

SPECIFICATION Fire Retardant Composition

This invention relates to fire retardant compositions, especially coating compositions, and articles, especially utility lines and apparatus such as electric cables and cable trays, coated therewith.

Asbestos, its incombustibility revered for centuries, was originally employed during the Stone Age as an additive to pottery. Later, the ancients, preparing for a king's cremation, frequently draped their ruler in funerary garments woven from this amazing fibre. During the Middle Ages, charlatans and magicians dazzled the peasantry with asbestos cloths that refused to burn. It was not until the late 19th Century, however, that asbestos received widespread industrial application. Today, the myriad of products containing this mineral defy cataloguing.

Unfortunately, asbestos is not without deleterious side effects. As early as two thousand years ago, the Greek geographer, Strabo, and the Roman naturalist, Pliny the Elder, described a sickness of the lungs found in slaves who wove asbestos into cloth and postulated that the adverse biological consequences evidenced by such slaves stemmed from their contact with this mineral. Apart from this passing reference to the disease, the effects of lengthy exposure to this mineral went unnoticed. As the use of asbestos became more prevalent, however, mysterious deaths and debilitating lung diseases were discovered in many workers. Originally attributed to ordinary dust and the poor ventilation of the factories, these infirmities were quickly ascribed to asbestos. The diseases, generally entitled asbestosis, were later found to be forms of pneumoconiosis, a general term for all dust diseases of the lungs, and are characterised by pulmonary fibrosis.

While asbestos has been recognised as a serious health problem to workers in the field for at least 50 years, the voracious appetite for this material and the absence of adequate substitutes prevented its ban. Within the past few years however public concern over its potential health hazards has reached a zenith. This interest stems in part from the widespread use of this material which brings nearly everyone within its specter and this, coupled with an understandable fear that one may be unknowingly subjected to the fibres and will be unable to take necessary precautions, has aroused the public concern. Particularly frightening is a peculiar characteristic of this mineral. Because of its virtual indestructibility, once inhaled, asbestos continues to react with the lungs for a lifetime. Recently, the medical profession has also noted a correlation between asbestos exposure and an increased incidence of cancer. Contact with asbestos has been found to cause, inter alia, mesothelioma, a frequently malignant tumor of the pleura. The potency of asbestos is so great that even those whose exposure to the material is minimal suffer a risk of

being stricken. The by-product of this concern, increasingly stringent controls placed on the use of asbestos, has triggered a quest for suitable substitutes embodying the beneficial aspects of resistance to heat, flexibility, and availability, without concomitant health problems. This search for replacements that have the diversity of functions found with asbestos has heretofore been unsuccessful.

In one particular industrial area, the use of asbestos has been deemed particularly critical. Utility companies and other major industrial plants frequently have a series of high temperature conduits such as electric cables, control cables and pneumatic lines in close proximity. In utility companies large number of high voltage electric cables are separated by only a short distance. Because high voltages traverse these cables, they frequently operate at very high temperatures. Also, if one cable should ignite, the close proximity of the other cables presages a blazing inferno that quickly jumps from cable to cable, each cable in turn fueling the spreading conflagration.

A similar problem is found in many other industries, oil refineries for instance. There, control cables and pneumatic lines are subject to fires, and economic considerations often dictate that these conduits be close together as in the case of utility cables. Thus the need for a fire retardant composition.

While it is virtually impossible, in light of today's technology, completely to eliminate the prospect of a fire, it has been found that when a fire does break out, the damage can be minimized if the plant is quickly shut down, thereby preventing further fuel from reaching the flames. In a utility, termination of the electric current quickly lowers the temperature of the cables below the critical temperature and the fire can be extinguished at its inception. Critical to this method is prompt discovery of the blaze while it is still in its formative stages and a means of preventing the fire from spreading from its place of origin. One means of ensuring a small fire is to coat the cable with a flame-retardant composition that will prevent the spread of the flames. This enables plant operators to shut down operations before the fire rages.

These compositions have frequently contained asbestos as one of the primary flame retardant constituents. This is primarily due to its widespread acceptance under nearly all building codes, its low cost, and its ease of application. While other compositions were not unknown, they frequently lacked the flexibility, acceptance, and low cost attendant to asbestos. Successful compositions employing other materials in addition to asbestos are disclosed in U.S. Patents Nos. 3,642,531, 3,928,210 and 4,064,359, the disclosures of which are incorporated by reference. While these compositions are in the form of an emulsion or mastic and thus do not have the free asbestos fibres that are at present the subject of debate by health authorities,

nevertheless the regulatory climate throughout the world is such that use of the mineral is likely to be barred within a relatively short period of time irrespective of the form in which it is used.

- 5 The patents noted above disclose self-extinguishing fire protective compositions containing, inter alia, asbestos and other non-combustible fibres. An important characteristic of such other fibres, however, is that they have high
- 10 temperature resistance. Such fibres are considerably more expensive than asbestos, however, and a manufacturer unconcerned about the deleterious effects of this substance has little incentive to employ them. Further more, many of
- 15 these fibres lack the flexibility of asbestos as well as its high heat emissivity properties. Consequently, there is needed a fire retardant composition that embodies the beneficial attributes obtained with asbestos, including low
- 20 costs, ease of application, flexibility, etc., but which does not contain asbestos and hence is totally free from concern as to any possible deleterious consequences.

- The present invention provides a fire-retardant
- 25 composition which comprises an aqueous emulsion containing a water-emulsified or dispersed resin, a compound which contains organically bound halogen, a clay and a low-temperature fibrous material. The composition
- 30 typically contains from 25 to 90 weight per cent solids, with from 1.5 to 50 weight per cent resin, from 1.5 to 20 weight per cent halogen-containing compound, if this is present as a separate component of the compositions, from 5
- 35 to 70 weight per cent clay and from 1.5 to 70 weight per cent fibrous material. As will be explained in more detail hereinafter other materials may advantageously be included for various purposes and the source or partial source
- 40 of organically bound halogen may be one of the other main components of the composition and/or one of said other materials.

- The present invention also provides an article protected by said composition, i.e. by a dried
- 45 coating of said composition.

- The fire protective composition of the present invention which, upon application, forms a self-extinguishing fire barrier and does not
- 50 significantly retain heat under normal operating conditions achieves these desirable results without employing asbestos and yet embodies the beneficial properties achieved when using such material.

- Even though it does not contain asbestos it is
- 55 nonetheless highly effective in preventing propagation of a fire and the spreading of flames when applied to combustible substrates and it is capable of being formed into a flexible coating which permits the protected articles, e.g. a cable
- 60 to be handled easily and which may conveniently be removed therefrom.

- The water-based resinous emulsion preferably one or more thermoplastic polymers such as polyvinyl acetate, GRS rubber, a natural rubber
- 65 latex, methacrylate and acrylate resins and

copolymers, elastomeric polyurethanes, polyvinylchloride and polyvinylidene chloride. Copolymers of such materials as vinyl acetate and vinyl chloride, and vinyl acetate and ethylene may also be employed. However, it is often desirable to minimize the use of chlorinated hydrocarbons because of their potential harmful effects on the environment. Water emulsified epoxy resin may also be used, as can polystyrene and acrylonitrile-butadiene-styrene polymers. The composition should have sufficient resinous emulsion to produce a coherent plastic film or coating when the composition is applied to electrical cables and also one which adheres well to the surface of cable insulation but which can be easily removed if desired. Accordingly, although the quantity of resinous emulsion solids and other ingredients will vary somewhat, as explained in more detail hereinafter, at least about 1.5 weight per cent of resinous emulsion solids, preferably at least about 4 per cent, will be used, based on the total weight of the composition as manufactured. In general, the quantity of resinous emulsion solids will be kept relatively low, with sufficient resin being used to provide satisfactory physical properties and a coating which is tough and sufficiently flexible to permit easy handling of coated cables and which contains as little combustible material as possible. Normally, the resinous emulsion solids should not exceed approximately 35 to about 40 weight per cent with about 25 weight per cent being a generally preferred maximum because of economic considerations, although in some instances, up to approximately 50 weight per cent is feasible.

- Various compounds may be employed as the source of organically bound halogen, but brominated hydrocarbons are generally preferred because weight for weight they are more effective
- 105 fire retardants. Decabromo-diphenyl oxide is especially desirable because it has been extensively tested and at the present time has posed no environmental or health problems in its use. However, other halogenated materials and
- 110 mixtures thereof may be employed including halogenated hydrocarbons, especially chlorinated and brominated hydrocarbons, which are generally preferred because of economic considerations. Examples of such halogenated
- 115 hydrocarbons include chlorinated paraffin, such as that available from Diamond Shamrock Corporation under the tradename designation "Chlorowax 70" which contains from 68 to 73 weight per cent chlorine, chlorinated naphthalene,
- 120 chlorinated terphenyl, mixtures of such materials, hexabromocyclodecane, tribromobenzene, polytetrafluoroethylene, polychlorotrifluoroethylene, and perchloropentacyclodecane. Other compounds which are suitable sources of
- 125 organically bound halogen may also be used, such as tetrabromophthalic anhydride and tris beta chloroethyl phosphate. Furthermore, if polyvinyl chloride or polyvinylidene chloride is used as the resin, such material, of course, also serves as a suitable source of organically bound halogen in
- 130

the composition, thereby possibly making it unnecessary to include a second such material. In such a case, the quantity of resinous emulsion may be increased an appropriate amount to compensate for this. For example, if the composition normally contained 35 weight percent resin and 5 percent halogen-containing compound, 40 percent resin could be used, although it will generally be unnecessary to do so. From about 0.5 percent to about 20 percent by weight halogen-containing compound ordinarily will be used, with the preferred range being from about 1 to about 5 weight percent, based on the total weight of the composition as manufactured, except where the resinous emulsion is halogenated, in which case the amount of halogen containing compound could be as much as 70 weight percent of the composition, i.e. the sum of the resinous emulsion and halogen containing compound.

Preferably, the composition includes a plasticizer to provide flexibility for the coating, although in some emulsions, such as elastomeric polyurethanes and rubbers, it may not be necessary to use a plasticizer. If one is used, the selection of a particular plasticizer, of course, depends upon the particular emulsion chosen, with suitable plasticizers being those generally used to plasticize such emulsions. An especially suitable plasticizer is a chlorinated hydrocarbon sold under the trademark "Chlorowax 500", which has also been found to satisfy environmental concerns. This chlorinated material shows excellent fire protective and plasticizing properties and presumably does not have the potential toxicity problems associated with halogenated phosphate plasticizers. Normally, the quantity of plasticizer will be relatively small, within the range of from about 1 to about 7.5 weight per cent based on the total weight of the manufactured composition.

Clays such as hydrated aluminium silicates and alkali metal aluminosilicates, which are also called fluxing materials, may be employed either alone or in combination. These clays include, for example, Kaolin, ball, fire and other well known clays, and the fluxing minerals include, for example, feldspar. It has been found that a mixture of Kingman Feldspar and Tennessee #1 Ball Clay produces satisfactory coatings. Hydrated clays produce superior results in terms of thermal conductivity as compared to calcinated clays and should be used whenever possible. The clay or fluxing mineral should be present in a range of about 5 weight per cent to about 70 weight per cent with a preferred range of about 10 to about 30 weight per cent. While some clay is essential to the composition, the upper limit is primarily dictated by practical considerations such as the ability to mix the material. Without limiting the scope of the present invention by theory, the unexpected result achieved with the composition; are believed to stem, at least in part, from the use of clay instead of asbestos and the ability of the clay to function essentially as a binder to hold the

compositions together as they melt or soften in a fire.

The fibers are low-temperature fibres in contrast to well known high-temperature fibres such as asbestos, quartz or ceramic fibres. The term low-temperature fibre refers to fibres that decompose, melt or lose their structural integrity as opposed to fibres that retain their reinforcing properties at typical fire temperatures, i.e., temperatures of about 1250°F to about 1800°F. If glass is used, it may be milled glass fibres made from E glass having a range from about 1/32" to about 1/2" in length.

Other fibrous materials such as nylon acrylics, e.g. Orion (Registered Trade Mark), polyesters, cellulose and other organic compounds may also be employed. It is preferable that the fibres chosen should not be highly flammable although this characteristic may be compensated for by increasing the amount of fire retardant additives. The total quantity of low-temperature fibres which may be included in the composition as manufactured may vary over a considerable range, as for example, from about 1.5 to about 70 weight percent. In general, if a composition is desired which will provide a coating having greater reinforcement capability, larger quantities of fibrous material will be used.

One preferred fibrous material comprises from 20 to 80 per cent weight of short fibres having a maximum length of about 1/32", the remainder being long fibres having a maximum length of about 1/2".

It has been found that this fire retardant composition eliminates the need for asbestos and other high-temperature fibres and yet still achieves the same and in some instances far superior end results. For example, even though asbestos is absent, the fire retardant composition does not reduce ampacity, i.e., the current carrying capacity of the cable, as shown by the Example, in coated cables to the extent traditional coatings have. Furthermore, it also produces a coating that remains after the organic material has burned off.

While the exact mechanism of operation is not known, it is surmised that the clay melts at the elevated operating temperatures and binds the inorganic residue of the coating materials together while simultaneously preventing the resultant film from being displaced from the cable insulation which it protects, as opposed to the fusion of glass fibres taught in U.S. Patent No. 3,551,276. Thus, the integrity of the coating is maintained.

The fire protective composition preferably includes an antimony-containing compound, such as antimony oxide. In general, about 0.5 to about 20 weight per cent of the antimony will be used with the preferred range being from about 2 to about 5 weight per cent. It is postulated that the antimony oxide functions in combination with the organic halogen during burning by interfering with the normal combustion process, or to limit burning, possibly by reacting with the halogen, to

form a heavy gas which forms at the boundary of the burning surface and thus prevents oxygen from reaching the flames.

Various inert organic fillers such as calcium carbonate or silica or other such stable inorganic materials may also be present in the fire protective composition. These fillers will normally be present in a range of approximately 5 to about 40 weight percent, based on the total weight of the composition as manufactured. Similarly, aesthetic considerations may dictate a desired colour. In that event, the composition may also include organic or inorganic pigments such as titanium dioxide, ferric oxide, etc., to impart the desired tint. Naturally, the quantity of such pigment will be relatively small, generally no more than approximately 4 weight per cent. By the same token, additives such as hydrated alumina may be used which contain chemically bound water of hydration that will be liberated when the coating is exposed to a fire and functions to reduce the heat transferred to the protected substrate in the early stages of a fire. Ordinarily, approximately 5 to 15 weight per cent of such additives may be used, based on the weight of the total composition as manufactured although, higher quantities may be used if desired.

One embodiment illustrating an application of the present invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a cut-away view of an electric cable protected with a composition according to this invention;

Figure 2 shows the configuration of electric cables as they often appear in an industrial application; and

Figure 3 is a cut-away view of the cable tray having a plurality of cables of Figure 2 taken along lines 3—3.

Referring now to the drawings, an electrical cable is illustrated in Figure 1 having a metallic core 1, insulation 2 and a coating 3 of fire-protective composition on its exterior. The insulation may be comprised of any of the well known material including neoprene rubber, butyl rubber, and cross-linked polyethylene. In addition to the insulation layer 2, there may be additional layers of material on the cable such as an extruded jacket (not shown) to prevent cutting the insulation 2. A series of these cables 10 in close proximity as found, for example in the utility operation is shown in Figure 2. There, a plurality of cables 10 are supported by a tray 5 and the insulation 2 of the cables 10 is being sprayed with the fire-retardant composition 3. Figure 3 exhibits a cut-away view of the cable tray 5 of Figure 2 along the axis 3—3 showing the configuration of a plurality of cables 10 with the composition 3 of this invention on the exterior surface of the grouped cables 10.

The composition may be applied as a fluid or as a mastic by various methods, including spraying, brushing, trowelling, gunning, etc. Depending

upon the form of the composition, the composition will contain the requisite amount of water, slightly greater quantities of water being required if a sprayable composition is to be produced. In general, the per cent of total solids of the composition may vary from approximately 25 per cent solids up to approximately 90 per cent. For reasons of performance and economy, the generally preferred range will be from about 45 per cent to about 80 per cent by weights of total solids, based on the total weight of the composition as manufactured.

The composition may also contain minor amounts of various additives to stabilize and protect the emulsion, such as wetting agents, defoaming agents, fungicides, etc. The quantity of such ingredients will usually be within the range of from about 1 to about 5 per cent by weight.

It is advisable to clean the surface to which the coating is to be applied if it contains excessive oil or grease contamination. The surface should also be free of excess loose dirt and dust. When the composition is applied to electrical cables, the coating should be approximately 1/8 inch in thickness. To attain such a coating, the initial thickness should be approximately 1/4 inch when the wet composition is applied as it will shrink approximately 45 per cent in drying. If the fire hazard is minimal, the thickness of the coating may be only approximately 1/16 inch, and conversely, if a strong fire hazard exists, the coating may be approximately 1/4 inch thick. Depending upon the thickness applied and the atmosphere conditions, the composition will usually dry to touch between 1 and 2 hours, and after approximately 24 hours, the cable may be handled or removed. Complete drying requires up to approximately 3 days, and consequently, fire testing should not take place until at least 3 days after application since traces of moisture left on the inside of the coating could expand and loosen adhesion.

After drying, the water, of course, will have evaporated and the resulting dried coating, in one formulation, where the total solids content of the liquid composition was approximately 70 weight per cent, will comprise the following materials in the indicated approximate percentages:

	wt %
115 Resin solids	25.5
Chlorinated hydrocarbon	4.4
Plasticizer	4.8
Low temp. fibres	7.6
120 Fillers and fire retardant additives	17.0
Antimony compound	6.7
Clay	19.0
Hydrated alumina	14.0
Process additives	1.0

125 The percent of the various ingredients in the dried coating will vary, of course, depending upon the resinous emulsion, plasticizer, fillers, and fibres used, which in turn depends upon the intended use of the composition and economic

and performance requirements, as explained above. In general, the dried coating will contain, based on the total weight of the coating, from about 2 to about 90 weight per cent resin solids from the emulsion, with from about 5 to about 60 weight percent being generally preferred, about 0.75 to about 30 weight per cent of the organically-bound halogen, from about 2 to about 90 weight per cent low temperature fibres, and from about 7 to about 90 weight per cent clay. If a plasticizer is used, the dried coating will normally contain from about 1.5 to about 10 weight percent of the plasticizer. Similarly, if hydrated alumina is included, about 10 to approximately 35 weight per cent may be used, and if inorganic fillers, pigments, wetting agents, etc., or an antimony compound is used, the dried coating will contain from about 6.5 to about 55 per cent and from 7 to about 30 weight per cent, respectively, of such materials.

It will be readily apparent to those skilled in the art that the ratio of the non-volatile components is the same in the dried film as in the wet composition, and accordingly, such persons will experience no difficulty in ascertaining the appropriate composition for use in a given situation.

The following Example illustrates the invention.

Example

A composition was formulated as shown in Table 1.

Table 1		
	Pounds	Material
A.	35	H ₂ O
B.	1	Hydroxy Methyl Cellulose
C.	1	Fungicide
D.	1	Surface Active Agent (dispersing aide)
E.	15	Titanium Dioxide
F.	35	Antimony Oxide
G.	70	H ₂ O
H.	23	Decabromo Diphenyloxide
I.	35	Zinc Borate
J.	50	Feldspar
K.	50	Tennessee Ball Clay
L.	50	Hydrated Alumina Medium Particle Size
M.	25	Hydrated Alumina Small Particle Size
N.	50	Calcium Carbonate
O.	30	1/4" Milled Glass Fibres
P.	10	1/32" Milled Glass Fibres
Q.	225	Ethylene/Polyvinyl Acetate Copolymer Emulsion (55 per cent solids)
R.	25	Chlorinated Hydrocarbon (Chlorowax 500)
S.	0.8	Bubble Breaker

Total Solids Content—Approximately 70 weight per cent.

The composition was prepared as follows. Raw materials B., C., and D. were dissolved in water

(A). The powdered ingredients E., F., H., I., J., K., L., M., and N were well dispersed in A with additional water (G) added as necessary to allow good dispersion. Some emulsion (Q) was added to allow all the powders to be stirred in. When all of the powders had been dispersed as a smooth paste, the rest of the emulsion was added. The plasticizer (R) was then stirred in. The glass fibres O and P were then added carefully with relatively slow agitation to prevent breaking the fibres. When these were completely dispersed, the bubble breaker (S) was stirred in.

After the composition has been prepared as above, it was applied by spraying with standard spray coating apparatus to an 8 foot horizontal cable tray containing approximately 20 insulated electrical cables. The coating was applied to one-half of the cable tray, top and bottom, to provide approximately one-eighth inch thickness of coating. The remainder of the cable tray and cables were not coated. The fire protective coating was permitted to dry for 2 days and a test rig was then positioned in a wind protected area so that wind direction did not influence the results. Burlap bags soaked in transformer oil were then wrapped around the cables and ignited with a propane blow torch. The burning time of the heat source was approximately 6 minutes on the section of the tray which had been coated as described, after which the fire had burned out. On the uncoated cables, the fire did not burn out until the cable insulation (layer 2 in the drawings) had been totally decomposed and the metal cables had charred and become completely unusable. In contrast to this, the coated cables, after being permitted to cool, were inspected and found to be substantially unharmed and suitable for further use.

Tests have also been performed on electrical cables coated with the fire protective composition of this invention to determine whether the coating affects the current carrying capability of the cable, as determined by the temperature rise in the cable during operation. It has been found that such coating does not reduce significantly the ampacity, the reduction being generally on the order of only less than 1 per cent, which is not sufficient to derate the cables, the temperature of the insulation on the cables increasing only approximately 2 per cent with a 1/8 inch thickness coating of the fire protective composition.

In addition to the previously described qualities, the fire-protective composition of which invention is odourless and environmentally acceptable and has a Shore A hardness of up to about 85. An unsupported 1/16 inch thickness film passes a 1.8 inch mandrel bend per ASTM D 1737-62. A 1/16 inch film on aluminum is capable of withstanding an impact of at least 24 inches per pound on a Gardener Impact Tester.

As will be appreciated from the foregoing, the fire-protective composition of this invention, is very effective in protecting electric cables and other substrates from the destruction effects of

fires. Also, the coating provided by such composition is flexible and does not interfere in any way with the normal use of the installed cables. Additionally, the composition does not
 5 cause a significant temperature increase in the cables during operation, will be stable as a coating agent over long periods of time, and the coating does not significantly reduce the ampacity.

10 Claims

1. A fire retardant composition which comprises an aqueous emulsion containing a water emulsified or dispersed resin, a compound which contains organically bound halogen, a clay,
 15 and a low temperature fibrous material.
2. A fire retardant composition as claimed in claim 1, which comprises 25 to 90 weight percent total solids.
3. A fire retardant composition as claimed in
 20 claim 2, which comprises from 45 to 80 weight percent total solids.
4. A fire retardant composition as claimed in any one of claims 1 to 3, which comprises at least 1.5 weight percent of the water emulsified or
 25 dispersed resin solids.
5. A fire retardant composition as claimed in one of claims 1 to 4, which comprises not more than 50 weight percent of the water emulsified or dispersed resin solids.
- 30 6. A fire retardant composition as claimed in claim 4 or claim 5, which comprises from 4 to 40 weight percent of the water emulsified or dispersed resin solids.
7. A fire retardant composition as claimed in
 35 any one of claims 1 to 6, which comprises at least 0.5 weight percent of a halogen-containing organic compound.
8. A fire retardant composition as claimed in claim 7, which comprises from 1 to 70 weight
 40 percent of a halogen-containing organic compound.
9. A fire retardant composition as claimed in any one of claims 1 to 8, which comprises from 0.5 to 20 weight percent of a halogen-containing
 45 organic compound other than the water emulsified or dispersed resin.
10. A fire retardant composition as claimed in claim 9, which comprises from 1 to 5 weight percent of said halogen-containing organic
 50 compound.
11. A fire retardant composition as claimed in claim 10, which comprises from 5 to 70 weight percent of a clay.
12. A fire retardant composition as claimed in
 55 claim 11, which comprises from 10 to 30 weight percent of a clay.
13. A fire retardant composition as claimed in any one of claims 1 to 12, which comprises from 1.5 to 70 weight percent of the low temperature
 60 fibrous material.
14. A fire retardant composition as claimed in any one of claims 1 to 13, wherein the water emulsified resin is a vinyl acetate homo or copolymer, a natural or synthetic rubber, an
 65 acrylic or methacrylic homo or copolymer, an elastomeric polyurethane or an elastomeric epoxy resin.
15. A fire retardant composition as claimed in claim 14, wherein the water emulsified resin is
 70 polyvinyl acetate, a vinyl acetate/ethylene copolymer or an acrylic resin.
16. A fire retardant composition as claimed in any one of claims 1 to 13, wherein the water emulsified resin is a homo or copolymer of vinyl
 75 chloride or vinylidene chloride.
17. A fire retardant composition as claimed in any one of claims 1 to 16, wherein the halogen-containing organic compound is a halogenated hydrocarbon.
- 80 18. A fire retardant composition as claimed in claim 17, wherein the halogen-containing organic compound is a brominated hydrocarbon.
19. A fire retardant composition as claimed in claim 17, wherein the halogen-containing organic
 85 compound is decabromo-diphenyl oxide.
20. A fire retardant composition as claimed in claim 18, wherein the halogen-containing organic compound is hexabromocyclodecane or tribromobenzene.
- 90 21. A fire retardant composition as claimed in claim 17, wherein the halogen-containing organic compound is a chlorinated hydrocarbon.
22. A fire retardant composition as claimed in claim 21, wherein the chlorinated hydrocarbon is
 95 a chlorinated paraffin.
23. A fire retardant composition as claimed in claim 22, wherein said chlorinated paraffin contains from 68 to 73 weight percent of chlorine.
- 100 24. A fire retardant composition as claimed in claim 21, wherein said chlorinated hydrocarbon is a chlorinated naphthalene, a chlorinated terphenyl, or perchloropentacyclodecane.
25. A fire retardant composition as claimed in
 105 claim 17, wherein said halogen-containing organic compound is a fluorinated hydrocarbon.
26. A fire retardant composition as claimed in claim 25, wherein said fluorinated hydrocarbon is polytetrafluoroethylene or polychlorotrifluoro-
 110 ethylene.
27. A fire retardant composition as claimed in any one of claims 1 to 16, wherein said halogen-containing organic compound is
 115 tetrabromophthalic anhydride or tris beta chloroethyl phosphate.
28. A fire retardant composition as claimed in any one of claims 1 to 27, wherein said clay is hydrated clay.
29. A fire retardant composition as claimed in
 120 claim 28, wherein said clay is hydrated aluminium silicate or an alkaline metal aluminosilicate.
30. A fire retardant composition is claimed in claim 29, wherein said clay is kaolin, a ball clay, a fire clay, Feldspar or a mixture thereof.
- 125 31. A fire retardant composition as claimed in claim 30, wherein said clay is a mixture of Feldspar and a ball clay.
32. A fire retardant composition as claimed in any one of claims 1 to 31, wherein the low

fires. Also, the coating provided by such composition is flexible and does not interfere in any way with the normal use of the installed cables. Additionally, the composition does not cause a significant temperature increase in the cables during operation, will be stable as a coating agent over long periods of time, and the coating does not significantly reduce the ampacity.

10 Claims

1. A fire retardant composition which comprises an aqueous emulsion containing a water emulsified or dispersed resin, a compound which contains organically bound halogen, a clay, and a low temperature fibrous material.

2. A fire retardant composition as claimed in claim 1, which comprises 25 to 90 weight percent total solids.

3. A fire retardant composition as claimed in claim 2, which comprises from 45 to 80 weight percent total solids.

4. A fire retardant composition as claimed in any one of claims 1 to 3, which comprises at least 1.5 weight percent of the water emulsified or dispersed resin solids.

5. A fire retardant composition as claimed in one of claims 1 to 4, which comprises not more than 50 weight percent of the water emulsified or dispersed resin solids.

6. A fire retardant composition as claimed in claim 4 or claim 5, which comprises from 4 to 40 weight percent of the water emulsified or dispersed resin solids.

7. A fire retardant composition as claimed in any one of claims 1 to 6, which comprises at least 0.5 weight percent of a halogen-containing organic compound.

8. A fire retardant composition as claimed in claim 7, which comprises from 1 to 70 weight percent of a halogen-containing organic compound.

9. A fire retardant composition as claimed in any one of claims 1 to 8, which comprises from 0.5 to 20 weight percent of a halogen-containing organic compound other than the water emulsified or dispersed resin.

10. A fire retardant composition as claimed in claim 9, which comprises from 1 to 5 weight percent of said halogen-containing organic compound.

11. A fire retardant composition as claimed in claim 10, which comprises from 5 to 70 weight percent of a clay.

12. A fire retardant composition as claimed in claim 11, which comprises from 10 to 30 weight percent of a clay.

13. A fire retardant composition as claimed in any one of claims 1 to 12, which comprises from 1.5 to 70 weight percent of the low temperature fibrous material.

14. A fire retardant composition as claimed in any one of claims 1 to 13, wherein the water emulsified resin is a vinyl acetate homo or copolymer, a natural or synthetic rubber, an

acrylic or methacrylic homo or copolymer, an elastomeric polyurethane or an elastomeric epoxy resin.

15. A fire retardant composition as claimed in claim 14, wherein the water emulsified resin is polyvinyl acetate, a vinyl acetate/ethylene copolymer or an acrylic resin.

16. A fire retardant composition as claimed in any one of claims 1 to 13, wherein the water emulsified resin is a homo or copolymer of vinyl chloride or vinylidene chloride.

17. A fire retardant composition as claimed in any one of claims 1 to 16, wherein the halogen-containing organic compound is a halogenated hydrocarbon.

18. A fire retardant composition as claimed in claim 17, wherein the halogen-containing organic compound is a brominated hydrocarbon.

19. A fire retardant composition as claimed in claim 17, wherein the halogen-containing organic compound is decabromo-diphenyl oxide.

20. A fire retardant composition as claimed in claim 18, wherein the halogen-containing organic compound is hexabromocyclodecane or tribromobenzene.

21. A fire retardant composition as claimed in claim 17, wherein the halogen-containing organic compound is a chlorinated hydrocarbon.

22. A fire retardant composition as claimed in claim 21, wherein the chlorinated hydrocarbon is a chlorinated paraffin.

23. A fire retardant composition as claimed in claim 22, wherein said chlorinated paraffin contains from 68 to 73 weight percent of chlorine.

24. A fire retardant composition as claimed in claim 21, wherein said chlorinated hydrocarbon is a chlorinated naphthalene, a chlorinated terphenyl, or perchloropentacyclodecane.

25. A fire retardant composition as claimed in claim 17, wherein said halogen-containing organic compound is a fluorinated hydrocarbon.

26. A fire retardant composition as claimed in claim 25, wherein said fluorinated hydrocarbon is polytetrafluoroethylene or polychlorotrifluoroethylene.

27. A fire retardant composition as claimed in any one of claims 1 to 16, wherein said halogen containing organic compound is tetrabromophthalic anhydride or tris beta chloroethyl phosphate.

28. A fire retardant composition as claimed in any one of claims 1 to 27, wherein said clay is hydrated clay.

29. A fire retardant composition as claimed in claim 28, wherein said clay is hydrated aluminium silicate or an alkaline metal aluminosilicate.

30. A fire retardant composition is claimed in claim 29, wherein said clay is kaolin, a ball clay, a fire clay, Feldspar or a mixture thereof.

31. A fire retardant composition as claimed in claim 30, wherein said clay is a mixture of Feldspar and a ball clay.

32. A fire retardant composition as claimed in any one of claims 1 to 31, wherein the low



temperature fibrous material is one which decomposes, melts or loses its structural integrity at a temperature in the range of from 1250°F to 1800°F.

5 33. A fire retardant composition as claimed in claim 32, wherein said fibrous material is a glass.

34. A fire retardant composition as claimed in claim 32, wherein said fibrous material is an organic polymer.

10 35. A fire retardant composition as claimed in claim 34, wherein said fibrous material is nylon, an acrylic, a polyester or cellulose.

36. A fire retardant composition as claimed in any one of claims 32 to 35, wherein said fibrous material comprises from 20 to 80 weight percent of short fibres having a maximum length of 1/32 inch, the remainder being longer fibres having a maximum length of 1/2 inch.

20 37. A fire retardant composition as claimed in any one of claims 1 to 36, which also comprises from 0.5 to 20 weight percent of an antimony compound.

25 38. A fire retardant composition as claimed in claim 37, which comprises from 2 to 5 weight percent of an antimony compound.

39. A fire retardant composition as claimed in claim 37 or claim 38, wherein said antimony compound is antimony oxide.

30 40. A fire retardant composition as claimed in any one of claims 1 to 38, which comprises from 1 to 7.5 weight percent of a plasticiser for the water emulsified or dispersed resin.

35 41. A fire retardant composition as claimed in claim 40, wherein the plasticiser is a chlorinated hydrocarbon.

42. A fire retardant composition as claimed in any one of claims 1 to 41, which comprises from 5 to 40 weight percent of one or more additives.

40 43. A fire retardant composition as claimed in claim 42, which comprises from 5 to 15 weight percent of said additive(s).

45 44. A fire retardant composition as claimed in claim 42 or claim 43, wherein said additive is a wetting agent, an inorganic or organic pigment, an inert organic filler, hydrated alumina or a mixture of any two or more of said substances.

45. A fire retardant composition as claimed in any one of claims 42 to 44, which comprises from 5 to 15 weight percent hydrated alumina.

50 46. A self-extinguishing fire-protective composition comprising an aqueous emulsion containing from 45 to 80 percent by weight total solids and comprising from 1.5 to 40 weight percent water-emulsified resin solids from the group consisting of polyvinyl acetate, vinyl acetate copolymers and acrylic resins, from 1.5 to 20 weight percent of a halogen containing organic compound other than the resin from 5 to

70 weight percent of a hydrated aluminium silicate clay or a alkali metal aluminosilicate clay, and from 1.5 to 70 weight percent of a low temperature fibrous material selected from the group consisting of organic and glass fibres.

60 47. A composition as claimed in claim 1, substantially as described in the Example herein.

65 48. An article which is protected by a fire-protective coating formed by drying a composition as claimed in any one of claims 1 to 47.

70 49. An article as claimed in claim 48, wherein said article is a utility line.

50. An article as claimed in claim 48, wherein said article is an electric cable.

75 51. An article as claimed in claim 48, wherein said article is a cable tray assembly.

52. An article as claimed in any one of claims 48 to 51, wherein the dried coating contains from 2 to 90 weight percent of resin, 0.75 weight percent of a halogen-containing organic compound, from 7 to 90 weight percent of clay and from 2 to 90 weight percent of low temperature fibrous material.

80 53. An article as claimed in any one of claims 48 to 52, wherein the dried coating contains from 0.7 to 30 weight percent of antimony compound.

85 54. An article as claimed in any one of claims 48 to 53, which comprises from 1.5 to 10 weight percent of a plasticiser.

55. An article as claimed in any one of claims 48 to 54, which comprises from 10 to 35 weight percent hydrated alumina.

90 56. An article as claimed in claim 48, substantially as described herein, with reference to, and as illustrated in, the accompanying drawings.

95 57. An electrical cable comprising an internal metal core, a layer of insulation surrounding said core, and a self-extinguishing fire-protective coating about said layer of insulation, said coating being the dried residue of an aqueous emulsion and comprising from 2 to 90 weight percent of water-emulsified resin solids, from 0.75 to 30 weight percent of a compound containing organically bound halogen, from 2 to 90 weight percent low temperature fibres and from 7 to 90 weight percent clay.

100 58. A tray of cables coated with a self-extinguishing fire-protective composition which comprises the dried residue of an aqueous emulsion and comprising from 2 to 90 weight percent of water-emulsified resin solids, from 0.75 to 30 weight percent of a halogen-containing hydrocarbon compound, from 2 to 90 weight percent low temperature fibres and from 7 to 90 weight percent clay.