(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 December 2004 (09.12.2004)

PCT

(10) International Publication Number
WO 2004/106002 A1

(51) International Patent Classification[7]: B24D 11/00, A47L 13/16

(21) International Application Number: PCT/US2004/010844

(22) International Filing Date: 8 April 2004 (08.04.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0311803.1 22 May 2003 (22.05.2003) GB

(71) Applicant *(for all designated States except US)*: **3M INNOVATIVE PROPERTIES COMPANY** [US/US]; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **THIOLIERE, Stephane** [FR/FR]; 3M France, 1 Avenue Boule BP 28, F-95250 Beauchamp (FR). **POLLAUD, Guy M.** [FR/FR]; 3M France, 1 Avenue Boule BP28, F-95250 Beauchamp (FR). **DUCHAMP, Laetitia A.** [FR/FR]; 3M France, 1 Avenue Boule BP28, F-95250 Beauchamp (FR). **CABRERO GOMEZ, Estrella** [ES/ES]; 3M Spain, Juan Ignacio Luca de Tena 19-25, E-28027 Madrid (ES).

(74) Agents: **JONAS, George W.,** et al.; Office of Intellectual Property Counsel, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

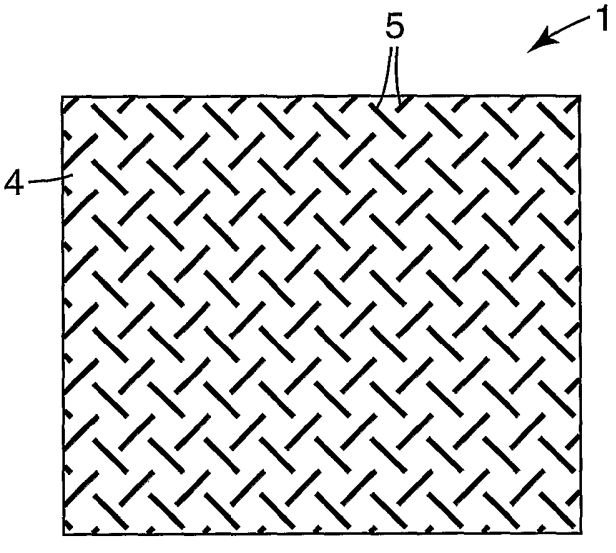
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: WIPING ARTICLES HAVING A SCOURING SURFACE



(57) Abstract: A wiping article (1), for cleaning surfaces, comprises a liquid-absorbent web material and, disposed on a liquid-absorbent surface thereof, abrasive areas (5) comprising at least cured particulate binder material, the abrasive areas being spaced apart by liquid-absorbent areas (4) of the web material. A method for making the wiping article, for cleaning surfaces, the method comprising the steps of : providing a liquid-absorbent web material; providing a dry particulate material that comprises at least particulate curable binder material; depositing spaced areas of the dry particulate material on a liquid-absorbent surface of the web material; and curing the binder material to form spaced abrasive areas on the surface of the web material, the said abrasive areas being spaced apart by liquid-absorbent areas of the web material.

WO 2004/106002 A1

WIPING ARTICLES HAVING A SCOURING SURFACE

The present invention relates to wiping articles that are suitable for consumer use in cleaning surfaces in various environments, including domestic, industrial, hospital and food industry environments. The invention relates, in particular, to wiping articles that have a scouring surface (also called a scrubbing surface), on at least one side.

BACKGROUND

Wiping articles are already widely used by consumers in the environments mentioned above for cleaning, for example, kitchen and bathroom surfaces, including floors. Many different wiping articles are currently available for domestic use, ranging from paper towels to conventional textile dish cloths and floor cloths, some being intended to be used dry (for example, to mop-up spilt liquid) and others being intended to be used in a damp or wet condition. It is also known to provide wiping articles that have a scouring action suitable for removing hardened soil and stains from a surface to be cleaned.

Examples of wiping articles that have a scouring action are described in US-A-4 142 334 and 5 213 588, and in EP-A-0 211 664. Each of those documents describes wiping articles that, on one surface, carry an ordered pattern of abrasive areas formed by a printing process using a dispersion of abrasive particles in a liquid adhesive or binding agent that is subsequently allowed or caused to solidify. Wiping articles that have a mild scouring action without the use of abrasive particles are also known: for example, a mild scouring action can be achieved by spraying one side of a wiping substrate with molten polymer fibres that are subsequently allowed to harden. Generally, however, the provision of spaced abrasive areas on a wiping substrate is preferred since it enables the flexibility of the substrate to be retained to a large extent and provides a wiping article that is easier for the consumer to handle and use.

SUMMARY

The present invention provides a method of making a wiping article for cleaning surfaces, the method comprising the steps of

(i) providing a liquid-absorbent web material;

(ii) providing a dry particulate material that comprises at least particulate curable binder material;

(iii) depositing spaced areas of the dry particulate material on a liquid-absorbent surface of the web material; and

(iv) curing the binder material to form spaced abrasive areas on the surface of the web material, the said abrasive areas being spaced apart by liquid-absorbent areas of the web material.The present invention also provides a wiping article for cleaning surfaces, comprising a liquid-absorbent web material and, disposed on a liquid-absorbent surface thereof, abrasive areas comprising at least cured particulate binder material, the said abrasive areas being spaced apart by liquid-absorbent areas of the web material.

BRIEF DESCRIPTION OF THE DRAWINGS

By way of example only, wiping articles in accordance with the present invention, and methods of making those articles, will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a plan view of a wiping article in accordance with the invention;

Fig. 2 is a diagrammatic cross-section of the article on the line I-I in Fig. 1;

Fig. 3 is a schematic illustration of a method of making the wiping article of Figs. 1 and 2; and

Figs. 4 and 5 are plan views of the scouring surface of other wiping articles in accordance with the invention.

DETAILED DESCRIPTION

The present invention is directed to wiping articles that, at least on one surface, carry abrasive areas that provide the article with a scouring action, the remainder of the surface being available to provide the normal wiping action of the article. The present invention comprises a liquid-absorbent web material and, disposed on a liquid-absorbent surface thereof, abrasive areas comprising at least cured particulate binder material, the said abrasive areas being spaced apart by liquid-absorbent areas of the web material.
As used herein, "particulate curable binder material" means a material that is solid at room temperature, has been processed to a particulate form, and which may be softened and cured either by heating and subsequent cooling (if thermoplastic) or by sufficient exposure to heat or other form of energy (if thermosetting or cross-linkable).

The invention is concerned with providing a method of making such wiping articles that has less environmental impact than methods that are currently employed. The use of a particulate binder material in a method in accordance with the invention enables the abrasive areas to be produced on the surface of the web material without producing volatile organic compounds (VOCs), and may also result in the energy requirements of the method being lower than those of methods that employ liquid binder materials.

In a further aspect, the invention is concerned with providing wiping articles of that type with an attractive visual appearance in addition to an effective scouring action.
The use of a particulate binder material enables the binder material to be deposited on the web material under the action of an electrostatic force: that, in turn, makes it possible to produce well-defined abrasive areas on the web material in a wide variety of patterns and thus provide consumers with an attractive choice of products.

The wiping article 1 shown in Figs. 1 and 2 comprises a liquid-absorbent web material 3 and, adhered to the upper surface 4 of the web material (as seen in the drawings), abrasive areas 5 arranged in an ordered pattern. The abrasive areas 5 comprise abrasive particles together with a cured particulate binder material that adheres the abrasive particles to each other and to the surface of the web material 3. Between the abrasive areas 5, the liquid-

absorbent surface 4 of the web material 3 is exposed. The abrasive areas 5 are shown in Fig. 1 as being in the form of bars: that is not essential, however, and other shapes can be used as will be described below. It is also not essential that the abrasive areas 5 should be arranged in an ordered pattern.

A method of making the wiping article 1 is illustrated diagrammatically in Fig. 3. A continuous length of the web material 3 is fed from a roll 7 through a powder coating booth 9. The web material 3 is conveyed through the powder coating booth 9 on a flat surface provided by a grounded, electrically-conductive, conveyor 11 and, within the booth 9, the upper surface 4 of the web material is closely contacted by a stencil or mask 13, into which the pattern for the abrasive areas 5 has been cut in known manner. As illustrated in Fig. 3, the stencil is a continuous band that is moved through the powder coating booth 9 at the same speed as the web material 3. Dry particulate material (comprising at least abrasive particles 14 and a curable particulate binder material 15) is supplied from a hopper 16 to an electrostatic spray gun 17 located in the upper part of the coating booth 9.

Electrostatic spray guns are known from the powder coating art, where they are used in electrostatic powder coating systems to apply electrically-charged powder coating material to an electrically-grounded workpiece. A typical known electrostatic powder coating system consists of a powder hopper, a high voltage power supply (generating, for example, up to 100 kV), an electrostatic spray gun and a powder recovery system. The powder is fluidized in the hopper and then fed to the spray gun, which directs it towards the workpiece to be coated. An electrode at the front of the spray gun is connected to the power supply and causes an electrostatic charge to be imparted to the powder coating material as it is being propelled toward the grounded workpiece. The charge causes the powder particles to be drawn towards, and to attach themselves to, the grounded workpiece. Powder that is not deposited on the workpiece can be recovered and re-used.

In the method illustrated in Fig. 3, the electrostatic spray gun 17 is operated to direct the dry particulate material 14, 15 downwards onto the stencil 13 and (through the cut-out parts of the stencil) the upper surface 4 of the web material 3 under the combined effects

of electrostatic attraction, gravity, and the flow of atomizing air from the spray gun 17. The stencil 13 is then moved away from the web 3 leaving spaced areas 5 of the particulate material 14, 15 on the surface of the web, in the pattern defined by the stencil. The particulate material 14, 15 that remains on the stencil 13 is collected in any suitable way, as is any particulate material that falls to the bottom of the booth 9, and can be re-used.

The web material 3 is then exposed to conditions that will cause the particulate binder material 15 to soften and then to cure, to bind the abrasive particles 14 in each of the spaced areas 5 to each other and to the surface 4 of the web material 3. In the process illustrated in Fig. 3, it is assumed that the particulate binder material 15 is a thermosetting or a thermoplastic material and the web material 3 is, therefore, passed through an oven 19 in which it is heated to soften the particulate binder material: a thermosetting binder material can then also be cured in the oven 19, and a thermoplastic binder material will be cured by cooling after the web material 3 has left the oven. The web material 3, having the spaced abrasive areas 5 on its surface 4, is then converted into individual wiping articles 1 of an appropriate size as shown in Fig. 1 (following storage, if required, on a roll 21).

Using the method illustrated in Fig. 3, it has been found that the spaced areas of particulate material 14, 15 deposited on the web material 3 in the powder coating booth remain undisturbed during the passage of the web material from the booth 9 into the oven 19. This is believed to be a consequence of the particulate material 14, 15 being deposited on the web material 3 under the action of an electrostatic force. As a result, the spaced abrasive areas 5 that are formed on the web material following passage through the oven are visually clear and well-defined, and present a pleasing appearance to the user.

The abrasive areas 5 need not be of the form shown in Fig. 1. Other suitable forms include dots as illustrated in Fig. 4, and pictorial shapes, for example as illustrated in Fig. 5. In general, any shape that can be defined by a suitable stencil 13 can be produced. It is also possible for the arrangement of the abrasive areas 5 to be non-ordered or confined just to one part of the surface of the wiping article (for example, a graphic or pictorial shape in a corner or in the center of the wiping article). For some wiping articles, it may be desirable

to form abrasive areas on both major surfaces of the article: that can be achieved in the process illustrated in Fig. 3 by passing the web material 3 through the powder coating booth 9 a second time with the other surface uppermost and then again through the oven 19.

To ensure that the wiping article 1 retains an adequate wiping action and remains flexible and easy for the user to handle, the abrasive areas 5 should preferably not cover more than about 50% of the surface of the wipe material 3. If the abrasive areas cover a greater amount of the surface of the wipe material, the liquid-absorbency of the wiping article may be substantially reduced, as may the scouring performance since there will be an increasing tendency for the wiping article to slip on the surface that is being cleaned. Generally, it has been found that the best results are obtained when the abrasive areas 5 cover about 15 - 40 % of the surface of the wipe material 3. The size of the individual abrasive areas 5 can vary depending on the way in which they are arranged on the surface of the wiping material but, if they are too large, the wiping article may slip on the surface to be cleaned and be less effective. In addition, the arrangement of the abrasive areas 5 on the surface of the wiping material 3 should preferably not be directional, to ensure that the user does not need to orient the wiping article 1 correctly before use.

In the particular case in which there is a single abrasive area 5 only on the surface of the wiping article, it is also preferred that it should cover no more than about 50% of the wiping surface of the article in such a way that the user can choose to utilize either the scouring or the liquid-absorbent area of the wiping article.

The powder coating booth 9 can be of any suitable type known for use in powder coating applications. The stencil 13 should preferably be non-conductive but can otherwise be of any suitable material provided that it can be moved into close contact with the surface 4 of the web material 3 and thereby ensure that the areas of particulate material 5 deposited on the web material are well-defined. The stencil 13 may, for example, be a textile belt (for example, a silk screen belt) or a belt of a polymeric material (for example, PVC, polyester, polyurethane, or polyamide).

It is not essential that the stencil 13 should be in the form of a continuous band as illustrated in Fig. 3. As an alternative, the method illustrated in Fig. 3 could be implemented as a semi-continuous process, in which an individual stencil member is placed on a discrete length of the web material before it enters the powder coating booth 9. The particulate material 14, 15 is then deposited over the stencil from the spray gun 17 as that part of the web moves through the coating booth. The stencil is removed when that part of the web material moves out of the coating booth 9, and can be cleaned and re-used. The web material, meanwhile, is moved into the oven 19 to soften and cure the binder material as described above. It is also not essential that the flat, grounded, electrically-conductive surface on which the web material is conveyed through the coating booth 9 should be provided by the conveyor 11. In a semi-continuous process it could, for example, be provided by an electrically-conductive plate that is inserted between the conveyor and a discrete length of the web material as the latter enters the coating booth 9.

The amount of particulate material 14, 15 that is deposited on the web material can be adjusted by changing the speed at which the web material moves through the coating booth 9. It can also be adjusted by changing the number of spray guns 17 that are used in the booth or by altering the spray gun settings. By reducing the amount of particulate material 14, 15 deposited to a low level and, at the same time, omitting the stencil 13, a wiping article can be produced in which one surface will be covered with randomly-located particle-size abrasive locations spaced apart by liquid-absorbent areas of the web material. In that case also, the area of the abrasive locations should not be more than about 50% of the area of the wiping surface.

If high-definition is not required for the abrasive areas 5 on the web material 3, it is possible to form a general pattern for the abrasive areas in the surface provided underneath the web material by the electrically-conductive conveyor 11 and omit the stencil 13. For example, the conveyor 11 may be in the form of a grid, in which case the particulate material from the spray gun 17 will collect on the surface of the web material 3 preferentially along the grid lines of the conveyor. The grid lines will, however, not be well-defined and some particulate material will also be deposited on the web material in the spaces between the lines.

As a further alternative, suitable also if high-definition is not required for the abrasive areas 5 on the web material 3, a general pattern of abrasive areas can be formed by omitting the stencil 13 and using a web material 3 with a surface structure (e.g. a crêpe material) that will result in some areas of the web material being in closer contact with the conveyor 11 than others. A greater amount of particulate material 14, 15 will be deposited on those areas of the web material that are in closest contact with the conveyor 11.

Other coating apparatus can be used, instead of the coating booth 9 with spray gun 17, to carry out the electrostatic deposition of the dry particulate material 14, 15 on the web material 3. These include, for example, apparatus in which the particulate material is aerated in a fluidizing chamber and electrostatically-charged by ionized air so that it will adhere to the web material. The web material with the particulate material adhered to it can then be passed to the oven 19 as described above.

If desired, the dry particulate material 14, 15 supplied from the hopper 16 to the electrostatic spray gun may include additives that are customary in the powder coating art, such as pigments, fillers, flow aids etc. Some of those additives, for example pigments and fillers, may be incorporated in the binder material particles.

The nature of the web material 3, and of the abrasive particles and particulate binder material that may be used in the process of Fig. 3 will now be described in greater detail.

A) The web material

Any web material known to be suitable for use as a consumer wiping article can be used as the web material 3, provided that the surface of the material is sufficiently closed to ensure that neither the abrasive particles 14 nor the particulate binder material 15 can penetrate the web material 1 but will always remain on the surface. If the abrasive areas 5 are to be well-defined, the surface of the web material on which they are formed should also be smooth and flat enough to ensure close contact by the stencil 13 in the powder coating booth 9.

The web material 3 should be selected having regard to the intended use of the wiping article 1. Known wipe materials generally have a basis weight in the range of from 15 to 300 gm/m^2, although materials having a higher basis weight could be used. Woven and knitted materials are suitable, as are non-woven materials including dry-laid, wet-laid and spun-bonded materials which may, as appropriate, be thermally-bonded, resin-bonded, ultrasonically-bonded, needle-punched, hydro-entangled etc. Wipe materials are often hydrophilic but can also be specifically constructed to absorb non-aqueous liquids, for example grease and oil. They are often categorized, depending on their durability, as "disposable" (meaning that a wiping article formed from the material is intended to be discarded immediately after use), "semi-disposable" (meaning that that a wiping article formed from the material can be washed and re-used a limited number of times), or "reusable" (meaning that a wiping article formed from the material is intended to be washed and re-used).

Disposable wipe materials suitable for use as the web material 3 include spun-bond and spun-lace non-woven materials having a basis weight in the range of from 15 to 75 g/m^2 and formed, for example, from PET, rayon, viscose, wood pulp, polypropylene, natural fibres, polyamide or mixtures thereof. Examples of disposable wipe materials are available under the trade names: "Sontara" from DuPont; and "TenoLace" from Tenotex of Terno d'Isola, Italy.

Semi-disposable wipe materials suitable for use as the web material 3 include spun-lace non-woven materials having a basis weight in the range of from 75 to 250 g/m^2 and formed, for example, from fibres or microfibres of polyester, polyamide, viscose. Examples of semi-disposable wipe materials are available under the trade names "Scotch-Brite™ Dusting Cloth" from 3M Company of St. Paul, Minnesota, USA; and "Sontara" from DuPont.

Reusable wipe materials suitable for use as the web material 3 include knitted, woven, thermo-bonded, latex-coated, and chamois-type materials having a basis weight in the range of from 100 to 300 g/m^2 and formed, for example, from fibres or microfibres of PET, rayon, viscose, polypropylene, natural fibres, polyamide or mixtures thereof. An

example of a reusable wipe material is the material used for wipes available under the trade name "Cif" from Lever Fabergé, Switzerland.

B) The particulate binder material

The particulate binder material 15 may be any suitable binder resin that is solid at room temperature and has been processed to particulate form, and should be selected having regard to the nature of the web material 3 on which it is to be deposited and its intended use in a domestic wiping material. The binder material should also be capable of being activated without damaging the web material. Depending on the intended use of the wiping article, the cured binder material may be required to be able to withstand washing and exposure to certain cleaning compositions. The particulate binder material 15 should also be of a size suitable for use in the electrostatic spray gun 17.

Suitable particulate binder materials include thermosetting and thermoplastic powders that are activated by heat, as well as powders that are activated other ways. Thermosetting resins from which the particulate binder material can be selected include formaldehyde-containing resins, such as phenol formaldehyde, novolac phenolics and especially those with added crosslinking agent (e.g., hexamethylenetetramine), phenoplasts, and aminoplasts; unsaturated polyester resins; vinyl ester resins; alkyd resins, allyl resins; furan resins; epoxies; polyurethanes; and polyimides. Thermoplastic resins from which the particulate binder material can be selected include polyolefin resins such as polyethylene and polypropylene; polyester and copolyester resins; vinyl resins such as poly(vinyl chloride) and vinyl chloride-vinyl acetate copolymers; polyvinyl butyral; cellulose acetate; acrylic resins including polyacrylic and acrylic copolymers such as acrylonitrile-styrene copolymers; and polyamides (e.g., hexamethylene adipamide, polycaprolactum), and copolyamides. Mixtures of the above thermosetting and thermoplastic resins may also be used.

Binder materials that are cured other than by heating or cooling can also be used, for example, materials that are cured by ultraviolet light.

Preferably, the particulate binder material is an epoxy, or a polyurethane, or a co-polyamide particulate resin.

C) The abrasive particles

The abrasive particles 14 can be of any type known to be suitable for use in domestic scouring articles, taking into account the nature of the surfaces to be cleaned and the scouring action desired. Included among the suitable abrasive materials are particles of inorganic materials, for example aluminum oxide including ceramic aluminum oxide, heat-treated aluminum oxide and white-fused aluminum oxide; as well as silicon carbide, tungsten carbide, alumina zirconia, diamond, ceria, cubic boron nitride, silicon nitride, garnet, and combinations of the foregoing. It is contemplated that abrasive agglomerates may also be used in the invention such as those described in U.S. Pat. Nos. 4,652,275 and 4,799,939. Suitable abrasive particles also include softer, less aggressive materials such as thermosetting or thermoplastic polymer particles as well as crushed natural products such as crushed nut shells, for example. Suitable polymeric materials for the abrasive particles include polyamide, polyester, poly(vinyl chloride), poly(methacrylic) acid, polymethylmethacrylate, polycarbonate, polystyrene and melamine-formaldehyde condensates. The abrasive particles 14, like the particulate binder material 15, should be of a size suitable for use in the electrostatic spray gun 17.

For a wiping article that has a non-scratch scouring action, preferred abrasive particles are polyamide or PVC.

Methods of producing wiping articles in accordance with the invention are described in greater detail in the following non-limiting examples. All parts and percentages quoted are by weight unless otherwise indicated.

EXAMPLES

The examples used the following materials, equipment, and test methods.

Materials

50%PET-50%rayon web material: a disposable spun-lace wipe material having a basis weight of 50 g/m^2 from Green Bay Nonwoven of Green Bay, Wisconsin, U.S.A.

PE/viscose/wood pulp web material: a disposable spun lace wipe material available under the trade name "TenoLace" from Tenotex of Terno d'Isola, Italy.

Semi-disposable microfibre web material: a material of the type used for wipes available under the trade name "Scotch-Brite™ Dusting Cloth" from 3M Company of St. Paul, Minnesota, U.S.A.

Re-usable microfibre web material: a material of the type used for wipes available under the trade name "Cif" from Lever Fabergé, Switzerland.

Epoxy resin powder: "Beckrypox AF" low temperature cure blue thermoset powder (mean particle size 35 microns) from DuPont of Montbrison, France.

High density polyethylene resin powder:"NB 6454F" thermoplastic powder (particle size 0 - 90 microns) from DuPont Polymer powders of Bulle, Switzerland.

Copolyamide resin powder: "Vestamelt 350 P1" thermoplastic powder (particle size 0-80 microns) from Degussa of Marl, Germany.

Copolyester resin powder: "Vestamelt 4680 P1" thermoplastic powder (particle size 0-80 microns) from Degussa of Marl, Germany.

Polyurethane resin powder: "UNEX 4073" thermoplastic powder (particle size 0-80 microns) from Dakota Coatings of Nazareth, Belgium

Low density polyethylene resin powder: "HA 1591" thermoplastic powder (particle size 0 - 75 microns) from DuPont Polymer powders of Bulle, Switzerland.

Powder flow aid: "Aerosil 200" from Degussa of Marl, Germany.

Polyamide particles: particle size 0 - 250 microns (average 105 microns) from Rhodia of Barcelona, Spain.

Equipment

Powder coating equipment: "Versaspray II" electrostatic spray gun from Nordson of Westlake, Ohio, USA, installed in a powder coating booth (also available from Nordson)

and directed downwards towards a 30cm wide horizontal metallic mesh conveyor belt, which was electrically-grounded. An electrically-conductive plate was provided to be placed on top of a length of the conveyor, as it entered the booth. The gun was fitted with a 2.5 mm flat spray nozzle. The powder coating booth was provided with a fluidizing hopper to contain powder (the hopper being fitted with a venturi pump to supply the powder to the gun); a recovery drum to collect waste powder at the bottom of the booth and an air control unit for regulating the supply of fluidizing air to the hopper, and of flow and atomizing air to the pump and gun. The hopper, pump and recovery drum are all available from Nordson. The powder booth incorporated features that enabled the safe handling of fine powders (including air extraction through cartridge and HEPA filters, and a fire detection system).

Stencil: A vinyl stencil with cut-outs corresponding to the pattern of Fig. 1. The length of the stencil corresponded to the length of the electrically-conductive plate provided for the conveyor of the coating booth (see above).

Through-air oven: a gas oven (4 meters long) from Cavitec of Munchwilen, Switzerland.

Test methods

Cut test: This test provided a measure of the cut (material removed from a work piece) by a wiping article under wet conditions. A 10.16 cm diameter circular specimen was cut from the wiping material to be tested and secured by a pressure-sensitive adhesive to a back-up pad that had been pre-conditioned by soaking in water. The wiping material was also pre-wetted. The back-up pad was secured to the driven plate of a Schiefer Abrasion Tester (available from Frazier Precision Company. Gaithersburg, Md.), which had been plumbed for wet testing. Circular wax work pieces 10.16 cm diameter by 1.27 cm thick, were cut from "Protowax" (available from Kinet Collins Co. of Cleveland, Ohio, U.S.A.). The initial weight of each work piece was recorded to the nearest milligram prior to mounting on the work piece holder of the abrasion tester. The water drip rate was set to 60 $\pm$ 6 drops per minute. A 2.00 Kg load was placed on the abrasion tester weight platform and the mounted abrasive specimen was lowered onto the work piece. The machine was set to run for 1000 cycles and then automatically stopped. The work piece was wiped free of water and debris and weighed. The cut for each 1000-cycle test was the difference between the initial weight and the weight following the test.

Example 1

The PET-rayon wipe material was conveyed continuously through the powder coating booth. The stencil was placed on the length of web material immediately up-stream of the coating booth and the plate underneath. As that length of web material was moved through the coating booth, a mixture of 75% epoxy resin powder and 25% polyamide particles was directed at the stencil by the "Versaspray II" spray gun located 30cm above the mesh conveyor. The powder mixture was supplied to the spray gun from the hopper in which it was fluidized until gentle bubbling using air at a pressure of 0.5 bar. The air pressure settings of the spray gun were 2-3 bar for the flow (or primary air) and 1-1.5 bar for the atomizing (or secondary) air and the maximum voltage (100 kV) was applied. The powder was deposited on the stencil at a weight of about 50 g/m^2. The stencil-covered part of the web was then moved out of the coating booth, and the stencil and plate were removed leaving a pattern of powder deposits on that part of the web material, which was then moved into the gas oven and heated at 170°C for 2 min to fuse and cure the epoxy resin in the deposits and form a pattern of abrasive areas on the surface of the web material. A low speed setting was used for the recirculating air in the gas oven, to avoid dislodging the resin powder. In the meantime, the stencil was cleaned using an air blower to remove the powder mixture that had been deposited on it in the coating booth: the reclaimed powder mixture was returned to the hopper of the coating booth, and the stencil and plate were re-used on another length of the web material.

Examples 2 to 4

Example 1 was repeated using powder mixtures in which the ratio of epoxy resin powder to polyamide particles was, respectively, 50/50; 95/5 and 100/0 (i.e., in Example 4, no polyamide particles were present in the powder mixture).

Examples 5 and 6

Example 1 was repeated except that the amount of powder deposited on the stencil in the coating booth was, respectively, 100 g/m^2 and 30 g/m^2.

Examples 7 to 9

Example 1 was repeated except that the PET-rayon wipe material was replaced by, respectively, the PE/viscose/wood pulp material, the semi-disposable microfibre material; and the re-usable microfibre material.

Examples 10 to 14

Example 1 was repeated except that the epoxy resin powder was replaced, respectively, by the HD polyethylene powder; the copolyamide powder; the copolyester powder; the polyurethane powder; and the LD polyethylene powder. Flow aid powder was included with the thermoplastic powders in an amount of 0.5% by weight.

Results

The cut test was carried out using samples of wiping articles resulting from Examples 1 to 13. In addition, samples resulting from Example 8 were subjected five times to a domestic washing machine cycle at 95°C and weighed following each cycle.

The scouring action of all of the samples tested could be classified as non-scratch, because the abrasive particles employed were comparatively soft and, according to a visual inspection, did not scratch a polycarbonate workpiece.

The cut test showed that all of the samples exhibited an adequate scouring performance for consumer use as a scouring wipe in domestic, industrial, hospital and food industry environments. The samples from Examples 11 to 13, in which softer resins were used, exhibited a gentler scouring action. Wiping articles exhibiting a gentler scouring action might find use as toiletry articles for cleaning human skin.

Samples from Example 4 indicated that an adequate scouring performance could be obtained through the use of a comparatively resin powder (possibly already formulated to include a filler material) without the use of additional abrasive particles.

Samples from Example 8 were found to be washable for at least 5 cycles at a temperature of 95°C.

Visual inspection of the samples from all of the Examples showed that the abrasive pattern on all samples was clear and well-defined.

An advantage of the process described in Example 1 above is that no volatile organic compounds (VOCs) are produced in the formation of the abrasive areas on the surface of the web material. In addition, the energy required in the process may be less than that required if a liquid, rather than a powder, resin were used. Consequently, the environmental effects of the process can be substantially less than those previously proposed for producing wiping article with a scouring action. In addition, due to the absence of liquids, the process is comparatively clean and the materials required are easy to handle. The examples also demonstrated that visually-attractive wiping articles with well-defined abrasive patterns could be produced in a comparatively simple manner.

CLAIMS

1. A method of making a wiping article for cleaning surfaces, the method comprising the steps of

(i) providing a liquid-absorbent web material;

(ii) providing a dry particulate material that comprises at least particulate curable binder material;

(iii) depositing spaced areas of the dry particulate material on a liquid-absorbent surface of the web material; and

(iv) curing the binder material to form spaced abrasive areas on the surface of the web material, the said abrasive areas being spaced apart by liquid-absorbent areas of the web material.

2. A method as claimed in claim 1, in which the dry particulate material is deposited on the web material to form spaced areas having a pre-selected shape, which shape is substantially retained when the binder material is cured.

3. A method as claimed in claim 2, in which the dry particulate material is deposited on the web material through a screen that defines the shape of the said spaced areas.

4. A method as claimed in claim 3, in which the screen is in direct contact with the surface of the web material while the dry particulate material is being deposited thereon.

5. A method as claimed in any one of the preceding claims, in which the areas of dry particulate material are deposited in an ordered pattern.

6. A method as claimed in any one of the preceding claims, in which the deposited areas of dry particulate material cover no more than 50% of the area of the surface of the web material.

7. A method of making a wiping article for cleaning surfaces, the method comprising the steps of

(i) providing a liquid-absorbent web material;

(ii) providing a dry particulate material that comprises at least particulate curable binder material;

(iii) depositing dry particulate material on a liquid-absorbent surface of the web material, to cover no more than 50% of the area of the surface; and

(iv) curing the binder material to form spaced abrasive locations on the surface of the web material, the said abrasive locations being spaced apart by liquid-absorbent areas of the web material.

8. A method as claimed in any one of the preceding claims, in which the dry particulate material also comprises abrasive particles.

9. A method as claimed in any one of the preceding claims, in which the deposited dry particulate material covers 15 - 40% of the surface area of the web material.

10. A method as claimed in any one of the preceding claims, in which the dry particulate material is deposited on the web material under the action of an electrostatic force.

11. A method as claimed in claim 10, in which an electrostatic charge is applied to the dry particulate material, which is then directed towards the web material while the latter is located on an electrically-grounded support surface.

12. A method as claimed in any one of the preceding claims, in which the particulate binder material is a thermosetting or a thermoplastic resin.

13. A method as claimed in claim 8, in which the abrasive particles comprise a polymeric or a natural material.

14. A method as claimed in claim 8 or claim 13, in which the dry particulate material comprises no more than 50% by weight of abrasive particles.

15. A method as claimed in any one of the preceding claims, in which the web material is a non-woven material having a basis weight in the range of from 20 to 300 g/m^2.

16. A wiping article for cleaning surfaces, comprising a liquid-absorbent web material and, disposed on a liquid-absorbent surface thereof, abrasive locations comprising at least cured particulate binder material, the said abrasive locations being spaced apart by liquid-absorbent areas of the web material.

17. A wiping article as claimed in claim 16, in which the abrasive locations are disposed in an ordered pattern over the surface of the web material.

18. A wiping article as claimed in claim 16 or claim 17, in which the abrasive locations cover no more than 50% of the area of the surface of the web material.

19. A wiping article as claimed in claim 18, in which the abrasive locations cover 15 - 40% of the area of the surface of the web material.

20. A wiping article for cleaning surfaces, comprising a liquid-absorbent web material and, disposed on a liquid-absorbent surface thereof, at least one abrasive area comprising at least cured particulate binder material, wherein the abrasive area covers no more than 50% of the surface of the web material and the remainder of the surface is liquid absorbent.

21. A wiping article as claimed in any one of claims 16 to 20, in which the abrasive locations/areas also comprise abrasive particles.

22. A wiping article as claimed in claim 21, in which the abrasive particles comprise a polymeric or a natural material.

23. A wiping article as claimed in claim 21 or claim 22, in which the abrasive locations/areas comprise no more than 50% by weight of abrasive particles.

24. A wiping article as claimed in any one of claims 16 to 23, in which the binder material is a thermosetting or a thermoplastic resin.

25. A wiping article as claimed in any one of claims 16 to 24, in which the web material is a non-woven material having a basis weight in the range of from 20 to 300 g/m^2.

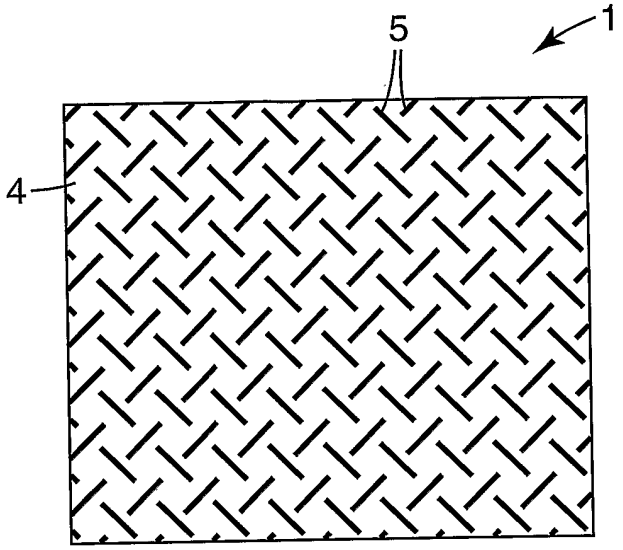


Fig. 1

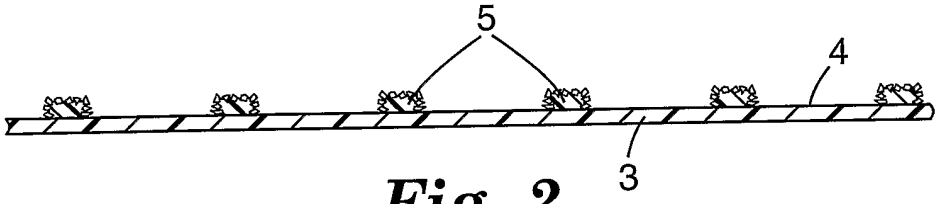


Fig. 2

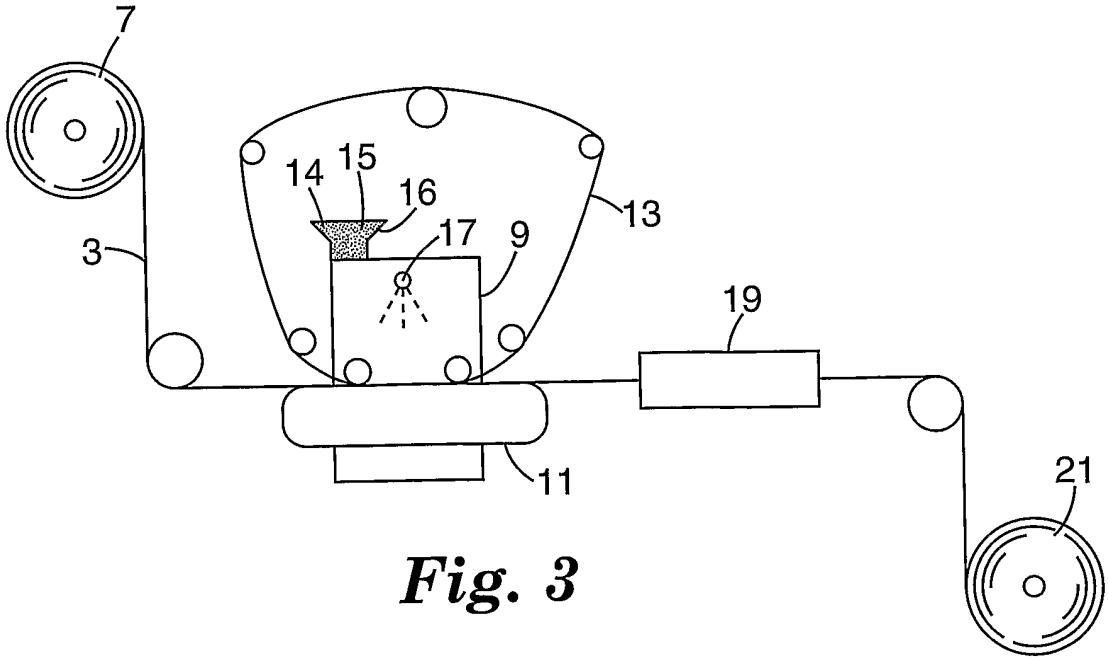


Fig. 3

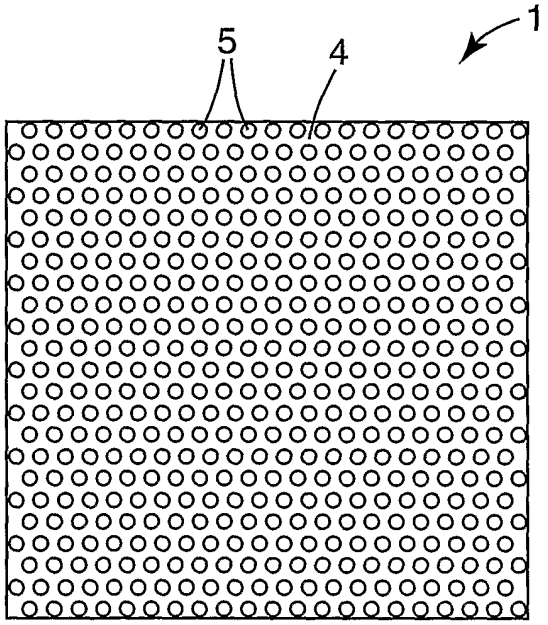


Fig. 4

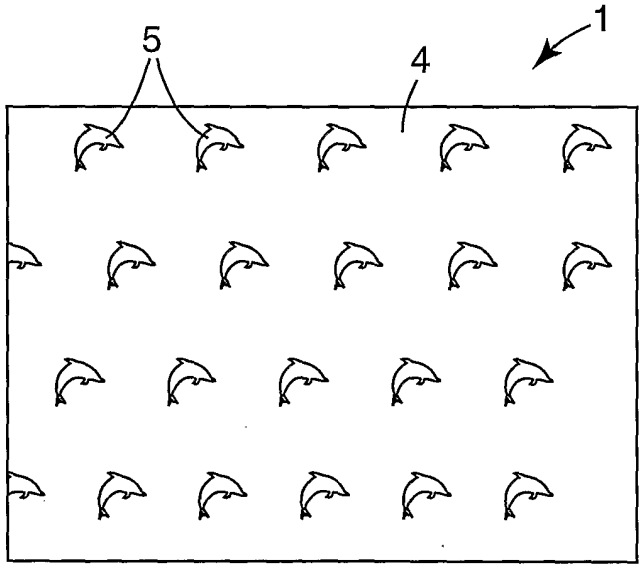


Fig. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/010844

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B24D11/00 A47L13/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B24D A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 211 664 A (UNILEVER PLC ; UNILEVER NV (NL)) 25 February 1987 (1987-02-25) cited in the application column 2, line 1 - column 6, line 26; claims 9-15; figures 1,2	1-25
Y	US 2002/123548 A1 (STUBBS ROY ET AL) 5 September 2002 (2002-09-05) paragraphs '0005! - '0007!	1-25
A	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 01, 31 January 1996 (1996-01-31) & JP 7 237134 A (NIPPON MICRO KOOTEINGU KK), 12 September 1995 (1995-09-12) abstract; figures a-e	1-25

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 August 2004	01/09/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Do Huu Duc, J

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/010844

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 142 334 A (KIRSCH WILHELM ET AL) 6 March 1979 (1979-03-06) cited in the application column 1, line 30 - column 4, line 14; figures 1-8	1-25

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US2004/010844

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0211664 A	25-02-1987	EP 0211664 A1	25-02-1987
		JP 62039700 A	20-02-1987
US 2002123548 A1	05-09-2002	US 2001011108 A1	02-08-2001
		US 6228133 B1	08-05-2001
		AU 3372299 A	23-11-1999
		EP 1077791 A1	28-02-2001
		JP 2002513685 T	14-05-2002
		WO 9956914 A1	11-11-1999
JP 7237134 A	12-09-1995	JP 2963329 B2	18-10-1999
US 4142334 A	06-03-1979	DE 7619792 U1	17-03-1977
		BE 853399 A1	01-08-1977
		CH 622146 A	31-03-1981
		FR 2355946 A1	20-01-1978
		GB 1577470 A	22-10-1980
		IT 1079627 B	13-05-1985
		JP 53000489 A	06-01-1978
		JP 61041655 U	17-03-1986
		NL 7703636 A ,B,	28-12-1977