

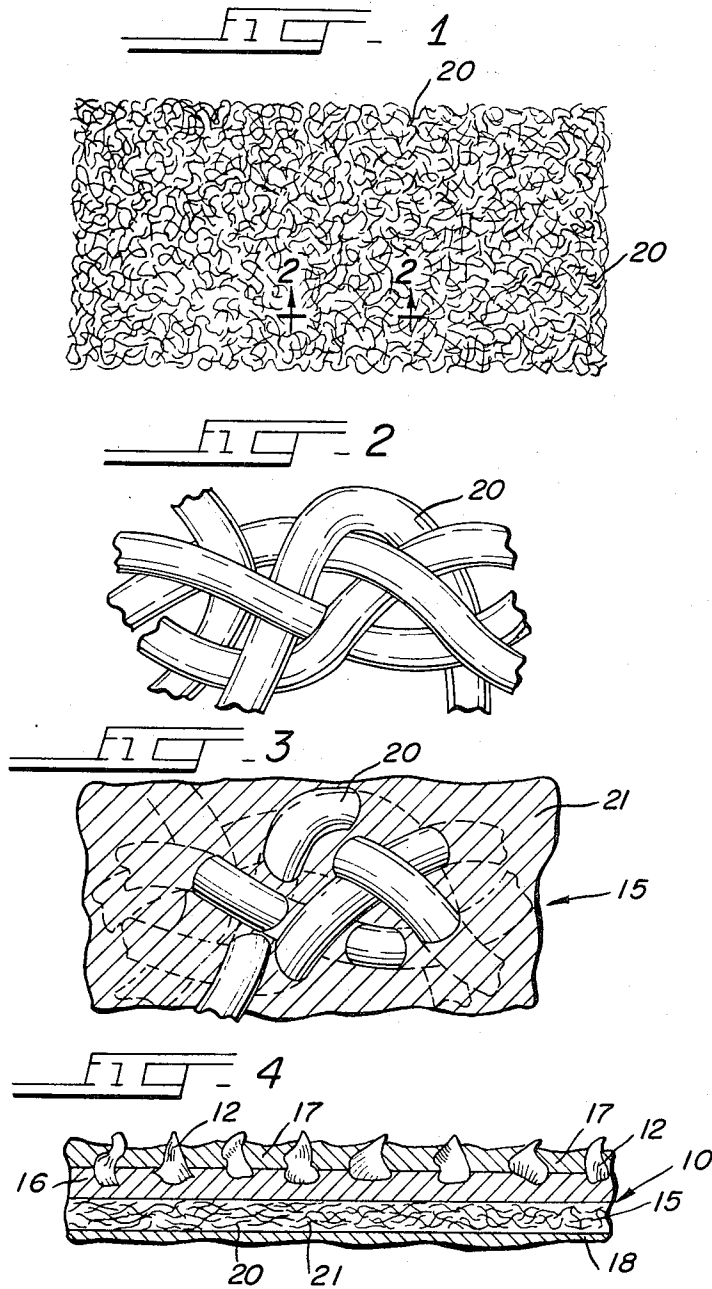
Sept. 17, 1968

H. W. SCHNABEL

3,402,034

COATED ABRASIVE PRODUCTS

Filed Oct. 19, 1965



INVENTOR
HERBERT W. SCHNABEL

BY *Carl C. Batz*
HHU

1

3,402,034

COATED ABRASIVE PRODUCTS

Herbert W. Schnabel, Alliance, Ohio, assignor to Armour and Company, Chicago, Ill., a corporation of Delaware
Filed Oct. 19, 1965, Ser. No. 497,644
3 Claims. (Cl. 51—295)

ABSTRACT OF THE DISCLOSURE

Coated abrasive products in sheet form which are resistant to heat build-up and curling having a backing consisting of a flexible sheet of self-bonded linear polyethylene fibers, the backing being impregnated with either a copolymer of vinyl chloride and vinylidene chloride or a combination of an epoxy resin, polyamide and long chain polyester. Abrasive grains are bonded to the impregnated backing by means of a polyurethane elastomeric adhesive and with a top-sizing of an epoxy novolac resin.

This invention relates to coated abrasive products and more particularly to coated abrasive products which are eminently useful in the wet sanding of various articles; such products being in the form of sheets, discs and belts.

In wet sanding operations and in other sanding and finishing operations where high humidity is encountered it is found that the customary paper-backed coated abrasive articles expand and curl resulting in a significant loss of their aggressive cut. Not only do these conditions reduce the aggressive cut of such abrasive products, but their life expectancy is also materially reduced. A number of solutions to the problem of providing satisfactory coated abrasive products for use in wet sanding operations have been proposed with varying measure of success. For example, in U.S. Patent 3,135,590 a coated abrasive product is disclosed which is stated to overcome the problem of the curling of paper-backings for coated abrasive when such abrasives are stored under conditions of variable humidities. However, experience has shown that such a product is not entirely suitable for use in wet sanding or abrading operations.

In U.S. 3,014,795 a coated abrasive product which consists of a Mylar polyester film as the backing material is disclosed. Although products prepared in accordance with this patent are useful in wet sanding operations, special precautions must be taken when such product is used in dry sanding operations to prevent heat build-up. Moreover a special web layer must be laminated to the polyester film in order to insulate the adhesive used from the frictional heat which is developed in a sanding operation.

If it were possible to provide coated abrasive articles which would remain flexible, resist heat build-up, while at the same time resisting curling and expansion and maintain a constant aggressive cut, a substantial advance in the art would be achieved.

A primary object of the present invention is to provide a coated abrasive article which overcomes the above-described disadvantages and which provides a flexible structure which maintains its aggressive cutting value under wet and other adverse conditions; in addition an article which resists heat build-up during dry sanding or finishing operations. A further object is to provide a plastic-backed abrasive article which is non-warping or non-

2

curling and which may be effectively held during hand sanding operations while at the same time maintaining its aggressive cutting value. Still another object is to provide an abrasive article having a flexible plastic-backing which is provided with a flexible coating for retaining its abrasive action. Other specific objects and advantages in this invention will appear as the specification proceeds.

The invention is illustrated in one embodiment by the accompanying drawing in which—

FIG. 1 is an enlarged view of the backing for the coated abrasive articles of this invention;

FIG. 2 is a greatly enlarged sectional view showing the fibers of the backing of the coated abrasive articles of this invention and taken on the line 2—2 of FIG. 1;

FIG. 3 is a greatly enlarged sectional view showing the fibers of the backing of the coated abrasive articles of this invention surrounded by a vinyl chloride polymer; and

FIG. 4 is a perspective view of a coated abrasive article embodying my invention.

I have found that a coated abrasive article which is highly resistant to moisture and heat build-up, which is flexible and in the form of a sheet, disc or belt may be made by using a backing for the coated abrasive product composed of a sheet of self-bonded linear polyethylene fibers, which sheet material has been saturated or impregnated with vinyl chloride polymers and copolymers or a modified epoxy resin.

The sheet materials which are formed of linear polyethylene fibers are paper-like in hand and appearance. Such materials are commercially available from E. I. du Pont de Nemours & Company and have been described as "spun bonded" which is a descriptive term for fiber structures manufactured from continuous synthetic polymeric filamentary materials in an integrated spinning and bonding process. The spun bonded sheet is formed by the random distribution of many minute continuous fibers (ordinarily less than about 4 microns in thickness) in web form. In the sheet material before processing according to the teachings of this invention, the fibers are self-bonded with no binder being employed to maintain sheet integrity.

The use of such a "spun bonded" product per se as a backing for coated abrasives has been found to be unsatisfactory. Experience has shown that it is extremely difficult if not impossible to get satisfactory bond between the abrasive grain and the spun bonded sheet polyethylene material. It is even more difficult to obtain a satisfactory bond to such spun bonded polyethylene sheet materials than it is to bond abrasive grain to Mylar polyester films. Moreover, such spun bonded sheet polyethylene materials have about a 20% elongation value. This elongation or stretch is considered excessive particularly when such a product is to be used as a backing for coated abrasives in the form of continuous belt. Experience has also shown that the spun bonded polyethylene sheet material tends to have poor internal adhesion and will delaminate under use.

In accordance with my invention the problems associated with the use of a spun bonded polyethylene sheet material in coated abrasives may be substantially reduced and even eliminated by impregnating the spun bonded sheet material with colloidal dispersions of vinyl chloride polymers and copolymers or a modified epoxy resin. Im-

pregnation of the sheet material with these compositions not only gives vastly improved adhesion of the maker coat to the backing, but also improves the internal adhesion of the spun bonded sheet material as well as increases the flexibility of the backing and reduces the tinniness associated with such materials. Moreover, the impregnated backing has reduced stretch over the non-impregnated material which makes the completed coated abrasive product much more suitable for use in coated abrasive belts.

The particular epoxy resins utilized in this invention are not considered as the hard or rigid type, but can be described as just as soft or even softer than the usual soft vulcanized rubber elastomers. These chemically modified epoxy resins can be further described as a combination of an epoxy resin, polyester and polyamide.

The epoxy resins employed in the present invention are the reaction product of epichlorohydrin with a dihydric phenol. Because of its ready availability, bisphenol A[bis (4-hydroxyphenyl)dimethylmethane] is preferred. The reaction is carried out in the presence of a caustic such as sodium hydroxide with the epichlorohydrin being employed in excess. The epoxy resins suitable for use in this invention may be characterized as having an epoxide equivalent of from 170 to 200; a viscosity at 25° C. in centipoises of from 3000 to 20,000; an average molecular weight of about twice the epoxide equivalent and are usually in a liquid condition at room temperature.

The polyamide component of the resin can be characterized as the condensation polymer of dimerized (and trimerized) vegetable oils, unsaturated fatty acids, and aryl or alkyl polyamines. The polyamides are amber colored thermoplastic resins with molecular weights ranging from about 3000 to about 10,000 and melting points ranging up to about 190° C. The polyamides having lower molecular weights, up to about 6,000, and lower melting points are used in this binder. I also prefer to use the polyamides in which a higher amine such as DETA is used in preference to ethylenediamine. It is also preferred to use the polyamides having higher amine values such as those having amine values ranging from about 290-450, with those polyamides having amine values ranging from 350-400 giving excellent results. The polyamides used can be further identified as having a viscosity (Gardner-Holdt) of from about 200-1,000 cps. at 25° C. Versamid 140 (available from General Mills) and D.E.H. 14 (available from Dow Chemical Co.) are two examples of polyamides which perform exceptionally well in the impregnating composition.

The polyamide component serves to cure the epoxy resin and to flexibilize the resin. Depending upon the amount of polyester, the weight ratio of polyamide to epoxy resin in the saturant is ordinarily from about 0.5/1 to about 1/1.

The polyesters useful in the resin composition are the long chain polyesters having chain lengths of at least 14 members. The chains may be terminated either with carboxy or alcoholic hydroxyl groups depending on the ratio of reactants employed in the synthesis. Excellent results have been obtained with a polyester identified as PL-5 available from General Resin Corporation and comprising the reaction product of approximately 3 mols of phthalic acid, 7 mols of adipic acid and 12 mols of dipropylene glycol. The weight ratio of polyester to epoxy resin is about 0.25/1 to about 1/1.

In preparing the saturant, the epoxy resin, polyamide and polyester are mixed together and thinned with a suitable solvent for ease in applying the binder to the fibrous web. The solvent is volatile; methylene chloride has proved to be an excellent solvent for this purpose.

The vinyl chloride polymers and copolymers useful in this invention may be described as colloidal dispersions in water having from about 48-58% total solids. We prefer the preplasticized or internally plasticized latices such as are commercially available under the trademark

Geon (B.F. Goodrich Chemical Company). An example of a suitable material is Geon 576 which is a preplasticized vinyl latex consisting of about 100 parts of resin solids with 35 parts of dioctyl phthalate. Geon 652 is a further example of a latex suitable for use as a saturant. It is an internally plasticized latex being a copolymer of vinyl chloride and vinylidene chloride.

When using a latex requiring a plasticizer care must be taken in the selection of the plasticizer. Dioctyl phthalate, dioctyl adipate and tricresyl phosphate are preferred since they ordinarily produce flexible films. Plasticizers such as propylene glycol and carbitol acetate are not desirable as plasticizers since the resulting films are too hard.

As previously stated, the use of the above impregnating compositions will actually increase the flexibility of the spun bonded polyethylene backing material. Moreover, such an impregnated backing has a reduced stretch over the non-impregnated material which makes the coated abrasive sheet product far more suitable for use in manufacture of coated abrasive belts.

Although impregnation of the spun bonded backing may be accomplished in a number of ways, I prefer to use the so-called "dip-squeeze" method whereby the spun bonded backing is passed through a tank containing the saturant and thereafter passed through rubber squeeze rolls to remove the excess saturant and give the desired ratio of saturant to backing.

The maker coat for imbedding the abrasive grains and uniting the grain to the impregnated spun bonded polyethylene sheet may consist of a urethane elastomer with such urethane elastomer ordinarily including the non-foaming group of polyol isocyanate products in solid or liquid phase which are usually made from diisocyanates and linear polyesters such as ethylene glycol adipate.

In order to securely anchor the abrasive grain while at the same time providing an upper hard-wear surface which is highly resistant to heat, I prefer to apply over the maker coat a top-sizing such as an epoxy novolac resin. The epoxy novolac resin is fully compatible with the more flexible urethane elastomer maker coating and this combination results in a very firm anchoring of the abrasive, at the same time providing an upper hard-wear surface which is highly resistant to heat. An epoxy novolac resin having at least 3 reaction epoxy groups is found to be highly effective. Such a material is produced by reacting epichlorohydrin with phenol formaldehyde to produce an epoxy resin product having 3 or more reaction groups. Such a product is on the market as epoxy novolac resin (DOW D.E.N. 438-A85).

Referring now to the drawings and in particular first to FIG. 4, there is shown a coated abrasive sheet comprising a layer of abrasive grains 12, the grains being firmly united to an impregnated spun bonded ethylene backing sheet 15 by means of maker coat 16. A top-sizing 17 is applied over the maker coat 16 which provides an upper wear surface highly resistant to heat. If desired, a very fine abrasive filler such as diatomaceous earth can be mixed in to the resin for impregnating the spun bonded polyethylene sheet and the addition of such an abrasive filler will provide a non-skid surface on the underside 18 of the backing 15.

FIGS. 1, 2 and 3 depict the spun bonded backing material of the coated abrasive product of this invention in greater detail. FIG. 1 is a greatly enlarged view of a portion of a piece of non-impregnated spun bonded polyethylene sheet material showing the random distribution of many minute continuous fibers 20 in web form. These fibers are self-bonded and no binder is employed to maintain the integrity of the sheet. FIG. 2 is a greatly enlarged and part-sectional view of fibers from the sheet material shown in FIG. 1. In FIG. 3 there is depicted the fibers as shown in FIG. 2 with the addition of the

impregnating resin or saturant **21** fully surrounding and filling the interstices between fibers **20**.

The abrasive grains may be deposited in any manner. If desired, they may be mixed in a slurry with the maker adhesive and the slurry deposited upon the sheet backing **15**, or the grains may be deposited upon the maker coating after the maker has been applied to the backing sheet **15**. The abrasive materials utilized may include all of the suitable or well known abrasives such as silicon carbide, aluminum oxide, garnet, flint, emery and pumice in varying grit size.

The following are typical specific examples of practicing this invention.

EXAMPLE I

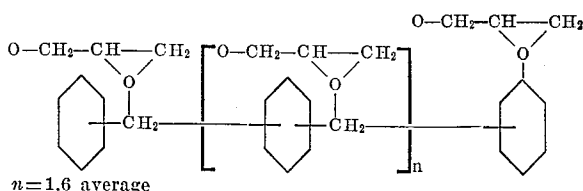
To a spun bonded polyethylene sheet 4-5 mils in thickness there was applied to the top surface a urethane elastomer maker coat which was subsequently coated with No. 80 grit silicon carbide in an open coat. The urethane elastomer maker coat had the following formulation:

	Parts
Bostick S-175-127-3A (a solution of a polyester glycol urethane substantially free of NCO and OH groups having a solids content of about 25%; a viscosity of about 30,000 cps. at 25° C.; a flash point of 98° F. T.O.C.; a weight of about 8.35 pounds/gallon) -----	57.5
Bostick S-175-127-3B (a triisocyanate which acts as a catalyst for Bostick S-175-127-3A; having an equivalent weight of about 290) -----	3.7
Cellosolve acetate -----	38.8

A top-sizing was then applied over the urethane elastomer which had the following formulation:

	Parts
Dow Epoxy Novolac D.E.N. 438-A85 ¹ -----	76.3
Cellosolve acetate -----	3.8
Xylol -----	8.8
DEH-14 (a polyamide curing agent and flexibilizer having an amine value of 350-400; a viscosity of 200-600 cps. at 75° C. [Gardner-Holdt] and available from Dow Chemical Company).	

¹ An epoxy novolac resin having an average of 3.6 epoxy groups per molecule can be represented by the structure



This resin reacts through its epoxy groups with all known curing agents and catalysts. Has an epoxide equivalent weight of 175-182; a viscosity at 25° C. (cps.) of 500-1200; specific gravity, 25/4° C. of 1.12-1.12; with a weight of about 9.5 pounds/gallon.

The spun bonded polyethylene sheet material was previously impregnated with a vinyl chloride-vinylidene chloride copolymer having the following formulation:

Geon 652 (a copolymer of vinyl chloride and vinylidene chloride, internally plasticized and having a solids content of 49-52%; pH at 6.0; viscosity [Brookfield at R. T.] of 7-12 cps.; a specific gravity of 1.120-1.132) -----	parts--	100
Acrysol A-5 (an aqueous solution of polyacrylic acid used as a thickener; available from Rohm & Hass Co.) -----	percent--	.01
Weight of saturant (lbs.):		
Wet -----		2-2.5
Dry -----		1 to 1.5

The spun bonded polyethylene sheet material was obtained from E. I. du Pont de Nemours and identified as Type 8822 having a thickness of 4 to 5 mils and a weight of approximately 1.5 ounces per square yard.

EXAMPLE II

Additional coated abrasive products were prepared as described in Example I except that the following additional formulations were employed:

Saturant

- (a) Geon 576 (a preplasticized vinyl chloride latex having a total solids content of from 55-57.5%; pH of 8.0; surface tension of 33-40 dynes/cm.; a viscosity [Brookfield at R.T.] of 29-40 cps., the specific gravity of the latex being about 1.26; available from B. F. Goodrich Chemical Co.).

Saturant weight (lbs.):

Wet -----	2
Dry -----	1

Parts

- (b) Epi-Rez 510 (an epoxy resin having a viscosity from 10,000 to 16,000 cps.; a specific gravity of 1.15-1.17 at 25° C.; an epoxide equivalent of 185-200; being the reaction product of 2 mols of epichlorohydrin with 1 mol of bisphenol A and available from Jones Dabney) ----- 100 |

PL-5 (a completely polymerized long chain polyester being the reaction of about 3 mols of phthalic acid with 7 mols of adipic acid and 12 mols of propylene glycol. It has an acid value of 28-32; available from General Resin Corporation) ----- 100 |

DEH-14 ----- 100 |

Methylene chloride ----- 120 |

Saturant weight (lbs.):

Wet -----	2.1
Dry -----	1.5

Maker coat

- Syntex 3414 (an epoxy ester having an oil length of about 35%; 79-81% solids and an acid value of 12 maximum) ----- 68.75 || High flash naphtha ----- | 29.18 |
| Cobalt naphthenate ----- | 1.81 |
| Lead naphthenate ----- | 0.23 |

Coated abrasive articles prepared in accordance with the foregoing examples prove to be highly flexible and supple. The flexibility of the spun bonded polyethylene backing impregnated with the compositions as set forth were actually more flexible and supple than the unimpregnated material.

The spun bonded polyethylene backing may have a thickness ranging from about 3 to about 12 mils. Materials having a thickness outside the foregoing range may be utilized although for most coated abrasives this range is quite satisfactory. The ratio of saturant to the spun bonded polyethylene backing by weight is approximately 1:3 to 1:2.

I claim:

1. A coated abrasive product comprising a backing composed of a sheet of self-bonded linear polyethylene fibers, said backing being impregnated with a material selected from the group consisting of a copolymer of vinyl chloride and vinylidene chloride and a copolymer consisting of:

- (a) an epoxy resin having an epoxide equivalent from 170 to 200, and a viscosity at 25° C. in centipoises of from 3,000 to 20,000;

- (b) a polyamide thermoplastic resin having a molecular weight of from 3,000 to 6,000, an amine value of from about 290 to 450, and a viscosity at 25° C. in centipoises of from 200 to 1,000, the weight ratio

7

of said polyamide to said epoxy resin being about 0.5/1 to about 1/1; and

- (c) a long chain polyester having chain lengths of at least 14 members and being the reaction product of phthalic acid, adipic acid and propylene glycol and wherein the ratio of said polyester to said epoxy resin is about .25/1 to about 1/1; 5

a layer of abrasive grains bonded to said impregnated backing by means of a polyurethane elastomeric adhesive, and a top-size coating over said grains and said polyurethane adhesive composed of an epoxy novolac resin having at least three reaction epoxy groups. 10

2. The coated abrasive product of claim 1 wherein a fine abrasive is included into said impregnating material.

3. The coated abrasive product of claim 1 wherein said polyester is a long chain polyester having chain lengths of at least 14 members and being the reaction of

8

about 3 moles of phthalic acid with 7 moles of adipic acid and 12 moles of propylene glycol and wherein the ratio of said polyester to said epoxy resin is about 1/1.

References Cited

UNITED STATES PATENTS

2,958,593	11/1960	Hoover et al.	51—295
2,981,615	4/1961	Baumgartner et al. ...	51—298
3,014,795	12/1961	Schmidlin	51—297
3,020,139	2/1962	Camp et al.	51—295
3,136,614	6/1964	Kuzmick	51—298
3,169,899	2/1965	Steuber	51—298.1
3,246,969	4/1966	Embree et al.	51—298

15 DONALD J. ARNOLD, *Primary Examiner*.