United States Patent Office 3,331,667
Patented July 18, 1967

3,331,667

FLEXIBLE, COATED ABRASIVE PRODUCT

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No Drawing. Filed Oct. 20, 1964, Ser. No. 405,279
4 Claims. (Cl. 51—298)

This invention relates generally to materials used in the art of wood and metal finishing, relating more particularly to the manufacture of abrasive products of the type comprised of a flexible backing and a coating of abrasive grit.

One of the problems encountered in manufacturing flexible, coated abrasive products resides in the provision of an adhesive which will tenaciously attach the abrasive particles to the flexible backing without coating over or enveloping the abrasive particles so as to reduce their cutting action. In the past, animal glue has been used extensively for mounting abrasive particles due to the fact that animal glue gels very rapidly and therefore tends to hold the abrasive particles in position partially protruding from the glue film. However, flexible, coated abrasive products based solely on animal glue perform unsatisfactorily in high speed sanding and polishing operations, under humid conditions and in circumstances wherein the coated product must either negotiate sharp radii or experience rapid and repeated flexing. Specifically, frictionally developed heat resulting from high speed operation softens the animal glue when a high percent of moisture is present either in the glue or in the atmosphere; and as the glue becomes soft and tacky, it picks up dust from the sanding or polishing operation. Such particles of dust clog the abrasive grit, diminishing and finally terminating the cutting action of the grit, usually long before the useful life of the grit has been reached. Animal glue is notoriously hygroscopic, rapidly picking up moisture from a humid atmosphere. An increase in the moisture content of the animal glue of a conventional, coated abrasive product results in a curling of the product which makes it difficult to use and which weakens it. In addition, animal glue has a lack of flexibility and produces a characteristically stiff and brittle coated abrasive product that has a strong tendency to shed the particles of abrasive material when caused to flex in a relatively extreme manner.

The present invention therefore takes as its principal object the solution of these prior art problems and the provision of a new and improved flexible, coated abrasive product.

Another object of the invention is to provide a flexible, coated abrasive product which has superior grain orientation.

Still another object of the invention is to provide a flexible, coated abrasive product which has a minimum tendency to absorb moisture from the atmosphere.

And still another object of the invention is to provide a flexible, coated abrasive product having excellent flexibility and little or no tendency to shed the abrasive grains when caused, for example, to negotiate a sharply curved path.

A further object of the invention is to provide a novel composition for use as a maker coat material and as a top size coat material in the manufacture of abrasive products.

A yet further object of the invention is to provide such a composition which produces a substantially continuous film.

And a yet further object of the invention is to provide such a composition which possesses superior bonding quality.

A still further object of the invention is to provide a

composition for use as a maker coat material which acts to bind the individual strands of a fibrous backing together, forming a more nearly unitary sheet and creating excellent unraveling characteristics in the coated abrasive product when the same is cut on the bias or torn for example.

These and other objects and features of the invention will become more apparent from a consideration of the following descriptions.

The objects of the present invention are achieved by combining animal glue and a latex containing an elastomeric copolymer, the animal glue being present in an amount of from about 5 to about 65 parts of glue for every 100 parts of combined glue and copolymer. The animal glue acts as a thickener for the latex and improves the adhesion and coatability of the latex. Cooperatively, the elastomeric copolymer imparts flexibility as well as moisture and heat resistance to the finished film. The composition produced by combining animal glue with a latex containing an elastomeric copolymer has utility as a top size coat in the manufacture of flexible, coated abrasive products. However, such a composition is especially useful as the maker coat, i.e. as the grit-anchoring adhesive. When suitably dewatered in the manufacture of a coated abrasive product, the composition of the invention becomes a gelatinous resilient material which is tough and which displays superior flexibility.

When it is to be employed as a maker coat material, the composition of the invention is intended to be applied directly to a flexible sheet backing of woven or felted fabric formed of either natural or synthetic fibers. Various types of paper and vulcanized fibre may also be employed for the flexible sheet backing. The coarse cotton drilling known as jeans cloth is rather frequently used. When jeans cloth is utilized for the flexible sheet backing, it is first dyed and stretched to the proper width, and then the back or print surface is sized, for example with a glue and starch mixture, in order to fill the spaces between the fibers and provide a barrier for preventing penetration of the maker coat material through the print surface of the cloth. Sizing of the flexible sheet backing so as to prevent penetration of the maker coat material facilitates application of the maker coat material by means of a calender roll since the sizing prevents the backing from adhering to the calender roll.

Whether it is to be employed as the maker coat material or as a top size coat material, the composition of the invention employs an animal glue which is characterized by comparatively low jelly strength, low viscosity and low molecular weight. Such animal glues have proved to be compatible with the latex, although some reaction between the copolymer of the latex and the carboxyl groups of the glue may occur. The general compatibility is believed to be due to the relatively low reactivity of the nitrogen and carboxyl groups present in the molecular make-up of the glue. Animal glue is classed as an albuminoid and consists of a complex mixture including such proteins as arginine, lysine and hystidine. The bone glue which is classified as jelly strength grade C2B has proved eminently useful in the instant composition, and this glue is produced by the so-called "last cook" in the manufacture of bone glue. Hide glue of equal test may also be employed. Another useful bone glue is known as C2 grade glue. This latter grade of glue has a jell strength of 35 grams.

The latex which is to be combined with the animal glue in making the composition of the invention comprises a water dispersion of a styrene-butadiene elastomer. Advantageously, a carboxylated styrene-butadiene elastomer is employed in the latex, such an elastomer having proved to cooperate with the animal glue to maximize the con-

tinuity of the applied film or layer. Suitable latices are available commercially from a numebr of manufacturers, including the International Latex Company and the Dow Chemical Company. The carboxylated styrene-butadiene latex available from the former company under the trade name Tylac GRS–CD–167–5 has proved suitable for use in the instant composition; and an example of a suitable non-carboxylated styrene-butadiene latex is the material sold by the latter company under the trade name Dow Latex 512–K, having a ratio of styrene/butadiene of 60/40 and a pH of 10±1.

To facilitate adding of the animal glue to the latex, the glue is first dissolved in water and the resultant solution is then added to the latex at room temperature. The proportions of animal glue and latex are calculated on the basis of the total weight of glue and elastomeric copolymer present in the final mixture, ignoring the water present. The animal glue is incorporated in an amount of no less than about 5 parts and no more than about 65 parts with the elastomeric copolymer being correspondingly present in an amount sufficient to produce 100 parts. The best balance of properties is achieved by incorporating the animal glue in an amount of about 15 parts with the elastomeric copolymer being present in an amount of about 85 parts. Five parts of the animal glue, on the described basis, has proved to be sufficient for improving the adhesion and coatability of the latex; and correspondingly, a minimum of 35 parts of the elastomeric copolymer is necessary in the dried film in order to insure the desired flexibility, heat resistance and moisture resistance.

The composition of the invention may be applied to the flexible sheet backing by means of a commercial sandpaper-making machine, the combined animal glue and latex being filled into the making box or the sizing box in accordance with which function it is to serve. The backing is fed through the making machine and the maker coat is applied in the conventional manner. The web of backing then travels past an abrasive applying device from which it is dispersed and applied to the side of the web which is wet with the maker coat. The web is then festooned for a short period to allow a preliminary set of the maker coat. Thereafter, the web is passed through the sizing section of the machine; and a sizing coat is applied over the grains in the usual way. The coated and sized web is then festooned in a sandpaper drying room where it is heated and dried in the customary manner. When the web is dried and cured, it is removed from the drying racks and cut into sheets or belts as is desired.

The composition of the invention successfully adheres all of the conventional abrasive grains or grit including garnet, fused aluminum oxide, flint, corundum, and silicon carbide. Moverover, when the composition of the invention is not used as the top size coat, various other materials may be employed. Such materials as animal glue and synthetic resins, for example phenolformaldehyde, epoxy and urea-formaldehyde resins have been employed as the top size coat material.

In order to describe the invention more fully, the following specific examples are given without, however, intending to limit the invention to the precise details set forth.

EXAMPLE I

Maker coat:	Percent by weight
Animal glue (C2B glue)	4
Water	16
Latex dispersion (Tylac GRS–CD–167–5— 42 to 43% carboxylated styrene-butadiene copolymer)	80
Top size coat:	
Animal glue (CC glue)	19⅓
Water	42
Filler (finely ground $CaCO_3$)	38⅔

The maker coat material and the top size coat material of Example I have been used at respective rates of 8.3 pounds per sandpapermaker's ream and 11.0 pounds per sandpapermaker's ream in attaching a suitable quantity of a wide range of grits to webs of jeans cloth backing. Specifically, the enumerated application rates for the maker coat material and the top size coat material of Example I have been employed in securing approximately 20–25 pounds per sandpapermaker's ream of No. 80 grit aluminum oxide to a jeans cloth backing in developing an open coat product.

In formulating the maker coat material of Example I, the animal glue is first brought into solution in the specified quantity of water. Subsequently, the resultant mixture is introduced gradually into the latex dispersion with mild stirring. The composition is ready for use when the components are thoroughly mixed together. The maker coat material of Example I incorporates approximately nine parts of the elastomeric copolymer to one part of the animal glue. This composition displays quick tack when applied to the flexible backing and therefore develops a superior orientation of the abrasive granules.

The flexible, coated abrasive product produced using the materials of Example I may be used in sheet form for manual operations or in belt form, such as for example in block sanding in the woodworking industry. Because of the superior adhesive character of the maker coat material of Example I and because of the flexibility of that composition, the finished product does not shed the abrasive grains when it is formed into a shape to sand intricate work.

EXAMPLE II

Maker coat:	Percent by weight
Animal glue (C2B glue)	16½
Water	62
Latex dispersion (Tylac GRS–CD–167–5— 42 to 43% carboxylated styrene-butadiene copolymer)	21½

The maker coat composition of Example II incorporates close to the minimum amount of the elastomeric copolymer which is necessary to overcome the tendency of animal glue to absorb moisture from the atmosphere, there being approximately two parts of glue to approximately one part of elastomer in the composition of Example II. The quantity of elastomeric copolymer present in Example II is also the minimum which is required to achieve the desired flexibility in a coated abrasive product. The maker coat material of Example II is employed with the same top size coat material and backing as in Example I. The abrasive grit, as to mesh and type of material and as to coating rate, is selected as is desired for the finished product.

EXAMPLE III

Maker coat:	Percent by weight
Animal glue (C2 glue)	5
Water	15
Latex dispersion (Dow Latex 512–K—48% styrene-butadiene copolymer)	80
Top size coat:	
Low temperature curing urea-formaldehyde resin (Urac 185)	85
Catalyst (ammonium chloride)	1.3
Buffer (tricalcium phosphate)	1.7

The maker coat material of Example III is prepared and applied as Example I. However, after the top size coat material of Example III is applied, the coated web is cured for about three hours at about 100–120° F. in the sandpaper drying ovens. The use of a catalyst permits a choice between a fairly long cure at room temperature and a shorter cure at an elevated temperature. The combination of the elastomeric copolymer and the animal glue develops sufficient heat resistance in the dried maker coat to permit this heat curing of the top size coat material. The top size coat material of Example

III promotes abrasive grain aggressiveness and resistance to frictionally develop heat in use without exhibiting the shedding of abrasive grains which is ordinarily encountered with products possessing such heat resistance and aggressiveness.

EXAMPLE IV

Maker coat:	Percent by weight
Animal glue (C2B glue)	2
Water	8
Latex dispersion (Tylac GRS–CD–167–5—42 to 43% carboxylated styrene-butadiene copolymer)	90

The maker coat composition of Example IV incorporates a near minimum amount of animal glue to thicken and make the latex dispersion sufficiently coatable and adequately adhesive in character. The maker coat of the composition of Example IV is intended to be used also as the top size coat material in order to further both the flexibility of the coated abrasive product and the attachment of the abrasive grit to the backing.

It is apparent that many widely different embodiments of this invention may be made without departing from the spirit and scope thereof; and therefore, it is not intended to limit the present invention except as is indicated in the appended claims.

The invention is claimed as follows:

1. A composition for use as maker coat material and as a top size coat material in the manufacture of abrasive products, said composition consisting essentially of a mixture of animal glue having a comparatively low jelly strength corresponding to grades C2B and C2 and a latex containing an elastomeric copolymer, said animal glue being present in an amount of from about 5 to about 65 parts of every 100 parts of combined glue and copolymer.

2. A composition according to claim **1** wherein said animal glue is present in an amount of about 15 parts for every 100 parts of combined glue and copolymer.

3. A composition according to claim **1** wherein said copolymer is a copolymer of styrene and butadiene.

4. A composition according to claim **1** wherein said copolymer is a carboxylated copolymer of styrene and butadiene.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,331,667 July 18, 1967

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It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 2, for "numebr" read -- number --; column 4, line 45, after "also" insert -- near --; column 4, line 66, for "as" read -- as in --; column 6, line 2, for "maker" read -- a maker --; line 9, for "of", second occurrence, read -- for --.

Signed and sealed this 18th day of June 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
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EDWARD J. BRENNER
Commissioner of Patents