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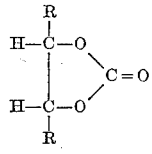
ETHOXYLATED ALKYLPHENOL AND ALKYL CARBONATE FIRE EXTINGUISHING COMPOSITION

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ABSTRACT OF THE DISCLOSURE

An improved fire-fighting composition of an ethoxylated alkylphenol and an alkyl carbonate of the formula:



where R is hydrogen or a methyl group has been discovered. This improved fire-extinguishing composition is useful as a wetting agent, emulsifying agent, low-expansion or high-expansion foam and performs exceptionally well in the presence of both fresh and salt water.

BACKGROUND OF THE INVENTION

The problem of extinguishing fires has plagued mankind throughout recorded history. Today in sophisticated society many improvements have been made and are being made to combat this age-old problem. With increased industrialization and particularly the exploitation of petroleum resources through petrochemicals, the science and art of fire extinguishing has become quite sophisticated. Fires have now become classified into various categories which vary according to the material involved and according to the mode of extinguishing a fire involving this material.

Our invention relates particularly to Class A and Class B materials. Class A materials, or ordinary combustible solids, include things like wood, cotton, paper, etc. Class B materials, or flammable liquids, include liquids such as gasoline, hexane, benzene, other aromatics and other liquid flammable hydrocarbons. Of special interest are the various polar solvents such as acetaldehyde, methyl ethyl ketone, 2-ethylhexanol, and the like. These polar solvents have previously been extremely difficult, if not impossible, to extinguish when burning.

Many method of extinguishing fires and fire extinguishing compositions have been explored by those interested in fire safety. Varied methods have been used such as water alone, particularly for the Class A type fire mentioned above. In addition, dry chemicals have been used in attempts to extinguish many Class B fires. In attempts to smother the fires many of these dry chemicals are used as foams produced by mixing two chemicals such as aluminum sulfate and sodium bicarbonate, which contain a foaming agent and a stabilizer.

Another method which has been often used in fighting Class B fires is with mechanical foam solutions where the foam is made with liquid inducted into the water stream before it comes into contact with air to form the foam. These mechanical-type foam liquids or fire-extinguishing compositions are generally classified as protein and synthetic compositions.

The protein concentrate usually contains a high molecular weight to polypeptide formed by the chemical hydrolysis of vegetable or animal proteins from which it

is made. Various metallic salts are included with these protein liquids to give strength to the foam bubbles in the presence of heat and the foam-forming mechanical action itself. Protein foams by and large base their fire-extinguishing ability upon the formation of a thick blanket of foam which smothers the fire. Protein foams are generally classified as a low-expansion foam. The various expansion-type classifications will be discussed hereinafter.

The synthetic mechanical foams are produced from concentrates which contain compounds of various types of synthetic detergents and are capable of rapid foam formation in suitable foam-generating equipment. While there are several synthetic-type concentrates and compositions on the market, it is generally necessary to maintain supplies of more than one concentrate in order to have a fire-fighting capability against all of the various types of fires. Additionally, each of these different-type synthetic concentrates requires specialized equipment for the use thereof depending upon whether it is high expansion, medium expansion, low expansion, an emulsification agent or a wetting agent. Thus, an installation, to have fire-fighting capability against a broad range of flammable hazards, must purchase various types of fire-fighting material and a variety of equipment with which to use this specialized material.

It has been found that most of the commercially available mechanical foam materials, both protein and synthetic, are substantially ineffective in fighting fires where polar solvents are involved. Accordingly, many fire-extinguishing concentrates are sensitive to whether they are used with salt water or fresh water. This is important when it may be necessary to extinguish a dockside or shipboard fire where a flammable water immiscible liquid is involved.

As hereinbefore mentioned, the fire-fighting compositions are categorized according to various classifications of material. Various fire-fighting compositions are generally called wetting agents, emulsifying agents, low, high or medium-expansion foams. A wetting agent is generally used when fighting a Class A fire to improve the soaking characteristics of the water coming in contact with the flammable material.

An emulsifying agent is used in fighting a flammable liquid fire and acts to combine with some of the flammable material and emulsify it, thus producing a film of some sort on the burning material. High-expansion foams are those which produce a foam of a volume between 100 and 1000 times that of the liquid used in fighting the fire. Medium-expansion foams generally range from about 10 times to 100 times the volume of the liquid and those below a ratio of 10 to 1 are known as low-expansion foams.

In copending application Ser. No. 561,342, filed June 29, 1966, and now abandoned, it was disclosed that a burning liquid fire could be extinguished by applying to the burning liquid a foam produced by passing through an air expansion nozzle a mixture of water with 2 to 6 volume percent of a nonionic surfactant having the formula $R—O(CH_2CH_2O)_nH$ wherein R was selected from the class consisting of alkyl groups containing from 4 to about 20 carbon atoms and alkylphenyl groups wherein the alkyl chain contains from about 4 to about 15 carbon atoms and n is a number of from about 4 to about 30. This material, though acceptable for extinguishing burning liquid fires in certain circumstances, has some inherent disadvantages. It was found that small amounts of water introduced into this concentrate caused gelation which rendered the concentrate totally unusable for fire fighting. The resulting gelation makes the material useless for further fire protection. As was also disclosed in the copending application, the nonionic surfactant had a rela-

tively high freezing point. Even though ethylene glycol was added thereto to reduce the freezing point to usable temperature, the gelation problem still remained.

In some instances, viscosity not necessarily caused by gelation proved a problem which impaired the effectiveness of the eduction of the concentrate into the water stream.

Accordingly, it is an object of our invention to provide a fire-fighting composition which is adaptable for the extinguishment of Class A and Class B fires.

It is a further objective of our invention to provide a fire-fighting composition which is useful either in salt or fresh water.

It is a further object of our invention to provide a fire-fighting composition which will be useful over a broad spectrum of applications from wetting agent through high-expansion foam.

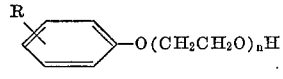
It is a further object of our invention to provide a fire-fighting composition which does not gel when contacted with a small amount of water.

It is a further object of our invention to provide a fire-fighting composition which produces a foam stable under conditions where it is subjected to an overhead water spray.

Further objects and advantages of our invention will be apparent to those skilled in the art upon reading the description which follows. Such objects and advantages are intended to be included within the scope of our invention.

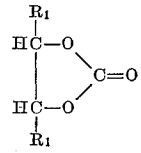
SUMMARY OF THE INVENTION

Our invention relates to an improved fire-fighting composition which is useful as a wetting agent, emulsifying agent or as an expanded foam in fighting Type A and Type B fires, including polar solvent fires, and the method of fighting said fires with our improved fire-fighting composition. More particularly, this invention is directed to an improved fire-fighting composition made up of a solution of an ethoxylated alkylphenol having the formula:



where R is a C_4 to C_{20} alkyl group and n has an average value of from 4 to about 30.

This ethoxylated alkylphenol is mixed with an alkyl carbonate of the formula:



wherein R_1 is hydrogen or a methyl group in such proportions that the carbonate is present in the amount of about 0.1 to about 0.75 part of weight per part of the ethoxylated alkylphenol.

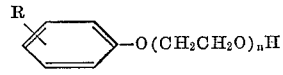
The method of extinguishing fires involves incorporating the improved fire-fighting composition of our invention into a water stream and expelling the water stream to contact the burning material. If it is desired to use the fire-fighting composition as a wetting agent or emulsifying agent, it is expelled along with water through a standard nozzle which does not produce an expanded foam.

When expelled through a nozzle which introduces air into the liquid stream, an expanded foam results and is applied to the burning material. The fire-fighting composition is introduced into the water stream such that it makes up about 0.5 to about 6 volume percent of the aqueous solution depending upon the type of fire involved and the classification of use; i.e., wetting agent or expanded foam. Wetting agents are usually applied to burning materials at the lower concentrations whereas the foamed material generally requires higher concentrations.

DESCRIPTION OF THE INVENTION

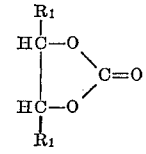
Our invention involves a fire-fighting composition adaptable to a broad spectrum application to various types of fires, including Class A fires of combustible solids and Class B fires of flammable fluids, which include the hard to extinguish polar solvent fires.

While other special purpose additives may be present, our improved fire-fighting concentrate is essentially a two-component system which is blended together to form a homogeneous solution. One component is an ethoxylated alkylphenol having the general formula:



where R is a C_4 to C_{20} alkyl group and n has an average value of from 4 to about 30.

The other essential component is an alkyl carbonate of the formula:



wherein R_1 is hydrogen or a methyl group. This alkyl carbonate is generally present with the ethoxylated alkylphenol in an amount of about 0.1 to about 0.75 part of weight of the carbonate per part by weight of the ethoxylated alkylphenol. It is especially preferred to use propylene carbonate as the alkyl carbonate.

While this is essentially a two-component composition, it is also permissible to include in the concentrate a foam stabilizer such as high molecular weight polymers of ethylene oxide, polyvinyl resins, polyglycols, and the like. The use of these materials is described in U.S. Patent 3,258,423. An especially effective foam stabilizer has been found to be 2000–4000 molecular weight polyethylene glycol. As taught by the aforementioned patent, these additives are included in an amount in the range of from about 0.5 to 5 wt. percent of the concentrate. It is within the scope of our invention to include in our fire-fighting composition this additive as long as the above two components, i.e., the alkyl carbonate and the ethoxylated alkylphenol are present in the proportions hereinabove mentioned.

In preparing and storing the concentrate of our invention, it is best to keep it as nearly anhydrous as possible since the presence of excessive water causes a hydrolyzation of the propylene carbonate. Slight amounts of water, however, do not cause excessive problems such as caused to the ethoxylated alkylphenol or the mixture of it with ethylene glycol when only slight amounts of water are present.

The use of this improved fire-fighting composition is not limited to any one particular aspect, but is equally applicable to use as a wetting agent in fighting fires of Class A substances such as wood, mattresses, textiles, cotton and other combustible solids.

It is also applicable for use as an emulsifying agent to act upon flammable fluids to form a thin emulsion layer on the top thereof. And it is also useful in forming low, medium or high-expansion foams for fighting fires of Class B flammables such as aromatic distillates, benzene, toluene, xylene, gasoline, kerosene, fuel oil, jet fuel, hexane, heptane, octane, and the like. We have also discovered it to be particularly useful in fighting previously very difficultly extinguished fires involving polar solvents such as acetaldehyde, benzaldehyde, methyl ethyl ketone, ethyl acetate, butyl acetate, and the like.

In addition, our fire-fighting composition is useful even in the presence of salt water and extinguishes fire particularly difficult to control, such as the polar solvents and hexane. This is true even when the fire occurs in the

presence of flashback hazards such as metal structures present in the burning fluid.

Our foam has also proved to be stable when used in conjunction with water deluge sprays. This situation often occurs when a flammable liquid becomes ignited in a chemical plant or petroleum refinery or around a storage tank containing flammable fluids. Deluge sprays, while ineffective to extinguish the fire itself, are used to keep the structural metal from reaching a temperature at which its structural strength fails. Prior art foams have been found to disintegrate badly under a water deluge spray system.

The fire-fighting composition of our invention has been found to be nongelling upon contact with minor amounts of water. The importance of this improvement is quite apparent.

In addition to prohibiting the gelation of the ethoxylated alkyl phenol, the alkyl carbonate also reduces the viscosity of the concentrate at lower temperatures. For example, a concentrate of 60% nonylphenol adduct with about 9.5 mols ethylene oxide and 40% propylene carbonate has the following viscosity in centistokes 270 at 20° F., 140 at 35° F. and 60 at 60° F.

Unlike many fire-fighting compositions, particularly the protein type material, our improved fire-fighting composition does not deteriorate upon standing in storage nor does it present corrosion problems to the fire-fighting system in which it is to be used.

Our invention will be further illustrated by the following examples which are intended to be merely for purposes of illustration and not to limit the scope of our invention.

EXAMPLE I

Into a test pit having approximately 1,000 square feet area was introduced 120 gallons of an aeromatic distillate having a flash point of 20° F., initial boiling point of 115° F., an end point of 165° F., and a Reid vapor pressure of 7 p.s.i. This material was ignited and allowed to burn for one minute. Then through a standard 200 gallon per minute fog nozzle water was used to attempt to put out the fire. After two minutes the fire was still not extinguished and was allowed to burn itself out.

EXAMPLE II

Example I was repeated except that the fire was extinguished in 45 seconds, using the same fog nozzle but applying a fog using a concentrate of the 9½ mol adduct of ethylene oxide with nonylphenol and 20% propylene carbonate educted into the water stream through a national Aer-O-Foam LP–17A eductor, which was rated at 3%.

EXAMPLE III

Two hundred and twenty gallons of JP–4 jet fuel was placed in the 1,000 square foot pit, ignited, and allowed a one-minute preburn. The 80% nonylphenol-9.5 mol ethylene oxide adduct and 20% propylene carbonate concentrate was applied to the fire using the eductor used in Example II through a National Aer-O-Foam PC–31 fog nozzle and extinguished the fire in 47 seconds.

EXAMPLE IV

A fire using fuel oil having a flash point less than −60° F., an initial boiling point of 98° F., an end point of 625° F., and a Reid vapor pressure of 11 p.s.i. was ignited as in Examples II and III. The eductor and concentrate of Example III and a Rockwood sprinkler Model CF–6200 nozzle rated at 250 gallons per minute was used to extinguish this fire in 42 seconds.

EXAMPLE V

Another fire was built in the 1,000 square foot pit using JP–4 jet fuel and allowed a one-minute preburn.

Using the eductor rated at 3% described in Example II, the 80%/20% concentrate of Example II was applied to burning fluid through a foam applicator which produced the foam and flowed it on to the burning fluid surface at one edge of the fire at a water rate of 200 gallons per minute. After one minute and 43 seconds the foam covered the pit and the fire was extinguished.

EXAMPLE VI

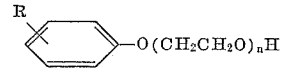
In a rectangular pit having a fuel area of 100 square feet was placed 110 gallons of methyl ethyl ketone, a polar solvent. The fuel bed, 2" deep, was ignited and allowed a 15-second preburn. The foam was applied using the eductor of Example II and the foam applicator described in Example V to apply the 80% nonylphenol 9.5 mol ethylene oxide adduct, 20% propylene carbonate concentrate at the edge of the fire pit. This fire was extinguished in 1 minute and 53 seconds.

The foam surface over the fuel was broken and the fuel was reignited. This was extinguished by pushing the foam back over the fire with a water fog. This further demonstrates the stability of the foam in the presence of an overhead water spray and the difficulty at which the flammable liquid may become reignited and spread to cause damage after the fire was considered to be extinguished.

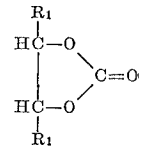
From the aforegoing description and discussion of our invention, it would be apparent to many skilled in the art how successful modification of the same may be made. It is our intention that these modifications and changes of our invention are within the scope of our invention and covered by the claims hereby appended.

We claim:

1. An improved fire-fighting composition useful as a wetting agent, emulsifying agent or as an expanded foam, consisting essentially of a concentrate solution of an ethoxylated alkyl phenol and an alkyl carbonate having about 0.1 to about 0.75 part by weight of the alkyl carbonate per part of the ethoxylated alkyl phenol wherein the ethoxylated alkyl phenol is represented by the formula:



and the alkyl carbonate is represented by the formula:



and R is a C_4 to C_{20} alkyl group, R_1, selected individually, is hydrogen or methyl and n has an average value from 4 to about 30.

2. The composition of claim 1 wherein R is a C_9 alkyl group and n has an average value of 9.5.

3. The composition of claim 2 wherein the alkyl carbonate is propylene carbonate.

References Cited

UNITED STATES PATENTS

2,088,085	7/1937	Gross et al.	252—351
2,529,211	11/1950	Busse et al.	252—3
3,008,905	11/1961	Wedell	252—307

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252—8.05, 307, 351