This invention relates to shoe outsoles, for sport and street wear, which exhibit a resistance to the adherence of foreign material. Certain adherence modifying agents, which help resist the adherence of foreign material, can be either incorporated into materials from which a shoe’s outsole or outer are formed, or applied as a coating thereto.
SELF CLEANING OUTSOLES FOR SHOES

FIELD OF INVENTION

[0001] This invention relates to shoe outsoles, for sport and street wear, which exhibit a resistance to the adherence of foreign material. The present invention relates to coating technology to reduce the adhesion of dirt and foreign material.

[0002] BACKGROUND DESCRIPTION

[0003] A problem with sports shoes in particular is that foreign material, such as dirt and grass, adhere to the outsole. The accumulated effects of this build-up include increased weight, and decreased traction and performance. This is particularly undesirable for players in competition games, though still is a significant problem during casual games or practice. Any player who has spent countless hours cleaning soccer or rugby boots will appreciate any improvement which will reduce cleaning time, or the need for extensive cleaning.

[0004] While this represents a significant problem for players of ball sports (e.g. soccer and rugby, etc.) the problem extends to other areas. For instance, golf is another sport where plant material and dirt adhering to shoes is a problem. This can be particularly a problem in transmitting weeds between different courses. Tramping and hiking boots can also suffer an accumulated build-up of dirt and foreign material, increasing weight, reducing traction, and distributing plant and soil flora and fauna between different environments.

[0005] Biosecurity measures during international travel often target shoes which have been used for hiking, visiting farms, golfing, ball sports etc. Any modifications which improve an outsole's resistance to accumulating soil and plant matter will be of assistance in preparing shoes for international travel.

[0006] Other similar problems appear in farming, and in farm boots (including gumboots and Wellington boots). Farm boots in wet weather tend to accumulate mud, and become very heavy and slippery underfoot. Farm boots also stand in animal dung and other microbiologically active material. Reducing transmission from one area to another can be of great significance. Reducing the amount of mud walked into the farm vehicle would be widely welcomed as well.

[0007] As can be seen, there is a problem in a wide range of fields where undesirable material is spread or transmitted from one area to another by being carried on the soles of shoes. Accordingly there is a need for an effective solution to such problems, such as an outsole which is resistant to the adherence of foreign material.

[0008] The applicant has also investigated various techniques for producing soiling resistant surfaces, and particularly techniques similar to that used by the lotus leaf in nature, and this is the subject of another patent application. The term ‘lotus-effect’ refers to the self-cleaning properties of lotus leaves. When rainwater dropped to the hydrophobic surface of the leaves of a lotus, it forms into water beads due to the effect of surface tension, i.e., the contact angle between the surface of the leaves of the lotus and water will be over 140 degrees, and the water beads will roll away from the leaves when shaking the leaves. Further, rolling water beads carry dust from the surface of the leaves. Therefore, the surface of the leaves is maintained clean and dry after a heavy rain. The chemical structure of the wax crystal is hydrophobic. When water contacts the surface of a lotus leaf, it forms into water beads due to the effect of surface tension. Due to the effect of the fine protruding epidermal cell structure, the contact area between water and the surface of the leaf is minimized and the contact angle between water and the surface of the leaf is maximized, enhancing the effect of hydrophobicity, and lowering the adhesion power of solid matter to the surface of the leaf. The nanometered fine structure also plays an important role in self-cleaning. However, rolling water beads on the hydrophobic smooth surfaces of other plants or man-made products cannot cause water beads to carry solid matter from the surfaces. Lotus leaves become clean and fresh when washed by a heavy rain.

[0009] In related examples United States (US) patent US2001037876 describes an evaporator having a heatable heat exchange surface, which has a self-cleaning micro-structured surface with elevations and depressions. In addition US patent US2000481764 discloses an antisooting hard coated film comprising a substantially transparent substrate, a hard coat layer comprising inorganic oxide particles dispersed in a binder matrix, and an antisooting layer comprising a perfluoropolyether.

[0010] Alternative attempts at achieving this effect on shoe outsoles are cited in Adidas patents DE3351141 and JP8252102. These patents both suggest a mechanical means for achieving this effect.

[0011] Ideally the industry requires effective techniques for reducing the adherence of foreign material on shoe outsoles, and which is ideally relatively easy to implement.

[0012] It is therefore an object of the present invention to provide an improved outsole whose outer surface exhibits a resistance to the adherence of soil or plant matter likely to be encountered during normal use of a shoe.

[0013] At the very least, it is an object of the present invention to provide the public with a useful choice.

[0014] Aspects of the present invention will be described by way of example only and with reference to the ensuing description.

GENERAL DESCRIPTION OF THE INVENTION

[0015] According to one aspect of the present invention there is provided a shoe outsole or outer, at least of a portion of the outer surface of which comprises a resin into which is incorporated at least one adherence modifying component.

[0016] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which an adherence modifying component comprises a member of the group comprising: fluorocarbons, silicones, siloxanes, and polysiloxanes, modified polyacrylates, modified polysiloxanes, and acrylates.

[0017] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which an adherence modifying component comprises a particulate material, the particulate material being of a member of the group comprising: compounds based on PTFE, polyethylene, polypropylene, and hydrophobic fumed silica.

[0018] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which an adherence modifying component comprises a particulate material, the particulate material being of a member of the group comprising: functionally modified PTFE compounds, and functionally modified polyethylenes, functionally modified polypropylenes.

[0019] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as
described above, in which a said particulate material has an average particle diameter within the range of 0.001 nanometres to 100 microns inclusive.

[0020] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which the proportion of adherence modifying component(s) present is based on a loading range of 0.5 to 20% (inclusive) by weight.

[0021] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which the proportion of adherence modifying component(s) present is based on a loading range of 5 to 15% (inclusive) by weight.

[0022] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which an adherence modifying component when incorporated into said resin provides a low surface energy, which is below 50 dynes/cm.

[0023] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which an adherence modifying component when incorporated into said resin provides a low surface energy, which is below 35 dynes/cm.

[0024] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which an adherence modifying component when incorporated into said resin provides a low surface energy, which is below 20 dynes/cm.

[0025] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which said resin comprises a cross-linkable resin, a self-cross-linking resin, or a compatible film-forming binder.

[0026] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which the resin is an acrylic or polyurethane resin.

[0027] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which the resin includes a cross-linking agent.

[0028] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which a resin with adherence modifying component is present as a coating on the outsole or outer.

[0029] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which the resin with adherence modifying component(s) is applied as a coating to an outsole or outer by a method comprising: spraying, dipping, plasma coating, corona discharge, brushing, or rolling.

[0030] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which the coating applied to the outsole or outer is based on a water based solvent system.

[0031] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which the coating applied to the outsole or outer is based on a water based solvent system.

[0032] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which the coating is applied to a thermoplastic outsole or outer.

[0033] According to another aspect of the present invention there is provided a shoe outsole or outer, substantially as described above, in which the outsole, or a portion thereof, is formed of a resin incorporating one or more adherence modifying components.

[0034] According to another aspect of the present invention there is provided a shoe which possessing either or both of an outsole or outer of which at least a portion is substantially as described above.

[0035] According to another aspect of the present invention there is provided a shoe, substantially as described above, which falls into one or more of the following categories: soccer boot, rugby boot, shoe or boot for ball sports, shoe for court sports (e.g. tennis, badminton, etc.), golf shoe, athletic shoe, cross-trainer, sporting shoe, hiking or tramping boot, walking shoe, and climbing shoe.

[0036] According to another aspect of the present invention there is provided a method for modifying the resistance of at least part of an outsole to the adhesion of foreign material, said method comprising the application of a coating on a resin including one or more adherence modifying components to produce an outsole or outer substantially as described above.

Definitions

[0037] The term ‘shoe’ is intended to include ‘boots’ and other footwear within this specification. Sometimes the term ‘boot’ will be used as it may be commonly used within the industry in the context being talked about, but for the purpose of determining the scope of the invention it shall fall within the definition of ‘shoe’—for instance it is common to refer to ‘soccer boots’ rather than ‘soccer shoes’, though ‘soccer boots’ will fall within the definition of a “shoe”. Equally the present invention is equally applicable to business and fashion shoes and boots. Again, for the purpose of determining the scope of this invention, both categories (boots and shoes) will fall within the term ‘shoe’. ‘Sandals’ are also intended to fall within the definition of ‘shoe’.

[0038] The term ‘outsole’ generally applies to the outer sole portion of a shoe, though radical shoe designs may blur where the sole starts and end. Generally this will refer to the sole portion and extensions (into the upper) thereof.

[0039] The term ‘shoe outer’ generally applies to outer portions of a shoe which are not the outsole.

[0040] The present invention relates a soil-resistant and/or self-cleaning outsole or outer for use on shoes. The outsole or outer may be synthetic, of natural products, or a mixture. It is intended that the present invention can be used on a variety of shoes, comprising (for instance) but not restricted to: soccer boots, rugby boots, boots and shoes for ball sports, golf shoes, tramping and hiking shoes and boots, cross-trainers, shoes for court sports, sandals, business and fashion footwear, walking shoes, running shoes, street shoes, gumboots, farm boots, safety boots and shoes, shoes and boots for in clean areas (e.g. food processing, dairy and meat industries, etc.), and shoes for use in biohazard areas. For simplicity of description however, the remaining specification will refer primarily to sports shoes such as soccer boots. It is envisaged that application to other shoes and boots will be readily apparent to the skilled reader in light of the description given herein.

[0041] Improvements according to the present invention can be made according to two primary techniques 1) surface treatment of the outsole or an outer part of the shoe, and 2) additives combined with the raw material of the outsole or shoe’s outer. These will be discussed individually as follows.
For simplicity the description refers to outsoles in particular, though it should be appreciated that coating and surface treatments can also be applied in many cases to other parts of the shoe's outer, and especially the upper (or portions thereof).

1. Surface Treatment of the Outsole Or Outer

[0042] Surface treatment coatings applied to the present invention typically include adherence modifying components, typically low surface energy materials, these components comprising (but not restricted to) fluorocarbons, silicones, siloxanes, polysiloxanes, and particulates. The particulates may, for instance, be waxes based on PTFE, polyethylene, polypropylene, hydrophobic fumed silica, etc. These particles can range in diameter, are not necessarily spherical, and are preferably within an inclusive size range of 0.001 nanometres to 100 microns (average particle diameter). Furthermore, these particulates can be chemically modified to achieve better compatibility and fixation, and consequently performance, e.g. hydroxy functional PTFE. All the materials quoted provide a low surface energy, which preferably should be below 50 dynes/cm, more optimally below 35 dynes/cm and ultimately below 25 dynes/cm in order to gain the desired effect. Combinations of these products are also a possibility, and within the scope of the present invention.

[0043] The surface treatment coating films are formed from a film forming resin, comprising cross-linkable (which include self cross-linking varieties) resins (generally of an acrylic or polyurethane nature), or suitable film-forming binders, having the above mentioned modifying components dispersed therein. Such films appear to exhibit improved anti-soiling characteristics, compared to films from cross-linkable resins that do not contain such materials.

[0044] This is particularly advantageous with regard to outsole and outer surfaces that need to remain free of contamination during use.

[0045] It has been found that 0.5 to 20% (inclusive) is a typical loading range of the adherence modifying component (by weight) within the surface treatment coating, with a range of between 5 to 15% (inclusive) being preferred.

[0046] A process is provided for making a film-forming composition (for use as a surface treatment coating) containing these materials dispersed in a cross-linkable resin. The process comprises adding the material to a medium (generally a film forming resin), being selected from (but not limited to) the group of film forming resins listed above. Then the material(s) and medium are mixed to form a dispersion, which may require high shear mixing with the aid of a suitable auxiliary dispersant. Next this coating composition is applied to the outsole surface (e.g. a TPU (Thermoplastic Polyurethane) resin outsole) by a suitable means of an application method which can control the specific amounts applied. Such equipment may be, but is not limited to, spraying equipment, dipping equipment, plasma coating techniques, corona discharge methods, etc.

[0047] As a result the coating is cured, dependent upon the resin type used, which can include (but is not limited to) moisture curing, heat curing, UV curing, and radiation curing, etc. Furthermore the coating can be reinforced (particularly to gain added hydrolytic stability) by the use of self cross-linking resins or the inclusion of cross linkers such as polyaziridines, polyisocyanates, etc., though may include other cross-linking agents.

[0048] Various solvent systems may be used, and may be chosen to reflect the nature of the substrate to which it is applied. Aqueous based solvent systems and components may be used, and these may be more appropriate for thermoplastic materials.

[0049] Once cured a durable anti-soiling film is formed upon the surface of the outsole. This achieves a hydric complex of resin and material, offering permanent self-cleaning, hydrophobic, oleophobic, and anti-adhesive effects.

2. Additives Combined With the Outsole Or Outer’s Raw Material

[0050] Outsoles (and outer portions) of the present invention can be formed including outsole modifying components, these comprising fluorocarbons, silicones, siloxanes, polysiloxanes, and particulates. The particulates may, for instance, be waxes based on PTFE, polyethylene, polypropylene, hydrophobic fumed silica, etc. These particles can range in diameter, are not necessarily spherical, and are preferably within an inclusive size range of 0.001 nanometres to 100 microns (average particle diameter). Furthermore, these particulates can be chemically modified to achieve better compatibility and fixation, and consequently performance, e.g. hydroxy functional PTFE. All the materials quoted provide a low surface energy, which preferably should be below 50 dynes, more optimally below 35 dynes and ultimately below 25 dynes in order to gain the necessary effect. Combinations of these products are also a possibility.

[0051] An outsole or outer modifying component is mixed with a TPU (Thermoplastic Polyurethane) resin before the moulding process begins. Once the TPU mix is injected into the mould, it will form an equilibrated structure throughout, with substantially permanent anti-soiling properties contained throughout the outsole, and where the effect is constantly replenished with wear. These improved outsoles and outer exhibit improved anti-soiling characteristics, compared to outsoles that do not contain such materials.

[0052] This has the potential to be particularly advantageous with regard to outsole and outer surfaces that need to remain free of contamination during use.

DESCRIPTION OF PREFERRED EMBODIMENT

[0053] With reference to the drawings, and by way of example only, preferred embodiments of the present invention will now be described.

1. Surface Treatment of the Outsole Or Outer

Example 1

[0054] The following formulation is made:

[0055] 78% Solvent based polyurethane

[0056] 10% Solvent based polyisocyanate

[0057] 10% modified acrylate e.g. NLC Additive SS1 (NLC, UK)

[0058] 2% Flow Agent

[0059] The above mixture may require high speed shear stirring to ensure adequate dispersion. Anti-foaming agent may be required and added as necessary.

[0060] The commercial preparation NLC Additive SS1 from NLC (Northants Leather Chemicals) in the UK is correctly described as an OH-functional silicone modified polyacrylate. The product is now marketed as “Norsol AD50” by the same company.

[0061] The mixture is then applied by a spraying, with the application of from 0.05 to 250 g/qt, though more preferably
in the range 7-30 gft⁻² inclusive. This is then heat cured until properly cured. For the preferred coating range, this may be for 3 minutes at a temperature of 125° C., and allowed to cure for a further 48 hours at room temperature before any sort of laboratory testing.

[0062] The outsole can then be applied to the upper. In addition the outsole of completed shoes can also be treated in this manner. Shoe outers (e.g. uppers) may be coated during shoe manufacture or after attachment of the outsole.

Example 2

[0063] The following formulation is made:
- 78% Solvent based polyurethane
- 10% Solvent based polyisocyanate
- 10% Solvent based fluorocarbon e.g. NLC Additive SS3 (NLC, UK)
- 2% Flow Agent

[0065] The above mixture may require high speed shear stirring to ensure adequate dispersion. Anti-fouling agent may be required and added as necessary.

[0069] The mixture is then applied by a spraying, with the application of from 0.05 to 250 gft⁻², though more preferably in the range 7-30 gft⁻² inclusive. This is then heat cured until properly cured. For the preferred coating range, this may be for 3 minutes at a temperature of 125° C., and allowed to cure for a further 48 hours at room temperature before any sort of laboratory testing.

[0070] The outsole can then be applied to the upper. In addition the outsole of completed shoes can also be treated in this manner. Shoe outers (e.g. uppers) may be coated during shoe manufacture or after attachment of the outsole.

2. Additives Combined With The Outsole Raw Material

Example 3

[0071] The following formulation is made:
- 88% TPU resin
- 10%, Hydrophobic fumed silica e.g. NLC Additive SS2 (NLC, UK)
- 2% Dispersing Agent

[0073] The mixture is then injected into an outsole mould for thermoforming.

[0074] The outsole can then be applied to the upper. In addition the outsole of completed shoes can also be treated in this manner. Shoe outers (e.g. uppers) may be coated during shoe manufacture or after attachment of the outsole.

[0077] This technique offers the potentially realisable added benefit of enhanced durability due to the effect being locked within the outsole or outer material and constantly offering benefits as the outsole or outer wears.

[0078] Some outsoles are manufactured from injected portions of different resins/plastics (sometimes visible as areas of different colour). Resins from different areas may be formulated to include additives according to the present invention—they may be also formulated differently from different areas.

[0079] Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the spirit or scope of the present invention as defined in the appended claims.

[0080] It should also be understood that the term “comprise” where used herein is not to be considered to be used in a limiting sense. Accordingly, ‘comprise’ does not represent nor define an exclusive set of items, but includes the possibility of other components and items being added to the list.

[0081] This specification is also based on the understanding of the inventor regarding the prior art. The prior art description should not be regarded as being authoritative disclosure on the true state of the prior art but rather as referencing considerations brought to the mind and attention of the inventor when developing this invention.

1-24. (canceled)

25. A shoe outsole or outer, at least of a portion of the outer surface of which comprises a resin into which is incorporated at least one adherence modifying component which comprises a member of the group comprising: fluorocarbons, silicones, siliconeoxes, and polysiloxanes, modified polycarboxylates, modified polysiloxanes, and acrylates.

26. A shoe outsole or outer, as claimed in claim 25 in which the adherence modifying component comprises an OH-functional silicone modified polycarboxylate.

27. A shoe outsole or outer, as claimed in either claim 1 which includes a particulate material, the particulate material being formed of a member of the group comprising: polytetrafluoroethylene, polyethylene, polypropylene, hydrophobic fumed silica, functionally modified PTFE compounds, functionally modified polyethylenes, and functionally modified polypropylenes.

28. A shoe outsole or outer, as claimed in claim 27, in which a said particulate material has an average particle diameter within the range of 0.001 nanometres to 100 microns inclusive.

29. A shoe outsole or outer, as claimed in claim 25, in which the proportion of adherence modifying component(s) present in the resin is within a loading range of 0.5 to 20% (inclusive) by weight.

30. A shoe outsole or outer, as claimed in claim 25 in which the proportion of adherence modifying component(s) present in the resin is within a loading range of 5 to 15% (inclusive) by weight.

31. A shoe outsole or outer, as claimed in claim 25 in which a said resin with adherence modifying component has a surface energy which is below 50 dynes/cm.

32. A shoe outsole or outer, as claimed in claim 25 in which a said resin with adherence modifying component has a surface energy below 25 dynes/cm.

33. A shoe outsole or outer, as claimed in claim 25 in which said resin comprises at least one of a cross-linkable resin, a self cross-linking resin, and a compatible film-forming binder.

34. A shoe outsole or outer, as claimed in claim 33 in which the resin is an acrylic or polyurethane resin.

35. A shoe outsole or outer, as claimed in claim 34 in which the resin includes a cross-linking agent.

36. A shoe outsole or outer, as claimed in claim 25 in which a said resin with adherence modifying component is present as a coating on the outsole or outer.

37. A shoe outsole or outer, as claimed in claim 36 in which the said resin comprises at least one of a cross-linkable agent.

38. A shoe outsole or outer, as claimed in claim 36 in which the outsole or outer to which the coating is applied is of a TPU (thermoplastic polyurethane).
39. A shoe outsole or outer, as claimed in claim 36 in which the coating applied to the outsole or outer is based on a water based solvent system.

40. A shoe outsole or outer, as claimed in claim 39 in which the coating is applied to a thermoplastic outsole or outer.

41. A shoe outsole or outer, as claimed in claim 25 in which the outsole, or a portion thereof, is formed of a resin incorporating one or more adherence modifying components.

42. A shoe which possessing either or both of an outsole or outer of which at least a portion thereof comprises a shoe outsole or outer as claimed in claim 25.

43. A shoe as claimed in claim 42 which falls into one or more of the following categories: soccer boot, rugby boot, shoe or boot for ball sports, shoe for court sports, golf shoe, athletic shoe, cross-trainer, sporting shoe, hiking or tramping boot, walking shoe, and climbing shoe.

44. A method for modifying the resistance of at least part of an outsole to the adhesion of foreign material, said method comprising the application of a coating of a resin including one or more adherence modifying components to produce an outsole or outer according to claim 25.

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