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CONTROL OF STATIC ELECTRIFICATION BY USE OF MIXTURE BRUSHES

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This invention concerns the control of electrostatic charges and antistatic brushes which can be used for electrostatic control.

Electrostatic charges are very often built up due to the contact or rubbing action of two materials. This can occur when an amber rod is rubbed against a silk cloth for laboratory demonstration purposes and it can also occur in various commercial operations due to the handling or conveying of products. In the photographic industry, electrostatic charges can be a serious problem since the discharge of static electricity results in static lines on sensitized photographic products making them unsuitable for general use. For this purpose, antistatic agents are often incorporated in the antihalation coating on the back of photographic film. However, special precautionary steps must be taken with much of the equipment which is used in connection with the manufacture of photographic elements, especially X-Ray film which sometimes does not have an antistatic coating.

In the handling of sheet film having a photographic emulsion thereon, it has been desirable to use a brush to push the film into place during the packaging operation. This makes a neat stack of a given number of film sheets and permits the stacks of film to be wrapped with suitable packaging material. These brushes should be long wearing, free from adverse effect on photographic materials, relatively easy to make or obtain, flexible, and relatively inexpensive.

Nylon brushes have been found to have the most satisfactory characteristics. However, the movement of a brush made from nylon against the edge of the photographic film results in the film having a pronounced electrostatic charge and the brush having a charge of the opposite polarity. After a number of sheets have been brushed with the stacking brush, the electrostatic potential between the brush and the stack of film becomes large enough to cause a discharge or spark with the resultant static marks on the photographic film. Accordingly, it has been desirable to find a means of counteracting the tendency of the film or the brush to pick off the static charge and to avoid damaging the sensitized film.

We have found that the static discharge between the brush and the photographic film can be prevented by preparing a brush of specific chemical composition.

One object of this invention is to provide an antistatic material which may be used for brushes, rollers, and the like. Another object is to provide an antistatic brush useful for packaging sensitized photographic film sheets. A further object is to provide a method of making antistatic materials useful in handling photographic sheeting.

The above objects are obtained by combining two polymeric compositions in a physical mixture or by combining bristles of different composition. A copolymer representing about 92 to 60 weight percent of vinylidene chloride and from 8 to 40 percent of acrylonitrile (identified herein as saran) is mixed with a polyhexamethylene diamine adipamide (66 nylon), or polycaprolactam (6 nylon), both of which are intended by the term nylon used herein.

The range of proportions of nylon to saran by weight which can be used in our invention is 10 to 40 percent nylon with 90 to 60 percent saran. This refers to individual bristles made of a mixture of the polymers or to

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brushes which are substantially composed essentially of either nylon or saran. However, our preferred proportion is 85 percent saran and 15 percent nylon. Some variation in the physical mixture proportions may be desired, depending upon the application for which the antistatic brushes or materials are intended.

In our preferred embodiment, bristles for the antistatic brushes are extruded fibers cut $1\frac{1}{2}$ inches in length including the portion used to anchor them in the support but other lengths may be used. The diameter of the bristles depends on the volume by weight of the material used. However, the diameter of the bristles is preferably between 0.008 to 0.017" averaging about 0.010".

In our preferred embodiment, brushes made according to our invention are used for packaging sheets of X-ray film. These brushes are made by mounting the bristles in a suitable mounting medium. In our preferred embodiment, the bristles are mounted in a steel support to provide rigidity for the brush, but the mounting medium could be nylon or some similar substantially rigid material, preferably one that is conductive so that the electrostatic charges which are induced in the brush bristles would be readily dissipated.

The following examples are intended to illustrate our invention but are not intended to limit it in any way.

EXAMPLE 1

For testing the antistatic properties of brushes, a laboratory testing device was constructed. A stack of X-ray film packets was placed on a grounded metal plate with a piece of cardboard inserted between the plate and the bottom of the packet. The metal plate was cut away so that the brushes would not touch it and the X-ray film packets were held in place on the plate using insulating (polystyrene) guide posts. Mechanical means were provided connected to a variable speed motor so that the brushes could be used to brush against the edge of the film packets. A field meter pick-up was mounted over the center of the stack to record the potential generated on the stack. Since the film in the packets extended beyond the paper, the brushes were contacting both paper and film. Tests were made at two different brushing speeds, approximately one brush passage per second and two brush passages per second. Tests were made also with two different amounts of overlap of the brush bristles on the stack— $\frac{3}{16}$ " and $\frac{1}{2}$ ". Before testing, the brush materials and packets were conditioned overnight at 75° F. to 50 percent relative humidity. These conditions were maintained during the testing period. The following Table I shows the field volts obtained with the various materials:

Table I

Material:	Field volts
55 Nylon	+150
Saran	-72
Nickel-coated nylon	+30
Vinyl chloride	-102
Horsehair	-25
60 Bronze wire	-25
Stainless steel crimped wire	+10
Nickel silver	+10
Nickel-coated nylon	+10

The above tests were run brushing the open end of the packet, two brushes per second and with $\frac{1}{2}$ -inch brush overlap.

EXAMPLE 2

The following results were obtained brushing the open end of the packet with brushes containing either pure nylon or pure saran or brushes containing bristles made completely of one or the other and intermixed in various

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proportions. The open end of the packet was brushed, two brushes per second, one-half inch overlap:

Table II

Nylon, percent	Saran, percent	Field volts
100	0	+110
80	70	+23
20	80	-10
10	90	-20
0	100	-25

EXAMPLE 3

The following table gives values for tests run under the same conditions as in Example 2 except that the closed end of the packet was brushed:

Table III

Nylon, percent	Saran, percent	Field volts
100	0	+100
80	70	+15
20	80	-15
10	90	+7
0	100	-50

The above values indicate that brushes prepared according to our invention have electrical properties which compare favorably to metal bristles or metal coated bristles but have essentially the flexibility, durability, etc. of nylon bristles.

The use of brushes which are composed essentially of nylon requires a special treatment. These nylon brushes must be soaked in a solution of an antistatic agent. A suitable antistatic agent which can be used for this purpose is identified as a cationic alkyl amine derivative. However, although this antistatic agent renders the brushes free from objectionable electrostatic charge, it is not a permanent treatment but wears off after a number of brushings over the photosensitive material. Therefore, the brushes must be frequently removed for retreating, necessitating additional time and expense which is avoided by the use of brushes made according to our invention.

Other antistatic agents which may be used for soaking brushes include such materials as triethanolamineoleate, triethanolaminestearate, and the like. Certain polymeric materials, such as polyalkylenepolyamine nucleus-containing polymers may also be used. These include poly-

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acrylyloxyalkyltrialkyl ammonium alkyl sulfate salts and the like. Certain phosphorous materials may be used such as a mixture of diethanolamine salts of phosphate esters, oxyalkyleneamine derivatives of phosphorous, and the like.

Although the conditions of treatment using the various antistatic agents for soaking brushes may be widely varied, we prefer to soak nylon brushes in a 10 percent solution of a commercially available cationic alkylamine derivative.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove and as defined in the appended claims.

We claim:

1. An antistatic brush containing bristles made from a mixture comprised of a polymer selected from the class consisting of polyhexamethylene diamine adipamide and polycaprolactam and a copolymer having 92 to 60 weight percent of vinylidene chloride and from 8 to 40 percent of acrylonitrile.

2. An antistatic brush comprising bristles made from a mixture comprised of 10 to 40 percent of a polymer selected from the class consisting of polyhexamethylene diamine adipamide and polycaprolactam and 90-60 percent of a copolymer containing 92 to 60 weight percent of vinylidene chloride and from 8 to 40 percent acrylonitrile.

3. An antistatic brush for use in packaging photosensitive materials comprising bristles made of a mixture comprised of a polymer selected from the class consisting of polyhexamethylene diamine adipamide and polycaprolactam and a copolymer of vinylidene chloride and acrylonitrile.

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