Artificial Leather– An Eco–friendly Alternative Textile Material For Leather

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Abstract: *Many people believe that leather is just a by product of the meat industry and that animals are not killed solely for their skin, but this is not the case. Much of the leather in athletic shoes, for example, comes from kangaroos, which are killed merely for their skins. Nowadays more and more people prefer to wear synthetic leather as an alternative to real leather because this textile material is eco–friendly and no animal cruelty is involved in its production. Today numerous advanced types of artificial leather materials have been developed, which are giving the feeling of wearing leather without actually wearing it.*

Keywords: *Artificial Leather, Artificial Suede, Manufacturing of Artificial Leather, Sewing of Artificial Leather*

Leather production is hazardous to the environment. Toxins that are emitted from leather tanneries endanger human and ecological health by polluting regional waterways with mineral salts, formaldehyde, coal-tar derivatives, oils, dyes, salt, lime sludge, sulfides, and acids. Residents of tannery towns have a greater-than-average chance of developing leukemia, and more than half of all tannery workers develop testicular cancer. On the other hand the leather industry uses an enormous amount of energy. Huge amounts of fossil fuels are consumed in raising, transporting, and killing the animals that are skinned for leather. Synthetics artificial leathers actually required fewer petroleum products to produce. Thus artificial leather is best alternative for the genuine leather, as it provide an opportunity to save our ecosystem without compromising the trendy clothing. Applications of artificial leather are enormous and include upholstery for automobiles and home, foot wears, garments, belts, soft luggage, stationary products, insulation tapes, table covers, urine bags, car matt and PVC geo membrane etc. Artificial leather can be hand sewing and requires leather needles and threads but for machine stitching heavy duty industrial sewing machine are suitable. Recent advances in this field produce newer materials with different useful properties for their versatile uses.

1 Historic and Upholstery Uses of Artificial Leather

Under the name of artificial leather, (not to be confused with the more modern leather) or of American leather cloth, large quantities of a material having, more or less, a leather-like surface were once used, principally for upholstery purposes, such as the covering of chairs, lining the tops of writing desks and tables, and so on. There was considerable diversity in the

preparation of such materials. A common variety consists of a web of calico coated with boiled linseed oil mixed with dryers and lampblack or other pigment. Several coats of this mixture were uniformly spread, smoothed and compressed on the cotton surface by passing it between metal rollers, and when the surface was required to possess a glossy enamel-like appearance, it received a finishing coat of copal varnish. A grained morocco surface was given to the material by passing it between suitably embossed rollers.

Clothing and fabric uses: synthetic leathers, at times made from plastics, are often used in clothing and fabrics. Artificial leather is marketed under many brands, including "leatherette", "faux leather," "patent leather", "Naugahyde" and "pleather" etc.

2 General Manufacturing Process of Artificial Leather

2.1 Artificial leather is composed of various layers

(1) A fibrous substrate, non-woven, or woven or knitted fabric

(2) A urethane polymer layer containing finely divided inorganic particles

(3) A thinner urethane polymer layer consisting of at least about 80% by weight of polyurethane

(4) A coating layer consisting of at least about 80% by weight of polyurethane

3 Specifications for Manufacturing of Artificial Leather

Artificial leather comprising a fibrous substrate having a thickness of about 0.3 mm to 3.0 mm. Fibrous substrate comprising a sheet of ultra fine fiber bundles and polymer impregnated therein, in which the denier of each fiber is about 0.01 to 1.0 denier and coating layers (III), (II) and (I) adhered in that order to the surface of said substrate, with the coating layer (III) immediately on the surface of the substrate. Coating layer (I) is prepared by a dry-coagulating method. Coating layer (I) is coated on coating layer (II) and dried to remove solvent. The satisfactory range of thickness of coating layer (I) is about 0.001 mm to 0.1 mm, more satisfactory about 0.003 mm to 0.05 mm, and the most satisfactory about 0.005 mm to 0.02 mm. In the case of a thickness of coating layer (I) larger than 0.3 mm, the appearance of creases and the feeling and appearance of the artificial leather obtained are not those of natural leather (the appearance of creases becomes too small), and water vapour permeability and flexibility resistance become worse, and the touch of the artificial leather becomes hard. Composition and preparation of various layers is as follows.

3.1 Preparation of non-woven fabric

Forty parts of Nylon-6 staple fiber of 3 denier and having a length of 51 mm, and 60 parts of polyethylene terephthalate staple fiber of 5 denier and having a length of 51 mm, are respectively opened and then mixed The mixed staple fiber was treated in crosslapping equipment to obtain a web and then was needle-punched to obtain a non-woven fabric. This non-woven fabric is heat pressed with a calender roll to obtain a non-woven fabric having a unit area weight of 200 g/m^2 and a thickness of 0.8 mm.

3.2 Preparation of impregnating composition

Polybutylene adipate having a mean molecular weight of about 2,000, diphenyl methane ci-isocyanate (DPMDI), methylene-bisaniline (MBA) and N-N'-di-methyl-formamide (DMF) were reacted to obtain a polyurethane (PU) solution having a concentration of 25 wt% and 350 poises of viscosity at 20℃ by the pre-polymer method. After adding DMF to the PU solution, an impregnating composition having 10 wt% of concentration and 2.2 poises of viscosity at 20℃ is obtained.

3.3 Preparation of coating composition

According to the combination component, each component was mixed to obtain coating composition (I), (II) and (III). coating composition (I) : Polyurathane, main component as polymer, carbon black (CB) as black pigment or a small amount other pigment dye are mixed and stirred, and then a mixture of DMF and tolune (3:1 by weight) were added to obtain the coating composition (I) having 1.2 poises of viscosity at 20℃ . Coating layer (I) is prepared from coating composition (I).

3.4 Preparation of artificial leather

Step (1) : the coating composition for coating layer (II) is uniformly coated on a release support such as plastic film, glass plate, steel plate, or paper, so as to attain a thickness of about 0. 01 mm to 0.3 mm of the coating layer (II).

Step (2): the coating composition for coating layer (III) is uniformly coated on the coating layer (II) in Step (1) so as to attain a thickness of about 0.1 mm to 3.0 mm of the coating layer (III).

Step (3): on the other hand, the non-woven, or woven or knitted fabric is impregnated with an impregnating composition and then coagulated by immersing in a liquid which is a non-solvent for the polymer. The product of this step is immersed in a solution composed of non-solvent and solvent for the polymer in the impregnating composition. In this way the wet-treated fibrous substrate is

obtained. This is then applied to the surface of the coating layer (III) obtained in Step (2), and pressed lightly.

Step (4): the material obtained in step (3) is immersed and coagulated in a coagulating liquid for a definite time at a definite temperature, to obtain a micro porous structure of coating layer (II) and (III), and to unite the coating (II) and (III) with the fibrous substrate.

Step (5): the release support is stripped from the surface of the coating layer (II), and the solvent which is contained in the coating layer (II), (III) and wet-fibrous substrate is extracted and washed and then dried.

Step (6): the coating composition for coating layer (I) is coated on the surface of the coating layer (II) so as to attain 0.001 mm to 0.1 mm in thickness of the coating layer (I), and then dried.

4 Types of Artificial Leather

Plastic leather (Pleather): the word "pleather" is a popular slang term for synthetic leather made out of plastic, and is actually a combination of the words "plastic leather." When "pleather" first arrived on the fashion scene in the 1970s, the word was used in a derogatory manner, implying that the "pleather" wearer was just too poor to buy the pricey, stylish genuine leather items that were in fashion. In today's more enlightened times, however, many people prefer wearing "pleather" articles of clothing because they are against using products made from animals. This animal friendly fabric gives individuals a trendy way to show their support for the animal rights movement without sacrificing any of their fashion sense. "Pleather" is often used as an inexpensive substitute for leather. The most popular form of "pleather" is made out of a polyurethane film, which is a lighter, more flexible and less restrictive material than leather. This kind of "pleather" is easy to clean, requiring the owner to simply wipe it off occasionally with a cloth dipped in a solution of mild detergent and warm water. This simple care routine ensures a longer life for "pleather" garments, making them nearly as durable and reliable as their true leather counterparts.

"Pleather", being made of plastic, will not decompose as quickly. But not all "pleathers" are the same. Polyurethane is washable, can be dry-cleaned and allows some air to flow through the garment. PVC "pleather" in contrast does not "breathe" and is difficult to clean. PVC cannot be dry-cleaned because the cleaning solvents can make the PVC unbearably stiff. Another reason for "pleather" consistent popularity is that it is a very versatile fabric that can be made into virtually any accessory or item of clothing. In recent years, "pleather" has been used by numerous designers to create garments such as form-fitted jackets, stylish jeans, flattering skirts, trendy tops, fabulous handbags, and sexy shoes. This multi-faceted textile is one that people of all ages and fashion styles can wear tastefully. This fabric also breathes, meaning that even individuals living in hot, muggy climates can enjoy "pleather" garments. In addition, the fact that it is easily dyed means consumers can always find "pleather" items in the "in colours" of the season. "Pleather" can even be made to look like real leather, ostrich skin, or python skin.

"Pleather" is still less expensive, sometimes costing three times less than real animal hide leather. This makes "pleather" an attractive fabric for companies that make mass-produced clothing lines and accessories. This also makes it a popular choice for use in furniture lines and car upholstery. The "pleather" of today isn't the much-ridiculed, squeaky, faux hides of yesteryear. The softer, realistic-looking "pleather" is a popular choice with designers, not only offering them a flexible, versatile textile to work with, but also bridging the great divide between being stylish and being animal friendly.

Naugahyde (Nauga): it is a well known and established brand of artificial leather ("leather"), made from vinyl polymer coated plastic. The product was developed by Uniroyal Engineered Products and is now manufactured and sold by a division of the same company, the Naugahyde Company. Its name comes from the Borough of Naugatuck, Connecticut, where it was first produced. A marketing campaign of the 1960s and 1970s asserted humorously that naugahyde was obtained from the skin of an animal known as a "Nauga"; this is an urban myth. The campaign emphasized that, unlike other animals, which must typically be slaughtered to obtain their hides, Naugas can shed their skin without harm to themselves. Naugahyde is one of the most popular premium "pleathers".

Vegan leather: vegan Leather is an artificial alternative to traditional leather. It may be chosen for ethical reasons or as a designed material which may have different properties but a similar look to the natural material.

Poromeric imitation leather: sometimes referred to as poromerics, poromeric imitation leathers are a group of synthetic 'breathable' leather substitutes made from a plastic coating (usually a polyurethane) on a fibrous base layer (typically a microporous and polymeric. The first poromeric material was DuPont's ill-fated Corfam introduced in 1963 at the Chicago Shoe Show. Newer poromerics include Clarino made by Kuraray Company of Japan. Corfam was the first poromeric imitation leather, invented by Kenny

Rowe of Fairfield Iowa, and introduced by DuPont in 1963 at the Chicago Shoe Show. Corfam was the centerpiece of the DuPont pavilion at the 1964 New York World's Fair in New York city. Its major advantages over natural leather were its durability and its high gloss finish that could be easily cleaned with a damp cloth. Its disadvantages were its stiffness which did not lessen with wearing and its relative lack of breathability. DuPont manufactured Corfam at its plant in Old Hickory, Tennessee, from 1964 to 1971. After spending millions of dollars marketing the product to shoe manufacturers, DuPont withdrew Corfam from the market in 1971 and sold the rights to a company in Poland. Corfam is mainly remembered as a textbook marketing disaster. Corfam is still used today in some products, an example being certain types of equestrian saddle girth. Corfam shoes are still very popular in the military and other uniformed professions where shiny shoes are an asset.

Koskin: in Swedish, koskinn means cow's skin (ko means cow, skinn means skin), often causing much confusion for consumers. Koskin is an artificial leather material commonly found in computer laptop cases. It is commonly used in Hewlett-Packard, Targus and Belkin laptop cases, CD wallets, and other consumer goods. It is made to look and feel like authentic leather.

Leatherette: leatherette is a form of artificial leather, usually made by covering a fabric base with plastic. The fabric can be made of a natural or a synthetic fibre which is then covered with a soft PVC layer. Leatherette bound books and 20th century cameras are good examples of leatherette. Leatherette clothing of various kinds (including lingeries) also exists. A disadvantage of plastic "leatherette" is that it is not porous and does not allow air to pass through it, thus sweat can accumulate if it is used for clothing, car seat coverings, etc. However, one of its primary advantages, especially in cars, is that it requires little maintenance in comparison to leather and does not crack or fade as easily. During a fire, leatherette may cause additional serious skin damage because it not only burns more vigorously than leather, but can also melt.

Microfibre leather: fiber manufactures uniform microfibre leather, which is environmentally friendly, and represents the latest development in synthetic leather production. Uniform microfibre leather could be the closest substitute for natural leather due to their high resemblance in physical characteristics. The uniform microfibre leather is produced from uniform sea-island short fibre. This short fibre is processed into non-woven fabric, which forms the base for making synthetic leather. Chucra is the registered trademark used to market the Group's uniform microfibre leather. Chucra has qualities similar to that of natural leather and is as exquisite as high-grade deer hide after post-production finishing. Its uniformity in thickness, high tensile strength, colour richness and end applications exceed that of natural leather. Its resistance to water, mould, toxins, and ultraviolet ray far surpass those of natural leather, which make it an ideal substitute. Synthetic upholstery leather, car ornament, bags synthetic fashion leather glove leather synthetic shoe leather.

Patent leather: patent leather is leather that has been given a high gloss finish. Patent leather refers to leather with a glossy surface. Patent leather is leather that has been treated with lacquer to give it a hard, glossy surface. The name Patent leather is derived from the idea of protection. The original process on making patent leather was developed by Newark, New Jersey based inventor Seth Boyden in 1818. Patent leather was manufactured commercially at the beginning September 20, 1819. Boyden's process used a linseed oil based lacquer coating. Modern patent leather usually has a plastic coating. Patent leather is sometimes confused with poromeric imitation leathers such as DuPont's Corfam and Kuraray Company's Clarino which are manmade materials with a similar glossy appearance. Patent leather and poromerics are cleaned in a similar way. Dirt adhering to the coating can be removed with a damp cloth, using a mild soap if needed. Minor scratches and scuff marks in the coating itself can be removed using one of several special purpose patent leather and poromeric cleaners on the market.

Bonded leather: bonded leather, or reconstituted leather, is an artificial material composed of 80% to 100% leather fibers (often waste scraps from leather tanneries or leather workshops). It consists of collagen fibers obtained from macerated hide pieces bonded together with latex binders constructed into a fibrous mat to create a look and feel similar or sometimes identical to that of genuine leather but at a fraction of the cost. Depending on the quality a man-made pattern is usually discernible as a "grain-like" look. Examples of products

Bonded leather diary cover

Kydex holster

that are most commonly constructed with bonded leather are: bibles, diaries, art books, desk accessories, hymnals, bags, belts, chairs, and sofas.

Kydex: kydex is a line of thermoplastic acrylic-polyvinyl chloride alloy sheet grades. It is frequently used as an alternative to leather in the production of firearm holsters and sheaths for knives. Kydex Thermoplastic Sheet is a registered trademark of Kleerdex Company and is the only manufacturer of this line of proprietary thermoplastic sheet.

Kydex sheet was originally produced in 1965 by Rohm and Haas, having been designed for use in aircraft interiors. In 1987, the product line was purchased by the Kleerdex Company, LLC, which manufactures the material at a location in Bloomsburg, Pennsylvania.

Kydex sheet is a non-porous material, which is easily moulded into shape by heating, forming, and cooling the material. Typically it is supplied in sheets of varying thickness, which can be cut into shape and formed. Kydex sheet is advertised to have a number of advantages over leather in forming holsters and other similar items, including: it is waterproof, scratch resistant, holds its shape, will not stretch or shrink under normal conditions.

5 Synthetig Suede

Synthetic suede material, also known as Alcantara, Novasuede, Ultrasuede, Street Suede and other brand names, is a hot new material in automotive interior applications. It successfully mimics the look and feel of real suede, but is far more durable and practical. Synthetic suede is a polyester or nylon microfiber material. The microfibers, one thousand times finer than silk, are intricately formed into a triaxial matrix that closely simulates the natural structure of leather.

5.1 Manufacturing process of synthetic suede

A synthetic suede product formed of thermoplastic foam adhered to a fibrous substrate, wherein the foam has the surface characteristics of natural suede. The synthetic suede product is formed by removing a surface layer of the foam so as to expose the pore structure thereof.

In the method of producing synthetic suede having the appearance of natural suede by coating a substrate with a foamable thermoplastic resin and heating said resin to generate a foam having a generally smooth and reflective outer surface layer, the improvement which comprises thereafter removing said outer surface layer by compressively contacting the same with a smooth surface heated to approximately the melt temperature of the thermoplastic resin to soften the outer surface portion of the foam and removing said outer surface layer by disengaging the contacting heated surface thereby exposing the underlying pore structure of the foam.

5.2 Advantages of synthetic suede

This material has many other advantages. It is water-resistant yet breathes. It has a soft, plush hand and is soothing to the touch in any climate. It has excellent colorfastness. It requires minimal care, and is both spot-cleanable and washable. The microfiber matrix formation results in material that is supple yet unusually strong - stronger than leather on a strength to weight ratio. It resists sagging, tearing, stiffening, cracking, piling, and shrinking. It is very abrasion-resistant - some brands surpass the 200,000 double rub test. Synthetic suede comes in a wide variety of colors. It can be used in cars as inserts in seats, as headliner material, and as a versatile material for covering dashes, center consoles, door panels, etc. It is also suitable for boat upholstery.

Ultrasuede: ultrasuede is a synthetic fabric invented in 1970 by Dr. Miyoshi Okamoto, a scientist working for Toray Industries. It was the world's first ultra-microfiber. Fabric content is 100% polyester. Ultrasuede feels like natural suede, but it is resistant to stains and discolouration; it can be washed in a washing machine. It is a woven fabric, but resists pulling or fraying because it is combined with a polyurethane foam in a non-woven structure. The fabric is multifunctional: it is used in fashion, interior decorating, automotive and other vehicle upholstery, and industrial applications, such as protective fabric for electronic equipment. It is also a very popular fabric in the manufacture of footbags (also known as hacky sacks).

Ultra suede application as car upholstery

5.3 Sewing of artificial leather

Artificial leather can be hand sewn or machine sewn. Hand sewing requires leather needles and special kind of threads. Light weight artificial leather may be stitched on home


JUMBRO Sewing Machine: suitable for medium-artificial leather materials

sewing machines but for medium and heavy weights heavy duty industrial sewing machine are suitable.

General tips for sewing of artificial leather: if first time sewing "pleather" then choose a simple project that does not have a lot of top stitching. Practice and test sewing machine settings on scraps before trying hand on final product.

Basting and pinning holes: Use paper clips, tape or weights instead of pins. Use glue stick where ever it won't be seen. If pinning is absolutely necessary, pin in seam allowances and remove the pins as sewing is completed.

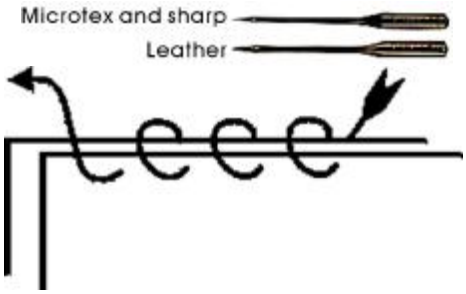
Avoid skipping of stitches by machine: Sew from the fabric (wrong side) whenever possible. A teflon foot on sewing machine will also help as it allow the fabric to move properly for sewing foam, plastic, plastic coated fabrics, leather and imitation leathers. The foot feeds over the fabric without sticking. A leather needle may solve the problem. If it is must to sew on the right side, place tissue paper on top of the fabric to help the machine feed the fabric properly.

Pressing and wrinkles removing: do not use a high temp iron. Use a dry iron set on the synthetic setting. Use a press cloth, on the right and the wrong side of "pleather" to prevent the iron from sticking to the fabric or scorching the fabric. Do not use a heavy hand. Work slowly and allow the heat to do the work, not the weight of the iron. Use alternative pressing tools such as a clapper to set creases and seams.

Cleaning: not all "pleather" is washable. Read the bolt end information or test a scrap. If you are going to wash the item, preshrink the fabric.

Although PVC is backed in a knit, you should not use a ball point needle, because it will tear ugly holes in the Polyurethane. Instead, use a sharp size 11 in your machine for seam construction and topstitching. Use a "leather" needle to baste in zippers. Leather needles are heavyweight needles designed with a razor tip to cut through leather and leather-like fabrics that resist normal needle piercing. This makes them a terrific choice for machine sewing through both PVC and zipper tape in a single line of stitching. Because PVC stretches, the thread it is sewn with must stretch also. Polyester has the best give when twisted into thread. 100% Polyester thread is recommended for normal seam construction, but all-purpose thread that contains at least 60% polyester will suffice and is often easier to find in stores. Do not use all-cotton thread. If teflon foot is not available, place a very small amount of sewing lubricant such as Sewers Aid on the bottom of the presser foot to provide smoother feeding.

Machine needles of artificial leather stitching: microtex and sharp needles are used for sewing microfiber, synthetic leather. These needles have an acute point. They are essentially trouble-free, but fabric may require a Teflon, roller, or even/dual-feed presser foot. Leather needle are excellent for sewing heavy weight artificial leather. They have slight cutting point (almost like an arrowhead). On synthetic leather, unless it's very heavy synthetic, cuts rather than pierces stitch hole and can tear leather. Most synthetic leathers require Microtex or sharp needle.



Machine needles of artificial leather

Hand sewing of artificial leather: artificial sinew is used instead of regular thread for sewing leather. It is a strong waxed thread that can be split into strands like embroidery thread. Use 1 or 2 strands to sew your moccasins together. If you cannot find artificial sinew, use a strong thread such as buttonhole or quilting thread. Leather needles are suitable. Which are also called a Glover's needle; pointy end on the needle has a three cornered knife edge so that it cuts the material rather than piercing it. It really makes sewing artificial leather much easier than using a regular needle. Use as small a needle as possible so it does not leave big holes in the leather. Be careful. Leather needles are sharp!

Sewing techniques: sewing is done by hand using overcast or whip stitch like the figure. Make a knot at the start and end of the seam. Stitch two pieces together inside out, with the right sides of the leather facing each other. After the seam is finished, turn the pieces right side out. Try and make your stitches small and neat but realize it does take practice until you can make perfectly uniform stitches. Aim for stitches that are about 1/8" apart and 1/8" deep (1/8" in from the edge of the leather). Pull the thread tight after each stitch.

6 Recent Advances In The Field of Artificial Leather

Artificial leather having a crepe pattern is produced by a process comprising preparing a base cloth material at least a part of which is composed of highly heat shrinkable yarn and less heat shrinkable yarn. Highly heat shrinkable yarn has a heat shrinkage rate of at least 10 percent at

a temperature within the range at 80℃ to 230℃. The difference in the heat shrinkage rate between highly heat shrinkable yarn and less heat shrinkable yarn being at least 5 percent within the same temperature range, forming a synthetic resin film layer on base cloth material to obtain an artificial leather material having a smooth synthetic resin surface, and subjecting artificial leather material to a heat treatment to form a crepe pattern on synthetic resin film layer due to the heat shrinkage difference between said highly heat shrinkable yarn and said less heat shrinkable yarn of said part of said base cloth material. The artificial leather-like product thus obtained is then heated by air, water vapour or other heating medium to cause shrinkage of the base fabric, with the shrinkage difference resulting in the expression of a three-dimensional pattern on the surface of the plastic film layer.

Fire-proof artificial leather:

process is particularly suitable for artificial leather of the type whereby a porous polyurethane resin matrix containing polyester and/or polyethylene fiber is covered with a compact, pressed polyurethane resin film, and consists of treating the artificial leather in rotary tanning drums, firstly, with a relatively concentrated solution of water and PIROFLAM (registered trade mark) or other similar commercial fireproofing/retarding substance of the type commonly employed for extinguishing forest fires, and, secondly, with a solution of water and softener, e. g. TRIANOL SP (registered trade mark) to which is added an appropriate amount of the same fireproofing/retarding substance used previously on the artificial leather. [14]

7 Conclusion Artificial Leather

Artificial leather provides better options than leather. It is cheaper than genuine leather, comes in numerous varieties. Production is not as much of hazardous to eco system and human health as leather manufacturing, requires less amount of fossil and human energy. Thus one should consider all above factors before going for genuine leather goods, when we have alterative artificial leathers which can provide equal or sometimes better excellence in appearance and performance that of leather.

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