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- [54] **HEAT-SEAL ADHESIVE AND PACKAGE**
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ABSTRACT: This invention relates to water base thermoplastic heat-seal adhesives having minimum penetration into porous surfaces when both wet and dry and being resistant to chemical, steam, and heat sterilization conditions, comprising specified proportions of a polyvinyl acetate emulsion, mineral filler and antipenetrant, and to packages utilizing said adhesives.

HEAT-SEAL ADHESIVE AND PACKAGE

BACKGROUND OF THE INVENTION

Articles for surgical or other medical use, such as sponges, gauze, other surgical dressings, needles, and the like are packaged and dispensed in commerce in packages made of microbial barrier paper. While porous, such paper is resistant to the passage of bacteria, or other micro-organisms, completely therethrough. The package is sterilized after the article has been placed therein and the package sealed so that the contents will remain in a sterile condition until the package is opened for use. Heat-seal adhesives have been and are used in order to seal the package formed and these must be resistant to sterilization conditions. These adhesives, while generally satisfactory in their resistance to sterilization conditions, are, however, deficient for present use because they cause excessive "feathering" of the barrier paper when the package is opened for use. "Feathering" is the formation of fine strands of paper which result when the package is delaminated or opened by the user. Since it cannot be determined how deeply micro-organisms have penetrated into the bacterial barrier paper, any contact between any portion of the barrier paper, except the portion thereof forming the interior of the package, and the material enclosed therein is a possible source of contamination of the material and such material can no longer be considered sterile. It has, therefore, been desired to obtain a heat-seal adhesive which will give both 100 percent fiber failure and will be "nonfeathering"; paper adhered therewith will delaminate almost exclusively along the adhesive line without tearing into strands that can contaminate the contents of the package.

SUMMARY OF THE INVENTION

A heat-seal adhesive has now been found which is nonfeathering, has minimal penetration into the barrier paper, and yet will give 100 percent fiber failure in use.

Briefly stated, the present invention comprises a water base heat-seal thermoplastic adhesive having minimal penetration into porous surfaces when both wet and dry and which is resistant to chemical, steam, and heat sterilization conditions, comprising a polyvinyl acetate resin emulsion, a mineral filler consisting of particles the majority of which have an average size of about two microns or greater, and an antipenetrant, said polyvinyl acetate resin emulsion consisting essentially of at least about 2 parts by weight of polyvinyl acetate of medium molecular weight for each part by weight of polyvinyl acetate of high molecular weight and said adhesive containing from about 2.5 to about 5 parts by weight of polyvinyl acetate resin for each part by weight of mineral filler.

The invention also comprises packages consisting essentially of a sterile article enclosed between layers of microbial barrier material heat sealed with said adhesive.

DETAILED DESCRIPTION

As to materials, the polyvinyl acetate resin emulsion must be a combination of polyvinyl acetate resins of medium and high molecular weight as such terms are used in the polymerization art. More specifically, there must be at least two parts by weight, and preferably 2.5 parts, and not more than 5 parts of medium molecular weight resin for each part by weight of high molecular weight resin. As to the medium molecular weight resin, it is preferred to use any having a molecular weight within the range of about 30,000 to 80,000 with ranges between 30,000 to 60,000 being preferred. With respect to the high molecular weight resins, used are preferably those having a molecular weight range of 150,000 to 300,000 although any over 100,000 can be used. These

emulsions are ordinarily prepared as 54—56 percent solids aqueous homopolymer emulsions and are utilized as such in the instant invention.

The mineral filler used is preferably aluminum silicate although other mineral fillers such as calcium silicate, magnesium silicate, magnesium aluminum silicate, calcium metasilicate, calcium carbonate, barium sulphate, potassium aluminum silicate, diatomaceous earth, attapulgite, bentonite, other like clays and mixtures thereof can be used. It is important for the instant invention that the majority of particles of the filler be at least two microns or larger in size. It is preferred, for example, to use aluminum silicate in which about 75 percent of the particles have a size (diameter) of two microns or greater.

The antipenetrant used can be any standard anionic or nonionic surfactant compound or mixture thereof used to decrease wetting properties in adhesives. Examples are the silicone antifoam compounds, anionic blends of saponifiable and nonoxidizing unsaponifying oils, emulsified waxes, polypropylene glycols, and solubilized fatty glycerides.

As to proportions, the ratio of medium to high molecular weight polyvinyl acetate has been set forth above and it is required that such ratio be maintained in order to minimize penetration of the resin particles into the paper when the adhesive is being applied as a wet film and being dried. In addition, this ratio is critical in order to minimize the thermoplastic flow or fluidity of the adhesive when the product is being heat sealed under pressure to adhere the barrier paper and when the entire package is heat sterilized.

The amount of mineral filler added must be within the range of 1 part by weight for each 2.5 to 5 parts by weight of polyvinyl acetate resin in the adhesive. Preferably, the ratio is 1 part filler for each 3 to 4 parts resin. Amounts of filler much below the ratio stated are inoperative since the adhesive will penetrate excessively into the barrier paper during its wet and dry states. Also, amounts of filler in excess are not suitable because the adhesive effect is decreased so as to make the performance of the adhesive unsatisfactory.

The amount of antipenetrant added will of necessity vary with the amount of resin and filler present in the adhesive and the porosity of the particular paper to be adhered. The proper proportion to use, however, is readily determined by measuring the surface tension of the wet adhesive on the paper and the most suitable amount is that which will adjust the surface tension of the adhesive to a point just below that required to form the adhesive into a wet discontinuous film.

As to use, it will be understood that the instant adhesive is used precisely as other heat-seal adhesives. It is first applied by means of a gravure printing press in a predetermined pattern onto the surface of a barrier paper. The adhesive thus formed is then dried and the article to be packaged, such as a surgical dressing, is then placed onto paper and a second sheet of barrier paper placed thereover. The two sheets of barrier film are then adhered together by heat and pressure applied to the adhesive areas of the paper. The sealed package is then subjected to sterilization conditions as, for example, steam sterilization at 300°F. for 20 minutes or chemical sterilization in order to sterilize the contents. In use the package is opened at the instant desired by the user and, as previously discussed, will delaminate along the glue line only; it will not "feather".

In commercial practice a dye which fluoresces is ordinarily incorporated into the heat-seal adhesive to enable inspection during application of the adhesive onto the barrier paper to insure proper application of the adhesive.

The invention will be further described in connection with the following examples which are set forth for the purpose of illustration only and wherein proportions are in parts by weight unless specifically stated to the contrary.

EXAMPLE 1

An adhesive was prepared having the following formulation:

	Parts by weight	5
Polyvinyl acetate resin emulsion ¹ (55% solids)-----	56.350	
Polyvinyl acetate resin emulsion ² (55% solids)-----	21.640	
Aluminum silicate (average particle size of 5 microns; 75% greater than about 2 microns)-----	13.000	10
Water-----	8.645	
Anti-penetrant:		
a. NOPCO JMY-----	.130	
b. COLLOID No. 581-----	.210	15
Fluorescent dye (CALCOFLUOR White)-----	.025	
	100.000	

¹ POLYCO 289 (medium mol. wt.).

² POLYCO 2188 (high mol. wt.).

The adhesive had a viscosity of 1000 cps.

The adhesive was applied by means of a gravure printing press onto a sheet of bacteria barrier paper in a predetermined pattern. The pattern was such as to form a series of substantially square areas enclosed by a continuous line of adhesive. The adhesive was dried in an oven (Hot Air Force Dried) at approximately 250°F. for 5—10 seconds and then the sheet was rolled. Surgical dressings were placed within each square. A sheet of barrier paper substantially coextensive with the adhesive treated sheet was placed thereover and the two sheets heat sealed together along the adhesive lines on a conventional heat sealing machine using a temperature of 400°F. for a compression time of 0.4 of a second at a compression force of 20 p.s.i. The series of sealed squares were then severed from the sheet and steam sterilized at 300°F. for 20 minutes.

The packages were then opened to remove the sterile contents and in every instance there was 100 percent fiber failure showing complete sealing of the package, but no feathering. The package opened cleanly along the adhesive line without causing the paper to tear into wispy strands or feathers. Tests of the surgical dressings showed them to be sterile.

EXAMPLE 2

Two adhesives (A and B) are prepared utilizing the same components as that of Example 1, except that the ratio of polyvinyl acetate to mineral filler was varied. The formulations are as follows:

	Parts by weight	
	A	B
Polyvinyl acetate resin emulsion (med. mol. wt.)-----	60.000	52.500
Polyvinyl acetate resin emulsion (high mol. wt.)-----	22.500	20.500
Aluminum silicate-----	9.000	16.000
Water-----	8.135	10.635
Anti-penetrant:		
a. NOPCO JMY-----	.130	.130
b. COLLOID No. 581-----	.210	.210
Fluorescent dye-----	.025	.025
Total-----	100.000	100.000

Each of the adhesives is used to prepare sterile packages of surgical dressings as set forth in Example 1 and in each case packages that are nonfeathering upon opening are obtained.

EXAMPLE 3

A series of adhesives are prepared utilizing the formulations of Examples 1 and 2 except that VINAC XX-220, POLYCO 571, DARATAK 71 L, DARATAK X-72-1, ELVACET 81900 and 811600, and GELVA S-55-H, all being medium molecular weight polyvinyl acetate emulsions, are each

separately and in turn substituted in equal amounts for the POLYCO 289. In each case the same excellent adhesive properties and nonfeathering properties of the packages are obtained.

EXAMPLE 4

A series of adhesives are made using the formulations employed in Examples 1, 2, and 3 except that DARATAK 56-L and GELVA S-51, high molecular weight resins, are each separately and in turn substituted in equal amounts for the POLYCO 2188. In each instance the same excellent adhesive properties and nonfeathering properties of the package are obtained.

EXAMPLE 5

A series of adhesives are made using the formulations employed in Examples 1, 2, 3, and 4 except that calcium carbonate, calcium metasilicate, calcium silicate, magnesium silicate, magnesium aluminum silicate, barium sulphate, potassium aluminum silicate, attapulgite, and bentonite are each separately and in turn substituted in equal amounts for the aluminum silicate. Each of these fillers is composed of a majority of particles greater than two microns in size. The product obtained in each case is resistant to sterilization, forms an excellent heat seal, and packages sealed therewith are nonfeathering when opened for use.

It will be understood that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of illustration which do not constitute departures from the spirit and scope of the invention.

We claim:

1. A water-based thermoplastic heat seal adhesive having minimum penetration into porous surfaces when both wet and dry and being resistant to chemical, steam, and heat sterilization conditions, consisting essentially of a polyvinyl acetate resin emulsion, a mineral filler consisting of particles, the majority of which have an average size of about two microns or greater, and an antipenetrant, said polyvinyl acetate resin emulsion consisting essentially of at least two parts by weight of polyvinyl acetate of medium molecular weight for each part by weight of polyvinyl acetate of high molecular weight, the medium molecular weight of the polyvinyl acetate resin is between about 30,000 and 60,000 and that of the high molecular weight between about 150,000 and 300,000, the antipenetrant being an antiwetting surfactant selected from the group consisting of silicones, anionic blends of saponifiable and non oxidizing unsaponifying oils, emulsified waxes, polypropylene glycols, and solubilized fatty glycerides, and said adhesive containing from about 2.5 to about 5 parts by weight of polyvinyl acetate resin for each part by weight of mineral filler.

2. The adhesive of claim 1, wherein the ratio by weight of polyvinyl acetate resin to mineral filler is from about 3 to 4 parts resin to 1 part filler.

3. The adhesive of claim 2, wherein there is at least 2.5 parts by weight of medium molecular weight polyvinyl acetate resin for each part by weight of high molecular weight resin.

4. The adhesive of claim 3, wherein the filler is aluminum silicate, about 75 percent of the particles thereof being at least two microns in size.

5. A package that is nonfeathering when opened consisting essentially of a sterile article enclosed within microbial barrier paper sealed together with the adhesive of claim 1.

6. A package that is nonfeathering when opened consisting essentially of a sterile article enclosed between two sheets of microbial barrier paper heat sealed together with the adhesive of claim 1.

7. A package that is nonfeathering when opened consisting of a sterile medical dressing enclosed between two layers of microbial barrier paper heat sealed together with the adhesive of claim 4.