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(54) Titre : COMPOSITION IGNIFUGE CONTENANT UNE COULEUR FUGITIVE POUR APPLICATION AERIENNE
(54) Title: FUGITIVE COLOUR FIRE RETARDANT COMPOSITION FOR AERIAL APPLICATION

(57) Abrégé/Abstract:
In a fugitive colour fire retardant composition, the colourant initially colours the composition to a hue which contrasts with the hue of ground vegetation. A non- fugitive component is included in the colourant, in an amount which is sufficient to provide improved aerial visibility when the composition is first aerially applied to the vegetation. However, the amount of non-fugitive pigment is less than an amount which would prevent the composition from fading after application to an acceptable hue.

ABSTRACT

In a fugitive colour fire retardant composition, the colourant initially colours the composition to a hue which contrasts with the hue of ground vegetation. A non-fugitive component is included in the colourant, in an amount which is sufficient to provide improved aerial visibility when the composition is first aerially applied to the vegetation. However, the amount of non-fugitive pigment is less than an amount which would prevent the composition from fading after application to an acceptable hue.

FUGITIVE COLOUR FIRE RETARDANT COMPOSITION FOR AERIAL APPLICATION

This invention relates to fire retardant compositions which are specially adapted for aerial application, to combat or prevent the spread of wildfires. More particularly, the invention concerns a fugitive colour fire retardant composition, having improved aerial visibility after it is first aerially applied to ground vegetation, but which fades over time and under ambient conditions to another colour (hue).

In the early 1960's, aerial application of fire retardant compositions to prevent or retard the spread of forest fires, range fires, etc., became very widespread. Typically, these fire retardant compositions contained an electrolytic fire-suppressing salt, e.g., ammonium phosphate, ammonium sulphate, and the like, and also included other components, e.g., viscosity modifiers, corrosion inhibitors and colouring agents, e.g., pigments or dyes. Typical fire retardant compositions of the type described above are disclosed in U.S. Patent No. 3,196,108, to Nelson and U.S. Patents Nos. 3,257,316 and 3,309,324 to Langouth, et al. These compositions generally consisted of an aqueous slurry or solution of a fire-suppressing salt, e.g., ammonium phosphate or ammonium sulphate and a thickening agent, e.g., attapulgite clay, guar gum or the like. Colouring agents, e.g., red iron oxide, were included to improve the visibility of the material after it was dropped. More recently, ammonium polyphosphate liquids, containing colouring agents and corrosion inhibitors, have been widely employed. Such liquid polyphosphate fire retardant compositions are disclosed in U.S. Patent No. 3,370,890 to Nelson and U.S. Patent No. 3,960,735 to Lacey.

Fire retardant compositions containing other thickeners, stabilizers and the like are disclosed in the following patents: U.S. Patent No. 4,822,524 to Strickland, U.S. Patent No. 3,634,234 to Morganthaler, U.S. Patent No. 4,606,831 to Kegler, et al.,

U.S. Patent No. 4,447,336 to Vandersall, U.S. Patent No. 4,447,338 to Adl, et al., and U.S. Patent Nos. 4,839,065 and 4,983,326 to Vandersall.

Fire retardant compositions are typically manufactured as dry or liquid "concentrates". These concentrates are shipped and stored in such form until just prior to use. Then, the concentrate is mixed with water to form the final diluted "mixed" fire retardant composition. This mixed retardant composition is then pumped in the tanker aircraft for transport, and dropping at, the wildfire site. In some instances, a dry concentrate is first mixed with an initial quantity of water to provide an intermediate liquid concentrate and this intermediate liquid concentrate is then further diluted just before use to the final diluted mixed form.

The active fire-suppressing components employed in such fire retardant compositions include any of the well-known electrolytic fire-suppressing salts, e.g., those which are disclosed in U.S. Patent No. 3,196,108 to Nelson, as well as the more recently employed liquid ammonium polyphosphate materials, as disclosed in U.S. Patent No. 3,960,735 to Lacey, ammonium sulphate, as disclosed in U.S. Patent No. 4,176,071 to Crouch, and mixtures of these salts with themselves and with other salts.

In general, the active fire retardant components are compounds or a mixture of compounds that degrade or decompose at temperatures which are below the ignition temperature of the fuels to be protected (e.g., cellulose), thereby releasing a mineral acid, e.g., phosphoric acid or sulphuric acid. Among the various fire retardants typically used in fire retardant mixtures and which might be used in the compositions of aspects of this invention are monoammonium orthophosphate, diammonium orthophosphate, monoammonium pyrophosphate, diammonium pyrophosphate, triammonium pyrophosphate, tetraammonium pyrophosphate, ammonium polyphosphate, substituted ammonium polyphosphate, amide polyphosphate, melamine polyphosphate, ammonium-alkali metal mixed salts of orthophosphate, ammonium-alkali metal mixed salts of pyrophosphate, ammonium-alkali metal mixed salts of polyphosphate, ammonium-alkaline earth metal mixed salts of orthophosphate, ammonium-alkaline earth metal mixed salts of pyrophosphate, ammonium-alkaline earth metal mixed salts of polyphosphate, ammonium sulphate, liquid ammonium polyphosphates and blends thereof. Some liquid

ammonium polyphosphates may be too dilute in their commercial forms for application as fire retardants but, other retardants, e.g., those noted above, may be mixed with a liquid ammonium polyphosphate until a minimum acceptable concentration is obtained. Ammonium polyphosphate is often called polyammonium phosphate, and commonly contains other ammonium phosphates, e.g., pyro- and metaphosphates, and the alkali metal equivalents thereof, as well as a blend of phosphate polymers. Such polyammonium phosphates are often referred to as 10-34-0, 11-37-0, 12-40-0, 13-42-0 or the like, where the first number indicates the percentage of nitrogen in the blend, the middle number indicates the percentage phosphate in the blend and the last number indicates the percentage potash in the blend.

The fire retardant components may also include thickening agents, which include standard thickeners, e.g., galactomannan guar gum compositions and derivatives thereof, attapulgite clay, carboxymethylcellulose and derivatives thereof, and the like. The thickening agent is employed to maintain the viscosity of the diluted mixed fire retardant composition, for example, at between 50 centipoise and 2000 centipoise for aerial application. In addition, the fire retardant components, in the concentrate or in the final diluted mixed form, may also typically include various adjuvants, e.g., corrosion inhibitors, flow conditioners, spoilage inhibitors, stabilizers and the like, and carriers for these adjuvants, in accordance with art-recognized principles.

When such fire retardant compositions, in final diluted mixed form for aerial application, are applied by dropping from fixed-wing or helicopter aircraft, successive "drops" are often made by the aircraft to form a fire-fighting line. Under these circumstances, it is important for the pilot of the aircraft to be able to determine visually where the preceding loads were dropped, such that the pilot can drop the load from the aircraft to form a continuation of this line. Since the fire retardant components (described above) may be colourless or may be of colours which do not contrast well with the ground or vegetation, it has been common practice to mix colouring agents with the fire retardant composition components. Colouring agents are used to give the fire retardant compositions a colour (hue) which contrasts with the hue of the ground vegetation, thereby enhancing the ability of the aircraft pilot to determine where the last

loads of fire retardants were dropped in constructing a fire-fighting line. Prior art colouring agents have included pigments which are dispersible in the liquid fire retardant compositions or soluble therein, most commonly red iron oxide or various water-soluble dyes. Such colouring agents were remarkably effective in enhancing the aerial visibility of fire retardant compositions after they were applied. However, certain prior art colouring agents, especially red iron oxide, were very "colourfast", such that the ground and structures (if any) to which the prior art fire retardant compositions were applied, remained permanently or semi-permanently stained. Consequently, certain government fire-fighting agencies have, more recently, required that aerially-applied fire retardant compositions have so-called "fugitive" colouring agents, such that the colour of the compositions would fade over a short time, e.g., 30 days, to a colour which did not objectionably contrast with the ground and ground vegetation.

Several dyes and pigments (encapsulated dyes) have been identified which impart a distinctive hue to fire retardant compositions, which contrasts with ground vegetation, but which fade in a short time to a "neutral" colour, i.e., such that the fire retardant compositions exhibit the colour they would have exhibited without the addition of such fugitive agents. However, although the fire retardant compositions themselves might be brilliantly coloured by fugitive agents, after first application it was often difficult to locate the fire retardant drop zone. It has been found that the reduced visibility of these highly coloured fugitive compositions is somewhat related to the viscosity of the fire retardant compositions themselves. Thus, more highly viscous fugitive compositions are somewhat easier to see on the vegetation, because they form a thicker coating. However, even highly viscous fugitive colour compositions are sometimes difficult to visualize from an aircraft after dropping on various kinds of vegetation and under various lighting conditions.

It would be advantageous to provide fugitive colour fire retardant compositions which exhibit improved aerial visibility after dropping. It would also be advantageous

to achieve this result in an economical manner and without using any materials which are toxic to humans, animals, to fish or to vegetation.

Briefly, a fugitive color liquid fire retardant composition has been discovered for aerial application to ground vegetation which achieves these objectives.

According to one aspect of the present invention there is provided a fugitive color liquid from retardant composition for aerial application to ground vegetation, said composition comprising: a) fire retardant components having a first hue, comprising a fire retardant salt; b)a colorant which initially colors said composition to a second hue which contrasts with the hue of said vegetation, said colorant comprising: i) a fugitive color component; ii) a non-fugitive component which is present in said composition in an amount which improves the aerial visibility of said composition, but in less than an amount which prevents said composition from fading to said first hue after aerial application; and c) an aqueous carrier.

According to another aspect of the present invention there is provided a concentrate composition for preparing a fugitive color liquid fire retardant composition for aerial application to ground vegetation, by dilution thereof with an aqueous carrier, said concentrate composition comprising:
a) fire retardant components having a first hue, comprising a fire retardant salt; and b) a colorant which initially colors said composition to a second hue which contrast with the hue of said vegetation, said colorant comprising: i) a fugitive color component, and ii) a non-fugitive component present in said composition in an amount which improves the aerial visibility of said composition, but in less than an amount which prevents said composition from fading to said first hue after aerial application.

According to a further aspect of the present invention there is provided a fugitive color liquid fire retardant composition for aerial application to ground vegetation, said

composition comprising: a) fire retardant components including a fire retardant salt; b) a fugitive color component which improves the aerial visibility of said composition and which colors said composition to contrast with normal vegetation or ground; and c) titanium dioxide, in an amount sufficient to improve the aerial visibility of said composition, but in less than an amount which prevents said composition from fading to a neutral color which blends with normal vegetation or ground.

According to another aspect of the present invention there is provided a method for fighting wildfires comprising the steps of: applying a fire retardant composition to ground vegetation, which composition includes: a) fire retardant components including a fire retardant salt; b) a fugitive color component which improves the aerial visibility of said composition and which colors said composition to contrast with the vegetation or ground; and c) a non-fugitive color component insoluble in an aqueous carrier which improves the aerial visibility of said composition, and said non-fugitive color component provided in less than an amount which prevents said composition from fading to a neutral color which blends with the vegetation or ground.

By two variants of this second broad aspect of this invention, the concentrate composition is a dry composition, or is a liquid concentrate composition.

By a variant of these two broad aspects of this invention, the non-fugitive component is red iron oxide.

By a second variant of these two broad aspects of this invention, and/or the above variants thereof, the fire retardant salt comprises a liquid ammonium polyphosphate.

In other words, the compositions of aspects of this invention generally comprise fire retardant components, a colorant and a liquid carrier, a typically an aqueous carrier.

The fire retardant components include a fire-suppressing salt and have a first hue. The colourant comprises a fugitive component and a non-fugitive component.

The colourant used in aspects of this invention initially colours the fire retardant composition components to a second hue which contrasts with the hue of the ground vegetation. This may be due solely to the colour which is imparted by the fugitive component, or to the colour which is imparted by the combined fugitive/non-fugitive components.

The non-fugitive component of the colourant of an aspect of this invention is present in an amount which is sufficient to improve the aerial visibility of the composition when it is first applied to the vegetation. However, the non-fugitive component in the composition of an aspect of this invention is present in less than an amount which prevents the composition from thereafter fading to the first hue, i.e., the hue of the fire retardant composition components without the colourant.

According to another embodiment of a general aspect of this invention, a concentrate composition is provided for preparing the liquid composition described above by dilution thereof with the aqueous carrier. The concentrate composition of this aspect of this invention generally comprises the fire retardant components and the colourant.

In one embodiment, the concentrate is a dry composition. In another embodiment, the concentrate is a liquid which is suitable for later dilution with water to form the final mixed liquid fire retardant composition.

As used herein, the term "fire retardant components" means all of the components of the composition except the "colourant" and the liquid carrier, if any. The fire retardant components will include a fire retardant salt and may optionally include (and usually will include) other common ingredients of fire retardant formulations, e.g., corrosion inhibitors, spoilage inhibitors, flow conditioners, anti-foaming agents, foaming agents, stability additives and thickening agents.

The term "colourant" means a combination of at least two components, namely, a fugitive component and a non-fugitive component.

The "fugitive component" is a dye, or a dye which is dispersed in a matrix (i.e., a pigment), which fades over time and under ambient field conditions to a colourless or less-highly-coloured hue. A number of such dyes and pigments are well-known in the art. For example, many water-soluble dyes fade rapidly and there are so-called fluorescent pigments (fluorescent dyes which are encapsulated in a resin integument) which are suspendible in the fire retardant compositions of aspects of this invention and which also fade rapidly to provide the "fugitive" effect. Typical examples of prior art fugitive dyes and pigments include C.I. Basic Red I dye, 6BL dye, Basic Violet II dye, Basic Yellow 40 and encapsulated-dye pigments which are available commercially, e.g., the pigments known by the trade name of the AX_{TM} series pigments, supplied by Day-Glo Color Corp., Cleveland, Ohio. At present, it is preferred to employ encapsulated-dye fugitive pigments without uv absorbers, rather than using water-soluble dyes because the encapsulated-dye pigments are less likely to stain.

The colourant is present in an amount which provides a colour ("second hue") to the composition which is different from the colour of the composition without the colourant ("first hue"). The second hue contrasts with the hue of the vegetation (normally green and/or brown). Advantageously, the second hue is red, orange or pink.

The colourant also includes a "non-fugitive" component, i.e., a component which is insoluble in the carrier liquid and which, if coloured, does not necessarily fade after aerial application of the fire retardant composition.

The non-fugitive component preferably has an index of refraction of at least 2.0. For example, prior art fire retardant compositions containing fugitive colourants and which also contain various clays and other insoluble materials, e.g., attapulgite clay, tricalcium phosphate, (components which have refractive indices below 2.0), did not have the improved aerial visibility which is exhibited by the compositions of aspects of the present invention unless the amounts of such lower-index materials are so large that the compositions are not "fugitive". To achieve improved aerial visibility, smaller quantities of non-fugitive components can be employed if the refractive index is higher and larger quantities of lower-index materials are required to achieve desirable results.

The non-fugitive component of an aspect of this invention is included in the colourant in an amount which is sufficient to provide improved aerial visibility of the composition when it is first aerially applied to the vegetation. However, the amount of the non-fugitive component in the fire retardant composition of an aspect of this invention is less than the amount which would prevent the fire retardant composition of an aspect of this invention from fading to the first hue after application.

The non-fugitive component is dispersible or suspendible in the final fire retardant composition of an aspect of this invention and in a liquid concentrate of an aspect of this invention of such composition. The dispersibility or suspendibility of such a component is primarily dependent upon particle size and particle size distribution and the nature of the other components which are present in the fire retardant composition of an aspect of this invention, e.g., thickeners, etc.

Also, the chemical structure and characteristics of the non-fugitive pigment in the fire retardant composition of an aspect of this invention must be compatible with the other components, especially with the carrier liquid. It must be sufficiently chemically-inert that it does not lose its functional capability when combined with the other components of the fire retardant composition of an aspect of this invention. It should also be non-toxic, and, if coloured, should not undesirably affect the hue established by the fugitive component of an aspect of this invention.

For example, in a presently preferred practice of aspects of this invention, red iron oxide pigments are employed as the non-fugitive component. Yellow iron oxide pigments and white pigments, e.g., titanium dioxide can also be employed. Although coloured pigments, e.g., red or yellow iron oxide do not fade appreciably, the amounts of such pigments in the fire retardant compositions of an aspect of this invention are small enough that the overall composition of an aspect of this invention ultimately fades to a neutral colour, i.e., substantially the same colour which the composition of an aspect of this invention would have exhibited if no colourant had been added.

For example, if a red fugitive component and red iron oxide (non-fugitive component) are employed, the initial colour (second hue) of the resultant fire retardant composition of an aspect of this invention will be red. If a red fugitive component and

yellow iron oxide (non-fugitive component) are employed, the second hue will be orange. If a red fugitive component and a white non-fugitive component are employed, the second hue will be pink. Any of these second hues may provide sufficient contrast with the hue of the ground vegetation to provide acceptable aerial visibility. At present, it is preferred to employ red iron oxide in combination with a red fugitive component to form the colourant of an aspect of this invention.

The maximum quantity of non-fugitive pigment which can be employed, which will still maintain the overall fugitive (fading) characteristics of the fire retardant composition of an aspect of this invention, will vary, depending on the natural or "neutral" colour of the fire retardant composition components and the natural colours of the terrain and vegetation. For example, if a blue-coloured fire retardant composition, e.g., that disclosed in U.S. Patent No. 3,960,735 to Lacey, is employed on darkly-coloured vegetation, e.g., spruce fir, a greater quantity of a coloured non-fugitive colourant, e.g., red iron oxide, can be employed. On the other hand, less of a coloured non-fugitive component can be employed if the base composition is highly viscous, or if the composition is applied on less highly coloured vegetation or terrain, e.g., chaparral. It appears that the maximum quantity of coloured non-fugitive component is higher when using a clay thickener than when using a gum thickener in the fire retardant composition of an aspect of this invention. In general, it appears that the coloured non-fugitive pigment can be no more than 20% to 30% by weight of the total colourant. The maximum amount of the total colourant which is employed will be less than the amount which would prevent the fire retardant compositions of an aspect of this invention from fading to a neutral colour. These amounts can be determined by routine tests by persons skilled in the art having regard to this disclosure.

For example, the maximum amount of red iron oxide which can be employed, irrespective of the amount of fugitive component presently appears to be 0.5% by weight of the liquid concentrate formulations and 0.10% by weight in diluted mixed concentrate compositions. However, for any given base composition of fire retardant composition components (fire retardant salt, thickener, corrosion inhibitor, etc.), the optimum and maximum concentrations of colourant components of an aspect of this invention can be

determined by those skilled in the art without undue experimentation, having regard to the disclosure hereof. For example, suitable procedures for assessing the aerial visibility and fugitive fading characteristics of these compositions are set forth in Sections 3.8 and 4.3.7 of Specification 5100-304a, February 1986, U.S. Department of Agriculture Forest Service Specification for Long Term Retardant, Forest Fire, Aircraft or Ground Application.

The use of both a dye and a pigment in the same fire retardant composition is disclosed by U.S. Patent No. 3,960,735, issued June 1, 1976 to Lacey. In the Lacey patent (Example III) both "red iron oxide" and "6BL dye" are included in a fire retardant concentrate composition. However, the primary colouring agent, red iron oxide, was present in an amount which was far in excess of that which would permit the composition to fade to the hue which it would exhibit if the dye/iron oxide had not be added, i.e., in U.S. Patent No. 3,960,735, to Lacey, the compositions were not "fugitive". The 6BL dye was added to the composition of Example III disclosed in that patent for the purpose of supplementing the red colour of the iron oxide, i.e., making the composition "redder", because the iron cyanide blue corrosion inhibitor of Lacey (Col. 2, lines 5 et seq.) and the red iron oxide otherwise provided a "purplish" composition.

A prior art composition was known and used in the United States prior to the present invention which may have included a colourant consisting of a mixture of a dye and a small quantity of TiO_2, which was encapsulated in a polymeric matrix. This prior composition was manufactured and shipped as a dry powder "concentrate" which was then diluted with water for field application. The quantity of TiO_2 in this product was only 40ppm to 50ppm in the final diluted concentrate, which was far less than the amount which is required to provide the enhanced visibility which is achieved by the compositions of aspects of the present invention.

The determination of whether the hue of the fugitive composition (second hue) fades to the hue of the fire retardant composition of an aspect of this invention without any colourant (first hue) can be determined by the method which is described in Section 4.3.7.2 of Specification 5100-304a (February 1986), "USDA Forest Service Specification for Specification for Long Term Retardant, Forest Fire Aircraft or Ground Application".

The following examples are presented to illustrate principles of the present invention further to those skilled in the art. These examples do not, however, constitute limitations on the scope of aspects of this invention.

EXAMPLE 1

This example illustrates the practice of an aspect of this invention in the manufacture of so-called "liquid concentrate"-type fire retardant products. The products are prepared in accordance with the procedure described U.S. Patent No. 3,960,735 to Lacey, except that the colourant in the fire retardant composition of an aspect of the present invention is substituted for the colouring agents described therein.

A concentrate composition is manufactured using two different types of ammonium polyphosphate liquid. The ingredients of each of these compositions are set forth in Tables A and B. Both of these compositions have improved aerial visibility in comparison to the same compositions which do not contain the red iron oxide pigment. However, these fire retardant compositions of aspects of this invention have acceptable fading characteristics, i.e., fade to hue which are substantially the same as the compositions would exhibit without addition of the colourant.

TABLE A

FIRE RETARDANT COMPONENTS	Wt. % in Concentrate	Wt. % in Final Diluted (5:1) Composition
Ammonium Polyphosphate Liquid (11-37-0)	99.3 - 78.6	22.2 - 17.58
Attapulgite Clay (AA Special)	0 - 10.0	0 - 2.24

TABLE A (Continued)

	Wt. % in Concentrate	Wt. % in Final Diluted (5:1) Composition
COLOURANT COMPONENTS		
Corrosion, Inhibitor Reagent(s), Stabilizers, Spoilage Inhibitor(s), Defoamer(s), etc.	0 - 10.0	0 - 2.24
Fugitive Pigment (DAY-GLO$_{TM}$ 122-9180)	0.5 - 1.0	0.22 - 0.22
Non-Fugitive Pigment (Titanium Dioxide)	0.2 - 0.4	0.04 - 0.09
LIQUID CARRIER		
Water	None	Balance
TOTAL	100.00	100.00

TABLE B

	Wt. % in Concentrate	Wt. % in Final Diluted (4.25:1) Composition
FIRE RETARDANT COMPONENTS		
Ammonium Polyphosphate Liquid (10-34-0)	99.3 - 77.4	24.74 - 19.28
Attapulgite Clay (AA Special)	0 - 10.0	0 - 2.49

TABLE B (Continued)

FIRE RETARDANT COMPONENTS	Wt. % in Concentrate	Wt. % in Final Diluted (4.25:1) Composition
Corrosion Inhibitor Reagent(s), Stabilizers, Spoilage Inhibitor(s), Defoamer(s), etc.	0 - 10.0	0 - 2.49
COLOURANT COMPONENTS		
Fugitive Pigment (DAY-GLO$_{TM}$ 122-9180)	0.5 - 2.0	0.12 - 0.50
Non-Fugitive Pigment (Yellow Iron Oxide)	0.2 - 0.6	0.05 - 0.15
LIQUID CARRIER		
Water	none	balance
TOTAL	100.00	100.00

EXAMPLE 2

This example illustrates the practice of an aspect of this invention by the manufacture of so-called dry or powder concentrate compositions. These dry compositions are thereafter mixed with water to form a final diluted fire retardant composition which is suitable for aerial application. These compositions are manufactured in accordance with the methods disclosed in U.S. Patent No. 4,176,071 to Crouch. The ingredients in each composition are set forth in Tables C, D and E. Each of these fire retardant compositions of aspects of this invention has acceptable aerial visibility and fugitive fading characteristics.

TABLE C

		Wt. % in Concentrate	Wt. % in Final Composition
FIRE RETARDANT COMPONENTS			
	Ammonium Sulphate	78.20	14.5
	Diammonium Phosphate	3.78	0.7
	Guar Gum	4.20	0.8
	Xanthan Gum	0.11	0.2
	Corrosion Inhibitors	1.08	0.20
	Spoilage Inhibitor	0.54	0.10
	Defoamer/Anti-Oxidant	10.79	2.00
COLOURANT COMPONENTS			
	Fugitive Pigment	1.08	0.20
	Non-Fugitive Pigment (Red Iron Oxide)	0.22	0.04
LIQUID CARRIER			
	Water	none	balance
	TOTAL	100.00	100.00

TABLE D

		Wt. % in Concentrate	Wt. % in Final Composition
FIRE RETARDANT COMPONENTS			
	Ammonium Sulphate	24.52	3.2
	Diammonium Phosphate	65.90	8.6
	Guar Gum	5.98	.8
	Stabilizer/Corrosion Inhibitor	2.30	.3
COLOURANT COMPONENTS			
	Fugitive Pigment	1.00	0.13
	Non-Fugitive Pigment	0.30	0.04
LIQUID CARRIER			
	Water	None	Balance
	TOTAL	100.00	100.00

TABLE E

	Wt. % in Concentrate	Wt. % in Final Composition
FIRE RETARDANT COMPONENTS		
Ammonium Sulphate	64.15	8.5
Diammonium Phosphate	24.15	3.2
Guar Gum	6.00	.8
Spoilage Inhibitor	0.75	.1
Stabilizer/Corrosion Inhibitor	0 - 3.77	0 - 0.5 (variable)
COLOURANT COMPONENTS		
Fugitive Pigment	0.98	0.13
Non-Fugitive Pigment (Red Iron Oxide)	0.20	0.03
LIQUID CARRIER		
Water	None	Balance
TOTAL	100.00	100.00

EXAMPLE 3

This example illustrates the practice of aspects of the invention in the manufacture of fugitive compositions of the general type which is disclosed in U.S. Patent No. 4,983,326 to Vandersall. A blended dry powder concentrate is prepared in accordance with Example 4B of U.S. Patent No. 4,983,326 to Vandersall. The dry concentrate is mixed with water to form an intermediate low-viscosity liquid concentrate, which is then further diluted to form a high-viscosity final mixed fire retardant composition of aspects of this invention having improved aerial visibility in comparison to the same fire retardant compositions without the iron oxide pigment and has acceptable "fugitive" fading characteristics. Table F depicts the weight percentages of the components of the dry concentrate, intermediate liquid or so-called "fluid" concentrate and the final diluted mixed retardant composition of aspects of this invention.

TABLE F

	Dry Concentrate	Liquid Concentrate	Final Mix
FIRE RETARDANT COMPONENTS			
Monoammonium phosphate	52.24	24.46	5.62
Diammonium phosphate	34.81	16.30	3.74
Guar Gum	7.24	3.39	0.78
Sodium Molybdate	0.19	0.09	0.02
Tricalcium Phosphate	2.01	0.94	0.22
Sodium Silicofluoride	0.47	0.22	0.05
Mercaptobenzothiazole	0.30	0.14	0.03
Dimercaptothiadiazole	0.72	0.34	0.08

TABLE F (Continued)

	Dry Concentrate	Liquid Concentrate	Final Mix
FIRE RETARDANT COMPONENTS			
Polyalkylene Derivatives of Propylene Glycol	0.13	0.06	0.01
COLOURANT			
Fugitive Component	1.61	0.75	0.17
Red Iron Oxide	0.28	0.13	0.03
LIQUID CARRIER			
Water	none	53.18	balance
TOTAL	100.00	100.00	100.00

Example 4 illustrates the best mode presently known for practising an aspect of the present invention. Each of the products described in Examples 4 and 5 has acceptable aerial visibility and fugitive fading. If the red iron oxide is deleted from the compositions or reduced below 0.20 wt % in the concentrate, the compositions will not have acceptable aerial visibility, even if the red iron oxide which is deleted is replaced by equal amounts of the fugitive pigment. If the fugitive pigment is eliminated or reduced and the red iron oxide content is increased to provide sufficient aerial visibility, then the compositions do not have acceptable fugitive fading.

EXAMPLE 4

The following compositions were prepared in accordance with method described in the U.S. Patent No. 3,960,735 to Lacey, except that the colourant in the fire retardant composition of aspects of the present invention is substituted for the colouring agents described therein. The ingredients used in preparing the liquid concentrates and the final diluted mixed fire retardant are listed in Tables G, H and I.

TABLE G

	Wt % in Liquid Concentrate	Wt % in Diluted Mixed Retardant
FIRE RETARDANT COMPONENTS		
Ammonium Polyphosphate Liquid (ARCADIAN$_{TM}$ 11-37-0)	90.60	20.29
Attapulgite Clay (FLORIDIN$_{TM}$ AA Special)	3.50	0.78
Sodium Ferrocyanide (WEGO$_{TM}$ Technical)	4.50	1.01

TABLE G (Continued)

		Wt % in Liquid Concentrate	Wt % in Diluted Mixed Retardant
COLOURANT			
Fugitive Pigment (DAY-GLO$_{TM}$ #122-9180)		1.00	0.22
Non-Fugitive Pigment (Mobay Corp. BAYFERROX$_{TM}$ Red Iron Oxide 130M)		0.40	0.09
LIQUID CARRIER			
Water		none	balance
	TOTAL	100.00	100.00

TABLE H

	Wt % in Liquid Concentrate	Wt % in Diluted Mixed Retardant
FIRE RETARDANT COMPONENTS		
Ammonium Polyphosphate Liquid (SIMPLOT$_{TM}$ 10-34-0)	90.70	22.98
Attapulgite Clay (FLORIDIN$_{TM}$ AA Special)	4.00	1.01
Sodium Ferrocyanide (WEGO$_{TM}$ Technical)	3.90	0.99
COLOURANT		
Fugitive Pigment (DAY-GLO$_{TM}$ #122-9180)	1.00	0.25
Non-Fugitive Pigment (Mobay Corp. BAYFERROX$_{TM}$ Red Iron Oxide 130M)	0.40	0.10
LIQUID CARRIER		
Water	none	balance
TOTAL	100.00	100.00

TABLE I

	Wt % in Liquid Concentrate	Wt % in Diluted Mixed Retardant
FIRE RETARDANT COMPONENTS		
Ammonium Polyphosphate Liquid (MACGREGOR$_{TM}$ 11-37-0)	90.60	21.10
Attapulgite Clay (FLORIDIN$_{TM}$ AA Special)	3.50	0.82
Sodium Ferrocyanide (WEGO$_{TM}$ Technical)	4.50	1.05
COLOURANT		
Fugitive Pigment (DAY-GLO$_{TM}$ #122-9180)	1.00	0.23
Non-Fugitive Pigment (Mobay Corp. BAYFERROX$_{TM}$ Red Iron Oxide 130M)	0.40	0.09
LIQUID CARRIER		
Water	none	balance
TOTAL	100.00	100.00

EXAMPLE 5

This example illustrates the practice of an aspect of this invention by the manufacture of liquid concentrate products from ammonium polyphosphate liquids, using non-fugitive components other than red iron oxide. These fire retardant compositions of aspects of this invention have acceptable aerial visibility and fugitive fading characteristics. The fire retardant compositions of aspects of this invention are prepared in accordance with the procedure of Example 1, with the components listed in Table J and Table K.

TABLE J

	Wt. % in Concentrate	Wt. % in Solution
Ammonium Polyphosphate (11-37-0)	90.6	20.26
Attapulgite Clay	3.5	0.78
Corrosion Inhibitor	4.5	1.01
Water	none	balance
Fugitive Pigment	1.0	0.22
Titanium Dioxide	0.4	0.09
TOTAL	100.00	100.00

TABLE K

	Wt. % in Concentrate	Wt. % in Solution
Ammonium Polyphospate (10-34-0)	90.7	22.83
Attapulgite Clay	4.0	1.01
Corrosion Inhibitor	3.9	0.99
Water	none	balance
Fugitive Pigment	1.0	0.25
Yellow Iron Oxide	0.4	0.10
TOTAL	100.00	100.00

EXAMPLE 6

This example illustrates the practice of aspects of this invention by the manufacture of dry concentrate products from ammonium phosphate and ammonium sulphate, using non-fugitive components other than red iron oxide. These fire retardant compositions of aspects of this invention have acceptable aerial visibility and fugitive fading characteristics. The fire retardant compositions of aspects of this invention are prepared in accordance with the procedure of Example 2, with the components listed in Tables L-O.

TABLE L

	Wt. % in Concentrate	Wt. % in Solution
Ammonium Sulphate	94.47 - 82.21	14.70
Diammonium Phosphate	4.56 - 3.97	0.71
Guar Gum	0 - 4.47	0 - 0.8
Stabilizer(s)/Corrosion Inhibitor(s)/Spoilage Inhibitor(s), Defoamer(s), etc.	0 - 8.40	0 - 1.5
Fugitive Pigment	0.84 - 0.73	0.13
Yellow Iron Oxide	0.13 - 0.22	0.02 - 0.04
Water	None	84.44 - 82.14
TOTAL	100.00	100.00

TABLE M

	Wt. % in Concentrate	Wt. % in Solution
Ammonium Sulphate	93.90 - 83.44	10.00 - 20.00
Diammonium Phosphate	4.69 - 6.25	0.50 - 1.50
Guar Gum	0 - 4.47	0 - 0.8
Stabilizer(s)/Corrosion Inhibitor(s)/Spoilage Inhibitor(s), Defoamer(s), etc.	0 - 6.26	0 - 1.5
Fugitive Pigment	1.22 - 0.54	0.13
Titanium Dioxide	0.19 - 0.17	0.02 - 0.04
Water	None	89.35 - 76.03
TOTAL	100.00	100.00

TABLE N

	Wt. % in Concentrate	Wt. % in Solution
Ammonium Sulphate	71.61 - 59.98	8.5
Diammonium Phosphate	26.96 - 22.58	3.2
Guar Gum	0 - 5.65	0 - 0.8
Stabilizer(s)/Corrosion Inhibitor(s)/Spoilage Inhibitor(s), Defoamer(s), etc.	0 - 10.59	0 - 1.5
Fugitive Pigment	1.09 - 0.92	0.13
Yellow Iron Oxide	0.34 - 0.28	0.04
Water	None	88.13 - 85.83
TOTAL	100.00	100.00

TABLE O

	Wt. % in Concentrate	Wt. % in Solution
Ammonium Sulphate	69.47 - 53.53	14.00 - 5.00
Diammonium Phosphate	29.78 - 20.02	6.0 - 1.87
Guar Gum	0 - 4.47	0 - 0.8
Stabilizer(s)/Corrosion Inhibitor(s)/Spoilage Inhibitor(s), Defoamer(s), etc.	0 - 16.06	0 - 1.5
Fugitive Pigment	1.65 - 1.40	0.13
Titanium Dioxide	0.10 - 0.43	0.02 - 0.04
Water	None	79.85 - 90.66
TOTAL	100.00	100.00

CLAIMS

1. A fugitive color liquid fire retardant composition for aerial application to ground vegetation, said composition comprising:

a) fire retardant components having a first hue, comprising a fire retardant salt;

b) a colorant which initially colors said composition to a second hue which contrasts with the hue of said vegetation, said colorant comprising:

i) a fugitive color component;

ii) a non-fugitive component which is present in said composition in an amount which improves the aerial visibility of said composition, but in less than an amount which prevents said composition from fading to said first hue after aerial application; and

c) an aqueous carrier.

2. A concentrate composition for preparing a fugitive color liquid fire retardant composition for aerial application to ground vegetation, by dilution thereof with an aqueous carrier, said concentrate composition comprising:

a) fire retardant components having a first hue, comprising a fire retardant salt; and

b) a colorant which initially colors said composition to a second hue which contrast with the hue of said vegetation, said colorant comprising:

i) a fugitive color component, and

ii) a non-fugitive component present in said composition in an amount which improves the aerial visibility of said composition, but in less than an amount which prevents said composition from fading to said first hue after aerial application.

3. The concentrate composition of claim 2 which is a dry composition.

4. The concentrate composition of claim 2 which is a liquid concentrate composition.

5. The composition of any one of claims 1 to 4, wherein said non-fugitive component is red iron oxide.

6. The concentrate composition of claim 1, 2 or 4, wherein said fire retardant salt comprises a liquid ammonium polyphosphate; and wherein said non-fugitive component is red iron oxide.

7. The composition of claim 1, in which said non-fugitive component is titanium dioxide.

8. A fugitive color liquid fire retardant composition for aerial application to ground vegetation, said composition comprising:

a) fire retardant components comprising a fire retardant salt;

b) a fugitive color component which improves the aerial visibility of said composition and which colors said composition to contrast with normal vegetation or ground; and

c) titanium dioxide, in an amount sufficient to improve the aerial visibility of said composition, but in less than an amount which prevents said composition from fading to a neutral color which blends with normal vegetation or ground.

9. A method for fighting wildfires comprising the steps of:

applying a fire retardant composition to ground vegetation, which composition comprises:

a) fire retardant components comprising a fire retardant salt;

b) a fugitive color component which improves the aerial visibility of said composition and which colors said composition to contrast with the vegetation or ground; and

c) a non-fugitive color component insoluble in an aqueous carrier which improves the aerial visibility of said composition, and said non-fugitive color component provided in less than an amount which prevents said composition from fading to a neutral color which blends with the vegetation or ground.

10. The method of claim 9, wherein said non-fugitive color component comprises titanium dioxide.

11. The method of claim 9, wherein said non-fugitive color component comprises red iron oxide.

12. The method of claim 9, where said fire retardant salt comprises a liquid ammonium polyphosphate and said non-fugitive component is red iron oxide.