Abstract Title: Production of leather

A process for the production of leather from hide or skin, comprising tanning the hide or skin, then neutralizing and retanning the resulting leather, optionally dyeing the retanned leather, lubricating the leather and drying the lubricated leather, characterized in that the lubricating step is carried out by a fatliquoring step in which the treatment of the leather is carried out with an emulsion of an organofunctional polysiloxane which contains an organic group substituted by a polar functional group. Preferably the organofunctional polysiloxane is the only material used for lubricating the leather during its production. Use of such polysiloxanes for reducing the fogging of the leather is also provided.
PRODUCTION OF LEATHER

FIELD OF THE INVENTION

5 [0001] This invention relates to the production of leather. In particular it relates to the lubricating step involved in leather production, often known as 'fattiquoring'.

BACKGROUND TO THE INVENTION

10 [0002] Leather is produced from hides or skins. The terminology of the raw material reflects the size of the animal: large animals provide hides, small animals provide skins. Production generally includes the initial beamhouse processes, to prepare the hide or skin for tanning, then the steps of tanning, neutralizing, retanning, drying and finishing the leather.

15 [0003] The beamhouse processes involved in leather manufacture are generally as follows:-
Soaking: to rehydrate the pelt, to allow reagents to penetrate the cross section.
Unhairing: may be achieved by dissolving the hair, but more frequently involves the removal of intact hair (to reduce the environmental impact of the process).
Liming: a generic term, indicating the breakdown of non structural protein and controlled damage to the collagen, under alkaline conditions. Hides may be split through the cross section at this stage – usually for upholstery leathers.
Deliming: the depletion of the alkali swollen pelt, in preparation for the next step.

Bating: the application of proteolytic enzymes, to complete the reactions of liming.
Pickling: acidification in brine solution (to prevent acid swelling) to prepare the pelt for tanning.

[0004] Tanning stabilises the pelt to degradation by micro organisms. The most usual type of tanning is chrome tanning, using basic chromium (III) sulfate. Hides are split and shaved to the desired thickness prior to post tanning. Post tanning incorporates neutralising, to modify the charge on the leather, which controls the reactivity towards post tanning reagents, which are typically anionic. Retanning may be undertaken with any tanning agent, depending on the final use for the leather. Usually the leather is dyed after retanning.

35 Dyeing is the colouring step, usually although not exclusively using modern synthetic dyes.
[0005] Modern leather, for example leather that has been tanned with chromium (III) salts, must contain a lubricant. The primary reason is to prevent the fibre structure sticking when it dries after processing in the factory or after wetting in use. The secondary reason is to provide a mechanism for the fibres to slip when stressed. These effects introduce softness to the leather and avoid the weakening effect of a stiff, brittle structure. Fatliquoring is a generic term for the step to provide lubrication to the leather fibre structure, whether or not the agent contains fat. Lubrication or fatliquoring is typically applied at or after the stage of retanning and dyeing, but may also be applied at more than one stage, starting as early as pickling.

[0006] The process of lubrication or ‘fatliquoring’ is well known in the art. Typically it is conducted by applying a formulation of a neutral vegetable oil (animal, vegetable, mineral or synthetic), partially reacted to form a sulfate or sulfonate derivative, so that in solution it forms an oil-in-water emulsion. The emulsifying agent is the so called sulfo fraction and the actual lubricant is the neutral oil, carried into the leather fibre structure as an emulsion particle. The process is highly effective, in which controlling the nature of the oil, the nature of the emulsifier and the chemical conditions in processing can result in leather of any desired softness. In leather for automotive upholstery, softness is an important property, since the material must be able to conform to the seat design in manufacture and must feel comfortable to sit on.

[0007] After lubrication, drying can be conducted in any of a variety of ways, including tunnel or vacuum techniques. Finishing involves application of a selection of natural protein or synthetic polymer or resin coatings on the surface, to provide special effects and/or added durability and/or enhanced aesthetic appeal.

[0008] In recent years, alternative tanning and retanning procedures and alternative approaches to lubrication have been frequently investigated by the industry with particular reference to the problem of ‘fogging’. Motorists are familiar with phenomenon of clouding occurring on the inside of their car windows. Unlike the dirt deposited on the outside, this cloudiness is a product of the interior components of the car. In warm weather, the interior temperature of a car can rise to surprisingly high values; volatile chemicals are released from plastics, leather, fabrics, rubber, elastomers etc., and the vapour condenses on the cooler surfaces, usually the windows – this is the fogging mechanism. Automotive suppliers
have long recognised that one of their preferred materials of construction, leather, can be a major contributor to fogging. Consequently, each manufacturer has set stringent standards for the amount of volatile material that is released over a stipulated time period, at a stipulated temperature. The causes of fogging can include the presence of ammonium salts in the leather, deriving from agents used for deliming or retanning or other special treatments. However, the commonest source of volatiles is the lubricant; even if the oil has low intrinsic volatility, it is likely to cause the leather to fail in this test.

[0009] EP-A-280152 describes a hydrophobising agent for leather, containing hydrocarbons having at least 10 carbon atoms which are partially halogenated, aminosiloxanes or aminopolysiloxanes, carboxyl group-containing emulsifiers which are fixed in the leather by acids or multivalent metal ions, and water.


[0011] US-A-6110230 describes the use of carboxyamide-polysiloxanes for waterproofing leather. WO-A-00/77292 describes a process for dyeing leather with reactive and acid dyes comprising pre-impregnating the leather with an aminosilane or aminosiloxane that provides additional dyesites in the collagen matrix. DE-A-19646916 describes the application of carboxyamide polysiloxanes for waterproofing materials with a fibrous structure, particularly leather or pelts. US-6326061 describes the use of a silane or siloxane containing both Si-C bonded aminoalkyl group and Si-OC bonded iso oxyalkyl radical for the treatment of textiles or leather, claiming the advantages to be very good slip effect and outstanding softness coupled with very good hydrophilicity. US-5072490 and US-6379751 disclose processes for water repellent treatment of leather and skins which comprises the use of certain carboxyl-containing polysiloxanes. EP-A-1087021 describes a leather treatment composition for the simultaneous hydrophobing, softening, filling and retanning of leather, comprising a carboxylic acid or carboxylic anhydride containing polysiloxane, an amphiphilic copolymer, an emulsifier and an oil or wax for the production of washable leathers. In FR-2343049 there is described a method of ‘feeding’ a tanned leather by applying certain epoxy-functional silicones to provide supple, flexible water-resistant leather. Although the prior art does refer to the use of certain silicone based materials in the treatment of leather, their use
concentrates in general on the hydrophobing of the leather and may result in some beneficial additional properties to the leather.

[0012] There is a desire to develop an alternative fatliquoring process which improves the overall benefits to leather and does not require the use of traditional fatliquoring ingredients which often result in fogging problems for example in automotive leather.

SUMMARY OF THE INVENTION

[0013] A process according to the invention for the production of leather comprising tanning hide or skin, neutralizing and retanning the resulting leather, optionally dyeing the retanned leather, lubricating the leather and drying the lubricated leather, is characterised in that the lubricating step is carried out by treating the leather with an emulsion of an organofunctional polysiloxane which contains an organic group substituted by a polar functional group.

[0014] The invention includes the use of an organofunctional polysiloxane emulsion, wherein the organofunctional polysiloxane contains an organic group substituted by a polar functional group, applied as substantially the only lubricating material in the fatliquoring step of leather production or more preferably during the steps of the preparation of the leather hide or skin after tanning up to the point of it being made into a finished product.

[0015] The invention also includes the use of an organofunctional polysiloxane emulsion, wherein the organofunctional polysiloxane contains an organic group substituted by a polar functional group in the fatliquoring step of the treatment of leather for the purpose of reducing the fogging of the finished leather.

DETAILED DESCRIPTION OF THE INVENTION

[0016] The polar functional group can for example be an amino group, a carboxy group, an epoxide group or a hydroxyl or thiol group. Most preferably the organofunctional polysiloxane is an amino-functional polysiloxane. We use the term "amino-functional polysiloxane" to include polysiloxanes in which the amino group may have been further reacted, for example to form amide groups, provided that the >NH group is retained.
[0017] The amino-functional polysiloxane is generally a polydiorganosiloxane containing aminooalkyl groups attached to silicon. The aminooalkyl groups can be terminal groups to the polydiorganosiloxane and/or pendant to the polydiorganosiloxane chain. The amino groups are preferably secondary or primary amino groups and the aminooalkyl groups are preferably of the formula

\[ R-(\text{NH-A'})_q-\text{NH-A}^- \]

wherein A and A' are each independently a linear or branched alkylene group having 1 to 6 carbon atoms; q = 0-4; and R is hydrogen, an alkyl or hydroxyalkyl group having 1 to 4 carbon atoms, or an alkoxyalkyl or carboxyalkyl group having 1 to 4 carbon atoms in the alkyl moiety. If R is a carboxyalkyl group, it is preferably esterified. Most preferably q = 0 or 1; and A and A'(if present) each contain 2 to 4 carbon atoms.

[0018] The groups attached to silicon other than aminooalkyl groups are generally optionally substituted alkyl, aryl or aralkyl groups and are preferably alkyl groups having 1 to 4 carbon atoms, most preferably methyl groups. The polysiloxane is preferably linear but can be branched, for example it can contain branching units such as CH₃SiO₃/₂ units, but such branching units preferably form no more than 5 mole% of the polysiloxane.

[0019] The amino-functional polysiloxane used in the invention can for example be of the formula

\[ R-(\text{NH-A'})_q-\text{NH-A-Si(CH₃)₃-O-(Si(CH₃)₃-O-x-Si(CH₃)₃-A-NH-(A'-NH)_q-R} \]

where A, A', R and q are defined as above and x is for example 4-1000, or may have the formula

\[ \text{Z} \quad \text{Y} \quad \text{Z} \]
\[ \text{XO-((Si-O)_m-Si-O)_n-(Si-O)_m-X} \]
\[ \text{Z'} \quad \text{Z'} \]
\[ \text{A} \]
\[ \text{H-N-(A'-NH)_q-R} \]

where A, A', R and q are defined as above; Y is an optionally substituted alkyl or aryl group;
Z and Z', which can be the same or different, are each an optionally substituted alkyl, aryl or aralkyl group; X is hydrogen or an aliphatic group, preferably an alkyl group having 1 to 30, particularly 6 to 20, carbon atoms, or a triorganosilyl group such as trimethylsilyl; m is for example 4-1000; and n is for example 1-1000, preferably 2-100. The preparation of such amino-functional polysiloxanes is described in WO-A-03/16380.


[0021] The organofunctional polysiloxane can alternatively be a carboxy-functional polysiloxane. The carboxyl functional groups can be on terminal and/or pendant organic groups in the polysiloxane molecule. Preferably, at least some of the carboxyl functional groups are present in free acid or salt form although the carboxyl groups can alternatively be in ester form.

[0022] The organofunctional polysiloxane can be emulsified by mixing with water and an emulsifying agent, such as a nonionic surfactant and/or an ionic surfactant such as an anionic, amphoteric or cationic surfactant. Examples of non-ionic surfactants include polyoxyalkylene alkyl ethers such as polyethylene glycol long chain (9-22C, especially 12-14C) alkyl ether, polyoxyalkylene sorbitan ethers, polyoxyalkylene alkoxylate esters, polyoxyalkylene alkylphenol ethers, ethylene oxide propylene oxide copolymers, polyvinyl alcohol, glyceride esters and alkylpolysaccharides. Examples of anionic surfactants include alkyl sulphates such as lauryl sulphate, polymers such as acrylates/C_{10-30} alkyl acrylate copolymer, (6-20C alkyl) benzenesulphonic acids and salts, the sulphate esters of monoalkyl polyoxyethylene ethers, sulphonated glyceryl esters of fatty acids, and salts of sulphonated monovalent alcohol esters. Examples of cationic surfactants include quaternary ammonium salts such as 8-22C alkyl trimethyl ammonium halides, 8-22C alkyl dimethyl benzyl ammonium halides or di(8-22C alkyl) dimethyl ammonium halides. Examples of suitable amphoteric surfactants include cocoamidopropyl betaine, cocoamidopropyl hydroxysulphate, cocobetaine, sodium cocoamidoacetate, cocodimethyl betaine, N-coco-3-amino butyric acid and imidazolinium carboxyl compounds. The amount of surfactant is generally at least 0.2% by weight based on the amino-functional polysiloxane, preferably at least 0.5%, for example from 2% up to 10 or 20%. The amino-functional polysiloxane
emulsion can alternatively be prepared by emulsion polymerisation.

[0023] The particle size of the organofunctional polysiloxane emulsion is preferably below 5μ, more preferably below 1μ, and most preferably below 500nm, for example it may be in the range 50-400nm. Emulsions of this low particle size are sometimes referred to as microemulsions.

[0024] The concentration of polysiloxane in the emulsion applied to the leather is generally in the range 3 to 50% by weight. Usually emulsions containing 10 to 25% polysiloxane are preferred, but emulsions of higher or lower concentration may be preferred depending on the water content of the leather when the emulsion is applied.

[0025] The process for the production of leather includes at least the steps of tanning hide or skin, neutralizing and retanning the resulting leather, lubricating the leather and drying the lubricated leather. Tanning is preferably chrome tanning with chromium (III) salts, but can alternatively be vegetable tanning, aldehyde tanning, polymer tanning, or synthetic tanning or combinations of tanning chemistries. A post-tanning step can be carried out before neutralisation, for example an acrylic syntan resin used in conjunction with a non-swelling organic acid such as that sold under the Trade Mark ‘Picaltal’. The leather is generally neutralised to adjust the slightly acidic pH to the desired somewhat higher pH, usually by salts having a buffering action, for example sodium formate and/or sodium bicarbonate, optionally used with a weak organic acid. The leather is usually water washed after neutralisation.

[0026] Retanning is usually carried out using mineral tanning agents, particularly chromium (III) salts, vegetable tanning agents, that is plant polyphenols, in the form of the hydrolysable gallotannins or ellagitannins or the condensed, flavonoid tannins, and/or non-chrome synthetic tanning agents or resin tanning agents or polymer tanning agents. In most cases the leather is dyed, and this optional dyeing step can be carried out in conjunction with retanning, either by applying the retanning agent and dye together or by applying the dye after retanning without an intervening wash step, although washing can be carried out at this point if desired. Dyes can be traditional vegetable colouring materials, often in conjunction with a mordant, such as an aluminium (III) salt. They are more typically synthetic dyes, including the following types: anionic, cationic, mordant, 1:1 or 1:2 premetallised, direct or reactive dyes.
The lubricating step is generally carried out after retanning and dyeing. However, the invention is not limited to such order, as the lubricating or fatliquoring step could be carried out at other times or at multiple steps during the treatment of leather. Some washing of the leather is preferably carried out after dyeing and before lubrication, although this is not essential. In the lubricating step according to the invention, the polysiloxane emulsion is preferably applied to the leather at a level of 0.3 to 15% polysiloxane by weight based on the damp shaved weight of the leather, preferably 0.5 to 8%. For example a 15% polysiloxane emulsion may be applied at 4 to 20% based on the damp shaved weight of leather. The polysiloxane preferably comprises at least 60% of the organic chemical content of the emulsion used to lubricate the leather. Most preferably the emulsion simply comprises polysiloxane, water and emulsifying surfactant. In particular the emulsion is preferably substantially free from the fatty triglyceride oils such as vegetable oil or fish oil used in conventional fatliquor.

A lubricating step can also be carried out alternatively or additionally at an earlier stage of leather production, for example as early as the pickling or tanning processes and/or after the neutralization step and before retanning. If two lubricating steps are thus used, it is preferred that both lubricating steps are carried out by treating the leather with an emulsion of an organofunctional polysiloxane which contains an organic group substituted by a polar functional group. The earlier lubricating step may be carried out using a lower level of polysiloxane, for example 0.3% to 5% polysiloxane based on the damp shaved weight of the leather. The total amount of organofunctional polysiloxane applied to the leather (adding both lubricating steps) is preferably 0.5 to 8% polysiloxane based on the damp shaved weight of the leather.

After lubrication, the leather is preferably acidified. An acid such as formic acid can be added following the lubrication step. Following acid treatment, the leather is water washed. A fixative may then be applied to fix the various treating agents on the leather, although this is not essential for the organofunctional polysiloxane. The fixative can for example be an aluminium salt such as aluminium sulphate, or can be chrome powder. The leather can optionally be waterproofed; waterproofing is usually carried out as the final step of the wet end. The waterproofing agent can for example be an organic wax, a silicone polymer such as a polydimethylsiloxane, and/or an organic resin or polymer, such as a partially esterified acrylate resin. The leather is then dried. Finishing agents can then be
applied to the leather, for example agents to increase the oil resistance or hydrophobicity or feel or appearance or abrasion resistance of the leather. Most previous uses of silicones in the leather industry have been as a finishing agent.

[0030] The organofunctional polysiloxanes are effective fatliquors, because they can perform the typical functions required of this aspect of processing, which is to prevent the elements of the fibre structure from sticking, to allow the structure to move easily when distorted placed under stress. The effect additionally is to prevent the leather from being brittle, which is manifested as ease of breaking or tearing, perceived as weakness. The consequence of effective fatliquoring is that the leather is lubricated and softened. The softness, tensile and tear strengths and elongation of the leather produced according to the invention are at least equal to those of leather produced using conventional fatliquors, and in most cases the softness or flexibility of the leather is far superior compared to when they have been treated with conventional fatliquors. The leather produced according to the invention also shows a remarkable and unexpected absence of fogging. Tests revealed that fogging from the polysiloxane lubricated leather is essentially zero. The inventors believe that this may arise from the multiple interactions between the amino-functional polysiloxane and the substrate, causing the polysiloxane to be bound more firmly to the leather than conventional oils, thereby reducing the volatility. The polysiloxanes can have effects both at the surface and within the fibre structure, thereby reducing the requirement for more than one agent. Moreover, applying the polysiloxane emulsion is easier than a conventional fatliquor, because its effect is less dependent on a crucial fixing procedure. This is important, because it lessens the danger of depositing the lubricant on the leather surface, where it is ineffective and damages quality.

[0031] The process of the invention is applicable to all leathers, whether for shoe uppers or other clothing leathers, but is particularly useful for producing leather for upholstery, and especially for producing leather for automotive upholstery and other applications of leather in automobile interiors, where the absence of fogging is a great advantage.

[0032] We have found that the amino-functional polysiloxane emulsions may also confer fire resistance to the leather, particularly to chrome tanned leather. Fire resistance is an important property of materials, especially in upholstery leather applications to public places and environments where fire hazard is acute.
[0033] The invention is further illustrated by the following examples, in which percentages are by weight based on the dry damp shaved weight of leather.

Example 1

[0034] Chrome tanned bovine leather was processed in a commercially conventional way for making upholstery leather, as follows.

Neutralisation: 200% water at 30°C containing 3% Leukotan 1028 (acrylic syntan, ex Rohm and Haas) and 0.5% Picaltal Flakes (non swelling acid, ex BASF)
Run 30 minutes to give pH 3.8
Add 2 % Sellasil NG (retanning agent, ex TFL) and 1% sodium formate
Run 15 minutes
Add 0.8% sodium bicarbonate
Add 3% lubricant. The lubricant in Example 1 was an 18% nonionic emulsion of a trimethylsilyl-endblocked amino-functional polysiloxane containing aminoalkyl groups having both primary and secondary amine groups. Comparative examples were carried out using 3% Truposol ELF (a commercial fatiquor, ex Trumpler, capable of producing leather passing most fogging tests) or no lubricant
Run 30 minutes, check pH 6.1

Drain
Wash with 200% water at 30°C for 15 minutes
Drain
Retan/dye/fatiquor Add 100% water at 30°C containing 8% Basyntan MLB (syntan, ex BASF) and 4% Trupoten MT (modified tara gallotannin, ex Trumpler)
Run 30 minutes
Add 0.5% Invaderm LU (dye levelling agent, ex TFL) and 2.5% blue acid dye
Run 60 minutes
Add 100% water at 50°C containing 9% of the same lubricant as was used in the previous lubrication step
Run 30 minutes
Add 1% formic acid
Run 60 minutes to give pH 3.7

Drain
Wash with 200%
water 60°C for 10 min
Drain
Add 200% water at 60°C containing 0.1% formic acid and 0.3%
aluminium sulphate

Fix
Run 20 minutes

Drain
Dry on Horse
Toggle dry, condition,
then dry while staked

The leather produced in each Example was tested for fogging as follows: a 75mm circle of leather was heated to 80°C and held for 16 hours, when the amount of condensed volatile matter emitted was weighed. An acceptable result is generally less than 4 or 5mg. Tests of fogging do vary and most car manufacturers have their own version of the test, varying the temperature and time of the test, sometimes measuring the effect of the film rather than its weight, but a result of less than 4mg in this test is equivalent to a pass in most tests used. The colour and physical properties of the leather were also measured. The following results were obtained as shown in Table 1.
### Table 1

<table>
<thead>
<tr>
<th>Test</th>
<th>No lubricant</th>
<th>Example 1</th>
<th>Conventional oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fogging (mg)</td>
<td>3.3</td>
<td>&lt;0.1</td>
<td>3.5</td>
</tr>
<tr>
<td>Colour fastness (grey scale)</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Slot tear strength (N)</td>
<td>25 at 1.2mm</td>
<td>35 at 1.3mm</td>
<td>39 at 1.2mm</td>
</tr>
<tr>
<td>Tensile strength (Mpa)</td>
<td>12</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Elongation at break (%)</td>
<td>30</td>
<td>50</td>
<td>56</td>
</tr>
<tr>
<td>Softness gauge (mm)</td>
<td>2.2</td>
<td>3.7</td>
<td>3.4</td>
</tr>
</tbody>
</table>

5 [0036] The colour fastness is measured on a scale of 0 to 5, with being the highest colour fastness. The slot tear strength specified for automotive upholstery is minimum 25N at 1.2mm. The tensile strength specified is minimum 12MPa, and the elongation specified is 35-60%. The softness is measured according to the Official Method of the Society of Leather Technologists and Chemists SLP 37 / IUP 36, and a guideline is 2.7-3.5mm (higher values indicate softer leather.) It can be seen that the polysiloxane causes no detectable fogging. Furthermore, the polysiloxane treated leather is comparable in strength or stronger than the conventionally fatliquored leather, and is also softer.

Examples 2A to 2E

5 [0037] The process of Example 1 was repeated, using five different formulations of amino-functional polysiloxanes (silicones) as the lubricant. The formulations were:

Silicone A: an 18% nonionic emulsion of an amido-functional polysiloxane in which the primary groups of an amino-functional polysiloxane similar to that of Example 1 had been reacted with a lactone.

Silicone B: a 15% nonionic emulsion of a n-propoxy-endblocked amino-functional polysiloxane containing aminoalkyl groups having both primary and secondary amine groups.
Silicone C: a 15% nonionic emulsion of an amido-functional polysiloxane derived from Silicone B

Silicone D: a 15% nonionic emulsion of an ethoxy-endblocked amino-functional polysiloxane containing primary aminoalkyl groups.

Silicone E: a 15% nonionic emulsion of a n-propoxy-endblocked amino-functional polysiloxane containing aminoalkyl groups having both primary and secondary amine groups and of higher molecular weight than Silicone B.

[0038] In Example 2, the leather was milled after staking and the leather properties were measured after milling. The following results were obtained as shown in Table 2

**Table 2**

<table>
<thead>
<tr>
<th>Test</th>
<th>No oil</th>
<th>Conventional oil</th>
<th>Silicone A</th>
<th>Silicone B</th>
<th>Silicone C</th>
<th>Silicone D</th>
<th>Silicone E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fogging (mg)</td>
<td>0.3</td>
<td>3.5</td>
<td>0.5</td>
<td>1.0</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Slot tear (N)</td>
<td>30</td>
<td>40</td>
<td>32</td>
<td>27</td>
<td>36</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Tensile strength (MPa)</td>
<td>12</td>
<td>14</td>
<td>10</td>
<td>18</td>
<td>14</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Elongation at break (%)</td>
<td>44</td>
<td>56</td>
<td>40</td>
<td>52</td>
<td>47</td>
<td>45</td>
<td>44</td>
</tr>
<tr>
<td>Softness (mm)</td>
<td>2.2</td>
<td>3.3</td>
<td>3.8</td>
<td>3.0</td>
<td>2.4</td>
<td>3.5</td>
<td>2.7</td>
</tr>
</tbody>
</table>

[0039] It can be seen that the polysiloxanes caused no detectable fogging or very low fogging, and that the polysiloxane treated leathers were comparable in strength and softness to the conventionally fatliquored leather.
CLAIMS

1. A process for the production of leather from hide or skin, comprising tanning the hide or skin, then neutralizing and retanning the resulting leather, optionally dyeing the retanned leather, lubricating the leather and drying the lubricated leather, characterized in that the lubricating step is carried out by a fatliquoring step in which the treatment of the leather is carried out with an emulsion of an organofunctional polysiloxane which contains an organic group substituted by a polar functional group.

2. A process according to Claim 1 in which the leather is also lubricated at an earlier stage of processing before retanning, characterized in that both lubricating steps are carried out by treating the leather with an emulsion of the organofunctional polysiloxane.

3. A process according to Claim 1 or Claim 2, characterised in that the organofunctional polysiloxane is an amino-functional polysiloxane.

4. A process according to Claim 3, characterized in that the amino-functional polysiloxane contains primary amine groups.

5. A process according to Claim 3 or Claim 4, characterized in that at least some of the amino groups of the amino-functional polysiloxane have been converted to amide groups.

6. A process according to Claim 1 or Claim 2, characterised in that the organofunctional polysiloxane is a carboxy-functional polysiloxane.

7. A process according to any of Claims 1 to 6, characterized in that the emulsion is applied at a level of 0.5 to 15% polysiloxane by weight based on the damp shaved weight of the leather.

8. A process according to any of Claims 1 to 7, characterized in that the polysiloxane comprises at least 60% of the organic chemical content of the emulsion used to lubricate the leather.
9. Use of an organofunctional polysiloxane emulsion, wherein the organofunctional polysiloxane contains an organic group substituted by a polar functional group, applied as substantially the only lubricating material in the fatliquoring step of leather production.

10. Use of an organofunctional polysiloxane emulsion, wherein the organofunctional polysiloxane contains an organic group substituted by a polar functional group, applied as substantially the only lubricating material in the leather production between the tanning step and the use of the leather in the manufacture of a finished product.

11. Use of an organofunctional polysiloxane emulsion, wherein the organofunctional polysiloxane contains an organic group substituted by a polar functional group, applied in the fatliquoring step of leather production for the reduction of the fogging effect of the leather.

12. Leather for use in automotive upholstery, which has been prepared by a process according to anyone of claims 1 to 8.
Application No: GB0511304.8  
Claims searched: 1-12  
Examiner: Vaughan Thomas  
Date of search: 23 September 2005

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

<table>
<thead>
<tr>
<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>1,3-5,9-12</td>
<td>US 6326061 B1 (LAUTENSCHLAGER ET AL.) see col.2 ll.9-15 and col.6 ll.29-47</td>
</tr>
<tr>
<td>X</td>
<td>1,6,9-12</td>
<td>US 6379751 B1 (SCHAEFER ET AL.) see abstract, col.1 ll.5-11 and col.5 l.9 - col.6 l.18</td>
</tr>
<tr>
<td>X</td>
<td>1,6,9-12</td>
<td>US 5702490 A (KNEIP ET AL.) see col.1 l.51 - col.2 l.5, col.2 l.51 - col.3 l.10 and col.3 ll.44-53</td>
</tr>
<tr>
<td>X</td>
<td>1,7,9-12</td>
<td>US 6110230 A (FRIEDRICH ET AL.) see col.2 ll.29-64, col.3 ll.11-40 and col.10 l.61 - col.11 l.14</td>
</tr>
<tr>
<td>X</td>
<td>1,9-12</td>
<td>JP 2002030149 A (SHINETSU CHEM.) see WPI abstract Acc. No. 2002-438360 [47]</td>
</tr>
</tbody>
</table>

Categories:

| X | Document indicating lack of novelty or inventive step |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. & Member of the same patent family |
| A | Document indicating technological background and/or state of the art |
| P | Document published on or after the declared priority date but before the filing date of this invention |
| E | Patent document published on or after, but with priority date earlier than, the filing date of this application |

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC: X

Worldwide search of patent documents classified in the following areas of the IPC: 07
C14C

The following online and other databases have been used in the preparation of this search report:

Online: EPODOC, WPI, BIOSIS, CAS-ONLINE