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# STRONG FIRE RETARDANT WEBS

Gary H. Meitner, Oshkosh, Wis., assignor to Kimberly-Clark Corporation, Neenah, Wis.

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## ABSTRACT OF THE DISCLOSURE

Nonwoven webs such as cellulosic webs are treated with a binder polymer having a low glass transition temperature and containing halogen substitutes and a fire retarding agent. The resulting products are strong, drapable, and fire retardant.

Cellulosic webs such as creped cellulose wadding have recently found increasing use in textile applications such as tablecloths, garments, and related uses where a fabric like feel and opaque appearance are important characteristics. Typically, in order to be useful in such applications, the strength of the cellulosic web has to be increased. One method for increasing the strength involves laminating the web to a reinforcing means such as a scrim material or a bonded, drafted or carded web of fibers. After formation, the reinforced cellulosic product can be treated with fire retardants and/or water repellants in order to enhance its utility in its end use application. While such a reinforced cellulosic product has found widespread use, the fact that a reinforcing means must be included in order to produce a product with sufficient strength detracts somewhat from the attractive economics of using a cellulosic based product.

Over the years there have been many attempts to prepare products from cellulosic webs without independent reinforcing means which preserve the desirable appearance and feel characteristics of the basic web while imparting sufficient strength to the web to render it suitable as a textile substitute. One technique for accomplishing such involves impregnating the cellulosic web with a binder polymer. The products so produced are stronger than conventional paper, and thus they are suitable for a vaiety of uses. However, the use of such products in textile applications where fire retardancy is a necessary characteristic has not been widespread.

As is well known, fabrics are generally made fire retardant by the use of fire retarding agents which are generally applied to the fabrics in an aqueous medium. If fire retardancy is the only requirement, customary treating methods for cellulosic webs can be used, with the fire retarding agent generally being applied in that amount which achieves the desired level of retardancy. On the other hand, the situation is not so simple when the resultant paper product is to have, in addition to fire retardancy, other desirable attributes such as an acceptable drape and feel and good strength.

Attempts to impart fire retardancy to cellulosic webs impregnated with binder polymers as described above have not been very successful. It has been found that in order to impart an acceptable degree of fire retardancy to the webs, an extraordinarily large amount of retarding agent must be employed to compensate for the flammability of the binder polymer. The use of such amounts of retarding agent adversely affects the strength characteristics of the paper web, particularly at high humidities and when the retarding agent is a water soluble hydroscopic material such as an inorganic salt. In this respect, at high humidities webs containing large quantities of hydroscopic retardants become quite soggy and weak. On the other hand, attempts to compensate for the adverse



effect on strength through the use of additional quantities of binder is detrimental to the drapability of the cellulosic web. Compensating for this undesirable phenomenon by employing external plasticizers or the like has not been completely successful since the amounts of such plasticizers which are required decrease web strength, and also have processing drawbacks since the stability of the system in which the binder and retardant are applied is diminished.

Accordingly, it is a principal object of the present invention to provide a treating composition which can be used in preparing a strong, fire retardant cellulosic web with desirable textile-like qualities without the necessity of employing independent reinforcing means. It is a related object to provide the fire retardant webs so prepared. In this connection, another object is to provide cellulosic webs having the above-described desirable characteristics and which do not contain external plasticizers in amounts which adversely affect their strength or their economic preparation.

It is a further object of the present invention to provide cellulosic webs as described in the above objects wherein smaller than expected quantities of fire retardants are necessary in order to achieve the desired level of fire retardancy.

Other objects and advantages of the present invention will become apparent upon reading the following detailed description.

While the invention is susceptible of various modifications and alternative constructions, there will herein be described in detail the preferred embodiments. It is to be understood, however, that it is not intended to limit the invention to the specific forms disclosed. On the contrary, it is intended to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Briefly stated, the present invention is based on the discovery that when a binder polymer having a low glass transition temperature and containing halogen substituents is employed in combination with a fire retarding agent, smaller than expected quantities of the agent can be used. In turn, since the bonding efficiency of the polymer is not diluted by excess quantities of retardants, only those amounts of binder necessary to impart the required strength to the cellulosic web need be employed. Thus, the webs so prepared have, to a large extent, the desirable drape and feel characteristics of the original unbonded cellulosic web.

The halogenated binder polymer employed herein should have a glass transition temperature of less than about 20° C. and, preferably, below about 0° C. Particularly preferred polymers have a glass transition temperature of less than about —15° C. In order to be useful as a binder the polymer must also have a sufficient quantity of active binder groups to impart adequate strength to the paper. Moreover, the polymeric should itself be fire retardant. Additionally, in order to permit one step application wherein the polymer and fire retardant are applied as a single system, the polymer should be capable of being applied in a carrier which is compatible with the fire retarding agent which is used. Of course, the binder polymer should not have undesirable characteristics with respect to odor, toxicity, etc. which would prevent its effective use on webs intended for textile related applications.

Polymers possessing the above-mentioned characteristics include copolymers of a soft monomer i.e., a monomer which produces a soft polymer, and a monomer containing halogen substituents. Suitable soft monomers include, for example, alkyl acrylates such as methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, 2-ethyl-

hexyl acrylate, etc. and olefins such as ethylene and butene. While, with respect to the halogen containing monomer, monomers with any of the halogen atoms can be used, those with chlorine as a substituent are most widely available and, thus, monomers such as vinyl chloride and vinylidene chloride are preferred for use herein. Of course, other monomers can be copolymerized with the monomers previously recited in order to give useful copolymers so long as the resulting copolymer has an acceptable glass transition temperature. The amount of the halogen containing monomer included in the copolymer should be such that the copolymer has a halogen content of about 15–35 weight percent. Copolymers with 20–25 weight percent halogen are generally preferred. The binder polymers useful herein are usually prepared by an aqueous polymerization technique and are ordinarily directly usable in such form.

Concerning the fire retarding agents which are useful in combination with the above discussed polymers, any of a variety of well known retardants can be employed. For a description of many useful fire retardants, both of the inorganic salt and organic types, reference is made to the journal "Textile World" 119 (10), 102–106 (1969), October. Particularly useful fire retardants are those containing nitrogen, phosphorus, boran, sulfur, and/or halogen substituents. Specific examples of useful compounds include water soluble salts such as ammonium chloride, ammonium sulfamate, sodium borate, barium meta borate, zinc borate complexes, and mono- and di-ammonim phosphate, as well as other retardants such as urea, boric acid, antimony chloride, antimony oxychloride, antimony trioxide, titanium acetate, and titanium oxychloride.

In order to prepare the present compositions, it is simply necessary to mix together the fire retarding agent and the binder polymer dispersion. Based on the weight of the binder polymer, an amount of fire retarding agent of about 30–75 weight percent is ordinarily effective in order to achieve the advantages described herein. In contrast, systems using conventional binder polymers ordinarily contain the retarding agent in an amount at least equal to the binder polymer itself.

For application to a cellulosic web, the aqueous system useful herein containing the halogenated binder polymer and fire retardant is generally adjusted to a solids level of about 15–30%, and thereafter, the cellulosic web is saturated with the aqueous system and then dried. Based on 100 parts by weight of the dry untreated web, the pick up of binder polymer should be about 20–35 parts and the retarding agent about 15–25 parts. Pick-ups of about 25–28 parts binder and about 20 parts retarding agent are generally preferred. Other methods of applying the binder and retarding agent such as by separate applications can also be used though single step application of both ingredients is preferred.

While it is clear from the above discussion that the compositions useful herein consist essentially of the halogenated binder polymer and the fire retarding agent, other ingredients can also be present which do not adversely affect the desirable characteristics which the above-specified ingredients impart to a cellulosic web. For example, the aqueous system in which the polymer and retardant are applied can contain surfactants, protective colloids, pigments, and/or water repellants. In addition, other ingredients which are used to adjust pH or otherwise tend to enhance the stability of the aqueous system can be included. Moreover, while not essential, a plasticizer can also be present where especially soft products are desired. In general, the amount of plasticizer should not exceed about 35 parts per 100 parts of binder polymer, and the plasticizer should be of a fire resistant type. Suitable plasticizers include phosphate esters such as 2-ethylhexyl diphenyl phosphate, tricreysl phosphate, and halogenated phosphate esters.

The compositions described herein have found particular application in the preparation of cellulosic webs



suitable for tablecloths, airline head rest covers, and garments as well as related uses. In particular, the compositions have been found to be useful in treating cellulosic products containing two plies of creped cellulose wadding, with each of the plies having a dryer air (before creping) basis weight of about 6–13 lbs./2880 ft.$^2$ and preferably about 8–11 lbs. per 2880 ft.$^2$.

The following examples illustrates the present invention. All parts and percentages are by weight unless otherwise indicated.

## EXAMPLE I

An aqueous system was prepared by mixing together the following ingredients:

27 parts E-518, 50% solids acrylic dispersion supplied by Rhom and Haas containing a butyl acrylate-vinylidene-chloride copolymer and 10 parts/100 parts resin of a phosphate ester plasticizer. The copolymer contained 37 mole percent vinylidene chloride (22.7 weight percent chlorine content)
15 parts of an aqueous solution containing 50 parts ammonium sulphamate, 10 parts urea, and 40 parts water
1.5 parts titanium doxide pigment
0.6 part "Triton" QS44 surfactant
55.9 parts water.

Two plies of creped cellulose wadding (each ply having a basis weight of about 9 lbs.) was immersed in the aqueous system as prepared above and pressed to remove excess saturant. Thereafter, the wadding was dried at 250° F. Based on the weight of the dry wadding, the pick-up from the aqueous system was as follows:

28 parts of binder polymer
15 parts of amomnium sulphamate
3 parts urea
1.2 parts "Triton" QS44
3 parts titanium dioxide

The sheet so prepared was strong, fire retardant, and possessed very good textile-like qualities with respect to feel and drapability.

## EXAMPLE II

The procedure described above with respect to Example I was repeated except that the following aqueous systems was used for bonding and imparting fire retardancy to the cellulose wadding:

28 parts of a 50% solids dispersion of a butyl acrylate-vinylidene chloride copolymer containing about 23 weight percent chlorine
17 parts "Fyran" 260K (aqueous system containing 55% ammonium sulphamate fire retardant salt plus a non-yellowing agent)
3 parts urea
3 parts titanium dioxide
0.6 part Triton surfactant
48.4 parts water

As with the sheet prepared in Example I, the sheet of the present example also was strong, fire retardant and had desirable textile-like qualities.

While, as illustrated above, the compositions of the present invention are particularly applicable in treating cellulosic webs such as creped cellulose wadding, it should be apparent that the advantages associated with their use can be realized with any web wherein it is desired to increase strength and enhance fire retardancy. Accordingly, in addition to paper products per se, the present compositions are useful in treating other nonwoven webs such as, for example, carded, garnetted, or air laid fibrous webs.

I claim as my invention:

1. A nonwoven material suitable for textile applications having a desirable combination of strength, fabric-like drape, and fire retardancy, said material consisting essentially of low strength cellulose wadding impregnated

with, based on the weight of the wadding, 20–35% of a binder polymer and 15–25% of a fire retarding agent selected from chloride, sulphamate, borate and phosphate fire retarding salts, ureas, and antimony containing fire retarding compounds, said binder polymer having a glass transition temperature of less than about 0° C. of an alkyl acrylate or olefin monomer and a vinyl chloride or vinylidene chloride monomer, with said chloride containing monomer being present in an amount such that the copolymer has a chloride content of about 15–35 weight percent.

2. The nonwoven material of claim 1 wherein the binder polymer has a glass transition temperature of less than about 0° C. and a halogen content of about 20–25 weight percent and wherein the fire retarding agent is a water soluble salt.

3. The nonwoven material of claim 1 wherein the binder polymer has a glass transition temperature of less than about −15° C. and contains copolymerized ethyl acrylate, butyl acrylate, or 2-ethylhexyl acrylate and copolymerized vinyl chloride or vinylidene chloride and wherein the fire retarding agent is ammonium sulphamate.



4. The nonwoven material of claim 2 wherein the cellulose wadding is creped cellulose wadding.

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MELVIN GOLDSTEIN, Primary Examiner

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