

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

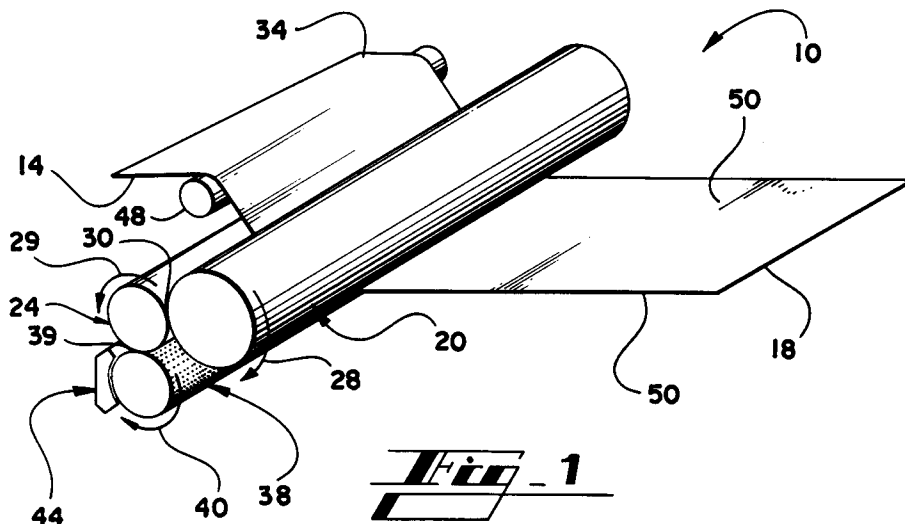
0 546 580 A1

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **92121195.9**(51) Int. Cl.⁵: **D04H 1/64**(22) Date of filing: **11.12.92**(30) Priority: **13.12.91 US 806747**(43) Date of publication of application:
16.06.93 Bulletin 93/24(84) Designated Contracting States:
BE DE ES FR GB IT NL SE(71) Applicant: **KIMBERLY-CLARK CORPORATION**
401 North Lake Street
Neenah Wisconsin 54957-0349(US)(72) Inventor: **Colman, Charles Wilson**
5501 Glenridge Drive, Apt. 823**Atlanta, Georgia 30342(US)****Inventor: Perkins, Cheryl Anne****4977 Fairhaven Way****Roswell, Georgia 30075(US)****Inventor: Sayovitz, John Joseph****4687 Trinity Court****Marietta, Georgia 30068(US)**(74) Representative: **Patentanwälte Grünecker,**
Kinkeldey, Stockmair & Partner
Maximilianstrasse 58
W-8000 München 22 (DE)(54) **Nonwoven, coated substrates and method of applying a coating at high bath concentration and low wet pick-up.**

(57) Nonwoven, hydrophobic fibrous substrates uniformly coated with a wetting agent are disclosed which have improved tensile strength properties over conventional coated, nonwoven substrates. Also disclosed is a process for applying a high solids content wetting agent to a substrate in a manner which results in low wet pick-up and eliminates drying

requirements. The low wet pick-up reduces degradation of the tensile strength of the material normally resulting from with the wetting and drying of nonwoven substrates. In one embodiment the untreated side remains hydrophobic producing a "one-way valve" effect.

**EP 0 546 580 A1**

Technical Field

This invention relates to coated materials and processes for coating fibrous materials. More particularly, this invention relates to nonwoven, hydrophobic materials uniformly coated with a wetting agent and having improved tensile strength. This invention also particularly relates to a process for uniformly coating a nonwoven, hydrophobic material with a wetting agent at high bath concentration and low wet pick-up. In addition, it relates to resulting nonwoven fabrics which may be either hydrophilic on both sides or hydrophilic on one side and hydrophobic on the other, in the latter case exhibiting "one-way valve" properties.

Background of the Invention

Nonwoven, hydrophobic substrates or materials are well known in the art. Many disposable products such as diapers and sanitary napkins are constructed with top sheets made of nonwoven, hydrophobic material. The outer surface of these top sheets is typically treated with a wetting agent to allow fluid to more readily penetrate the outer surface for capture by an underlying absorbent pad. Top sheets made with a hydrophobic material having an outer surface treated with a wetting agent are preferred for such applications over top sheets made with a hydrophilic material because the wetting agent provides hydrophilic properties to the outer surface to improve fluid penetration without compromising the desired hydrophobic properties of the inner surface of the top sheet. The hydrophobic inner surface retains the penetrated fluid and inhibits flow back of the penetrated fluid to the outer surface, thus acting as a "one-way valve".

It is desired to apply the wetting agent to the nonwoven material in a uniform concentration for aesthetics and to provide uniform wettability to the outer material. Nonwoven materials, however, typically have irregular surfaces onto which it is difficult to uniformly apply the wetting agent. This is particularly so if a coating solution having a high concentration of wetting agent is used. For these reasons, wetting agents are typically applied by spraying, direct printing, or roller coating a low concentration solution of the wetting agent onto the outer surface of the material. One example of a material treated using conventional techniques is disclosed in United States Patent No. 4,585,449 to Karami.

One disadvantage of coating nonwoven materials using a low concentration solution is that a large amount of the solvent (usually water) is typically "picked-up" by the material. The wet "pick-up" is removed by drying the coated material to

evaporate the solvent. This drying step is detrimental to the strength and softness of the material, as it has been observed that the action of wetting and drying a nonwoven material significantly decreases the tensile strength of the material. Thus, there is a need in the art for a method of uniformly applying a wetting agent to a nonwoven material which results in a uniform application of the wetting agent on the material without a significant decrease in the tensile strength of the material.

Summary of the Invention

The present invention fills the above need by providing a process for uniformly applying a high concentration solution of a wetting agent to a fibrous substrate such as a nonwoven material. The application of a high concentration solution results in lower wet pick-up by the material, which reduces subsequent drying of the material and the associated loss in tensile strength. This provides a strong, nonwoven material having a uniform coating.

Generally described, the present invention provides a process for coating a material, the process comprising the steps of introducing a coating solution to a first rotating roll, the coating solution containing between about 20 and 30 percent by weight of a wetting agent compound and between about 70 and 80 percent by weight of a solvent; and passing the material through a nip defined between the first roll and a second rotating roll positioned adjacent the first roll, wherein a portion of the coating solution is applied by the first roll to a surface of the material in an amount such that the wetting agent is applied to the material in an amount of between about 0.1 and 0.5 percent by weight of the material, and the solvent is applied to the material in an amount not exceeding about 1 percent by weight of the material.

Another aspect of the present invention provides a coated substrate, comprising a nonwoven material and a substantially uniform coating on a surface of the nonwoven material. The coating comprises a wetting agent applied to the nonwoven material in an amount of between about 0.1 and 0.5 percent by weight of the nonwoven material and a solvent applied to said nonwoven material in an amount not exceeding about 1 percent by weight of said material.

Thus, it is an object of the present invention to provide an improved coated material and process for coating a material.

A further object of the present invention is to provide a process for coating a fibrous material using a high concentration coating solution such that wet pick-up and loss of tensile strength are reduced and drying requirements are reduced and

may be eliminated.

A still further object of the present invention is to provide a process for coating a fibrous material which does not require drying of the coated material and yet microbiological testing confirms that no unacceptable levels of bacteria are present.

It is also an object of the present invention to provide a coated material which has improved tensile strength and in one preferred embodiment is hydrophobic on one surface and hydrophilic on the other, exhibiting one-way valve properties.

Brief Description of the Drawings

Figure 1 is a perspective drawing of the "inverted L" differential offset printer used to apply a coating to a material in accordance with the present invention.

Figure 2 is a graph showing the percent surface concentration of the wetting agent on the coated material of the present invention as a function of cross-direction position.

Figure 3 is a graph showing the percent surface concentration of the wetting agent on the coated material of the present invention as a function of machine-direction position.

Figure 4 is a graph showing the percent surface concentration of the wetting agent on the coated material of the present invention as a function of gravure roll speed.

Detailed Description of the Invention

While the invention will be described in connection with a preferred embodiment and method, it will be understood that we do not intend to limit the invention to that embodiment or method. On the contrary, we intend to cover all alternatives, modifications, and equivalents as may be included within the scope of the invention as defined by the appended claims.

The nonwoven material 18 is preferably a hydrophobic, nonwoven spunbonded web having a basis weight of between about 0.5 and 1.0 ounces per square yard ("osy") although the basis weight is not known to be critical and may be higher, for example, up to 2.5 osy depending on the desired application. Such material is well known in the art and may be prepared in conventional fashion such as illustrated by the following patents: Dorschner et al. United States Patent No. 3,692,618; Kinney United States Patent Nos. 3,338,992 and 3,341,394; Levy United States Patent No. 3,502,538; Hartmann United States Patent Nos. 3,502,763 and 3,909,009; Dobo et al. United States Patent No. 3,542,615; Harmon Canadian Patent No. 803,714; and Appel et al. United States Patent No. 4,340,563. Other nonwoven materials and methods for forming non-

woven materials are contemplated for use with the present invention.

The wetting agent 14 is applied to a surface 50 of the nonwoven material 18 using the printer 10 to provide hydrophilic properties to the surface 50. The printer 10 is preferably a "differential" type printer, with the term "differential" referring to printers wherein the gravure roll speed may be varied with respect to the material or line speed to allow compensation for basis weight changes without changing the gravure roll. The most preferred printer is that which is referred to in the art as an "inverted L" differential offset printer, such as is shown in Fig. 1. The wetting agent 14 is preferably a non-ionic surfactant. A preferred wetting agent for use with nonwoven materials having a basis weight up to about 0.8 osy is "Triton X-102," available from Union Carbide. "Gemtex SM-33", available from Finetex Inc. is a preferred wetting agent for use with nonwoven materials having a basis weight in excess of about 0.8 osy, particularly where "one-way valve" properties are not necessary. For certain personal care applications, it has been experienced that a surface concentration of the wetting agent on the material of between about 0.1 percent to 0.5 percent, broadly and, preferably, between about 0.16 percent and 0.38 percent is desired. The "fountainless pan" doctor blade system 44, supplies a uniform application of a solution containing the wetting agent 14 to the gravure roll 38 in a conventional manner. The solution is preferably a high concentration aqueous solution having the wetting agent 14 present in an amount of between about 20 and 100 percent, and most preferably about 25 percent, by weight of the solution.

The gravure roll 38 is preferably a metal roll of a type conventionally used in the printing art, and having a cell pattern known in the art as a "quad" pattern with between about 300 and 700 cells per inch and a cell size of between about 1.5 and 4.0 CBM (cubic billion microns, volume per square inch). The most preferred gravure roll is one known in the art as a 550 (cells per inch) quad, 1.7 CBM. The gravure roll preferably rotates at a speed of between about 20 and 120 percent of the line speed, and most preferably about 60 percent of the line speed (line speed is described below as preferably being between about 300 and 1,500 feet per minute). A graph showing the percent surface concentration of the wetting agent as a function of gravure roll speed for a representative sample is shown in Fig. 4.

The transfer roll 24 is preferably a rubber roll of a type conventionally used in the printing art, and having a durometer hardness of between about 60 and 85. The gravure roll 38 is spaced apart from the transfer roll 24 such that in operation a desired amount of the coating solution transfers to

the transfer roll for subsequent application to the nonwoven material. The distance between the transfer roll 24 and the gravure roll 38 which defines the nip 39 is preferably between about 1/16 and 1/2 inch to achieve the desired surface concentration, and is optimally about 3/16 inch when applying the coating solution to nonwoven materials having a basis weight of about 0.7 osy. The transfer roll 24 preferably rotates at a rate which advances the material at a line speed of between about 300 and 1,500 feet per minute, with an optimum line speed of about 500 feet per minute. The backing roll 20 is preferably either a metal or rubber roll of a type well known in the printing art, having a durometer hardness of about 90. The backing roll 20 rotates at a rate which provides the same line speed as the transfer roll 24. The spacing between the backing roll 20 and the transfer roll 20 which defines the nip 30 is preferably between about 1/4 and 3/4 inch and is optimally about 3/8 inch when coating nonwoven materials having a basis weight of about 0.7 osy.

By using the differential printer 10 for coating the nonwoven material 18, the resulting coated material 34 has a more uniform coating of wetting agent and has improved tensile strength over conventionally prepared coated materials. In order to evaluate the effect of coating a nonwoven material using a high concentration bath or solution, a representative sample was produced by applying a 25 percent by weight "Triton X-102" aqueous solution to a 0.7 osy nonwoven, hydrophobic material. The solution was applied using an "inverted L" differential offset printer producing a line speed of 500 fpm and a gravure roll speed of 300 fpm (60% line speed). The wet pick-up for the representative sample was determined to be about 0.9 percent and the average surface concentration of the wetting agent was about 0.3 percent solids (coat weight). No drying was necessary. This yielded a uniform distribution of about 0.24 grams of coating solution per square yard.

With reference to Figs. 2 and 3, one can see graphically the uniformity of the surface concentration of the wetting agent on the representative sample in the cross-direction (Fig. 2) and in the machine-direction (Fig. 3). The representative sample exhibited overall a 5.0 percent coefficient of variation in surface concentration across the material, and materials of the invention will generally exhibit a coefficient of variation in surface concentration of 10.0 percent or less. Loss in tensile strength for the representative sample was determined (in accordance with RTM-6200) by comparing the tensile strength of treated material with untreated material for the same cross-direction or deckle position. Material treated in accordance with the present invention experienced a 5 percent loss

in tensile strength. This compares with a typical tensile strength loss of at least 21 percent for coated materials prepared utilizing spray treatment and treatments requiring secondary drying over steam cans.

The printing process of the present invention coats the material from the transfer roll; therefore, only one side of the coated material is hydrophilic, while the other side is hydrophobic. Hydrophilic material is wettable material that produces less than 20 milliliters of runoff; hydrophobic material produces greater than 20 milliliters of runoff. A material having a hydrophilic and hydrophobic surface rapidly allows fluid to pass through and does not allow it to flow back. Thus, such material acts as a "one way valve." It has been observed that materials having basis weights between 0.5 and 1.0 osy which are treated in accordance with the present invention behave as one way valves when, after treatment, they are not wound up into roll form in a manner that causes contact between opposing sides of the material. It has also been observed that when materials having a basis weight of less than about 0.85 osy are rolled up after application of the wetting agent, some of the wetting agent transfers to the untreated side, producing a two-sided hydrophilic material. The time required for the wetting agent to transfer to the untreated side being dependent upon the basis weight. Materials having a basis weight greater than about 0.85 osy remain one way valves in sheet or roll form. If two sided hydrophilic behavior is desired for materials having a basis weight in excess of 0.85 osy, a conventional four roll differential printer (dual printer) may be utilized to apply the wetting agent to both sides.

Micropore filtration testing of materials treated in accordance with the invention showed reduced levels of Class I, Class II and Class III bacteria when compared with untreated materials. Class I included *Bacillus* sp, *Corynebacterium*, other gram positive rods, mold and yeast (other than *Candida albicans*). Class II included *Staphylococcus* sp. (other than *S. Aureus*), *Psuedomonas* sp. (other than *P. Aeruginosa*), *Enterobacteriaceae* (other than *E. Coli* and *Salmonella* sp.), other gram positive cocci, *Oxidative-Fermentative* bacteria, and other gram negative rods. Class III included *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella* sp., and *Candida albicans*. While the control had a total CFU of 17, none of the treated samples exceeded 10 CFU.

The foregoing description relates to preferred embodiments of the present invention, and modifications or alterations may be made without departing from the spirit and scope of the invention as defined in the following claims.

Claims

1. A process for coating a material, said process comprising the steps of:
 - (i) introducing a coating solution to a first rotating roll, said coating solution containing between about 20 and 30 percent by weight of a wetting agent and between about 70 and 80 percent by weight of a solvent; and
 - (ii) passing said material through a nip defined between said first roll and a second rotating roll positioned adjacent said first roll,
 - (a) wherein a portion said coating solution is applied by said first roll to a surface of said material in an amount such that,
 - (b) said wetting agent is applied to said material in an amount of between about 0.1 and 0.5 percent by weight of said material, and
 - (c) said solvent is applied to said material in an amount not exceeding about 1 percent by weight of said material.
2. The process of Claim 1, wherein after said coating solution is transferred to said surface of said material, said material has a tensile strength which is at least 90 percent of the tensile strength of said material before it is coated.
3. The process of Claim 1, wherein said material is a nonwoven material.
4. The process of Claim 3, wherein said nonwoven material comprises a nonwoven, hydrophobic material having a basis weight of between about 0.5 and 1.0 ounces per square yard.
5. The process of Claim 1, wherein said nip is formed by positioning said first roll and said second roll between about 1/4 and 3/4 inch apart.
6. The process of Claim 1, further comprising a third roll positioned to apply said coating solution to said first roll.
7. The process of Claim 6, wherein said third roll is positioned between about 1/16 and 1/2 inch apart from said first roll.
8. The process of Claim 1, wherein said wetting agent is a surfactant.
9. A material made in accordance with the method of Claim 1.
10. A material made in accordance with the method of Claim 2.
11. A material made in accordance with the method of Claim 3.
12. A material made in accordance with the method of Claim 4.
13. A material made in accordance with the method of Claim 5.
14. A material made in accordance with the method of Claim 6.
15. A material made in accordance with the method of Claim 7.
16. A material made in accordance with the method of Claim 8.
17. A coated substrate, comprising a fibrous material having on at least one side a coating with a coefficient of variation in surface concentration of 10 percent or less.
18. The coated substrate of Claim 17 comprising:
 - (i) a nonwoven material; and
 - (ii) a coating on a surface of said nonwoven material, said coating comprising:
 - (a) a wetting agent applied to said nonwoven material in an amount of between about 0.1 and 0.5 percent by weight of the nonwoven material, and
 - (b) a solvent applied to said nonwoven material in an amount not exceeding about 1 percent by weight of said material.
19. The coated substrate of Claim 18, wherein said coated substrate has a tensile strength which is at least 90 percent of the tensile strength of the nonwoven material.
20. The coated substrate of Claim 18, wherein said solvent is water.
21. The coated substrate of Claim 18, wherein said wetting agent comprises a surfactant.
22. The coated substrate of Claim 18, wherein said coating is applied to said surface using a differential printer.

23. The coated substrate of Claim 18 wherein said wetting agent provides hydrophilic properties on the coated side of said substrate and the opposite side of said substrate is hydrophobic.

5

10

15

20

25

30

35

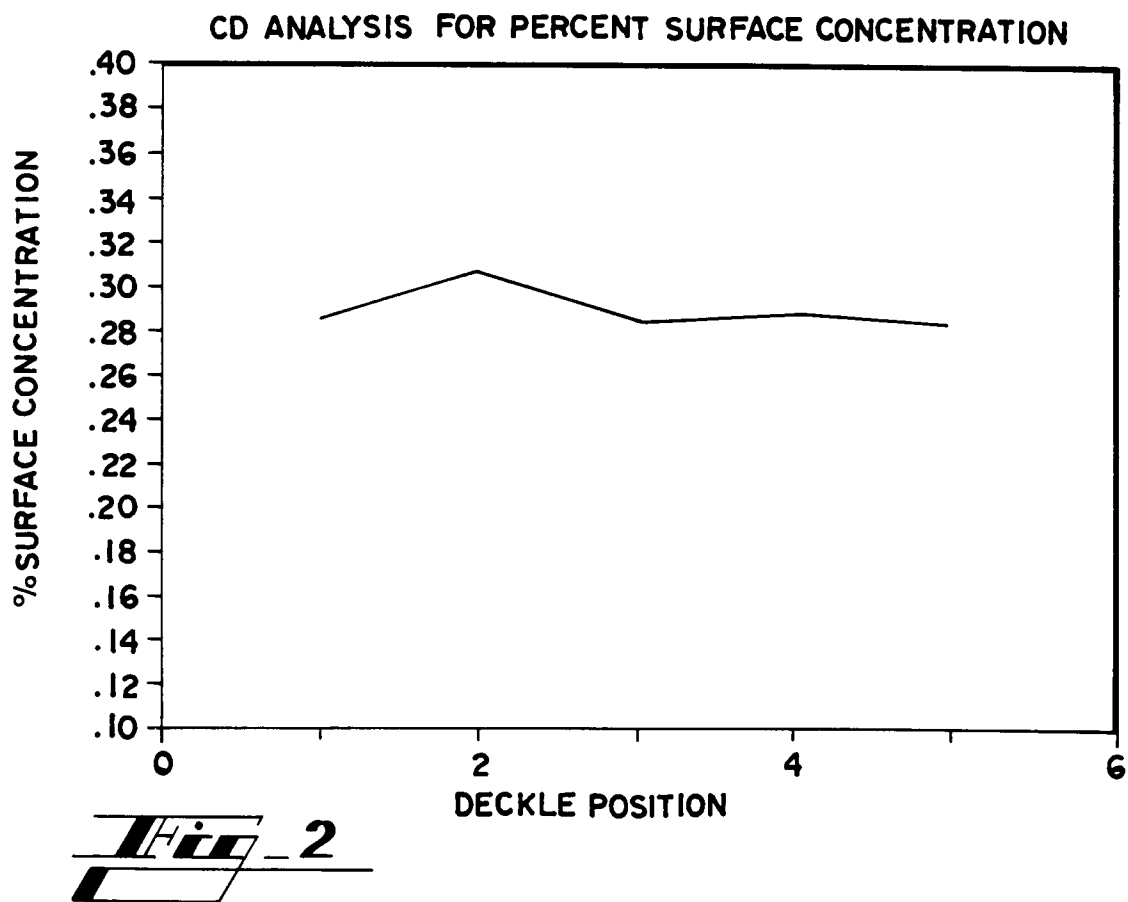
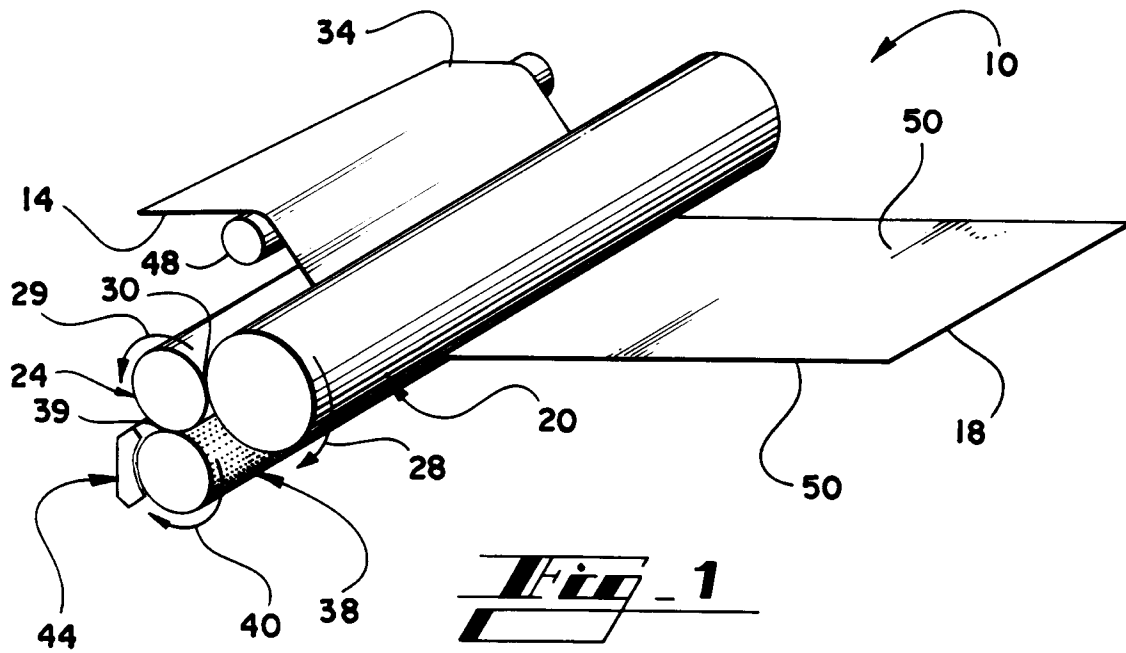
40

45

50

55

6



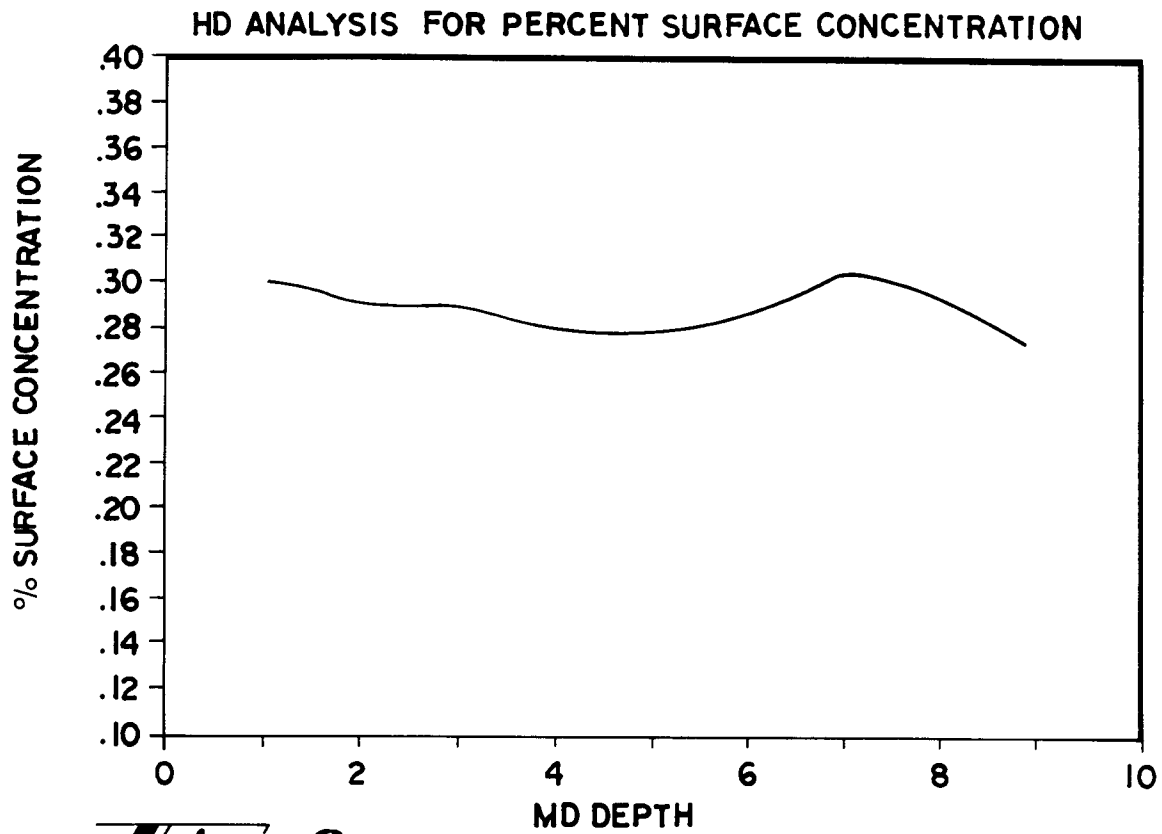


Fig. 3

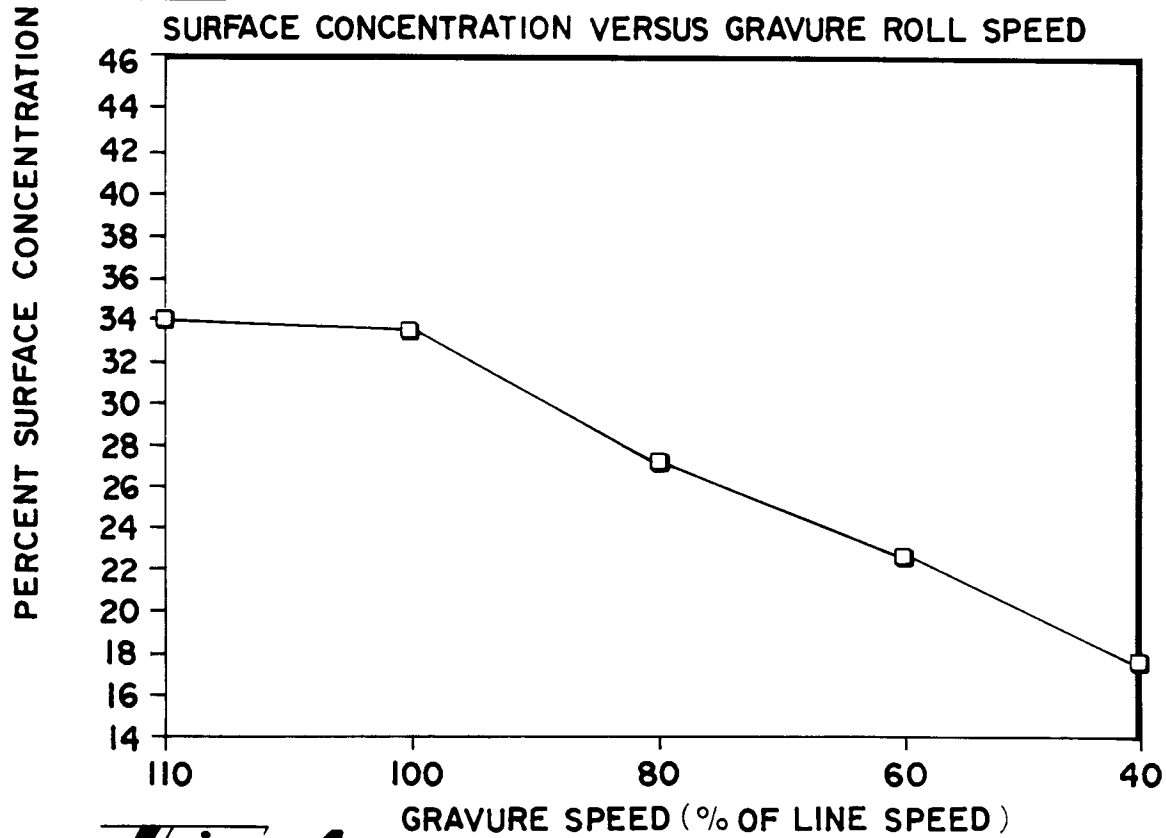


Fig. 4



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 12 1195

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 356 229 (BRODNYAN) * column 2, line 29 - column 8, line 9 * ---	1,3,4,8, 9,11,12, 16	D04H1/64
A	US-A-4 379 192 (WAHLQUIST ET AL.) * whole document * ---	1,4,8	
A	GB-A-2 190 111 (KIMBERLY-CLARK) * whole document * ---	1,4,8	
A	GB-A-941 073 (PORTALS LTD.) * whole document * -----	1,5,7	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D04H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 12 MARCH 1993	Examiner VAN BEURDEN-HOPKINS
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			