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(54) **METHOD FOR IMPROVING THE
PERFORMANCE OF FOOTWEAR**

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(57) **ABSTRACT**

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(60) Provisional application No. 61/459,111, filed on Dec.
7, 2010.

A mixture of ester based chemicals applied to shoes for the purpose of improving performance in the normal use of the shoe. The mixture is applied to a surface of the shoes and allowed to penetrate the material forming the surface of the shoe. When applied to the sole of a shoe, the esters in the material will alter bulk properties of the shoe sole to alter the adhesion of the shoe to a traversed surface, the operative life of the shoe, the shoe performance and the shoe hardness. The mixture is especially suited for application to previously manufactured climbing shoes.

METHOD FOR IMPROVING THE PERFORMANCE OF FOOTWEAR

CROSS REFERENCE TO PRIOR CO-PENDING APPLICATION

[0001] This application claims the benefit of prior filed co-pending Provisional Patent Application 61/459,111 filed Dec. 7, 2010.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention is in the technical field of shoes. More particularly, the present invention is in the field of shoes for high performance uses. More particularly, the present invention is in the field of high-performance footwear for use in athletics and/or military applications. More particularly, the present invention is in the technical field of chemical treatments of shoes for climbing and/or use on steeper than horizontal surfaces.

[0004] 2. Description of the Prior Art

[0005] Over the normal lifetime, conventional athletic footwear used for high-performance activities typically suffers performance decline, especially decreases to the coefficient of friction, which reduces the shoe's ability to maintain contact with the surface being traversed due to thinning of the rubber sole from wear, environmental damage to the rubber, and build up of dust, dirt, and grime. Currently, to the best of our knowledge, the only common practices for improving shoe performance post-manufacturing involves 1) cleaning said shoes using a solution of water with or without detergents, 2) vigorous use of brushes made from wire, plastic or stiff animal hair, or 3) to physically heat the sole of the shoe through fire or rubbing the shoe repeatedly. Detergents and cleaners that are currently available leave residues that negatively impact the performance of the footwear based on empirical evidence. Furthermore, applying mechanical and physical force will expose undamaged rubber and remove particulate matter build up but will shorten the usable life of the shoe due to the removal of the rubber from the physical force. Finally, the use of heat or fire results in damage to the rubber and separation of the sole from the rest of the shoe due to reactivation of the glue used to bind the sole to the rest of the shoe.

[0006] This invention will improve footwear performance, especially high performance footwear, both before initial use and throughout the life of the shoe.

[0007] U.S. Pat. No. 7,837,778 discloses a method of applying esters to the surface of automobile or racing tires, such as go kart tires to improve the performance of the tires. The esters applied to these tires will penetrate the tire instead of forming surface films, such as those shown in U.S. Pat. No. 6,949,271 and US Published Patent Application 1008-0241371. A method of producing friction compositions and products is shown in U.S. Pat. No. 5,132,065 which discloses a solvent, paste and liquid resin that forms a coating that does not penetrate the rubber on a railroad brake shoe.

[0008] High performance shoes, such as climbing shoes are shown in U.S. Pat. No. 7,373,738; U.S. Pat. No. 6,470,599; U.S. Pat. No. 5,142,797; U.S. Pat. No. 4,716,663 and U.S. Design Pat. D611,231. A liner that can be placed in Alpine boots and snowboard boots is shown in U.S. Pat. No. 7,314,840. None of these prior art patents discuss a composition that can be applied to a pre-manufactured shoe, such as a climbing shoe to improve the performance of the shoe and prevent or slow degradation of the shoe with use.

SUMMARY OF THE INVENTION

[0009] The present invention is a mixture of monomeric, dimeric, trimeric, tetrameric, quintameric, hexameric and oligomeric esters that are applied to the natural rubber, synthetic rubber or elastomeric (i.e., urethane or other rubber-like substances) surfaces of shoes for the purpose of improving the shoe's performance, including but not limited to sports and athletics. Some examples of the sports where increased shoe or cleat performance can be beneficial, include but are not limited to rock/ice climbing, climbing at gym facilities (e.g., sport climbing), trail running, parkour, free-running, hiking, backpacking, bowling, golf, basketball, baseball, football, and soccer.

[0010] The disclosed invention is wiped onto the shoe's rubber surfaces, allowed to soak into and penetrate the rubber surfaces, and may then be cured for a set period of time. This time is usually from less than a minute to over 20 days.

[0011] The method of improving the performance of a shoe according to this invention includes the step of applying a mixture containing at least one ester to a surface material of the shoe. The ester is then allowed to soak into and penetrate the surface material of the shoe for a cure time to change the bulk properties of surface material to improve the performance of the shoe.

[0012] This method of improving the performance of a climbing shoe is suitable for use in climbing a surface selected from the group consisting of granite, sandstone, silica-cemented quartz, and modular indoor climbing plastic handholds. The performance of an athletic shoe on surfaces including but not limited to grass, false turf (e.g., astroturf), sod, dirt, mud, rocky terrain, asphalt, and roads etc. can also be improved by applying a mixture containing at least one ester to a sole of the athletic shoe before use.

[0013] According to another aspect of this invention the method of improving the performance of a shoe sole formed of an elastomeric material includes the step of applying different esters to alter different bulk properties of the shoe sole, the bulk properties being selected from the group consisting of adhesion of the shoe to a hardened surface, the hardness of the shoe sole, and the operative life of the shoe sole.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Referring now to the invention in more detail, formulations including esters are applied to the shoe to improve the performance of the shoes, especially to improve the athletic and extreme activities' performance of the shoes to which the esters have been applied. It has been found that the application of esters and of formulations containing esters can improve the performance of shoes, especially with regards to the soles of the shoes. It has also been found that the addition of different esters can result in improvement of different shoe performance characteristics. It has also been found that the addition of multiple esters as part of the same formulations can also result in performance enhancements. Furthermore, it has been found that the application of different formulations of esters, in separately applied coats can also be advantageous in improving the performance of shoes.

[0015] This method of treating shoe surfaces and the material forming the shoe surfaces, including but not limited to the natural and/or synthetic rubber soles and/or elastomeric

material, to modify performance includes the steps of: applying at least one ester selected from the group of esters consisting of monoesters, diesters, triesters, tetraesters, ester resins, polyesters, phosphate esters and phosphonate esters to a shoe surface to vary the adhesion or bite or coefficient of friction of the shoe to the traversed surface, and/or the shoe life, and/or the shoe performance and/or the shoe hardness.

[0016] In practicing this method the group members include chemical monomers with a number of ester moieties, including, but not limited to, mono-esters, di-esters, tri-esters, tetra-esters, penta-esters, phosphate esters, and phosphonate esters, as well as oligomers and telomers of ester containing monomers, dimers, trimers, tetramers, pentamers, hexamers, septamers, octomers, and nonamers.

[0017] According to aspects of this method the hydrocarbyl groups can be selected from straight chain, branched chain, aromatic hydrocarbyl groups, or admixtures thereof and may be saturated or unsaturated. The oligomers may be either homomeric or heteromeric in their subunit composition, including but not limited to oligomers of a dimer or trimer subunit. The specific ester moieties include but are not limited to the esters of hydrocarbyl monocarboxylic acid and hydrocarbyl polycarboxylic acid as well as hydrocarbyl monohydroxy alcohol and hydrocarbyl polyols. The specific hydrocarbyl groups are predominately composed of hydrogen and carbon, but may also incorporate select non-metal heteroatoms, including but not limited to nitrogen, oxygen, fluorine, silicon, sulfur, zirconium, and chlorine.

[0018] According to one aspect of this invention, the group member phosphate esters are selected from a group of esters consisting of hydrocarbyl phosphate ester free acids and non-ionic hydrocarbyl phosphate esters.

[0019] The group member phosphonate esters can be selected from a group of esters consisting of hydrocarbyl phosphonate ester free acids, nonionic hydrocarbyl phosphonate esters, hydrocarbyl diphosphonate ester free acids and nonionic hydrocarbyl diphosphonate esters.

[0020] After cleaning and drying the shoe surfaces, at least one ester is applied to the natural and/or synthetic rubber surfaces of the shoe. The ester mixture can be applied to any portion of the shoe that is natural and/or synthetic rubber, including but not limited to the sole, heel, cleats, spikes, tread, heel cup, rand, toe, toe cup, outer edges and inner edges, or any other surface that come into contact with the surfaces in contact with the shoe.

Benefits

[0021] The advantages of the present invention include, without limitation, 1) penetrating and modifying the shoe's sole's composition and structure to improve the short term and long term performance of the shoe on all surfaces being traversed including those steeper than horizontal, 2) improving performance without a thick coating on the shoe which may impact the users ability to feel the surfaces in contact with the shoe, 3) restoring usable life to the rubber surfaces of the shoe without physically or mechanically removing the rubber, 4) more thoroughly and easily cleaning the shoe, and keeping the shoe clean of dust, soil and grime, after application of the invention, for a longer period of time than currently available products and methods.

[0022] When applied to a surface of the shoe, the different esters employed herein will change A) the coefficient of friction (or adhesion), B) softness (or hardness), and/or C) the ability to resist particulate matter, such as dust, adhering to the shoe. The coefficient of friction (or adhesion) and the softness (or hardness) are structural properties of the natural

and/or synthetic rubber components and are at least in part bulk properties of the natural and/or synthetic rubber portions of the shoe. These structural changes would not occur if the formulations merely formed films on the surface of the shoe. To effect these bulk structural changes the ester or esters employed herein penetrate the natural and/or synthetic rubber surfaces. Based on empirical evidence we have observed that monomeric, oligomeric, or polymeric esters will penetrate and soak into the rubber but that monomeric and oligomeric esters penetrate exponentially faster on the order of minutes to hours. We hypothesize that this is due to the smaller size and free range of motion of the monomers and oligomers as compared to the polymers.

[0023] More specifically, the coefficient of friction is defined as the ratio of the force that maintains contact between a surface and an object and the frictional force that resists the motion of the same object. The softness (or hardness) of the shoe's sole is defined more specifically as the ability of the shoe's sole to deform to fit the shape of the surface in contact with the shoe so as to provide greater surface area for contact. Finally, any dust, soil, and other particulate matter that clings to the sole of the shoe and undermines the coefficient of friction are detrimental to the shoe's performance. Such dust includes but is not limited to, soil, soot, organic matter, rock dust, and powders that are used to absorb sweat such as chalk, calcium carbonate, magnesium carbonate, or talcum powder.

[0024] Secondly, besides improving the performance characteristics of a shoe, it is important that a shoe maximizes the shoe user's ability to feel tactile feedback from the surface being traversed. For example, the tactile feedback that rock provides to a climber or that trails provide to hikers can be vitally important especially in low-visibility and/or high-risk situations such as extreme environmental conditions. Similarly, it is important that any performance modifications to a shoe do not reduce the tactile feedback to the end-user. Coatings increase the thickness of the sole and/or add additional materials through which a user will have to try to receive tactile feedback which will lead to trade-offs between frictional performance and end-user responsiveness.

[0025] Thirdly, by changing the structural and bulk properties of a shoe's natural and/or synthetic rubber materials, the invention can restore usable-life to damaged shoes. Additionally, since this does not involve physical and/or mechanical force, this will not remove the rubber from the shoe, which would correspondingly, reduce the usable life of the shoe.

[0026] Fourthly, select formulations of chemicals that fall under the categories described in this invention can be specifically used for the cleaning of natural and/or synthetic rubber materials. These formulations are designed so as to remove dust, dirt, grime, and other particulate matter from the shoe without removing the synthetic oils and other chemicals that enhance the natural and/or synthetic rubber materials performance, such as coefficient of friction.

[0027] Furthermore, while the changes to the natural rubber, synthetic rubber, or other elastomeric components begin immediately upon application, performance continues to improve for approximately three weeks after a single application. Repeated application can show improvements up to two to three months post application, after which performance will plateau. For example, approximately 5 minutes after application we have observed that rubber hardness can drop 0-2 point as measured by standard Rex Gauge (model 1000) durometer=>A scale shore hardness. Approximately

one month after final application durometer readings showed a 0-5 point drop in hardness, while six months post-application, we have observed 0-3 points drop in rubber hardness. When testing for dynamic coefficient of friction using pin-on-disk tribometry according to ASTM G99 standards, we observed a 24% higher coefficient of friction for samples treated with the described invention versus untreated samples. Samples that were treated with commercially available cleaners had dynamic coefficients of friction that were 60-90% below invention treated samples, and 40-60% lower than untreated samples.

EXAMPLES

[0028] The following examples demonstrate improvements that have been demonstrated by the application of specific formulations.

Example No. 1

Cleaning Formulation and Method

[0029] This method is also used to clean shoes. This composition or formulation is a water based cleaner that is used to clean shoes that either are to be treated with another shoe treatment or will subsequently be treated. This composition will improve the way in which other shoe treatments are absorbed, because the surface of the shoe will be cleaner. This method employs the following formulation.

	Percentage by Weight
DOWANOL DPM-SOLVENT ETHER DPM	3.00000
DOWANOL PnP	5.00000
DOSS 70%	1.00000
STEOL CS_460	0.50000
WATER	85.50000
ETHYLENE GLYCOL DIACETATE	1.00000
DIBASIC ESTER	3.00000
F3700	0.50000
4500 MW POLYACRYLATE Na SALT	0.50000
** Total Percentage **	100.00000

DPM:	DIPROPYLENE GLYCOL MONOMETHYL ETHER (CAS No: 34590_94_8)
SYN:	DIPROPOXYMETHANOL, DPM, DIPROPYLENE GLYCOL METHYL ETHER, DPGME
PnP:	PROPOXYLATED n-PROPANOL (CAS No: 1569_01_3)
SYN:	DOWANOL PnP, PROPYLENE GLYCOL n-PROPYL ETHER, PGnPE
DOSS:	DIOCTYL SULFOSUCCINATE 70% (CAS No. 577_11_7)
SYN:	DIOCTYL SULFOSUCCINATE SODIUM SALT, DIOCTYL SODIUM SULFOSUCCINATE
CS-460:	SODIUM LAURETH SULFATE (CAS No. 9004_82_4)
SYN:	ALCOHOL ETHOXYLATE SULFATE SODIUM SALT, SODIUM POE LAURYL SULFATE POE n > 3
WATER (CAS No. 7732_18_5) SYN:	H ₂ O ETHYLENE GLYCOL DIACETATE (CAS No. 111_55_7)
SYN:	1,2-DIACETOXYETHANE, 1,2-ETHANEDIOL DIACETATE, ETHYLENE GLYCOL ACETATE, APTEX DONOR H_Plus

-continued

DBE—DIBASIC ESTER - INVISTA's NAME FOR BLEND OF:	DIMETHYL GLUTARATE (CAS No: 1119_40_0) DIMETHYL ADIPATE (CAS No: 627_93_0) DIMETHYL SUCCINATE (CAS No: 106_65_0)
F3700:	MITSUBISHI IDENTIFIER FOR AMBIENT CURE PERFLUORO ALKYL ACRYLATE DISPERSION IN WATER (CAS No. PROPRIETARY)
454N:	4500 MW POLYACRYLATE Na SALT (CAS No. 9003_04_7)
SYN:	SODIUM POLYACRYLATE

[0030] This composition is water soluble and can be sprayed liberally on and removed with a rag to clean shoes that have been used on dirt. This composition can be sprayed liberally on the shoe, which is allowed to sit for 30 seconds to 5 minutes, and not more than 10 minutes. If the composition has been allowed to dry, and additional layer should be sprayed on the shoe surface. The composition is wiped off with a rag, preferably in the form of a dry terry cloth towel. The shoe should then be allowed to dry completely before another shoe treatment is applied. This method can be used to clean shoes in conjunction with or prior to use the methods for treating shoes, including the examples subsequently described herein.

Example No. 2

Diisononyl Cyclohexanoate

[0031]

Dipropoxylated Methanol	0.00%
Diisononyl Cyclohexanoate	100.00%

[0032] This formulation consists of esters which contain zero Volatile Organic Chemicals (VOC). A benefit of formulations with zero VOC is that the ester is completely absorbed and modifies the stretch and recovery of the shoe in hot weather. This allows for greater bite when making quick changes in direction, when compared to an untreated shoe.

[0033] In addition to use as a single component ester, the solvent can range from 97% down to 0.00% depending on the type of surface that the shoe is used on, environmental and other conditions and shoe chosen, and the ester can range from 100% down to 3% depending on the type of surface that the shoe is used on, conditions and shoe chosen. Different conditions will allow for varied ratios of solvent to ester and type of solvent to type of ester, and will result in different performance characteristics that can match the conditions of the surface that the shoe is used on.

[0034] One specific example of the use of a specific combination of the use of Diisononyl Cyclohexanoate with a solvent is as follows:

Dipropoxylated Methanol	90.00%
Diisononyl Cyclohexanoate	10.00%

[0035] This mixture can be wiped or rolled on the outside of a shoe approximately 20 to 30 minutes prior to use, such as running a race. The benefit of this combination is that it allows use of a low toxicity solvent and an oily ester that is rapidly absorbed into the surface of the shoe (i.e., tread, sole, cleats, etc.) to give additional short term modification of the dynamic coefficient of friction that allows for the chemical to substitute for the thermal energy obtained from the actual use of the shoe.

Example No. 3

[0036] This method will decrease the hardness of shoes, at room temperature, between 0 and 5 points, depending on the number of coats applied, and is used after shoes are cleaned with the formulation of Example No. 1 This method employs the following formulation

	Percentage by Weight
ISOPAR G	59.50000
BUTYL BENZOATE	3.00000
DIOCTYL SEBACATE	9.50000
2_ETHYLHEXYL BENZOATE	11.00000
TRIBUTOXYETHYL PHOSPHATE	9.50000
SOLVENT FLUOROALKYL ACRYLATE	5.00000
RESIN	
d-LIMONENE	2.50000
** Total Percentage **	100.00000
ISOPAR G:	SYNTHETIC ISOPARAFFINIC HYDROCARBON (CAS No: 64742_48_9)
SYN:	BRANCHED ALIPHATIC HYDROCARBON
BB:	BUTYL BENZOATE (CAS No: 136_60_7)
SYN:	BUTYL BENZOATE, n-BUTYL BENZOATE, BENZOIC ACID n-BUTYL ESTER, BENZOIC ACID BUTYL ESTER
DOS:	DIOCTYL SEBACATE (CAS No: 122_62_3)
SYN:	OCTYL SEBACATE, BIS(2_ETHYLHEXYL)SEBACATE, DOS, DEHS, SEBACIC ACID, BIS(2_ETHYLHEXYL) ESTER, DECANEDIOIC ACID, BIS(2_ETHYLHEXYL) ESTER
SYN:	2_ETHYLHEXYL BENZOATE (CAS No: 5444_75_7)
SYN:	OCTYL BENZOATE, 2EH BENZOATE, BENZOIC ACID 2-ETHYLHEXYL ESTER
TBEP:	TRIBUTOXYETHYL PHOSPHATE (CAS No: 78_51_3)
SYN:	TRIBUTOXYETHYL PHOSPHATE, TRI(2_BUTOXYETHYL)PHOSPHATE, 2_BUTOXYETHANOL PHOSPHATE, TBEP, TRIBUTYL CELLOSOLVE PHOSPHATE, PHOSPHORIC ACID TRIS(BUTOXYETHYL)ESTER, TRI(BUTOXYETHYL)PHOSPHATE
F611	MITSUBISHI IDENTIFIER FOR AMBIENT CURE SOLVENT SOLUBLE FLUOROALKYL ACRYLATE RESIN (CAS No. PROPRIETARY)
SYN:	FLUOROACRYLATE COPOLYMER RESIN - SOLVENT SOLUBLE
d-LIMONENE:	(CAS No: 8028-48-6)
SYN:	ORANGE TERPENE, TERPENE HYDROCARBON, ORANGE RIND STEAM DISTILLATE

[0037] On average the hardness is dropped by 2 points when this formulation is employed. This formulation is used to provide dirt repellent when running on dirt, but it can also be used on asphalt or granite. A single thin coat is sufficient for most circumstances, but it should be allowed to dry fully for the most benefit. This formulation can be used as a base

coat applied approximately 3 days before the shoe is used. A spray bottle, sponge, cloth, or some other applicator can be used to completely coat the shoe's rubber surfaces with one or two coats. This formulation works on both natural or synthetic rubber shoes.

Example No. 4

[0038] This method is used to prepare shoes for wet or soft dirt surfaces, but is not suited for use on cold, dry, or slick surfaces. This method employs the following formulation:

	Percentage by Weight
DIBASIC ESTER	5.00000
BUTYL BENZOATE	15.00000
METHYL BENZOATE	40.00000
SOY METHYL ESTER	35.00000
BUTYL CELLOSOLVE BENZOATE	5.00000
** Total Percentage**	100.00000
DBE—DIBASIC ESTER -	DIMETHYL GLUTARATE
INVISTA's NAME	(CAS No: 1119_40_0)
FOR BLEND OF:	DIMETHYL ADIPATE (CAS No: 627_93_0)
	DIMETHYL SUCCINATE (CAS No: 106_65_0)
BB:	BUTYL BENZOATE (CAS No: 136_60_7)
SYN:	BUTYL BENZOATE, n-BUTYL BENZOATE, BENZOIC ACID n-BUTYL ESTER, BENZOIC ACID BUTYL ESTER
MB	METHYL BENZOATE (CAS No: 93_58_3)
SYN:	MB, BENZOIC ACID METHYL ESTER, BENZOIC ACID ESTER of METHANOL, NIOBE OIL
SOY METHYL ESTER	FATTY ACID METHYL ESTER (CAS No. 67784_80_9)
SYN:	C14-C24 METHYL ESTER, FATTY ACID METHYL ESTER, SOYA METHYL ESTER, METHYL SOYATE
BCB	BUTYL CELLOSOLVE BENZOATE (CAS No: 5451_76_3)
SYN:	BUTOXYETHYL BENZOATE, ETHYLENE GLYCOL MONOBUTYL BENZOATE, BENZOIC ACID BUTYL CELLOSOLVE ESTER

[0039] This formulation can be used after cleaning the shoes with the formulation of Example No. 1. It has been empirically observed that the hardness of natural rubber shoes, at room temperature, will drop between 5 to 20 points, depending on the number of coats applied. The reduction in hardness is permanent. Five days before use, a spray bottle, sponge, cloth, or other applicator should be used to cover the shoe's rubber surfaces with two or more coats. Each coat should be allowed to dry before applying the next coat, or approximately 10 to 20 minutes between coats. The next day the same process should be repeated, and the process can be again repeated after another 24 hours. This process can improve the length of usable life for shoes made with natural rubber. It has been empirically observed that this formulation should not be used on synthetic rubbers as they do not maintain improved coefficient of friction for longer than 2-3 weeks.

Example No. 5

[0040] This method uses a formulation that will provide extra tackiness or stickiness to the shoe's rubber surfaces under cold conditions. This method employs the following formulation:

Percentage by Weight	
ISOPAR G	27.00000
SOY METHYL ESTER	9.00000
METHYL BENZOATE	9.00000
DIBASIC ESTER	6.00000
DIBUTYL MALEATE	10.00000
BUTYL BENZOATE	10.00000
BUTYL CELLOSOLVE BENZOATE	10.00000
2-ETHYLHEXYL BENZOATE	9.00000
d-LIMONENE	10.00000
** Total Percentage **	
100.00000	

ISOPAR G:	SYNTHETIC ISOPARAFFINIC HYDROCARBON (CAS No: 64742_48_9)
SYN:	BRANCHED ALIPHATIC HYDROCARBON
	SOY METHYL ESTER
	FATTY ACID METHYL ESTER (CAS No. 67784_80_9)
SYN:	C14-C24 METHYL
	ESTER, FATTY ACID METHYL ESTER,
	SOYA METHYL ESTER, METHYL
	SOYATE
	MB
	METHYL BENZOATE (CAS No: 93_58_3)
SYN:	MB, BENZOIC ACID METHYL
	ESTER, BENZOIC ACID ESTER of
	METHANOL, NIOBE OIL
DBE—DIBASIC	DIMETHYL GLUTARATE (CAS No:
ESTER -	1119_40_0)
INVISTA's NAME	DIMETHYL ADIPATE (CAS No: 627_93_0)
FOR BLEND OF:	DIMETHYL SUCCINATE (CAS No: 106_65_0)
DBM:	DIBUTYL MALEATE (CAS No: 105_76_0)
SYN:	2_BUTENEDIOIC ACID DIBUTYL
	ESTER, BUTYL MALEATE, MALEIC ACID
	DIBUTYL ESTER
	BUTYL BENZOATE (CAS No: 136_60_7)
SYN:	BUTYL BENZOATE, n_BUTYL
	BENZOATE, BENZOIC ACID n_BUTYL ESTER,
	BENZOIC ACID BUTYL ESTER
	BCB
	BUTYL CELLOSOLVE BENZOATE (CAS No:
	5451_76_3)
SYN:	BUTOXYETHYL BENZOATE,
	ETHYLENE GLYCOL
	MONOBUTYL BENZOATE,
	BENZOIC ACID BUTYL CELLOSOLVE ESTER
	2_ETHYLHEXYL BENZOATE (CAS No:
	5444_75_7)
SYN:	OCTYL BENZOATE, 2EH BENZOATE,
	BENZOIC ACID 2-ETHYLHEXYL ESTER
	d-LIMONENE: (CAS No: 8028-48-6)
SYN:	ORANGE TERPENE,
	TERPENE HYDROCARBON,
	ORANGE RIND STEAM
	DISTILLATE

[0041] This formulation and method will drop the hardness of the shoe's rubber pieces at room temperature, between 10 and 30 points, depending on the number of coats employed. Five days before use, a spray bottle, sponge, cloth or other applicator should be used to cover the shoe's rubber surfaces with three or more coats. Each coat is allowed to dry for about 10 to 20 minutes before applying the next coat. These steps should be repeated the next day and optionally on a third day to maximize the drop in hardness. Twenty four hours before

shoe use, these steps can be repeated to provide additional grip to the shoes. This method is suited for use with natural and synthetic rubber shoes.

Example No. 6

[0042] This method is best suited for use after a local rainy season is over, but before the full heat of summer has begun, and has been shown to drop the hardness of a shoe, at room temperature, between 3-25 points with the average being 10 points. This method employs the following formulation.

Percentage by Weight	
DIBASIC ESTER	58.00000
DIBUTYL MALEATE	10.00000
2_ETHYLHEXYL BENZOATE	17.00000
DIOCTYL SEBACATE	15.00000
** Total Percentage **	
100.00000	

DBE—DIBASIC ESTER -	DIMETHYL GLUTARATE
INVISTA's NAME	(CAS No: 1119_40_0)
FOR BLEND OF:	DIMETHYL ADIPATE
	(CAS No: 627_93_0)
	DIMETHYL SUCCINATE
	(CAS No: 106_65_0)
DBM:	DIBUTYL MALEATE
	(CAS No: 105_76_0)
SYN:	2_BUTENEDIOIC ACID DIBUTYL
	ESTER, BUTYL MALEATE, MALEIC
	ACID DIBUTYL ESTER
2_ETHYLHEXYL	OCTYL BENZOATE, 2EH
BENZOATE (CAS No:	BENZOATE, BENZOIC ACID
5444_75_7) SYN:	2-ETHYLHEXANOL ESTER
DOS:	DIOCTYL SEBACATE
	(CAS No: 122_62_3)
SYN:	OCTYL SEBACATE,
	BIS(2_ETHYLHEXYL)SEBACATE, DOS,
	DEHS, SEBACIC ACID
	BIS(2_ETHYLHEXYL) ESTER,
	DECANEDIOIC ACID
	BIS(2_ETHYLHEXYL) ESTER

[0043] Five days before use, a spray bottle, sponge, cloth, or other applicator should be used to cover the shoe's rubber surfaces with two or more coats. Each coat is allowed to dry before applying the next coat. The process steps for this method are the same as for Example No. 4.

Example No. 7

[0044] This process is suited for use on asphalt, such as road running or outdoor basketball shoes. It will drop the hardness of a shoe, at room temperature, between 5 to 25 points, depending on the number of coats. This method employs the following formulation.

Percentage by Weight	
ISOPAR G	61.50000
DIBASIC ESTER	11.00000
DIBUTYL MALEATE	11.00000
DIOCTYL SEBACATE	11.00000
d-LIMONENE	5.50000
** Total Percentage **	
100.00000.	

-continued

ISOPAR G:	SYNTHETIC ISOPARAFFINIC HYDROCARBON (CAS No: 64742_48_9)
SYN:	BRANCHED ALIPHATIC HYDROCARBON
DBE:	DIMETHYL GLUTARATE
DBE—DIBASIC ESTER - INVISTA's NAME FOR BLEND OF:	(CAS No: 1119_40_0) DIMETHYL ADIPATE (CAS No: 627_93_0) DIMETHYL SUCCINATE (CAS No: 106_65_0)
DOS:	DIOCTYL SEBACATE (CAS No: 122_62_3)
SYN:	OCTYL SEBACATE, BIS(2_ETHYLHEXYL)SEBACATE, DOS, DEHS, SEBACIC ACID BIS(2_ETHYLHEXYL) ESTER, DECANEDIOIC ACID BIS(2_ETHYLHEXYL) ESTER (CAS No: 8028-48-6)
d-LIMONENE:	ORANGE TERPENE,
SYN:	TERPENE HYDROCARBON, ORANGE RIND STEAM DISTILLATE

[0045] Five days before use, apply this formulation such that it completely covers the shoe's rubber surfaces with 2 or more coats. Allow to dry between coats and repeat the next day. This formulation can be used immediately prior to shoe use if allowed to dry.

Example No. 8

[0046] This method is suited for use on dirt, especially hot, dusty surfaces. The hardness will be reduced between 0 to 5 points, with the average being 2 points. This method employs the following formulation

	Percentage by Weight
DIBASIC ESTER	63.00000
DIOCTYL SEBACATE	23.00000
CYCLIC OLIGOMER PHOSPHONATE	6.00000
TRIBUTOXYETHYL PHOSPHATE	7.00000
** Total Percentage **	100.00000
DBE:	DIMETHYL GLUTARATE
DBE—DIBASIC ESTER - INVISTA's NAME FOR BLEND OF:	(CAS No: 1119_40_0) DIMETHYL ADIPATE (CAS No: 627_93_0) DIMETHYL SUCCINATE (CAS No: 106_65_0)
DOS:	DIOCTYL SEBACATE (CAS No: 122_62_3)
SYN:	OCTYL SEBACATE, BIS(2_ETHYLHEXYL)SEBACATE, DOS, DEHS, SEBACIC ACID BIS(2_ETHYLHEXYL) ESTER, DECANEDIOIC ACID BIS(2_ETHYLHEXYL) ESTER (CAS No: 41203-81-0 and 42595-45-9)
CYCLIC OLIGOMERIC PHOSPHONATE TBEP:	TRIBUTOXYETHYL PHOSPHATE (CAS No: 78_51_3)
SYN:	TRIBUTOXYETHYL PHOSPHATE, TRI(BUTOXYETHYL)PHOSPHATE, 2_BUTOXYETHANOL PHOSPHATE, TBEP, PHOSPHORIC ACID TRIS(BUTOXYETHYL)ESTER, TRI(2_BUTOXYETHYL)PHOSPHATE, TRIBUTYL CELLOSOLVE PHOSPHATE

[0047] On the first night apply 2 to 4 coats to the shoe's rubber surfaces. Allow 1-2 hours for drying between coats. Shoes should be stored for eight to ten days after the formulation is applied to allow time for curing of the rubber. This formulation will not appreciably soften the shoe, but will give it excellent bite. When used, dilute this formulation with Naphtha VM &P using 3 parts Naphtha VM &P to one part of this formulation. The formulation can be diluted as much as 1 part in 10 and will still be effective.

Example No. 9

[0048] This method is intended for use when the temperature falls below 50 degrees F. This method employs the following formulation:

	Percentage by Weight
d-LIMONENE	28.00000
AROMATIC 150 ND	10.00000
PROPOXYMETHYL ACETATE	30.00000
SOY METHYL ESTER	9.00000
DIBUTYL MALEATE	9.00000
BUTYL BENZOATE	9.00000
DIBASIC ESTER	3.00000
CYCLIC OLIGOMER PHOSPHONATE	0.50000
DIOCTYL SEBACATE	1.00000
TRIBUTOXYETHYL PHOSPHATE	0.50000
** Total Percentage **	100.00000
d-LIMONENE:	(CAS No: 8028-48-6)
SYN:	ORANGE TERPENE, TERPENE HYDROCARBON, ORANGE RIND STEAM DISTILLATE
AROMATIC 150 ND (CAS No. 64742-94-5)	AROMATIC 150 NAPHTHALENE DEPLETED, HEAVY AROMATIC NAPHTHA NAPHTHALENE DEPLETED
SYN:	DEPLETED
PMA:	PROPYLENE GLYCOL MONOMETHYL ETHER ACETATE (CAS No: 108-65-6)
SYN:	PROPOXYMETHYL ACETATE, PMA, PGMEA, METHYL PARASOL ACETATE
SOY METHYL ESTER	FATTY ACID METHYL ESTER (CAS No. 67784_80_9)
SYN:	C14-C24 METHYL ESTER, FATTY ACID METHYL ESTER, SOYA METHYL ESTER, METHYL SOYATE
DBM:	DIBUTYL MALEATE (CAS No: 105_76_0)
SYN:	2_BUTENEDIOIC ACID DIBUTYL ESTER, BUTYL MALEATE, MALEIC ACID DIBUTYL ESTER
BB:	BUTYL BENZOATE (CAS No: 136_60_7)
SYN:	BUTYL BENZOATE, n_BUTYL BENZOATE, BENZOIC ACID n_BUTYL ESTER, BENZOIC ACID BUTYL ESTER
DBE:	DIMETHYL GLUTARATE
DBE—DIBASIC ESTER's NAME FOR BLEND OF:	(CAS No: 1119_40_0) DIMETHYL ADIPATE (CAS No: 627_93_0) DIMETHYL SUCCINATE (CAS No: 106_65_0)
CYCLIC OLIGOMERIC PHOSPHONATE	(CAS No. 41203-81-0 and 42595-45-9)

-continued	
DOS:	DIOCTYL SEBACATE (CAS No: 122_62_3)
SYN:	OCTYL SEBACATE, BIS(2_ETHYLHEXYL)SEBACATE, DOS, DEHS, SEBACIC ACID BIS(2_ETHYLHEXYL) ESTER, DECANEDIOIC ACID BIS(2_ETHYLHEXYL) ESTER
TBEP:	TRIBUTOXYETHYL PHOSPHATE (CAS No: 78_51_3)
SYN:	TRIBUTOXYETHYL PHOSPHATE, TRI(BUTOXYETHYL)PHOSPHATE, 2_BUTOXYETHANOL PHOSPHATE, TBEP, PHOSPHORIC ACID TRIS(BUTOXYETHYL)ESTER, TRI(2_BUTOXYETHYL)PHOSPHATE, TRIBUTYL CELLOSOLVE PHOSPHATE

[0049] This formulation works well when the formulation of Example No. 5 is used as a base treatment. At 40 degrees F., it takes about 15 minutes to dry, but at 65 degrees F. 3 or 4 coats can be applied in less than 20 minutes.

Example No. 10

[0050] This method provides increases the coefficient of friction between the shoes and a surface, without softening the shoe. This formulation can be used as a pretreatment in the same manner as in the method of Example No. 8. The formulation used in this method is as follows:

Percentage by Weight	
DIBASIC ESTER	39.00000
PROPOXYMETHYL ACETATE	5.00000
DIPROPOXYMETHANOL	5.00000
DIOCTYL SEBACATE	14.50000
CYCLIC OLIGOMER PHOSPHONATE	3.20000
TRIBUTOXYETHYL PHOSPHATE	2.50000
BUTYL BENZOATE	1.50000
DIBUTYL MALEATE	2.00000
ISOPAR G	25.30000
TEXANOL	2.00000
** Total Percentage **	
	100.0000

DBE:	DIMETHYL GLUTARATE (CAS No: 1119_40_0)
DBE—DIBASIC ESTER - INVISTA's NAME FOR BLEND OF:	DIMETHYL ADIPATE (CAS No: 627_93_0) DIMETHYL SUCCINATE (CAS No: 106_65_0)
PMA:	PROPYLENE GLYCOL MONOMETHYL ETHER ACETATE (CAS No: 108-65-6)
SYN:	PROPOXYMETHYL ACETATE, PMA, PGMEA, METHYL PARASOL ACETATE
DPM:	DIPROPYLENE GLYCOL MONOMETHYL ETHER (CAS No: 34590_94_8)
SYN:	DIPROPOXYMETHANOL, DPM, DIPROPYLENE GLYCOL METHYL ETHER, DPGME
DOS:	DIOCTYL SEBACATE (CAS No: 122_62_3)
SYN:	OCTYL SEBACATE, BIS(2_ETHYLHEXYL)SEBACATE, DOS, DEHS, SEBACIC ACID BIS(2_ETHYLHEXYL) ESTER, DECANEDIOIC ACID BIS(2_ETHYLHEXYL) ESTER

-continued	
CYCLIC OLIGOMERIC PHOSPHONATE	(CAS No. 41203-81-0 and 42595-45-9)
TBEP:	TRIBUTOXYETHYL PHOSPHATE (CAS No: 78_51_3)
SYN:	TRIBUTOXYETHYL PHOSPHATE, TRI(BUTOXYETHYL)PHOSPHATE, 2_BUTOXYETHANOL PHOSPHATE, TBEP, PHOSPHORIC ACID TRIS(BUTOXYETHYL)ESTER, TRI(2_BUTOXYETHYL)PHOSPHATE, TRIBUTYL CELLOSOLVE PHOSPHATE
BB:	BUTYL BENZOATE (CAS No: 136_60_7)
SYN:	BUTYL BENZOATE, n_BUTYL BENZOATE, BENZOIC ACID n_BUTYL ESTER, BENZOIC ACID BUTYL ESTER
DBM:	DIBUTYL MALEATE (CAS No: 105_76_0)
SYN:	2_BUTENEDIOIC ACID DIBUTYL ESTER, BUTYL MALEATE, MALEIC ACID DIBUTYL ESTER
ISOPAR G:	SYNTHETIC ISOPARAFFINIC HYDROCARBON (CAS No: 64742_48_9)
SYN:	BRANCHED ALIPHATIC HYDROCARBON
TEXANOL	2,2,4_TRIMETHYL_1,3_PENTANEDIOL MONOISOBUTYRATE (CAS No: 25265_77_4)
SYN:	PROPIONIC ACID, 2_METHYL_, MONOESTER WITH 2,2,4_TRIMETHYL_1,3_PENTANEDIOL, ISOBUTYRIC ACID ESTER WITH 2,2,4_TRIMETHYL_1,3_PENTANEDIOL

[0051] It should be understood that the precise percentages of the components for each of these representative formulations is in general not critical. Changes in the concentrations of specific esters can result in similar performance. It is rather the selection of the esters and subsidiary components and their resulting effect on such parameters as hardness, adhesion, bite and cleaning that is significant.

[0052] The formulations employed in Examples 2-10, while applied to a natural and/or synthetic rubber surface of the shoe are in a form which will allow the ester or esters to penetrate the shoe over time to change structural properties of the shoe and are not limited to forming films on the surface of the shoe for the purpose of merely improving the appearance, such as commercially available shoe shines. The esters in these formulations are small enough to penetrate the voids created in by the polymer strands forming the shoe. While the esters introduced into the shoes, do penetrate the polymer strands, they are not believed to chemically react with the polymers forming part of the shoe structure. Preferably the combination of materials applied to a shoe surface will be such that most if not all of the components of the mixture will penetrate the voids created by the polymer strands and will not leave a residual film. Introduction of the esters into the shoes does however alter bulk properties, such as durometer, and they can alter physical properties, such as adhesion or bite, without significantly reducing the durometer of the shoe. Therefore the addition of these ester formulations can increase the adhesion or bite without decreasing the durometer of the shoe.

[0053] When applied to a surface of the shoe, ester or esters employed herein will change the coefficient of friction (or adhesion) and/or the softness (or hardness) of the shoe. These are structural properties and are at least in part bulk properties of a shoe. These structural changes would not occur if the formulations merely formed films on the surface of the shoe.

To effect these bulk structural changes the ester or esters employed herein penetrate the shoe. With the exception of Example 1, which is used as a cleaner, and Example 11, which is applied as a thin layer to act as a dirt repellant or act as a base coat and, as previously described, will not completely pass through the shoe, these formulations are applied to act on the shoe over a period of time of at least 10 minutes per coat and up to 10 days as described with reference to Examples 4-11 before using the shoe on a surface.

[0054] In addition to these formulations, which employ multiple esters, other shoe treatment formulations can employ only individual esters, (e.g., monoesters, diesters) which are small enough to penetrate the polymer structure of a shoe's natural and/or synthetic rubber pieces to alter the performance of the shoe. The following examples, show how such formulations, each containing only one ester, function. These individual ester compositions can be employed after the shoe surface has been cleaned, for example according to Example 1.

Example No. 11

Isononyl Isononate

[0055]

Branched Aliphatic Hydrocarbon Solvent	0.00%
Isononyl Isononate	100.00%

[0056] This formulation consisting of the ester, without solvents, can be used by submerging only the shoe's natural and/or synthetic rubber pieces to soak up the formulation for up 36 hours. An additional benefit is that this formulation contains zero Volatile Organic Chemicals (VOC), which allows the ester to be completely absorbed by the natural and/or synthetic rubber shoe pieces and modifying the stretch and recovery of the shoe's natural and/or synthetic rubber pieces for hot weather use. This allows for improved grip when making quick changes in direction when compared to an untreated shoe, such as is common in basketball and tennis.

[0057] In addition to use as a single component ester, the solvent can range from 97% down to 0.00% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen, and the ester can range from 100% down to 3% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen. Different conditions will allow for varied ratios of solvent to ester and type of solvent to type of ester, and will result in different performance characteristics that can match the environmental and surface conditions.

[0058] One specific example of the use of a specific combination of the use of Isononyl Isononate with a solvent is as follows:

Branched Aliphatic Hydrocarbon Solvent	90.00%
Isononyl Isononate	10.00%

[0059] This mixture can be wiped or applied to the outside of a shoe approximately 20 to 30 minutes prior to use. The benefit of this combination is that it allows use of a low toxicity solvent and an oily ester that is rapidly absorbed into the surface of the tread and/or sole of a shoe to give additional

short term modification of the dynamic coefficient of friction that allows for the chemical to substitute for the thermal energy obtained from the actual use of the shoe.

[0060] There are many instances that the exterior treatment may need to be completed 20 minutes in advance up to several weeks in advance.

Example No. 12

Dioctyl Maleate

[0061]

d-Limonene	0.00%
Dioctyl Maleate	100.00%

[0062] Similar to example 11, this formulation consisting of the ester, without solvents, can be used by submerging only the shoe's natural and/or synthetic rubber pieces to soak up the formulation for up 36 hours. An additional benefit is that this formulation contains zero Volatile Organic Chemicals (VOC), which allows the ester to be completely absorbed by the natural and/or synthetic rubber shoe pieces and modifying the stretch and recovery of the shoe's natural and/or synthetic rubber pieces for hot weather use. This allows for improved grip when making quick changes in direction when compared to an untreated shoe, such as is common in basketball and tennis.

[0063] In addition to use as a single component ester, the solvent can range from 97% down to 0.00% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen, and the ester can range from 100% down to 3% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen. Different conditions will allow for varied ratios of solvent to ester and type of solvent to type of ester, and will result in different performance characteristics that can match the environmental and surface conditions.

[0064] One specific example of the use of a specific combination of the use of Dioctyl Maleate with a solvent is as follows:

d-Limonene	90.00%
Dioctyl Maleate	10.00%

[0065] This mixture can be wiped or applied to the outside of a shoe approximately 20 to 30 minutes prior to use. The benefit of this combination is that it allows use of a low toxicity solvent and an oily ester that is rapidly absorbed into the surface of the tread and/or sole of a shoe to give additional short term modification of the dynamic coefficient of friction that allows for the chemical to substitute for the thermal energy obtained from the actual use of the shoe.

[0066] There are many instances that the treatment may need to be completed 20 minutes in advance up to several weeks in advance.

Example No 13

Dibutyl Maleate

[0067]

d-Limonene	0.00%
Dibutyl Maleate	100.00%

[0068] Similar to example 11, this formulation consisting of the ester, without solvents, can be used by submerging only the shoe's natural and/or synthetic rubber pieces to soak up the formulation for up 36 hours. An additional benefit is that this formulation contains zero Volatile Organic Chemicals (VOC), which allows the ester to be completely absorbed by the natural and/or synthetic rubber shoe pieces and modifying the stretch and recovery of the shoe's natural and/or synthetic rubber pieces for hot weather use. This allows for improved grip when making quick changes in direction when compared to an untreated shoe, such as is common in basketball and tennis.

[0069] In addition to use as a single component ester, the solvent can range from 97% down to 0.00% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen, and the ester can range from 100% down to 3% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen. Different conditions will allow for varied ratios of solvent to ester and type of solvent to type of ester, and will result in different performance characteristics that can match the environmental and surface conditions.

[0070] One specific example of the use of a specific combination of the use of Dibutyl Maleate with a solvent is as follows:

d-Limonene	90.00%
Dibutyl Maleate	10.00%

[0071] This mixture can be wiped or applied to the outside of a shoe approximately 20 to 30 minutes prior to use. The benefit of this combination is that it allows use of a low toxicity solvent and an oily ester that is rapidly absorbed into the surface of the tread and/or sole of a shoe to give additional short term modification of the dynamic coefficient of friction that allows for the chemical to substitute for the thermal energy obtained from the actual use of the shoe.

[0072] There are many instances that the exterior treatment may need to be completed 20 minutes in advance up to several weeks in advance.

Example No. 14

Dioctyl Maleate

[0073]

Parachlorobenzotrifluoride (PCBTF)	0.00%
Dioctyl Maleate	100.00%

[0074] Similar to example 11, this formulation consisting of the ester, without solvents, can be used by submerging only the shoe's natural and/or synthetic rubber pieces to soak up the formulation for up 36 hours. An additional benefit is that this formulation contains zero Volatile Organic Chemicals (VOC), which allows the ester to be completely absorbed by the natural and/or synthetic rubber shoe pieces and modifying the stretch and recovery of the shoe's natural and/or synthetic rubber pieces for hot weather use. This allows for improved grip when making quick changes in direction when compared to an untreated shoe, such as is common in basketball and tennis.

[0075] In addition to use as a single component ester, the solvent can range from 97% down to 0.00% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen, and the ester can range from 100% down to 3% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen. Different conditions will allow for varied ratios of solvent to ester and type of solvent to type of ester, and will result in different performance characteristics that can match the environmental and surface conditions.

[0076] One specific example of the use of a specific combination of the use of Dioctyl Maleate with a solvent is as follows:

Parachlorobenzotrifluoride (PCBTF)	90.00%
Dioctyl Maleate	10.00%

[0077] This mixture can be wiped or applied to the outside of a shoe approximately 20 to 30 minutes prior to use. The benefit of this combination is that it allows use of a low toxicity solvent and an oily ester that is rapidly absorbed into the surface of the tread and/or sole of a shoe to give additional short term modification of the dynamic coefficient of friction that allows for the chemical to substitute for the thermal energy obtained from the actual use of the shoe.

[0078] There are many instances that the exterior treatment may need to be completed 20 minutes in advance up to several weeks in advance.

Example No. 15

Dioctyl Sebacate

[0079]

Mineral Spirits Rule 66	0.00%
Dioctyl Sebacate	100.00%

[0080] Similar to example 11, this formulation consisting of the ester, without solvents, can be used by submerging only the shoe's natural and/or synthetic rubber pieces to soak up the formulation for up 36 hours. An additional benefit is that this formulation contains zero Volatile Organic Chemicals (VOC), which allows the ester to be completely absorbed by the natural and/or synthetic rubber shoe pieces and modifying the stretch and recovery of the shoe's natural and/or synthetic rubber pieces for hot weather use. This allows for improved grip when making quick changes in direction when compared to an untreated shoe, such as is common in basketball and tennis.

[0081] In addition to use as a single component ester, the solvent can range from 97% down to 0.00% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen, and the ester can range from 100% down to 3% depending on the surface the shoe is being used on, environmental conditions and type of shoe chosen. Different conditions will allow for varied ratios of solvent to ester and type of solvent to type of ester, and will result in different performance characteristics that can match the environmental and surface conditions.

[0082] One specific example of the use of a specific combination of the use of Dioctyl Sebacate with a solvent is as follows:

Mineral Spirits Rule 66	90.00%
Dioctyl Sebacate	10.00%

[0083] This mixture can be wiped or applied to the outside of a shoe approximately 20 to 30 minutes prior to use. The benefit of this combination is that it allows use of a low toxicity solvent and an oily ester that is rapidly absorbed into the surface of the tread

and/or sole of a shoe to give additional short term modification of the dynamic coefficient of friction that allows for the chemical to substitute for the thermal energy obtained from the actual use of the shoe.

[0084] There are many instances that the treatment may need to be completed 20 minutes in advance up to several weeks in advance.

[0085] The solvent portion of the examples may have any number of substitutes. The solvents listed are only for example. The choice of solvent is limited solely by the solubility of the chosen ester in the solvent. The solvent may be chosen from petroleum distillates, coal tar distillates, distilled solvents from vegetable matter sources, water and synthetic solvents. The preferred solvents for environmental reasons are vegetable matter distillates, water and synthetic solvents.

[0086] The ester portions of the formulations from the examples are a small number of examples and have many substitutes. The only exceptions are those esters that are so large in structure that either absorption (penetration) does not happen or is impractical. Currently the time limit for absorption is approximately five weeks.

[0087] Each of these formulations adds esters to a previously manufactured shoe instead of extracting esters by using solvents or drawing the existing esters to the surface of the shoe.

[0088] The application of this invention that has been tested the longest on high-performance footwear has been on rock-climbing shoes. Currently, unlike traditional footwear, climbing footwear foregoes the use of patterned treads on most surfaces of the shoe's sole because no tread pattern can provide shapes that could fit the infinite number of possible macroscopic rock formations on which people climb. Instead, climbing shoe manufacturers currently opt for a smooth sole that incorporates high performance rubber that provides high friction on the surface being traversed. Furthermore, depending on the surface being traversed and/or climbed, the sole of the climbing shoe must balance the hardness and softness of the rubber, depending on the need for rigid shoe edges versus a sole that can deform to match the microscopic shape and texture of the climbing surface to maximize the surface area

in contact with the surface being traversed. This provides an ideal surface for the invention to be applied to test performance improvements that are not due to shaped treads or cleats. While we have empirically observed improvements to the performance of shoes used in other activities, such as golf cleats, tennis shoes, and hiking boots, in our testing of climbing shoes we have observed that in blinded performance tests that climbers will be able to pick out and prefer the shoes that have been treated with the invention and formulations described in this document. This preference and improved performance has been seen on multiple types of climbable surfaces, including (but not limited to) granite, sandstone, silica-cemented quartz, modular plastic handholds for indoor-climbing, and across environmental conditions, including hot versus cold; dry/dusty versus wet/slick; etc.

[0089] The benefits that have been observed with climbing shoes and hiking boots naturally raises applications of the invention for improving the performance of footwear for military personnel especially in instances where they may be operating in a variety of extreme environments such as rocky and/or mountainous terrain, extremely cold and/or hot environments, or extremely dry or wet environs.

[0090] While the foregoing written description of the invention enables one of ordinary skill to make and use what is considered presently to be the best mode thereof, those of ordinary skill will understand and appreciate the existence of variations, combinations, and equivalents of the specific embodiment, method, and examples herein. The invention should therefore not be limited by the above described embodiment, method, and examples, but by all embodiments and methods within the scope and spirit of the invention.

We claim:

1. A method of improving the performance of a shoe comprising the steps of applying a mixture containing at least one ester to a surface material of the shoe, allowing the ester to soak into and penetrate the surface material of the shoe for a cure time to change the bulk properties of surface material to improve the performance of the shoe.

2. The method of claim 1 comprising the steps of applying multiple esters to the surface material of the shoe.

3. The method of claim 2 where the mixture contains ester and non-ester components.

4. The method of claim 2 where the ester is a blend of at least 2 of the following 3 esters. Ester of Adipic acid, Esters of Glutaric Acid and Esters of Succinic Acid.

5. The method of claim 1 wherein the surface material comprises a rubber material.

6. The method of claim 1 wherein the surface material comprises an elastomeric material.

7. The method of claim 1 wherein the mixture is applied to an exterior surface of a shoe sole.

8. The method of claim 1 wherein the mixture is applied to shoe sole to increase the a bulk property of the shoe sole selected from the group consisting of adhesion of the shoe to a hardened surface, the hardness of the shoe sole, and the operative life of the shoe sole.

9. The method of claim 1 wherein material is not removed from the shoe sole during application of the mixture to the shoe sole.

10. The method of claim 1 including the step of applying a mixture containing at least one ester to the surface material before adding a different ester to the surface material to alter the bulk properties of the surface material.

11. The method of claim **1** wherein the at least one ester applied to the surface material comprises an ester which will penetrate polymer chains forming the surface material, but will not react with constituents of the polymer chains to break down the polymer chains.

12. The method of claim **1** wherein the esters are selected from the group consisting of mono-esters, di-esters, tri-esters, tetra-esters, penta-esters, phosphate esters and phosphonate esters are applied to the shoe surface to alter bulk properties of the surface material.

13. The method of claim **1** wherein the esters are selected from the group consisting of oligomers and telomers of ester containing monomers, dimers, trimers, tetramers, pentamers, hexamers, septamers, octomers and nonamers.

14. The method of claim **1** wherein the mixture is applied to a surface material of a previously manufactured shoe.

15. The method of claim **14** wherein the mixture is applied to a surface material of a shoe after use of the shoe.

16. The method of claim **1** wherein the mixture is applied to a smooth sole of a climbing shoe.

17. The method of claim **16** wherein the mixture is allowed to soak into a material forming the shoe sole before climbing.

18. The method of claim **1** wherein the mixture is applied to a treaded sole of a sporting shoe.

19. A method of improving the performance of a shoe sole formed of an elastomeric material comprising the application of different esters to alter different bulk properties of the shoe sole, the bulk properties being selected from the group consisting of adhesion of the shoe to a surface, the hardness of the shoe sole, and the operative life of the shoe sole.

20. The method of claim **18** wherein different esters are applied to improve the performance of the shoe sole in environments selected from the group consisting of dry/dusty environments and wet/slick environments.

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