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(54) **Abrasive product and the production process thereof**

(57) The invention provides an abrasive product comprised of a web of undulated polymer filaments coated with a cured binder resin that includes abrasive particles having a hardness which renders them capa-

ble of removing soft coatings from a hard substrate surface but incapable of altering the hard substrate surface. The invention concerns also the use and the process of production of this abrasive product.

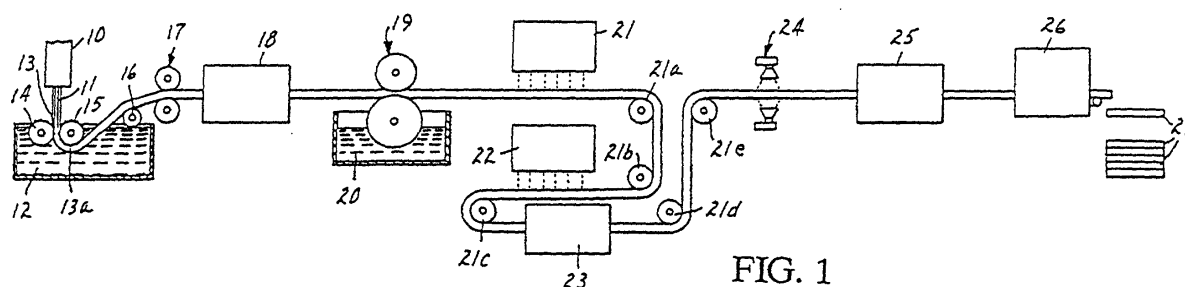


FIG. 1

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DescriptionField

- 5 **[0001]** This invention provides a non-woven abrasive product capable of removing coatings from hard substrate surfaces without altering the substrate surface.

Background

- 10 **[0002]** Non-woven, low-density abrasive products made of a uniform lofty web of continuous three-dimensionally bonded polyamide filaments, such as those abrasive products described in US Patent No. 4 227 350 (Fitzer), have found successful application for treating or conditioning various types of surfaces. These applications include, in part, removing mill scale from steel coil stock, blending of weld lines, preparing surfaces for painting or other coating operations, and removing various surface coatings in repair and maintenance operations.

- 15 **[0003]** Conventional abrasive products typically incorporate very hard minerals such as aluminum oxide, silicon carbide, and the like that have very high hardness and toughness properties. They are able to abrade any of a variety of workpieces including those made of steel, stone, wood, plastic, and the like. This is an advantage in many applications, for example grinding, finishing and polishing. When used for removing coating layers from a sensitive base substrate, however, such hard abrasive minerals will also attack the substrate and are, accordingly, less satisfactory.

- 20 **[0004]** It is already known, in the domestic environment, to use non-woven abrasive products for cleaning sensitive surfaces such as coated cooking utensils, ceramic surfaces and the like. US-A-4 991 362, for example, describes a hand scouring pad formed from an open lofty array of filaments. Hand pads for use in the domestic environment are intended for use on small areas and are not generally suitable for use in an industrial context because they will not provide the high levels of efficiency that are required and will wear out rapidly.

- 25 **[0005]** WO-A-00/41850 discloses a durable, non-woven abrasive product having a significantly longer useful product life compared to conventional, but similar, abrasive products. The abrasive product has a porous, lofty web of multiple layers of coiled, autogenously bonded thermoplastic filaments, binder resin, abrasive granules and size resin.

- [0006]** Other abrasive products that have been proposed for removing coatings from sensitive substrates include coated abrasives as described, for example, in US-A-3 382 058 and molded abrasive brushes as described, for example, in US-A-6 126 533.

- [0007]** A number of alternative approaches, not using abrasive products, have been taken in different industries to specifically remove coating layers from sensitive base substrates.

- 35 **[0008]** For example, in some industries, methyl chloride has been used for many years for removing coatings from base substrates. This chemical has a selective action. Only the top layers react with the methyl chloride and soften, leaving the base material untouched. Methyl chloride is now classified as a low category carcinogen if present in concentrations of more than 1% and, consequently, its use is being phased out.

- [0009]** Aerospace maintenance companies have found chemical removal of coatings useful because aerospace substrates typically comprise materials, for example aluminum alloy, that are easily damaged by conventional abrasives. Chemical removal of coatings as a technique is also rapidly applicable to large surface areas. The main application is paint removal on the body of an aircraft (one Airbus™ aircraft Model A 340, for example, represents 2000 m² of painted surface) but another important application is sealant removal from fuel tanks and various other areas. However, chemical strippers and softeners are not allowed on composite materials and cannot, therefore, be used for coatings removal on all parts of an aircraft.

- 45 **[0010]** Increasing use is being made of composite and aluminum alloy panels in the automotive manufacturing industry, and similar problems in selective removal of coatings from such substrates are also experienced in the automotive repair trade.

- [0011]** Other techniques for removing coatings from substrates include the following: blasting using plastic and natural media; cryogenic removal; water-jet removal; and laser removal. Plastic/natural media blasting and laser removal are not suitable for large surface areas, while cryogenic and water-jet removal are not suitable for use on composites. Moreover, each of those techniques requires the use of comparatively expensive equipment. There is therefore an urgent, increasing and important need for a selective coating removal technique featuring many of the following properties:

- effectiveness on both metallic and composite substrates
- 55 - high efficiency, enabling coating removal over an area of at least 4m²/h, preferably 6m²/h (working time only; preparation, for instance masking, protecting, cleaning, not included)
- uniform finish
- selectivity, i.e. no damage to the substrate or its surface preparation (e.g. chromic anodisation in the case of

aluminum; primer in the case of composite) coupled with effective removal of the coating(s)

- controlled average roughness of the substrate, to allow repainting

Summary of the invention

[0012] Useful exploitation is made of the surprising discovery that using abrasive granules bonded to a particular type of porous, lofty web by a particular type of binder resin results in a selective abrasive product.

[0013] The present invention provides an abrasive product comprising:

- a. a three-dimensional web comprised of a plurality of undulated polymeric filaments, with adjacent filaments contacting and being bonded to one another;
- b. a cured binder resin comprised of the cured product of a mixture of an aqueous dispersion of carboxylated butadiene-acrylonitrile copolymer and a second binder selected from the group consisting of phenolic resin and aqueous-dispersible epoxy resin; and
- c. a plurality of abrasive particles having a hardness which renders them capable of removing soft coatings from a hard substrate surface but incapable of altering the hard substrate surface.

[0014] The present invention further provides a process for making an abrasive product, said process comprising:

- a. providing a three-dimensional web comprised of a plurality of undulated polymeric filaments, with adjacent filaments contacting and being bonded to one another;
- b. coating the polymeric filaments of the web with a resin binder comprised of a mixture of an aqueous dispersion of carboxylated butadiene-acrylonitrile copolymer with a second binder selected from the group consisting of phenolic resin and aqueous-dispersible epoxy resin;
- c. depositing on the coating before curing a plurality of abrasive particles having a hardness which renders them capable of removing soft coatings from a hard substrate but incapable of altering the hard substrate surface; and
- d. curing the coating to provide the abrasive product.

[0015] The present invention therefore provides a selective non-woven abrasive product comprising a porous, lofty web preferably of multiple layers of coiled, autogenously bonded thermoplastic filaments, a conformable binder resin, abrasive granules and optionally a size resin. The conformable binder resin is advantageously provided by including a latex in the binder resin formulation. The abrasive granules are preferably soft, preferably with a Moh's hardness of 4 or less.

Detailed description

[0016] More preferably, the present invention provides an abrasive product comprising

- a porous, lofty web of multiple layers of coiled, autogenously bonded polyamide filaments, the web having a basis weight of between 0.8 and 1.80 kg/m²,
- a binder resin wherein the binder resin is selected in the group consisting of
 - a) a mix of a phenolformaldehyde resin and an aqueous dispersion of acrylonitrile butadiene polymer with a dry materials weight ratio of resin/polymer in the range of from 15/85 to 35/65, preferably from 20/80 to 40/60,
 - b) a mix of a water-dispersible epoxy resin and an aqueous dispersion of acrylonitrile butadiene polymer with a dry materials weight ratio of resin/polymer in the range of from 40/60 to 60/40,
- abrasive granules, and optionally
- a size resin.

[0017] The abrasive granules may vary in Moh's hardness depending on the coating to be removed and the substrate to be preserved. The abrasive granules have preferably a Moh's hardness of 4 or less (typically between 2 and 4).

[0018] Suitable abrasive granules may be any known abrasive particles or materials commonly known as plastic blasting media.

[0019] Examples of plastic blasting media include ground thermoplastic or thermosetting polymer particles, melamine formaldehyde media (plastic media type III) and other particles such as plastic particles from type I to VI.

[0020] The abrasive granule size may vary from 10 grit to 600 grit (average diameter 2 to 0.01 mm).

[0021] Agglomerated granules of abrasive particles and a binder may also be useful.

[0022] The abrasive product may also contain mixtures of several granule sizes, different abrasive materials uniformly incorporated therein or different abrasive sizes, hardnesses or materials.

[0023] Abrasive granules should preferably be applied in an amount by weight of between 30 and 60% of the wet binder resin mix, more preferably in an amount of between 35 and 45%.

[0024] The preferred binder resin employed in the production of the present abrasive products has a liquid state to provide a coatable and impregnating composition. Yet it can be cured to form a tough, adherent material capable of adherently bonding the optional abrasive granules to the web even under aggressive use conditions (though the abrasion nevertheless remains selective).

[0025] When the binder resin material comprises a mix of a phenolformaldehyde resin and an aqueous dispersion of acrylonitrile butadiene polymer, an anti-foaming agent is preferably used to prevent latex foaming; a lubricant is preferably used to provide smearing resistance and a thickener is preferably added to achieve a workable viscosity of coating. The resin/polymer weight ratio (dry materials) is preferably 25/75.

[0026] When the resin binder material comprises a mix of a water-dispersible epoxy resin and an aqueous dispersion of acrylonitrile butadiene polymer, a curing agent is preferably used for the epoxy; an anti-foaming agent is preferably used to prevent latex foaming, and a lubricant is preferably used to provide smearing resistance. The resin/polymer weight ratio (dry materials) is preferably 50/50.

[0027] In an abrasive product in accordance with the invention, the resin component of the binder resin ensures the cohesion of the porous, lofty web and the adhesion of the abrasive granules, and provides the product with thermal resistance.

[0028] When the resin component of the binder resin is a phenolformaldehyde resin, it preferably has a very high water tolerance to allow admixture with a high percentage of a latex dispersion without the formation of gels denoting incompatibility. Such a resin would not have advanced much in the condensation reaction between formaldehyde and phenol and would have a low molecular weight. Most preferably, the resin has a water tolerance of at least 300% by weight (meaning that it can be mixed with 3 times its own weight of water without precipitation).

[0029] Suitable phenolformaldehyde resins are commercially available, for example, under the trade designations Lacfen® 420 from Satef Hüttenes Albertus Spa or SW378® from Bakelite Corporation.

[0030] A suitable water-dispersible epoxy resin is commercially available, for example, under the trade designation EPI-REZ CMD 3522W60, from Shell Chemical Co., and a suitable epoxy curing agent for the epoxy resin is 2MI commercialized by Merck Clevonot. Further information on the use of water-dispersible epoxy resins in abrasive products can be obtained from US-A-5 549 719.

[0031] The acrylonitrile butadiene polymer is preferably carboxylated (hereinafter referred to as an "NBR" latex) and functions to provide the abrasive product with thermal resistance, thereby protecting the filaments of the porous, lofty web from softening at high temperatures. An NBR latex does not exhibit residual thermoplasticity as a result of heating, and provides the abrasive product with flexibility and smear resistance.

[0032] Suitable acrylonitrile butadiene polymer/latex compositions are commercially available, for example, under the trade designations, HYCAR® latex 1561 from B.F. Goodrich Co.; LN240S® from BASF and, preferably, PERBUNAN® N latex X 2342 commercialized by Bayer S.A.

[0033] Suitable anti foaming agents are commercially available, for example, under the trade designations "1520" from Dow Corning Corp., of Midland, MI, USA; "1512M" from Hercules and, preferably, BYK 22 from BYK Chemie. The amount of anti foam agents included in the present abrasive products can preferably be an amount by weight of less than 5% of the water dispersion of acrylonitrile butadiene polymer, preferably less than 5%, more preferably less than 4%, most preferably less than 3%.

[0034] Suitable lubricants are alkali metal salts of stearic acid. A preferred lubricant is an aqueous dispersion of calcium stearate commercially available under the trade designation SOLUFAX® from HQ France. The amount of lubricants included in the present abrasive products is preferably an amount by weight less than 15% of the total dry binder (resin, acrylonitrile butadiene polymer and optional components), preferably less than 10%, more preferably less than 6%, most preferably about 4%.

[0035] Suitable thickeners used for adjusting the viscosity of the binder system include for example salts of polyacrylic acid carboxymethyl cellulose, guar gum, gum tragacanth, homo- and copolymers of poly (vinyl alcohol), methyl cellulose, modified starch and amorphous silica. A preferred thickener is commercially available under the trade designation LATEKOL D® from BASF. The amount of thickener included in the present abrasive products can preferably be an amount by weight of less than 5% of the water dispersion of acrylonitrile butadiene polymer, more preferably less than 4%, most preferably less than 3%.

[0036] The binder resin of an abrasive product in accordance with the invention may include other optional additives such as colorants, fillers and grinding aids. Examples of colorants known for use in abrasive products include inorganic pigments and organic dyes. Fillers known for use in abrasive products take the form of short organic or inorganic fibres, spheres and particles, and comprise materials that are primarily inert having regard to the intended use of the abrasive product. Filler materials that are known for use in abrasive products include calcium carbonate and fumed silica. Known

grinding aids for use in abrasive products include poly(vinyl chloride) and potassium fluoroborate.

[0037] In order to further anchor the optional abrasive granules to the web, a second, or "size" coating of resin may be applied to the abrasive product. Size resins suitable for these size coatings are constitutionally the same as those used for the initial coating, and are applied and hardened in the same manner.

Process

[0038] Processes used to prepare the web of the low-density abrasive products used in the present invention are set out in US Patent No. 4 227 350 or in WO-A-00/41850. The major differences are the nature of the binder (or binders) and of the abrasive granules used.

[0039] The abrasive product can be formed in a continuous process, if desired, virtually directly from the basic ingredients, i.e., from polyamide filament-forming material, liquid curable binder resin and abrasive granules. That is, the polyamide filament-forming material can be extruded directly into a lofty, open, porous, filament web. Abrasive granules, binder and optional size resins are then applied to the web to provide the finished abrasive product. In the web-making process employed in the present invention, polyamide filament-forming material is inserted into an extruder equipped with a spinneret head which has a multitude of openings equally spaced in at least one row, preferably in a plurality of spaced rows of equally spaced openings. The row or rows of molten filaments are then extruded downwardly, permitted to freely fall a short distance through an air space and then into a quench bath. As the filaments enter the quench bath, they begin to coil and undulate, thereby setting up a degree of resistance to the flow of the molten filaments, causing the molten filaments to oscillate just above the bath surface. The spacing of the extrusion openings from which the filaments are formed is such that, as the molten filaments coil and undulate at the bath surface, adjacent filaments touch one another. The coiling and undulating filaments are still sufficiently tacky as this occurs, and where the filaments touch, most adhere to one another to cause autogenous bonding to produce a lofty, open, porous filament web.

[0040] The web is then directed into a quench bath between opposed rollers positioned a distance below the surface of the quench bath where the filaments of the integrated mat will still be sufficiently plastic to be permanently deformed as they pass therebetween.

[0041] These rolls are operated at the same speed but in opposite directions to draw the formed filament web away from the area where the filaments initially coil and bond together. The rolls are spaced to contact the surfaces of the web with slight pressure sufficient to smooth any uneven surface lops or undulations to provide a web with generally flat surfaces. The roller contact will not provide a higher density of filaments at either surface of the web. Instead, the web will have a defined thickness after being passed between the rollers. For this purpose, the surfaces of the rolls are preferably smooth to produce the generally flat surface. Since useful abrasive products may also have other than flat surfaces, the roll surfaces may have other configurations to provide an abrasive product with a modified surface. For example, a pleated surface roller will produce webs with a pleated surface. Alternatively, the roller surface may have spikes uniformly disposed on its surface to provide for more secure web handling. The rolls are operated at a surface speed substantially slower than the extrusion speed to permit sufficient time for the filaments to coil and undulate and form a lofty web with a high degree of undulation in each filament.

[0042] This process produces a web wherein each filament is coiled and undulated throughout its length.

[0043] The undulations of each filament are typically irregular although it is possible to adjust the process to produce regular helically coiled filaments. Irregular filament undulation is characterized by random looping, kinking or bending of the filaments through the web in a pattern defined generally by the pattern of openings of the spinneret.

[0044] It should be noted that, where more than one row of filaments is extruded, a web is produced having layers of coiled and undulated filaments, each layer representing a row of extruded filaments. Each layer is discernible, sometimes with great difficulty, in the web.

[0045] The adjacent filaments between layers will also be autogenously bonded together for the most part where they touch one another.

[0046] A binder resin containing abrasive granules is prepared by mixing the resin, the polymer, the abrasive granules and the optional components. The binder resin containing abrasive granules is then applied to the web in an appropriate amount using any suitable known manufacturing techniques, including roll-coating, dip-coating and spray-coating. After application of the binder resin containing abrasive granules, the web is exposed to conditions for hardening the binder. Alternatively, the binder resin may be applied to the web at the desired coating weight without the abrasive granules, the latter then being drop-coated onto the web before the binder hardens. As a further alternative, suitable especially for small-scale production of abrasive discs in accordance with the invention, discs can be prepared from the uncoated web by die-cutting and then immersed in a mixture of the binder resin and the abrasive granules. The impregnated discs are then rotated at an appropriate speed to remove a controlled amount of the mixture until only the desired amount (corresponding to the desired coating weight) remains. The discs are then exposed to conditions suitable for hardening the binder.

[0047] Preferred conditions for hardening the binder include conditions that cause rapid hardening such as exposure to elevated temperature or exposure to radiation.

[0048] The abrasive products produced by the process described above are particularly suited for selective abrasion.

[0049] The present abrasive products are extremely open, porous, and lofty which permits prolonged usage of the abrasive product for conditioning (for example, surfaces where large amounts of attrited matter are produced), without filling the web and thus interfering with the abrasive product's properties. The degree of openness and loftiness is evidenced by the web void volume which is typically at least about 80% (preferably about 85% to about 97%) in the uncoated state. Upon coating with the binder resin, the web also has a considerable degree of structural integrity that permits prolonged usage of the abrasive article.

[0050] The flattening effect of the rollers used in the production of the web provides a unique abrasive structure that is highly open at the surface yet has a flat face capable of use on flat surfaces without requiring bending or modification of the web. Additionally, the web, even with the binder resin coating and abrasive granules, is flexible and conformable and will typically conform to most surfaces upon which it is used.

[0051] The web may be made in a wide variety of thicknesses, limited principally by the design of the spinneret through which it is extruded and the gap between the rollers that direct the web into the quench bath. Typical web thicknesses useful for abrasive products will vary between 0.5 to 8 cm. The filament diameter of the filaments in the web produced by the process described above may be varied by modification of the web-making process.

[0052] Typically, the filament diameter for a suitable web will be in the range of from 5 to 125 mils (0.13 to 3.18 mm). Spinneret extrusion openings of 5 to 125 mils (0.13 to 3.18 mm) will produce such webs. Preferably, the filament diameter is in the range of from 13 to 17 mils (0.33 to 0.44 mm). The openings in the spinneret will be in rows, as previously stated, and separated by at least about 0.1 inch (2.54 mm) to produce satisfactory results. The openings of adjacent rows may be offset from one another although the spinneret performs suitably when the openings in the rows are aligned.

[0053] In order to realize long-life characteristics, the resultant web should weigh between 0.8 and 1.80 kg/m² and preferably should weigh between 0.8 and 1.0 kg/m². Lesser weights do not provide the increased useable life of the resulting abrasive product. Heavier web weights results in a product that is insufficiently compliant to smoothly run against a typical workpiece.

[0054] The abrasive products of the present invention may be in any of a variety of shapes as typically encountered for nonwoven abrasive products. For example, suitable shapes are both rectangular pads and disc-shaped pads which may have a central opening for attachment of an arbor or rod for rotation. Alternatively, they may be cut into shapes such as rectangular shapes and mounted about the periphery of a rotatable hub to provide a flap wheel. Other shapes are also contemplated such as endless belts and abrasive wheels or sheets. The wheels typically have a central opening for support by an appropriate arbor to enable the wheel to be rotated in use.

[0055] The abrasive product of this invention may be laminated to other layers to provide a modified abrasive article. For example, the abrasive product may be laminated to a foam or sponge layer to provide dual functions or to provide a cushioning layer. Alternatively the abrasive product may be laminated to a web that provides one component of a hook-and loop attachment system to enable the abrasive product to be secured to the back-up pad of an abrading machine. Any of a variety of mounting devices or handles may also be applied to the abrasive product to provide an implement that may have a removable or permanently attached handle.

[0056] The abrasive products of the present invention are selective treating or conditioning implements that have been found to perform in a superior manner to conventional abrasive products in the situations such as efficiently removing paint from metallic (such as aluminum) or composite substrates, allowing complete selective removal of the paint without destroying the primer covering the metallic or composite substrate. There is no damage to the surface preparation such as chromic anodisation (CAO) in case of aluminum, primer in case of composite though a rapid abrasion of the desired layer is obtained.

[0057] The present invention is therefore further directed to a process for cleaning a base substrate covered with a layer to be removed comprising abrading the said layer with an abrasive product described above. The base substrate is preferably selected in the group consisting of aluminum or aluminum alloy, steel, plastic materials and composites and more particularly is made of aluminum, aluminum alloy or composite. The base substrate could, alternatively, be wood.

[0058] The preferred features of the above abrasive products also apply to the above process for cleaning a base substrate.

[0059] The present process provides a cheap and effective alternative to conventional selective paint-removal processes.

Drawings

[0060] The present invention is illustrated and described in Figures 1-3.

- [0061]** Fig. 1 is a schematic illustration of the process used to make an abrasive product of the present invention.
[0062] Figs. 2-3 are perspective views that illustrate two embodiments of an abrasive product of the present invention.
[0063] The present invention is further illustrated by the following examples.

Examples

Preparation of a web

[0064] As illustrated in Fig. 1, polyamide filament-forming material is heated to a molten state and extruded from an extrusion spinneret 10 which contains at least one row of openings to provide a bundle of free-falling filaments 11. Filaments 11 are permitted to freely fall through an air space into a quench bath 12 where they coil and undulate at or near the surface of bath 12 to form an autogenously bonded web 13. While it is still sufficiently plastic to be permanently deformed, web 13 is then passed between opposed smooth-surfaced rollers 14 and 15 which may have a pattern of uniformly spaced spikes projecting from the roller surface which are positioned to provide a substantially flat-surfaced web. Web 13 is then drawn around one of the rollers, e.g. roller 15, for removal from quench bath 12. Web 13 is then passed over idler roll 16 between guide roll set 17 and dried in forced air oven 18 to remove residual quench liquid. The web is wound onto a roll and stored for about 4 weeks to allow morphological equilibration.

[0065] The web is then passed through roll coating station 19 where liquid curable binder resin 20 is applied to web 13. Other conventional web coating techniques may be employed to coat the web so long as such techniques provide a substantially uniform binder resin coating. For example, dip coating and spray-coating techniques may also be used. The binder resin coating should be sufficient to permit uniform coating of the web with abrasive granules. Thereafter, the wet coated web is passed beneath a first abrasive granule dropping station 21 to coat one side of the web with abrasive granules and deployed in an S-shaped arrangement around suitable idler rollers 21a, 21b, 21c, 21d and 21e to reverse the web surfaces (that is, face the bottom side up). The other surface of the web is then passed under a second abrasive granule depositing station 22 to provide a web, which has been coated on both web surfaces with abrasive granules. Other abrasive granule applications or coating devices may also be used; e.g. the abrasive granules may be applied by spray methods such as employed in sandblasting except with milder conditions, by electrostatic coating method, and the like. The abrasive granule-coated web is then passed through forced air oven 23, to cure the first binder resin coating. If required, a second coating of a size resin may be applied with a suitable device such as spray station 24 which simultaneously sprays top and bottom surfaces of the web with a quantity of size resin material which will bond the abrasive granules to the surface of the web. The quantity of the size resin coating should be limited so it will not cover or mask the abrasive granules. Once coated, the web is then passed through forced air oven 25, and finally into converting station 26 where it is cut into desired shapes 27.

[0066] Typical shapes of the abrasive product of the invention include those depicted by Figs. 2 and 3. Fig. 2 shows a rectangular shape abrasive product 30 while Fig. 3 shows an annulus shape abrasive product 50.

[0067] The filament-forming material which is extruded to provide the lofty web contained in the low-density abrasive product of the invention is formed of a thermoplastic polyamide material which can be extruded through extrusion orifices to form filaments. Particularly useful polyamide materials for forming the polycaprolactam and poly(hexamethylene adipamide) (e.g., commonly referred to as nylon 6 and nylon 6,6). Other useful filament forming materials may include polyolefins (e.g., polypropylene and polyethylene), polyester (e.g., polyethylene terephthalate), polycarbonates and the like.

[0068] In a preferred form the web has a basis weight of between 0.8 and 1.0 Kg/m² and a thickness of 1.5 cm, and is formed from nylon 6 fibers having a diameter of between about 13 and 17 mils (0.33 and 0.44 mm). The total coating weight of the wet binder resin plus abrasive granules applied to the web is in the range of from 4500 - 7000 g/m² (more preferably in the range of from 5000 - 6000 g/m²), of which the abrasive granules preferably comprise between 30 and 60% by weight (more preferably between 35 and 45%).

Example 1: Abrasive product preparation using a phenolformaldehyde resin in the binder resin material

[0069] The following compounds were successively poured into an agitator:

Phenolformaldehyde resin (LACFEN® 420 of Satef Hüttenes Albertus SpA)	165 g
Aqueous dispersion of a polymer of acrylonitrile and 1,3-budadinene (PERBUNAN® N latex X 2342 of Bayer S.A.)	845 g
Antifoam (BYK 22 of BYK-Chemie)	17 g
Aqueous dispersion of calcium stearate (SOLUFAX® of HQ France)	92 g

(continued)

Aqueous dispersion of a copolymer of acrylic acid ester and acrylic acid (LATEKOL D® of BASF)	17 g
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and agitated for 20 minutes at about 600 rpm.

[0070] 760 g of plastic material granules having a hardness of 3.5 Moh (Melamine Formaldehyde 30/40 of Maxi Blast, IN, USA) were added in small parts under agitation. Agitation was continued for 20 minutes after the last addition of plastic material granules. A suspension of plastic material granules in the binder resin was thus obtained.

[0071] A continuous filament non-woven web having a thickness of 1.5 cm was prepared as disclosed in WO 00/41850 from nylon 6 fibers. The web had a basis weight of about 0.9 Kg/m² and was formed from fibres having a diameter of about 15 mils (0.39 mm). Discs having a diameter of 15 cm were prepared from the web by die cutting.

[0072] The discs were mounted on the spin rod of the agitator and immersed in the above mixture of binder resin and plastic material granules for a few minutes. The impregnated discs were then removed from the mixture and rotated and their weight was checked at intervals until a target weight was obtained that corresponded to a wet coating weight of the mixture in the range 5600 - 5770g/m².

[0073] The discs were put in an oven at 120°C for 45 minutes, and were then allowed to cool.

Example 2: Abrasive product preparation using an epoxy resin in the binder resin material

[0074] The method of Example 1 was followed, except as noted below.

The compounds poured successively into the agitator were as follows:

Aqueous dispersion of a polymer of acrylonitrile and 1,3-butadiene (PERBUNAN® N latex X 2342 of Bayer S.A.)	600g
Antifoam (BYK 22 of Byk-chemie)	12.4g
Epoxy resin (EPIREZ CMD 3522 W60 from Shell)	410g
Catalytic agent (2MI of Merck Clevenot)	12.3g
Aqueous dispersion of a copolymer of acrylic acid ester and acrylic acid (LATEKOL D® of BASF)	98.3g

[0075] The same plastic material granules were used but in an amount of 810g. The impregnated discs were rotated until a target weight was obtained that corresponded to a wet coating weight of the binder resin/plastic granules mixture in the range 5100 - 5550g/m². The discs were then put in an oven at 120°C for 100 minutes, following which they were allowed to cool.

Test methods

Selectivity Test

[0076] Abrasive discs prepared according to the Examples 1 and 2 were evaluated for performance by using a selectivity test.

[0077] The selectivity test comprised rotating the abrasive discs against a sample of aerospace panel for a period of about 10 seconds.

[0078] The aerospace panel consisted of an anodised aluminum alloy substrate covered with a base primer and then a paint system comprising a primer layer, intermediate layers and a top coat. The panel was artificially aged in an oven.

[0079] Each abrasive disc was rotated on a rotating shaft at 3400 rpm with a hand-held force on the panel. As the disc was rotated, it was oscillated in a linear direction on the panel's surface for a distance of 3 to 4 cm, producing an abraded area with a width corresponding to the diameter of the disc.

[0080] It was found that the layers of the paint system were removed exposing the base primer but without exposing the aluminum alloy substrate.

Surface Finish Test

[0081] Abrasive discs prepared according to the Examples 1 and 2 were evaluated for performance by performing a surface finish test.

[0082] A procedure similar to the selectivity test procedure was used but, as the disc was rotated, it was oscillated in a linear direction on the panel's surface in order to remove the layers of the paint system and expose the base primer over an area of about 20 cm².

[0083] The surface finish in the treated area was good. The panel had the uniform color of the base primer and the surface was smooth enough to allow direct re-painting.

Smearing Test

[0084] Abrasive discs prepared according to the Examples 1 and 2 were evaluated by using a smearing test. Each disc was rotated, in a rotating shaft at 3400 rpm with a hand-held force, against a stainless steel panel. As the disc was rotated, it was oscillated in a linear direction on the panel.

[0085] The smearing resistance was good since there was no deposit left by any of the discs on the panel.

Claims

1. An abrasive product comprising:

- a. a three-dimensional web comprised of a plurality of undulated polymeric filaments, with adjacent filaments contacting and being bonded to one another;
- b. a cured binder resin comprised of the cured product of a mixture of an aqueous dispersion of carboxylated butadiene-acrylonitrile copolymer and a second binder selected from the group consisting of phenolic resin and aqueous-dispersible epoxy resin; and
- c. a plurality of abrasive particles having a hardness which renders them capable of removing soft coatings from a hard substrate surface but incapable of altering the hard substrate surface.

2. The surface conditioning product of claim 1, wherein said abrasive particles have a Moh's hardness value not greater than 4.

3. The abrasive product of claim 1 wherein said three-dimensional web comprises a web of multiple layers of coiled, autogenously bonded polyamide filaments having a basis weight of between 0.8 and 1.80 kg/m².

4. The abrasive product of claim 3, wherein said three-dimensional web has a basis weight of between 0.8 and 1.0 Kg/m².

5. The abrasive product of claim 1 wherein said phenolic resin is a phenolformaldehyde resin.

6. The abrasive product of claim 1 wherein said phenolformaldehyde resin and said carboxylated butadiene-acrylonitrile polymer are contained in said mixture on a dry weight basis in a ratio of phenolformaldehyde resin to carboxylated butadiene-acrylonitrile copolymer in the range of 15/85 to 35/65.

7. The abrasive product of claim 1 wherein said aqueous-dispersible epoxy resin and said carboxylated butadiene-acrylonitrile polymer, on a dry weight basis, are contained in said mixture in a weight ratio of resin to polymer of from 40/60 to 60/40.

8. The abrasive product of claim 1 further including a size coating over the abrasive particles and cured binder resin coating.

9. The abrasive product of claim 8 wherein said size coating is comprised of the same components as the cured binder resin coating.

10. The abrasive product of claim 1 wherein said abrasive particles are comprised of plastic blasting media.

11. The abrasive product of any of claims 1 to 10, wherein the binder resin is a mix of a phenolformaldehyde resin and an aqueous dispersion of carboxylated butadiene-acrylonitrile copolymer with a dry materials weight ratio of resin/polymer of 25/75.

12. The abrasive product of any of claims 1 to 11, wherein the binder resin further comprises a lubricant.

13. The abrasive product of any of claims 1 to 12, wherein the binder resin further comprises an anti-foaming agent.

14. The abrasive product of any of claims 1 to 13, wherein the binder resin further comprises a thickener.

15. The abrasive product of any of claims 1 to 14, wherein the binder resin is a mix of an aqueous-dispersible epoxy resin and an aqueous dispersion of acrylonitrile butadiene polymer with a dry materials weight ratio of resin/polymer of 50/50.

16. The abrasive product of any of claims 1 to 15 wherein the binder resin further comprises a curing agent for the epoxy resin.

17. The abrasive product of any of claims 1 to 16, wherein the polymer filament is comprised of nylon 6 or nylon 6,6.

18. The abrasive product of any of claims 1 to 17, wherein the filaments have a diameter of 13 to 17 mils (0.33 to 0.44 mm).

19. The abrasive product of any of claims 1 to 18, wherein the filaments are extruded thermoplastic polyamide material.

20. A process for cleaning a base substrate covered with a layer to be removed comprising abrading the said layer with an abrasive product of any of claims 1 to 19.

21. The process of claim 20, wherein the base substrate is selected in the group consisting of aluminum or aluminum alloy, steel, plastic materials and composites.

22. The process of claim 20 or claim 21, wherein the base substrate is made of aluminum, aluminum alloy or composite.

23. A process for making an abrasive product, said process comprising:

- a. providing a three-dimensional web comprised of a plurality of undulated polymeric filaments, with adjacent filaments contacting and being bonded to one another;
- b. coating the polymeric filaments of the web with a resin binder comprised of a mixture of an aqueous dispersion of carboxylated butadiene-acrylonitrile copolymer with a second binder selected from the group consisting of phenolic resin and aqueous-dispersible epoxy resin;
- c. depositing on the coating before curing a plurality of abrasive particles having a hardness which renders them capable of removing soft coatings from a hard substrate but incapable of altering the hard substrate surface; and
- d. curing the coating to provide the abrasive product.

24. The method of claim 23, wherein said abrasive particles have a Moh's hardness value not greater than 4.

25. The method of claim 23, wherein said three-dimensional web comprises a web of multiple layers of coiled, autogenously bonded polyamide filaments having a basis weight of between 0.8 and 1.80 kg/m².

26. The method of claim 23 further including applying a size coating over the resin binder coating and curing the size coating.

27. The method of claim 23 wherein steps b and c are carried out simultaneously by mixing the abrasive particles with the resin binder mixture and coating the resin binder mixture containing abrasive particles onto the web.

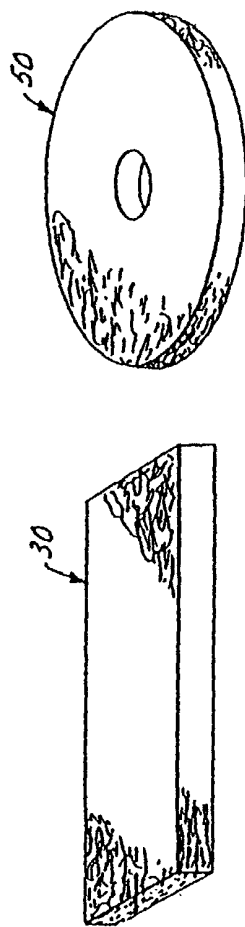
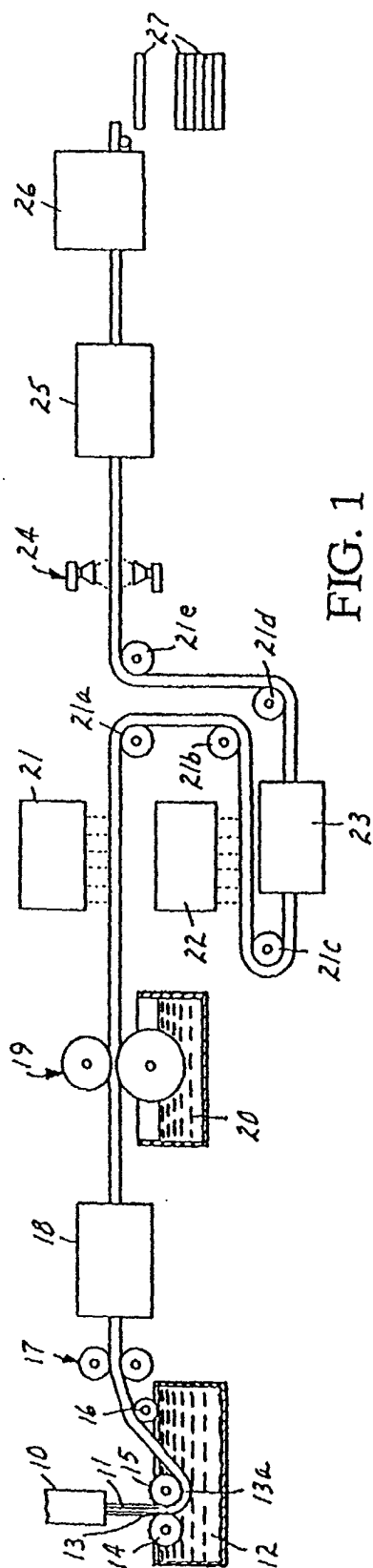


FIG. 3



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 02 29 1955

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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 13 December 2002	Examiner Koller, S
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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