Title: VISIBILITY ENHANCEMENT COMPOSITION

Abstract: The invention is directed toward biodegradable, non-toxic firefighting concentrate compositions including a fluorescent type compound for foam visualization within the visible and ultraviolet light spectrum and a process for its use.
Visibility Enhancement Composition

FIELD OF THE INVENTION

The present invention relates generally to compositions and methods for treating fuel hydrocarbons; more particularly, to the incorporation of a visibility enhancing amount of at least one fluorescent type compound effective to permit visualization or tracing of said composition in low light or no light conditions; and most particularly to compounds for providing an ability to visualize compositions utilized for treating fuel hydrocarbons at levels of light otherwise insufficient for such visualization, and to further determine the authenticity of a particular treating composition.

BACKGROUND OF THE INVENTION

It has been established that fire suppression agents can be extremely beneficial in effectively quenching fires of various types and eliminating their ability to reignite (U.S. Patent Nos. 5,945,026 and 6,139,775 to Thames.) According to these patents, a particularly disclosed class of compositions are shown to be useful for application to either surface or subsurface concentrations of hazardous or undesirable hydrocarbons, including masses of gasoline, oil and the like that are spilled on land, and which are intentionally or unintentionally disposed of in sewers, exposed to the soil or the air, or the like as the result of an accident of some sort. Chemical breakdown of the dispersed hydrocarbons can be accelerated by increasing the concentration of available bacteria for this purpose. In some cases, the surface active agent ("surfactant") composition itself can serve as a nutrient for the
bacteria, thus enhancing its action in degrading the 
hydrocarbon materials.

In the past, the concept of utilizing surface active 
agents in water for treating fires has often been 
suggested. One aspect of the use of surfactants in 
firefighting is that such treatment can render the water 
"wetter," i.e., better able to penetrate into and through 
the surfaces of semi-solid materials. Moreover, the 
ability of surfactant materials to create frothing or 
foaming has been used in an attempt to provide a barrier 
at the liquid-air interface, which barrier will block 
oxygen from access to vapor at the liquid surface, usually 
the surface of a mass of burning oil or gasoline. In this 
connection, it is well known that, particularly in a 
petroleum-based fire, the combustion occurs only in the 
vapor phase, wherein oxygen in large quantities is readily 
available to the vapors originating within the liquid. In 
a fire, the increase in temperature accelerates the liquid 
vaporation and hence the rate of combustion. In many 
instances, surface active agents, particularly when 
accompanied by agitation, serve to achieve a mix of liquid 
water and fuel, thus rendering the fuel less volatile and 
less susceptible to burning.

However, when combining an agent with the turbulent 
stream of firefighting water under high pressure, there 
are limited ways to ensure the adequate coverage of a fire 
suppressing agent, particularly in conditions where the 
amount of ambient light is limited. In addition, there 
are no practical methods available to ensure the 
authenticity of a stored agent, nor are these effective 
means for quantifying variable constituents.
DESCRIPTION OF THE PRIOR ART

U.S. Patent Nos. 5,945,026 and 6,139,775 issued to Thames relate to a biodegradable, non-toxic firefighting concentrate composition diluted with water and effective when mixed with foam-forming materials. The concentrate is extremely useful in aquatic and land fires. Although the composition in U.S. Patent No. 5,945,026 does incorporate a dye for visualizing and detecting the coverage of a firefighting agent when combined with other firefighting means, it is effective merely for identification purposes when viewed in sufficient ambient light. There is no suggestion to utilize a fluorescent dye for any purpose whatsoever.

U.S. Patent No. 6,065,545 to Williams teaches a method and composition for extinguishing fires. The composition involves the use of a visual coloration added to a firefighting agent to detect its presence in ambient light when thrown in a fluid stream comprising fluid and/or foam. However, there is no suggestion disclosed for incorporating the use of a fluorescent dye as a means of visualization other than in lighting conditions sufficient to be easily viewed within the stream of fluid or foam.

U.S. Pat. No. 5,990,486 issued to Chen et al. teaches an apparatus and method for measuring components of a solute stream. The method is accomplished by measuring a concentration of an indicator agent comprising a water soluble or water insoluble dye, specifically claiming rubrene, rhodamine B, or fluorescein or a salt thereof. The solute stream may contain an aqueous film-forming foam. One advantage suggested is that the indicator agents provide greatly increased visibility for the fluid streams in which they are introduced, e.g., enhanced
visibility of fire hose stream water or nighttime or other
dark situation firefighting applications. Light capable
of detecting the indicator agent, e.g., incandescent or
ultraviolet (UV) light, can illuminate the liquid at a
predetermined reference point. Chen et al. discloses the
addition of a fluorescent dye to a stream containing a
firefighting additive, e.g., a stream emanating from a
fire hose nozzle. The dye is incorporated as a means of
for aiding in quantifying the total concentration of the
solute, or firefighting agent, and as a means of enhancing
visibility of the liquid stream.

There are a multitude of instances when extremely low
levels of ambient light make it difficult or impossible to
visualize firefighting materials, particularly when the
concentration is substantially reduced by foaming of the
composition. Low-level light situations include examples
such as a fire within a structure without exposure to
natural light (i.e. the hull of a ship), a forest fire at
night, or any type of situation where the coverage of
active agent must be ascertained in the dark.

SUMMARY OF THE INVENTION

The present invention is directed to the
incorporation of fluorescent type compounds that are
useful for providing increased visualization of fire
suppression agents when used to fight fires at levels of
light insufficient to enable visualization of a fire
suppressant agent, to provide tracing capability to a bio-
remediation project, or as a quick reference for security
purposes to determine if the product is genuine or
counterfeit.

Fluorescent dyes are commonly employed to impart both
visible color and fluorescence to other materials to
enhance visualization, for example, imaging agents, leak
detection, detecting impurities, and the like. Types of
dyes typically utilized for visual enhancement are
fluoresceins, multi-fluoresceins, rhodamines, pyrenes,
etc. Inclusion of such dyes provides a useful addition to
methods and compositions of firefighting agents.

High visibility fluorescent dyes that are fluorescent
in the visible (400-700 nanometers) spectrum and
ultraviolet compounds/dyes, active in the 200-400
nanometer wavelength spectrum, can be used for these
purposes. Physical requirements of these compounds
include a need to be infinitely dispersible, soluble, or
miscible in a water-based system. Although not wishing to
be limited to a particular dye, examples of those useful
in the present invention are monoazo dyes, such as monoazo
xanthene, monoazo anthraquinone, monoazo stilbene, and
combinations thereof.

An ultraviolet dye or compound that is active in the
200 to 400 nanometer range can be added in trace amounts
to firefighting formulations such that the compound itself
is invisible to the unaided eye but exhibits a strong
absorbance at specific wavelengths in the Ultraviolet
spectrum. Such compounds can be seen on an
Ultraviolet/Visible Spectrophotometer as a very sharp peak
of absorbance at a very specific wavelength.

Accordingly, it is an objective of the invention to
provide a foam composition exhibiting an enhanced degree
of visibility.

Another objective of the invention is to provide a
composition including at least one fluorescent type
compound which enhances visibility while not impairing the
functionality of the end product.
A further objective of the invention is to provide a fluorescent type compound useful as an aid for security purposes to determine the authenticity of the product, e.g., a firefighting product.

Yet another object of the invention is to provide a composition for use in a bio-remediation project including a fluorescent type compound with tracing capability.

Another object of the invention is to provide a fluorescent type compound which is biodegradable and non-toxic.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A variety of different fluorescent dyes having specific visibility in particular ranges within the visible spectrum are described herein. The following examples are illustrative, but not limiting in showing several uses.

One embodiment includes a blend comprised of 3 to 50 parts of a 5 mole ethylene oxide (EO) \( C_{16} - C_{18} \) tertiary tallow amine, a quantity of carboxylic acid necessary to neutralize the tertiary amine to a pH range of from about 6.0 to about 8.0 (typically 4-20 parts), from about 3 to about 20 parts of a \( C_{6} - C_{18} \) linear alcohol (or ethoxylated alcohol), a fluorescent type compound 1500 parts per million of monoazo xanthene, with the remainder being water, such that 100 parts are present in the entire composition, wherein the blend imparts a deep fluorescent yellow/green color that is highly reflective in the visible (400-700 nanometer) spectrum. Additions of these types of compounds/dyes to firefighting and bio-remediation products, e.g. any and all of the formulations referenced in U.S. Patents 5,945,026 and 6,139,775, has a high positive visibility effect without impairing the
functionality of the end product. A foam producing agent, such as sodium lauryl sulfate, can also be added. In addition, the linear alcohols can be replaced with any C₆ - C₁₂ glycol ether with the addition of the sodium lauryl sulfate or other anionic, nonionic, or amphoteric foaming agent.

In a particularly preferred embodiment, the following components are utilized:

35 Parts of a 5 mole EO C₁₆ - C₁₈ Tallow Amine
12 Parts of a C₆ Carboxylic Acid (adjusted pH of the tallow amine: 7.23)
3 Parts of a C₈ - C₁₂ Linear Alcohol Blend
150 Parts per Million of Monoazo Xanthene
50 Parts Water

Foaming Agent

An ultraviolet dye or compound that is active in the 200 to 400 nanometer range, such that the compound itself is invisible to the unaided eye, allows the manufacturer to incorporate these compounds in the formulations referenced and inferred in, for example, U.S. Patent Nos. 5,945,026 and 6,139,775, to determine if the product in question is counterfeit or bona fide.

Another embodiment includes a blend consisting of 5 to 45 parts of a 2 mole (EO) C₁₂ - C₁₆ coconut amine; 5 to 45 parts of a 5 mole (EO) C₁₂ - C₁₄ coconut amine; 4 to 20 parts of a C₆ - C₉ carboxylic acid; 1 to 5 parts of a linear alcohol, 150 parts per million of a Ultraviolet compound/dye (200-400 nanometer active) and the balance of water when mixed has a sharp Ultraviolet absorbance as measured on a Hach DR 2000 UV/Vis Spectrophotometer or equivalent spectrophotometer when set at the compounds specific wavelength. The addition of a foaming agent (1 - 20 Parts of sodium lauryl sulfate) does not hamper the
effectiveness of the UV dye as it is generally accepted that in some firefighting incidents, high foam is a desirable characteristic of the products.

In a particularly preferred embodiment, the following components are utilized:
12 Parts of a 2 mole EO C_{12} - C_{14} Coco amine
23 Parts of a 5 mole EO C_{12} - C_{14} Coco amine
9 Parts of a C_5 Carboxylic Acid (adjusted pH of the Coco amines: 7.18)
3 Parts of a 2 mole EO C_{11} Linear Ethoxylated Alcohol
150 Parts per Million of a 200-400 nanometer active Ultraviolet active compound
53 Parts of Water
Foaming Agent

In the case of the 200 to 400 nanometer active compound additive, the amount of absorbance is directly proportional to the concentration. The ability of these compounds to be effective in such small quantity and not be readily visible, provides fingerprint utility for the product to insure it as being genuine. Other UV absorbing compounds which have absorbencies at different wavelengths can be used with equal results. These compound additions can be used with all the combinations of tertiary amines; linear, primary, or ethoxylated alcohols; carboxylic acids and others mentioned or found to be known in the art, e.g. as described in U.S. Patents 5,945,026 and 6,139,775.

All patents and publications mentioned in this specification are indicative of the levels of those skilled in the art to which the invention pertains. All patents and publications are herein incorporated by reference to the same extent as if each individual publication was specifically and individually indicated to be incorporated by reference.
It is to be understood that while a certain form of the invention is illustrated, it is not to be limited to the specific form or arrangement of parts herein described and shown. It will be apparent to those skilled in the art that various changes may be made without departing from the scope of the invention and the invention is not to be considered limited to what is shown and described in the specification.

One skilled in the art will readily appreciate that the present invention is well adapted to carry out the objects and obtain the ends and advantages mentioned, as well as those inherent therein. The compounds, compositions, biologically related compounds, methods, procedures and techniques described herein are presently representative of the preferred embodiments, are intended to be exemplary, and are not intended as limitations on the scope. Changes therein and other uses will occur to those skilled in the art, which are encompassed within the spirit of the invention and are defined by the scope of the appended claims.

Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments. Indeed, various modifications of the described modes for carrying out the invention which are obvious to those skilled in the art are intended to be within the scope of the following claims.
What is claimed is:

Claim 1. A method of firefighting comprising:
preparing a biodegradable, non-toxic foamable
firefighting concentrate composition comprising, by
volume, a mixture of at least one amine selected from the
group consisting of from about 3 to about 50 parts of a 5
mole ethylene oxide (EO) C₁₆ - C₁₈ tertiary tallow amine,
from about 5 to 45 parts of a 2 mole (EO) C₁₂ - C₁₄ coconut
amine, and from about 5 to 45 parts of a 5 mole EO C₁₂ - C₁₄
coconut amine, a carboxylic acid in an amount effective to
neutralize said tertiary amine to a pH within the range of
from about 6.0 to about 8.0, from about 3 to about 20
parts of an alcohol, a composition having fluorescent
properties in an amount effective to permit visualization
or tracing of said concentrate composition in low light or
no light conditions, and the remainder being water, such
that 100 parts by volume are present in the entire
composition;
injecting said concentrate composition into an
aqueous stream intended for firefighting such that said
stream includes said concentrate composition in an amount
effective to permit said visualization or tracing;
utilizing said stream to form an aqueous foam
effective to provide fire resistance to a target; and
directing said foam toward said target;
wherein said foam is visible when exposed to light in
a range of from about 200 to about 700 nanometers.
Claim 2. The method of claim 1, wherein said quantity of carboxylic acid is from about 4 to about 20 parts by volume.

Claim 3. The method of claim 1, wherein said alcohol is at least one alcohol selected from the group consisting of a C₆ - C₁₈ linear alcohol and an ethoxylated alcohol.

Claim 4. The method of claim 1, wherein said composition having fluorescent properties reflects in the visible spectrum of about 400 to about 700 nanometers.

Claim 5. The method of claim 1, wherein said composition having fluorescent properties reflects in the ultraviolet wavelength range of about 200 to about 400 nanometers.

Claim 6. A method according to claim 1, wherein said composition having fluorescent properties is a monoazo xanthene dye.

Claim 7. A method according to claim 1, wherein said composition having fluorescent properties is a monoazo anthraquinone dye.

Claim 8. A method according to claim 1, wherein said composition having fluorescent properties is a monoazo stilbene dye.

Claim 9. A method according to claim 1, wherein said carboxylic acid is a C₆ to C₉ carboxylic acid.
Claim 10. A biodegradable, non-toxic firefighting concentrate composition, said composition comprising, by volume, a mixture of at least one amine selected from the group consisting of from about 3 to about 50 parts of a 5 mole ethylene oxide (EO) C_{16} - C_{18} tertiary tallow amine, from about 5 to 45 parts of a 2 mole (EO) C_{12} - C_{14} coconut amine, and from about 5 to 45 parts of a 5 mole EO C_{12} - C_{14} coconut amine [from about 5 to 45 parts of a 2 mole ethoxylated oxide (EO) C_{12} - C_{14} coconut amine; from about 5 to 45 parts of a 5 mole EO C_{12} - C_{14} coconut amine]; from about 4 to 20 parts of a C_{6} to C_{9} carboxylic acid; from about 1 to 5 parts of an alcohol, 150 parts per million of a light reflecting compound having fluorescent properties, wherein said light reflecting compound reflects in the range of about 200 to about 700 nanometers, and the balance being water, such that 100 parts by volume are present in the entire composition.

Claim 11. A composition as defined in claim 10, which further includes a foaming agent, said foaming agent being present in the amount of from about 1 to 20 parts, said parts being added before the said balance being water.

Claim 12. A composition as defined in claim 10, wherein said foaming agent is sodium lauryl sulfate.

Claim 13. A composition as defined in claim 10, wherein said alcohol is at least one alcohol selected from the group consisting of a C_{6} - C_{18} linear alcohol and an ethoxylated alcohol.
Claim 14. A composition as defined by claim 10, wherein said light reflecting composition reflects in the visible spectrum of about 400 to about 700 nanometers.

Claim 15. A composition as defined by claim 10, wherein said light reflecting composition reflects in the ultraviolet spectrum of about 200 to about 400 nanometers.

Claim 16. A method according to claim 1, which further includes the step of:
adding a foaming agent, said foaming agent being present in the amount of from about 1 to 20 parts, said parts being added before the said balance being water.

Claim 17. A composition as defined in claim 16, wherein said foaming agent is sodium lauryl sulfate.

Claim 18. A method according to claim 1, wherein said composition having fluorescent properties is at least one composition selected from the group consisting of a monoazo xanthene dye, a monoazo anthraquinone, and a monoazo stilbene.

Claim 19. A method according to claim 10, wherein said composition having fluorescent properties is at least one composition selected from the group consisting of a monoazo xanthene dye, a monoazo anthraquinone, and a monoazo stilbene.

Claim 20. A method according to claim 10, wherein said composition having fluorescent properties is a monoazo xanthene dye.
Claim 21. A method according to claim 10, wherein said composition having fluorescent properties is a monoazo anthraquinone dye.

Claim 22. A method according to claim 10, wherein said composition having fluorescent properties is a monoazo stilbene dye.