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Description

The present invention relates to a flexilbe abrasive endless belt having abrasive grains adhesively bonded to at least one side of a backing. Products comprising a flexible backing on at least one side of which are adhered abrasive grits are being referred to in the art as coated abrasives.

Coated abrasives, in general, have been made on ranging from paper, cloth, leather, to plastic films and metal sheets. Except for specialty items the greater majority of all coated abrasive products are made on paper or woven cloth backings.

Coated abrasives, often subject to high stresses in operation, are made from strong paper backings, vulcanized fiber backings, or, for strength and flexibility, woven cloth backings. Laminates of various of these materials have also been used and taught in the patent literature.

Problems connected with the use of woven cloth as a backing for coated abrasive articles, and for belts in particular, are the elongation characteristic inherent in woven cloth, due to the repeated curvature in the yarns, inherently produced by the interlaced nature of the material, and a weakening of the material in certain circumstances due to the inherent presence of "knuckles" at the cross-over points in the yarn. Knuckles are the small bumps on the surface of woven cloth caused by yarns curving to cross over other yarns. The presence of such knuckles is believed to be responsible for the catastrophic failure of coated abrasive articles, particularly belts, in certain severe grinding operations.

U.S. Patent 3,146,560 shows an abrasive article in which six glass fiber strands are immersed in a resin bath and the resulting mass passed through a discharge slot. Abrasive particles are then pressed into the resulted reinforced plastic web. The six strands are described as being "substantially in parallelism" (col. 8, lines 48—90). There is only one array of such strands.

In accordance with the present invention there is provided a flexible coated abrasive endless belt having abrasive grains adhesively bonded to at least one side of a backing consisting of a structure of at least two arrays bound to each other by a stitching yarn, each of said arrays being of non-interlaced substantially coplanar and coparallel reinforcing textile yarns, said arrays being oriented in at least two respective distinct directions in the plane of the backing, most of the tensile strength of the coated abrasive sheet material along each of said at least two directions being furnished by the yarns of all the arrays of non-interlaced substantially coplanar and coparallel yarns oriented in said directions, one of said arrays forming the warp yams and another of said arrays running in the fill direction, and optionally a thin tissue sheeting between the warp and fill yarns, said structure being front, respectively back, filled to fill spaces between the yarns and the grains being attached on the such treated backing via a maker coat.

Further advantageous features are evident from the dependent claims.

The desirable properties of woven textiles as a backing material for coated abrasives are retained, and many of the undesirable properties are avoided by the use of arrays of substantially coplanar and coparallel textile yams, which are not woven but are bonded into the structure of the coated abrasives according to the invention.

Theoretically ideal properties for coated abrasives would be expected for backings in which the arrays of yarns are exactly coplanar and coparallel. However, such exactitude in the arraying of the yarns is neither practical nor necessary to derive benefit from the use of this invention.

For the purposes of the present invention, an array of yarns is substantially coplanar if all the yarns of the array can be accommodated in the shape between two parallel planes which are separated by a distance of four times the average diameter of the yarns in the array. An array is substantially coparallel if the largest angular difference in direction between any two yarns in the array is no more than thirty denrees.

The use of such fabrics as stitch bonded Malimo fabrics results in the elimination of many of the disadvantages referred to above in connection with the use of conventional woven cloth.

Thus, the elongation and failure problems caused by the presence of knuckles in the woven cloth are avoided.

A major advantage of the non-interlaced fabrics when employed as substrates for coated abrasive is the fact that such fabrics can be produced at much higher rates of speed than can conventional woven textiles, thus increasing the productivity and lowering the cost of manufacture.

Referring specifically to the stitch bonded, Malimo type fabrics, these materials are produced by laying fill yarns over warp yarns and, with a third yarn, stitching the warp and fill yarns together. Because of the space requirement for the multiple stitching needles, there is an upper limit on the number of warp ends per inch in such fabrics. Because of this, the stitch bonded fabrics tend to be or may be of more open construction than conventional woven cloth for coated abrasive use. The greater openness, combined with the use of strong multifilament yarns permits design of fabric having lower weight than conventional woven fabrics of the same or lower strength and lear resistance, thus economizing on the use of raw materials. Thus special procedures may

be required in filling the spaces between the yarn in such fabrics. The overall production of coated abrasive from stitch bonded fabrics is, however, closely analogous to production from conventional woven cloth.

The steps of sizing the yarn, back filling or sizing, saturating, front sizing, applying a maker coat, applying abrasive, and finally applying a "sand" size coat may all be used in coated abrasive production from the Malimo type, or stitch bonded fabrics.

In some cases it may be desirable to insert a thin tissue sheeting between the warp and fill yarns, to aid in preventing the back-fill treatment from penetrating too far into the cloth. This can be done in the Malimo machine during the manufacture of the backing.

The ability to control the longitudinal strength and stretch properties of the material is important. While the total strength of a woven fabric in the warp direction cannot always be predicted by summing the strengths of the individual warp yarns and the strength properties can almost never be predicted from the stretch of the individual yarns, both these properties can be more readily controlled and predicted in the fabric designs employed in the present invention. In addition any tendency of coated abrasive belts to split when subject to stresses in use due to the effect of the interlaced filling (weft) yarns is eliminated by the use of the non-interlaced backing construction disclosed herein.

The particular finishing materials employed are not critical and many variations are possible provided proper cover and adhesion are achieved.

Important aspects of the finishing are obtaining good adhesion to the backing, properly filling the cloth and preparing its surface for the maker coat to hold the abrasive, and adequately bonding the yarns so that the end product resists delamination, splitting, and tearing. Adequate flexibility for the end use intended is also important. Thus the particular chemical structure of the finishing compositions is not critical, except to the extent that it affects the physical properties described above.

Other methods than the Malimo machine may be used to produce the arrays of yarns which are useful in preparing the non-interlaced backings of this invention. For example, prepared cut-to-length crossing yarns may be laid across an array of warp yarns, for example at right angles, by a suitable machine, or manually. The warp and overlaid yarns may then be consolidated by a stitching yarn. Other machines are known which wind a filling (so-called) array of yarns around the longitudinal warp yarns arrayed in a tubular configuration. Other machines or methods such as welt insertion machines can be employed to produce yarns arrays suitable for the present invention.

The presently preferred material for the warp yarns is continuous filament polyester having relatively high strength and low elongation properties. Obviously other yarns of similar or higher strength properties and similar or lower elongation under load, may be used. In less critical applications yarns with less strength and higher elongation could be used, and other advantages of the present invention be still retained.

Besides the various synthetic organic yarns, glass or metal yarns may be employed as part or all of the yarn arrays.

The preferred yarns in the fill direction are texturized continuous filament synthetic yarns, as in the example below. Natural and synthetic staple fiber textile yarns may be employed. Continuous filament yarns are particularly useful if they texturized, given a false twist, or are otherwise produced to have a high bulk or surface area so that good adhesion to the cloth finishing materials is achieved.

The following are examples of specific embodiments of the invention.

Example

This example, a preferred construction, employs a stitch bonded backing of the type disclosed in Figure 9 of U.S. Patent 2,890,579. The fabric of the example was made on Malimo machine (available from Unitecha Aussonhandelgesellschaft mbH, DDR-108 Berlin, Mohrenstrasse 53/54 GDR). The approximately 10.2 cm (4 inch) wide carrier for the fill yarns holds 61 ends, and makes one complete cycle from one edge of the web and back for every 4 inch longitudinal forward motion of the web. For a 152 cm (60 inch) wide machine this produces a fill which crosses the warp yarns at an angle of about 88° in one direction and 92° in the other. The switch yarns, which bind the warp to the fill arc 70 denier continuous filament polyester. The stitch length is 1.2 mm. The warp yarns are 1000 denier duPont type 68 continuous filament high tenacity polyester (9.2 grams per denier broaking strength), and the warp count is 14 ends per 2.54 cm (inch). The fill yarns are continuous filament 170 denier (containing 33 filaments) available from Celanese Corporation as type 731 polyester. These yarns have a low twist (0.25 per 2.54 cm (inch) and are texturized to provide a bulky yarn for optimum adhesion to coatings later applied. The tenacity is 3.5 to 3.9 grams/denier and the elongation is 18 to 24% at break. The yarn is preferably not treated with a coning oil.

The above described backing was then saturated with a resin and acrylic latex composition to prepare it for front-filling, back-filling, and coating with maker grain and size coat. A heat setting step is combined with

the drying of the saturant. The fabric finishing steps will now be described in more detail.

Saturation and heat setting

Standard sizing rolls are employed to apply the following composition in the amount of 1360 to 1814 g. (3 to 4 pounds) per standpaper makers ream (S.P.M.R.) 30.6 m (330 square feet). The fill yarn side of the fabric was facing up.

Saturant Composition

Cymel 482, available from American Cyanamid, a melamine-formaldehyde resin syrup 80% solids, pH 8 to 9	160 parts
Beetle 7238, available from American Cyanamid, a urea formaldehyde resin syrup	124 parts
water	120 parts
aqueous solution containing 15% NH_4Cl and 24% 2 amino 2 methyl propanol	13 parts
5 to 7 parts pigment dispersions may be added to color backing.	

Upon completion of the application of the saturant the fabric is dried on a tenter frame for at least 3 minutes in a hot air oven in which the temperature in the entry zone is 96.1°C, (205°F), and the temperature at the exit zone is 176.7°C (350°F). A tension of at least 907 g (2 pounds) per 2.54 cm (inch) of width is maintained on the fabric during its travel through the oven. This process not only dries the saturant but also heat-sets the fabric.

Front fill coating

The composition of the front fill coating, applied to the fill yarn side in this example, but which tan instead be applied to the warp yarn side if desired, is as follows:

(1) phenol-formaldehyde A state resol resin syrup having a formaldehyde to phenol ratio of 1.5 and a solids content of 78%	199 parts
(2) $CaCO_3$	160 parts
(3) sodium lauryl sulfate	2 parts
(4) Hycar 2600×138, a latex of an acrylic acid ester polymer having a glass transition temperature at 25°C available from B. F. Goodrich Chemical Company	54 parts

The front fill coating composition is applied with a box knife in the amount of 10 to 11 pounds per ream, and water may be added as necessary to maintain the required viscosity for proper coating. The coated cloth is again dried on a tenter frame with a tension of at least 907 g (2 pounds) per inch of width by passing through a hot air oven in which the entry temperature is 205°F and the exit zone temperature is 300°F.

Back fill coating

To the side not coated with the front fill is applied a back fill of the following composition.

(1) Beetle 7238 urea formaldehyde resin syrup available from American Cyanamid	133 parts
(2) Nopco NXZ anti-foam agent, available from Nopco Chemical Co., Newark, New Jersey	5.3 parts
(3) UCAR 151 adhesive, a polyethylene, polyvinyl acetate 60% aqueous dispersion, available from Union Carbide Corporation, having a pH of 4 to 6	133 parts
(4) air washed clay	176 parts
(5) aqueous solution containing 15% NH_4Cl and 24% 2 amino 2 methyl propanol	5.3 parts
(6) water—to adjust viscosity to 11 Pas (11000 cps) at room temperature, as needed (pigment may be added if desired to color backing).	

The composition is applied by knife coating in the amount of A5.4 Kg (10 pounds) per 30.3 m^2 (S.P.M.R.), and dried in an oven having an entry zone temperature of 150°F and an exit zone of 200°F.

The thus coated fabric is now ready for application of a maker coat of phenolic resin, the application of abrasive, and the application of an abrasive size coat, as is conventional and well known in the art. A suitable formulation to be applied to the front sized side of the backing is as follows:

(1) phenol-formaldehyde alkaline catalyzed resol resin, F/P* factor 2.08, pH 8.7, solids 78% in water	7 parts
(2) phenol-formaldehyde alkaline catalyzed resol resin, F/P* 0.94, pH 8.1, solids in H_2O 78%	3 parts
(3) $CaCO_3$	1.54×total solids

*Formaldehyde/phenol mole ratio.

To the adhesively coated fabric is then applied by conventional electrostatic means 16.06 Kg. (35.4 lbs-.)/sandpaper maker's ream (S.P.M.R) 30.6 m^2 (330 square feet) grit 60 high purity aluminum oxide abrasive grain. The abrasive-adhesive coated backing member is then heated for 25 minutes at 170°F., 25 minutes at 190°F., and 47 minutes at 225°F. to provide a dry adhesive layer 11.89 Kg/30.6 m^2 (17.4 lbs/S.P.M.R.) and to anchor the abrasive grains in the desired orientation.

Afterwards, a size coat 4.8 Kg/30.6 m^2 (10.6 lbs./S.P.M.R. dry) of the same composition as the maker coat, except of lesser viscosity, is then applied according to usual techniques. The wet adhesive layer is then dried: 25 minutes at 51.7°C (125°F.), 25 minutes at 57.2°C (135°F.), 18 minutes at 82.2°C (180°F.),25 minutes at 87.8°C (190°F.), and 15 minutes at 107.2°C (225°F.), after which a final cure at 110°C (230°F.) for 8 hours is given. The coated abrasive material is then ready to be converted according to usual techniques, into belts.

While the above example described finishing the backing with the abrasive coat on the fill side of the cloth, in other cases it may be more desirable to coat on the warp side.

It should be noted that a central feature of the invention is the use of yarn arrays which are not interlaced as in conventional woven fabrics, and the use of the terms "warp" and "fill" in the description of fabrics bonded by other means than weaving does not imply such interlacing.

The abrasive sheet material of the above example can be formed into belts by conventional joining techniques well known in the art. Particularly suitable are the butt joints described in U.S. Patents 3,665,600 and 3,787,273. Lapped joints as described in U.S. Patent 4,194,618 may also be used. In such cases it may be desirable to apply the front fill coating and the abrasive and maker on the warp side of the backing, instead of on the fill side. In the case of butt joints the backing may be coated on either one side or the other.

It should also be readily appreciated that more complex mechanical arrangements could be used to assemble the material described in the Example at high speed.

Claims

1. A flexible coated abrasive endless belt having abrasive grains adhesively bonded to at least one side of a backing consisting of a structure of at least two arrays bound to each other by a stitching yarn, each of said arrays being of non-interlaced substantially coplanar and coparallel reinforcing textile yarns, said arrays being oriented in at least two respective distinct directions in the plane of the backing, most of the tensile strength of the coated abrasive sheet material along each of said at least two directions being furnished by the yarns of all the arrays of non-interlaced substantially coplanar and coparallel yarns oriented in said directions, one of said arrays forming the warp yarns and another of said arrays running in the fill direction, and optionally a thin tissue sheeting between the warp and fill yarns, said structure being front, respectively back filled to fill spaces between the yarns and the grains being attached on the such treated backing via a maker coat.

2. A flexible coated abrasive endless belt according to claim 1, in which at least one of said arrays oriented in at least two distinct directions comprises texturized continuous filament yarns, or staple yarns.

3. A flexible coated abrasive endless belt according to claim 1 or 2, which is prepared by applying the abrasive grains electrostatically to the adhesive maker coat on the sheet material.

Patentansprüche

1. Flexibles beschichtetes schleifend wirkendes endloses Band mit auf wenigstens einer Seite eines Tragkörpers haftend gebundenen Schleifkörnern, bestehend aus einer Struktur aus wenigstens zwei miteinander durch ein Nähgarn verbundenen Anordnungen, von denen jede aus nicht miteinander verflochtenen, im wesentlichen in einer Ebene liegenden und zueinander parallelen textilen Verstärkungsgarnen besteht, wobei diese Anordnungen in der Ebene des Tragkörpers in mindestens zwei jeweils unterschiedlichen Richtungen orientiert sind und der größte Teil der Zugfestigkeit des beschichteten schleifend wirkenden Blattmaterials in jeder der mindestens zwei Richtungen durch die Garne aller Anordnungen von nicht miteinander verflochtenen, im wesentlichen in einer Ebene liegenden und zueinander parallelen Garnen, die in diese Richtungen orientiert sind, bewirkt wird, wobei eine der Anordnungen das Kettegarn bildet und eine andere der Anordnung in Querrichtung verläuft und gegenbenenfalls eine dünne Gewebefolie zwischen dem Kettengarn und dem Quergarn, wobei diese Struktur von vorne bzw. von hinten eingefüllt ist, um Zwischenräume zwischen den Garn und den Körnern auszufüllen, welche auf dem so behandelten Tragkörper mittles einer Bindemittelbeschichtung befestigt sind.

2. Flexibles beschichtetes schleifend wirkendes endloses Band nach Anspruch 1, bei dem wenigstens eine der in wenigstens zwei unterschiedliche Richtungen orientierten Anordnungen texturierte Endlosfilamentgarne oder Stapelgarne enthält.

3. Flexibles beschichtetes schleifend wirkendes endloses Band nach Anspruch 1 oder 2, welches durch elektrostatisches Aufbringen der Schleifkörner auf die haftende Bindemittelbeschichtung auf dem Blattmaterial hergestellt ist.

Revendications

1. Courroie sans fin flexible revêtue d'un abrasif ayant des grains abrasifs fixés de manière adhésive sur au moins une face d'un support formé d'une structure composée d'au moins deux réseaux liés l'un à l'autre par un fil de piqûre, chacun desdits réseaux étant composé de fils textiles de renforcement non-entrelacés, situés sensiblement dans un même plan et parallèles entre eux, lesdits réseaux étant orientés dans au moins deux directions respectives distinctes dans le plan du support, la majeure partie de la résistance à la traction du matériau en feuille revêtu d'abrasif le long de chacune desdites directions étant fournie par les fils de tous les réseaux de fils non-entrelacés, situés sensiblement dans un même plan et parallèles entre eux, et orientés dans lesdites directions, l'un desdits réseaux formant les fils de chaîne et un autre desdits réseaux allant dans la direction de remplissage, et éventuellement une feuille de tissu mince étant placée entre les fils de chaîne et de remplissage, ladite structure étant chargée respectivement, côté frontal et côté arrière, pour remplir les espaces entre les fils, et les grains étant fixés au support ainsi traité par l'intermédiaire d'une enduction.

2. Courroie sans fin flexible revêtue d'un abrasif selon la revendication 1, dans laquelle l'un au moins desdits réseaux orientés dans au moins deux directions distinctes comprend des fils de filaments continus texturés ou des fils de fibres discontinues.

3. Courroie sans fin flexible revêtue d'un abrasif selon la revendication 1 ou 2, préparée en appliquant les grains abrasifs électrostatiquement à l'enduction adhésive formée sur le matériau en feuille.