (EPA) United States Environmental Protection Agency,
- (REACH) Registration, Evaluation, Authorization and Restriction of Chemicals,
- (SVHC) Substance of Very High Concern.⁶

(It is a substance of very high concern) chrome products can cause carcinogen disease and also such as eczema, asthma, pneumonia, skin burn, partially blindness and some allergic diseases, majorly this health issues can be seen in tannery workers who are working without any kind of safety measures. Approx 0.2-0.5mg/kg dose is enough to make humans ill. Also the chromium waste from tannery integrated with the river may ingest by the aquatic animals leads to death.

V. CONCLUSION

However, it concludes that new crack free (shoe upper) cow leather production uptakes the hide properties in order to make leather. If it is categorized, global cow leather production is 65-70% and chrome tanning usage is 80%; it can be assumed, the high demand in the fashion market. As we know the growing fashion sector continuously needs innovative trend changing products which may dominate the fashion sector and possibly crack free leather can change the fashion shoe market. Also new crack free chrome tanned leather holds heavy resins and binder base coat approx (total finish thickness about 0.15-0.25 mm) in order to make shoe upper more comfortable, soft and crack resistance and UV resistance. Also being sustainable finished leather it may also have a disadvantage, if leather is continuously in direct contact with sunlight or water for a long time may deteriorate soon

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