

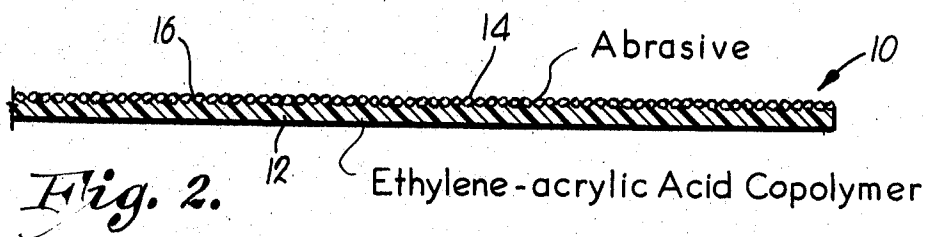
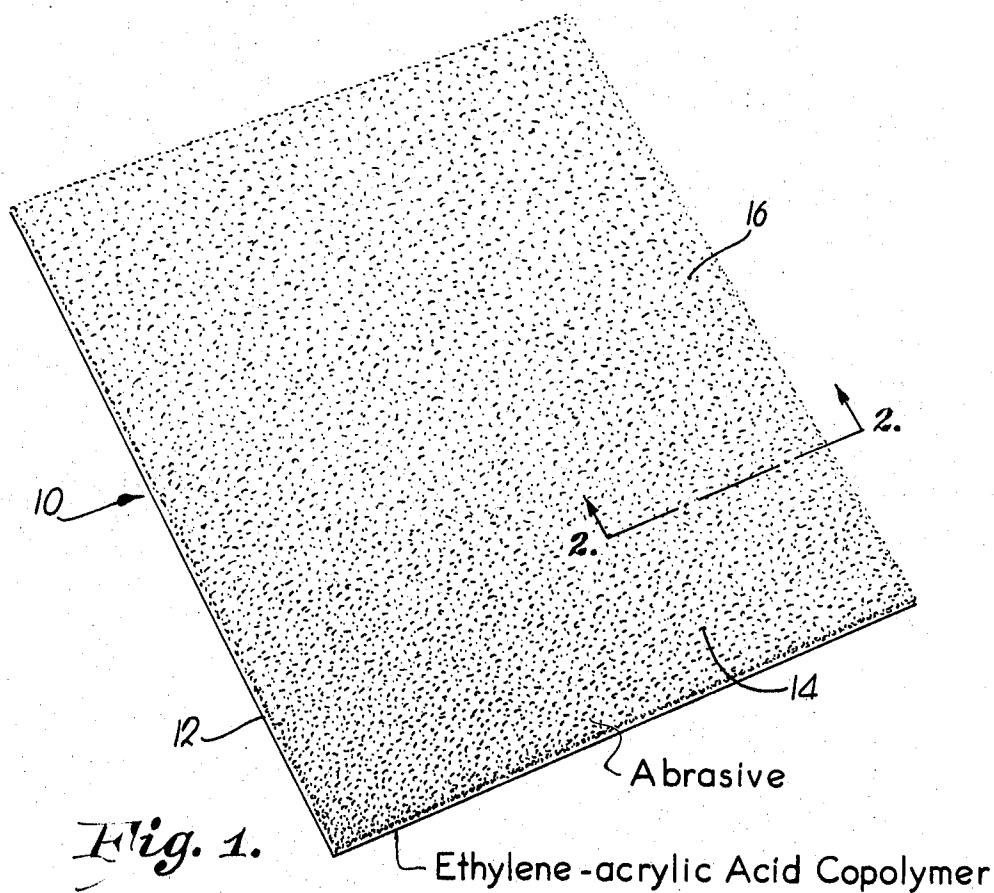
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1

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SANDPAPER

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4 Claims

ABSTRACT OF THE DISCLOSURE

An improved flexible abrasive sheet and a process for producing the same is disclosed. The flexible abrasive sheet includes a backing of a copolymer of ethylene and acrylic acid having a melt index as determined by ASTM Test No. D1238—57T of from about 10 up to about 50 and contains from about 15 up to about 20 percent polymerized acrylic acid based on the weight of the copolymer, and an abrasive grit partially embedded in the ethylene-acrylic acid copolymer backing. The flexible abrasive sheet is free of any adhesive or bonding agent between the backing and the abrasive grit.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a flexible abrasive sheet or an improved substitute for conventional sandpaper. In a more particular aspect, the invention pertains to a backing for an abrasive which is similar to but has a number of advantages over conventional sandpaper. The present invention relates not only to the abrasive backing but also to the complete abrasive paper, board, belt, wheel, or the like. The instant invention is concerned not only with the abrasive material and the paper or backing for the abrasives but also to a method of producing the abrasive sheet, sandpaper, or the like. These coated abrasive products may be made in the form of sheets, discs, belts, or the like and are known in the art as flint papers, garnet papers, emery cloth, sanding belts, abrasive discs, etc.

Description of the prior art

In many instances in the prior art, the life service of abrasive belts, papers, discs and other abrasive bodies including the particles or other abrasive materials employed in these abrasive bodies has been comparatively limited. Numerous causes have contributed to early failure and poor functioning of many of the prior art abrasive bodies. One of the contributing factors is the strength of the backing material which has often been limited and the flexibility of the same which in many cases has been poor. Another factor has been that the individual abrasive particles of the abrasive material have not been sufficiently bonded or held to the abrasive backing such that the particles have often quickly become dislodged from the backing and the abrasive material has been depleted of abrasive particles on its surface. In the past, the customary method of producing an abrasive surface has usually consisted of bonding abrasive particles or grit to a backing using adhesives such as glues, resins or plastics.

Coated abrasive products have in recent years become industrially important due in part to their enhanced cutting abilities when contrasted with solid bonded adhesive products, and also because of the greater convenience in

2

adopting coated abrasive products to intricate contour grinding. In the present state of the coated abrasive art, reliance is had mainly on relatively rigid binders or adhesives for bonding the abrasive grains or particles to the backing of the product, since retention of the surface abrasive grains is of primary importance for economy of service. Accordingly, most of the conventional abrasive coated products utilize as the bonding adhesive natural or synthetic glues, phenolaldehyde resins or modifications thereof.

In spite of the substantial industrial acceptance of coated abrasive products, their use has been limited or restricted for a number of reasons. Due to the hard or rigid character of many of the bonding adhesives used, the abrasive products are relatively rigid and stiff. In the abrading of surfaces of intricate convolutions and compound curves, it is difficult to properly abrade or polish such surfaces because of the nonconformability or stiffness of these conventionally made coated products. Bending to achieve conformability to the object being abraded usually cracks the abrasive surface and at times the backing material also, which can result in the loss of substantial amounts of abrasive particles or grits. For service where greater resistance to such failure is required, the backing material may be sized cloth such as cotton twill, chambric, etc. However, even with reliance on fabrics, the conventional adhesives are sufficiently rigid so that the end product retains sufficient rigidity to promote cracking, spalling and breakage when used under extreme conditions of flex and deflection. The adhesive bond is faulty in its inability to distend, deform and stretch consistent with the requisite adhesion of the abrasive grains to the backing of the abrasive product. In use, the abrasive surface becomes prematurely loaded with abraded particles, which later stay embedded between the grains of the abrasive surface impeding or inhibiting further abrading use of the abrasive product. The rigid adhesives are furthermore relatively weak as a bond, resulting in the tendency of the abrasive grains to loosen and fall away particularly if worked over surfaces other than flat.

SUMMARY OF THE INVENTION

It is the general object of this invention to provide an improved substitute for conventional sandpaper in the form of a flexible abrasive product which may be produced without the use of an adhesive or bonding agent between the backing and the abrasive particles or grit.

Another object of the subject invention is to provide a sandpaper substitute of improved quality in the form of a flexible abrasive sheet wherein the loss of abrasive particles from the sheet when the same is employed in abrading work is substantially reduced.

A further object of the invention is to provide an improved flexible abrasive product which when compared with sandpaper and other well known conventional abrasive products has an increased life, has a backing which is extremely tough, is water resistant, has a long wearing life and is of a tacky nature such that the backside of same is easily gripped and will not slip in one's hand or other equipment with which the abrasive product is employed.

In general, these objects are attained by providing an improved abrasive product and a process for producing the same, which product consists essentially of a backing of a copolymer of ethylene and acrylic acid and an abra-

sive grit which is partially embedded in the ethylene-acrylic acid copolymer backing. The abrasive product is free of and is produced without the use of any adhesive or bonding agent between the backing and the abrasive grit.

BRIEF DESCRIPTION OF THE DRAWING

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing in which:

FIG. 1 is a perspective view of the improved abrasive product or sandpaper substitute of this invention;

FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

It has been found that an improved abrasive product or an improved substitute for conventional sandpaper can be formed and produced without the use of an adhesive, bonding agent or binder between the abrasive particles or grit and the backing, if the abrasive particles or grit (such as the "sand" used in the manufacture of conventional sandpaper) is partially pressed at an elevated temperature into the softened surface of a backing which consists of a film prepared from an ethylene-acrylic acid copolymer. The sandpaper substitute or improved abrasive sheet prepared in accordance with this invention is superior to conventionally prepared sandpapers in that no adhesive or bonding agent is required between the abrasive particles and the backing. Furthermore, due to the tenacious gripping properties and characteristics of the ethylene-acrylic acid copolymer film backing of the abrasive sheet, the individual granules or particles of grit are not readily or easily pulled out or separated from the film backing. Additionally, the substitute sandpaper backing consisting of a film prepared from an ethylene-acrylic acid copolymer, as designated by the invention, has a markedly increased life when compared to the backing of conventional sandpapers, such that the same will not readily wear through as with the backing of conventional sandpapers. Another big advantage of the abrasive sheet of this invention when compared to conventional sandpapers having paper or cloth backings is that the product of this invention is non-reactive with water. The improved abrasive product of this invention also has the additional advantage and desirable characteristic over conventionally prepared sandpaper of possessing a tacky backside or surface whereby the same is readily gripped without slipping or sliding by one's hand or the surface of other equipment with which the abrasive product is employed, such as an electric sanding machine.

The improved flexible abrasive product of this invention may be prepared in any desired form, depending upon the end use in which the abrasive product is to be employed. This is to say that the abrasive product may be fabricated in the form of a flexible sheet, a belt, a disc, a board such as an emery board, or the same may be fabricated with a proper form or support into a wheel similar to an emery wheel or grinding disc. The thickness of the film backing of the ethylene-acrylic acid copolymer is determined by and depends upon the end use to which the abrasive product is to be put or employed. Typically and preferably, the thickness of the thermoplastic film backing of the abrasive product will range from about 5 up to about 50 mils depending upon desired end use. The abrasive particles themselves or the grit may be any suitably hard substance which has been powdered for use as an abrasive. Suitable examples would include alumina, silicon carbide, emery, garnet, or other like grit, or rouge or the like for polishing.

The ethylene-acrylic acid copolymer from which the film backing of the improved abrasive sheet or other like product of this invention is prepared should contain from about 5 up to about 30 percent acrylic acid based upon the weight of the copolymer. Preferably, the copolymer from which the film of the backing is prepared will contain in the range of approximately 15 up to approximately 20 weight percent polymerized acrylic acid with the remainder thereof being polymerized ethylene. The melt index of the ethylene-acrylic acid copolymer from which the film backing of the abrasive product is formed may be in the range of from approximately 0.5 up to about 80 as determined by ASTM Test No. D1238-57T. The ethylene-acrylic acid copolymer used will preferably have a melt index of from about 10 up to about 50 as determined by the above-identified test.

One method or process by which the improved abrasive product of this invention may be formed is initiated by forming the backing film from an ethylene-acrylic acid copolymer. Pellets of the copolymer are formed into a film which is to be used as the backing of the abrasive product by pressing the same between the platens of a platen press at a sufficient temperature and pressure to convert the pellets to a homogeneous film. After the film had cooled, a uniform layer of an abrasive or grit was evenly distributed over the surface of the same. Next, the combination of film and abrasive particles were pressed in the platen press with the platens thereof barely touching for a period of 30 minutes at a temperature in the range of from about 75 to about 100° C. After the 30 minutes had elapsed, the film was removed from the press and it was found that the abrasive particles or grit were well bonded to the film.

With detailed reference to the drawing, the improved flexible abrasive sheet or sandpaper substitute of this invention 10 is seen to include a sheet-like backing 12 which is a thermoplastic film prepared from a copolymer of ethylene and acrylic acid. In a specific embodiment of the invention, film backing 12 had a thickness of approximately 10 mils. As previously set forth hereinabove, the ethylene-acrylic acid copolymer may possess a melt index in the range of 0.5 to 80, and preferably will have a melt index of from about 10 up to about 50; all melt indexes being determined by ASTM Test No. D1238-57T. In one specific embodiment of the invention, the ethylene-acrylic acid copolymer employed in forming the film backing 12 of the flexible abrasive sheet 10 possessed a melt index of 40. Additionally, as described hereinbefore, the copolymer of ethylene and acrylic acid will have an acrylic acid content in the range of approximately 5 to 30 percent based on the weight of the copolymer, and preferably will contain from about 15 up to about 20 weight percent acrylic acid. In one specific embodiment of the invention, the ethylene-acrylic acid copolymer employed in preparing the film backing 12 of the flexible abrasive sheet 10 had an acrylic acid content of 18.1 weight percent. The other portion or part of flexible abrasive sheet 10, which completes the same, is the abrasive or grit 14 which as has been stated herein may be any suitably hard substance powdered for abrasive use such as alumina, silicon carbide, emery, garnet, or other like grit, or rouge or other like materials used in polishing. In one specific embodiment of the invention, the abrasive particles or grit employed was a silicon carbide grit of a No. 180 mesh. With particular reference to FIG. 2, it can be readily observed that the film backing 12 and the abrasive particles or grit 14 make up and comprise the flexible abrasive sheet 10, and that no adhesive or bonding agent is required or used between backing 12 and abrasive or grit 14. In the figure, it can be seen that the abrasive particles 14 are partially embedded in and held by the surface 16 of the film backing 12.

In order to illustrate the process of producing the improved flexible abrasive sheet of this invention, the

5

abrasive sheet itself, and some of its improved properties with greater particularity, the following specific examples are included, not only for illustrative purposes but also for comparative purposes. The examples are intended to illustrate only and are not intended to limit the invention in any way.

EXAMPLE 1

This example illustrates the preparation of an improved flexible abrasive sheet or sandpaper substitute of the invention. The product of this example will be used hereinafter as a basis for comparison with other similarly formed abrasive sheets wherein the backings thereof are prepared from other thermoplastic materials.

Pellets of an ethylene-acrylic acid copolymer were placed between the platens of a platen press for pressing into a film. The copolymer contained approximately 18.1 weight percent acrylic acid and had a melt index of about 40. A film of approximately 10 mils in thickness was pressed on the platen press using a temperature of 225° F., a pressure of 150 p.s.i. and a spacing between the platens of about 10 mils. After the pressed film had cooled, a layer of approximately $\frac{1}{16}$ inch in thickness of silicon carbide (Carborundum) grit of a No. 180 mesh size was evenly and uniformly distributed on the surface of the pressed film. This combination was then placed in the platen press with the platens thereof barely touching the respective sides of the combination at a temperature of about 200° F. for a period of 30 minutes. After the 30 minute time interval had elapsed, the film was removed from the platen press and it was observed that the Carborundum grit was well bonded to the film. The film was then trimmed to produce a sheet of flexible abrasive material similar to that depicted at reference numeral 10 in the figures of the drawing. The flexible abrasive sheet produced in this example is compared hereinbelow in Table I with other similar sheets produced in the following examples.

EXAMPLE 2

A flexible abrasive sheet similar to that prepared in Example 1 was fabricated in this example by the method and process set forth in Example 1 employing pellets of a high-pressure, low-density ethylene homopolymer to form the film backing of the abrasive sheet. The low-density, high-pressure polyethylene used had a melt index of approximately 2. The thus fabricated abrasive sheet in compared with other similarly prepared abrasive sheets hereinbelow in Table I.

EXAMPLE 3

In this example, a flexible abrasive sheet similar to the one fabricated in Example 1 was prepared by the same procedure as that used in Example 1 with the exception that pellets of a linear or high-density polyethylene were used in forming the film backing of the abrasive sheet. The linear polyethylene employed was a high-density, low-pressure polyethylene marketed by Phillips Petroleum Company under the trade designation Marlex 6003, and had a melt index of approximately 0.3. The resultant flexible abrasive sheet is compared with other similarly fabricated sheets in Table I hereinafter.

EXAMPLE 4

A flexible abrasive sheet similar to that obtained in Example 1 was prepared in this example by the method and process of Example 1 using pellets of a propylene homopolymer to form the film backing of the sheet in the platen press. The propylene homopolymer used had a melt index of approximately 3. The flexible abrasive sheet produced herein is compared in Table I hereinbelow with other similarly prepared abrasive sheets.

6

EXAMPLE 5

In this example, a flexible abrasive sheet similar to that obtained in Example 1 was produced by the procedures of Example 1 employing pellets of a copolymer of ethylene and methyl acrylate in the platen press to form the thermoplastic film backing. The ethylene copolymer used in this example contained approximately 20 weight percent methyl acrylate and had a melt index of approximately 2. The resultant abrasive sheet is compared with other similarly fabricated abrasive sheets in Table I which follows.

Portions or samples of each of the abrasive sheets prepared in the above Examples 1 through 5, inclusive, were cut to fit on the wheel of a Taber Abraser. This piece of laboratory equipment is used to give a quantitative analysis of the resistance to abrasion of various materials used therewith. Each of the cut samples obtained from the flexible abrasive sheets prepared in the above examples was in turn placed on the Taber Abraser apparatus to run thereon under a CS-17 Calibrase wheel which was used with a 500 gram weight or load. This combination of load and wheel produced a harsh abrasive effect. The results of each of the tests is set forth hereinbelow in Table I with the results being expressed in terms of a wear index.

TABLE I

Sample of Example	Wt. before abrasion	Wt. after abrasion	Net loss	No. cycles	Wear index
1.....	10.8289	10.6593	0.1696	1,125	150.8
2.....	5.0353	4.6250	0.4103	1,125	364.7
3.....	6.1608	5.9571	0.2037	1,125	181.1
4.....	4.4781	4.2663	0.2118	1,125	188.3
5.....	3.0181	2.7213	0.2918	17	(?)

¹ The sample of Example 5 began to curl, bunch and roll up after 7 cycles under the abrading wheel and, therefore, could not be run for the full 1,125 cycles, evaluated and compared.

² Very high.

As can be readily observed from the above table, the results of wear index obtained using the sample of Example 1 is substantially lower than the result or wear index obtained with the samples of the other examples. The wear index determined for the Example 1 sample indicates that this particular sample possesses the greatest resistance to abrasion of the various sheets or abrasion products tested and compared in the table. The low wear index determined for the sample of Example 1, the abrasive sheet having a film backing prepared from an ethylene-acrylic acid copolymer, indicates that the abrasive particles or grit of the sheet are more securely held in the backing than with the sheets of the other examples, and that the loss of abrasive particles from the sheet during abrasive work is substantially reduced and less than that of the sheets of the other examples.

While only certain preferred embodiments of the invention have been described and illustrated, many modifications and variations will occur to those skilled in the art. It is, therefore, to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed as new and what it is desired to secure by Letters Patent of the United States is:

1. An improved abrasive product consisting essentially of a backing of a copolymer of ethylene and acrylic acid and an abrasive grit partially embedded in said ethylene-acrylic acid copolymer backing, said abrasive product being free of any adhesive or bonding agent between said backing and said abrasive grit.

2. The improved abrasive product as set forth in claim 1 wherein said ethylene-acrylic acid copolymer contains from about 5 up to about 30 percent polymerized acrylic acid based on the weight of said copolymer and, correspondingly, about 95 to about 70 weight percent polymerized ethylene.

3. The improved abrasive product as set forth in claim 2 wherein said ethylene-acrylic acid copolymer contains from about 15 up to about 20 percent polymerized acrylic acid based on the weight of said copolymer.

4. The improved abrasive product as set forth in claim 5 3 wherein said ethylene-acrylic acid copolymer contains about 18.1 weight percent polymerized acrylic acid and said abrasive grit is silicon carbide.

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