WEB SMOOTHNESS IMPROVEMENT PROCESS

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ABSTRACT

The present invention provides a process for improving smoothness of a web surface by subjecting the web surface to an untreated smooth roll traveling at a different speed than the web and thereby producing heat generated by friction to plasticize the very top fibers in the mat. Surprisingly, the inventors found that no abrasive was needed to generate the amount of heat required to achieve the smoothness gain.
FIGURE 1

Abrasive vs Smooth Roll

Delta Sheffield = Sheffield Before - Sheffield After

Nip Length, mm

Abrasive Roll
- 1000 mpm (○)
- 650 mpm (□)

Smooth Roll
- 1000 mpm (●)
- 650 mpm (■)
FIGURE 2

Averages, SBS Board Treatment

Smoothness Improvement
Sheffield Smoothness: Before - After

-1000 mpm

-650 mpm

Roll Type

Abrasive Smooth

Smooth
FIGURE 3

Averages, SBS Board Treatment

Smoothness Improvement
Sheffield Smoothness: Before - After

Expected Value = 70+/-20

Expected Value = 0

Roll Type

Abrasive Smooth Roll Type

-1000 mpm

650 mpm
WEB SMOOTHNESS IMPROVEMENT PROCESS

FIELD OF THE INVENTION

[0001] This invention relates to a process for improving the smoothness of the surface of a fibrous web while not compromising other properties such as bulk, density, yield and quality. More specifically, the invention relates to a process wherein a paper/board web is passed over a smooth, untreated roll in such as manner as to create friction and thereby generating enough heat to plasticize or melt surface fiber.

BACKGROUND OF THE INVENTION

[0002] For the purpose of all printing operations, the surface of the paper/board should be as smooth and/or homogeneous as possible. Typical processes for improving surface smoothness of paper/board, either before coating, as a final finishing process after coating a paper/board substrate, or for uncoated paper/board, involve compressing the sheet. This is called calendering. In calendering, the paper is exposed to great pressure to give the surface a smooth finish. The objective of calendering is to smooth the paper surface or to deform the paper plastically and replicate the surfaces of a calender roll on the paper. This is done by passing the web through one or more two-roll nip(s), in this way the material is both pressed and rubbed and the glazed surface produced. The rolls may be of equal or unequal hardness. The process can be enhanced by using greater pressure, or by heating or moistening the surface fibers to make them more pliable. For example, in one method, the paper/paperboard is passed through one or more heated calendering nips which are at temperatures higher than the temperature of the web. The surface of the paper/paperboard that is to be finished is pressed against the heated roll. The applied heat raises the surface temperature of the paper/paperboard to the glass transition temperature, which causes the fibers to soften and conform to the surface of the roll.

[0003] There are numerous types of calenders, but all of them even the surface by mechanical pressing and sliding forces. Conventional calendering is hampered by some considerable disadvantages. After remoisturizing, surface smoothed by calendering will totally or partially regain its original form. It is also known that paper may lose up to 35-40% of its strength properties and 25-35% of its original opacity as a result of calendering. Also, the original tenacity of the paper web will remarkably decrease. Further, some sheet compaction or densification also occurs during calendering. In view of the problems related to calendering, great efforts have been made to find some different methods for surface smoothing.

[0004] U.S. Pat. No. 5,533,244 discloses method for polishing paper with a woven belt which slides at different speed over the paper web than the web itself, producing frictional action. U.S. Pat. No. 4,089,736 discloses a soft calender device, which acts as a rubbing friction device on paper surface. The device will smooth the paper surface in the same way as original supercalenders. U.S. Pat. No. 4,112,192 discloses the use of a heated calendering apparatus.

[0005] It is known in the papermaking art that various types of rolls may be used for different purpose such as for transporting the web, coating and calendering. For example, in the drying step the stock is fed to the dryer section, where it is passed over steam-heated rollers to dry it. After drying, the paper is fed to the size press where it is passed through rollers, such as calender rolls, and additives are applied to create the special surface properties needed for the final product.

[0006] U.S. Pat. Nos. 6,468,133 and 6,497,793 disclose a method for removal of high density flocks from the paper surface by grinding off the most protruding parts of the web with a grinding means, such as a grinding roll or vibrating grinding device or rotating grinding cylinder. U.S. Pat. No. 2,349,704 discloses a method for polishing the surface of a paper web with a cloth-polishing roll. The surface of the roll contains a powdered abrasive, which is bound to the surface with the aid of a binder. The object is to press and polish paper to the same extent as is made by the supercalendering process, and according to specification of the patent, the density of the treated paper is the same as after a supercalendering process and gloss, measured by a Baush & Lomb glossmeter, is 10 points higher than before the treatment. U.S. Pat. No. 4,267,215 discloses a method of coating a surface of web wherein a reverse roll technique in which the application roll contra-rotates relative to the direction of movement of the web. U.S. Pat. No. 2,118,763 relates to a method of treating fiber boards which method consists in traveling the boards in one direction and simultaneously subjecting the moving boards to the action of a pair of opposed, smooth surfaced and highly heated rollers in contact with the surfaces of the boards, said rollers revolving in a direction opposite that of the board travel and at a much higher rate of speed.

[0007] None of the prior art method will provide for a simple and economical method of smoothing the surface of a fibrous web. Further, it is apparent that the strength properties of the paper deteriorate during the application of the known methods. There would be a considerable economic advantage to achieving the smoothness gains that results from calendering without having to densify the sheet.

SUMMARY OF THE INVENTION

[0008] The present inventors have found that by ignoring the teaching of the prior art, namely that an abrasive or covered roll is needed to improve smoothness, and, instead, by using an uncoated, smooth roll, a substantial smoothness improvement can be obtained.

[0009] It is, therefore, an object of the present invention to eliminate the disadvantages of the prior art and to provide a novel process for treating the surface of a fibrous web, in particular a paper/board surface, in order to improve its smoothness while substantially retaining the caliper and mechanical properties of the web.

[0010] Thus, it is an object of the present invention is to provide a process for increasing the smoothness of the surface of a fibrous web while not compromising other properties such as bulk, density, yield and quality.

[0011] It is an object of the present invention to provide a process wherein the fibrous web is passed over an uncoated smooth roll, wherein the rotating speed of the roll and the rotating speed of the web are different enough so as to cause enough friction to generate heat and melt the surface of the fiber.
It is a further object of the present invention to provide a process wherein the fibrous web is passed over an uncoated smooth roll rotating in the same direction or in a direction opposite the direction of web travel.

The invention further comprises an improved process wherein the uncoated smooth roll is a simple mild steel roll.

The invention further comprises an improved process wherein the uncoated smooth roll is a simple mild steel roll that is chrome plated.

Additionally, the invention comprises a process that may include a soft backing roll pushing the paper/board against the web.

The invention further comprises a process wherein the backing roll runs at the same speed and direction as the web.

The invention further provides a process wherein the smoothing step is preferably applied before coating the board, size press treatment or calendering.

An object of the present invention to provide a process for improving the smoothness of a fibrous web, without loss of bulk which results from calendering, which process comprises subjecting the paper/board to an uncoated smooth roll prior to calendering.

A further object of the present invention is to provide a process wherein the calendering step is needed only to provide caliper control in the cross machine direction. As a result, the minimum bulk is lost.

An advantage of the present invention is that it allows many of the sheet properties to be achieved with less fiber, and the process results in improved surface smoothness without caliper loss.

Another advantage of the present invention is to uncouple two variables which are strongly linked in the normal calendering process, (smoothness and caliper), thereby giving the papermaker a choice as to whether to use the resulting paper with improved surface smoothness without caliper loss, to get improved stiffness, which comes with higher caliper, or to remove fiber, and end up with the same caliper as before.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows that a smooth uncovered roll gives similar improvement in smoothness as an abrasive roll.

FIG. 2 shows that the smooth uncovered roll gives similar improvement in smoothness as an abrasive roll.

FIG. 3 shows the smoothness expected, based on the prior art, with a smooth uncovered roll.

DETAILED DESCRIPTION OF THE INVENTION

In the papermaking art, rolls have been used for different purposes such as for transporting the web, coating and calendering. The present invention is based on the surprising discovery that a smooth roll can be used to generate heat and thereby impart substantial smoothness improvements on paper/board that previously were thought to require an abrasive covered roll. In particular, the present invention provides a process for improving smoothness of a web surface by subjecting the web surface to an uncoated smooth roll traveling at a different speed than the web and thereby producing heat generated by friction to plasticize the very top fibers in the mat. Surprisingly, the inventors found that no abrasive was needed on the steel roll to generate the amount of heat required to achieve smoothness gain.

The terms "paper/board," "paper" and "paperboard" refer to sheet-formed products containing cellulosic or lignocellulosic fibres. "Paperboard" is synonymous with "cardboard". The grammage of the paper or paperboard can vary within broad ranges from about 30 to about 500 g/m². The roughness of the web which is to be treated is about 0.1 to 30 μm, preferably about 1 to 15 μm, as measured by the Parker Print Surf method. In the present invention, the roughness as measured with the Sheffield roughness test varies from about 100 to 400 units, preferably 200 to 325 units, most preferably 125 units. The present invention can be employed for treating any desired paper or paperboard web. As a practical matter, the term "paper" or "paper web" is herein used to designate both "paper" and "paperboard" and "paper web" and "paperboard web", respectively.

Within the scope of the present invention, the terms "cellulosic" and "lignocellulosic" are used to designate materials derived from cellulose and lignocellulosic materials, respectively. In particular, "cellulosic" refers to material obtainable from chemical pulping of wood and other plant raw material. Thus, a web containing "cellulosic fibres" is made for example from kraft, sulphite or organosolv pulp. "Lignocellulosic" refers to material obtainable from wood and other plant raw material by mechanical delignering, for example by an industrial refining process, such as refiner mechanical pulping (RMP), pressurized refiner mechanical pulping (PRMP), thermomechanical pulping (TMP), groundwood (GW) or pressurized groundwood (PGW), or chemithermo-mechanical pulping (CTMP) or any other method for manufacturing a fibrous material which can be formed into a web and coated.

The terms "fines", "fibrils" and "fibres" denote finely divided material having a cross-sectional diameter of less than about 10 μm, typically in the range of 0.001 to 2 μm and the "fibrils" and "fibres" are materials having a length to cross-section diameter ratio of more than about 6.

The term "web tension" stands for the tension caused by the friction generated by the uncoated smooth roll, and not only the external web tension which is achieved by the means conveying the web forward.

Paper/board is manufactured on a conventional papermaking machine, such as a Fourdrinier machine. In such a machine, a furnish of papermaking stock ("furnish") is predominantly water, and stock ("stock") being virgin, recycled or mixed virgin and recycled pulp of wood fibers, fillers, sizing and/or dyes) is deposited from a headbox on a wire (a fast moving foraminous conveyor belt or screen) which serves as a table to form the paper. As the furnish moves along, gravity and suction boxes under the wire draw the water out. Typically, after the paper leaves the "wet end" of the papermaking machine, it still contains a predominant amount of water. Therefore, the paper enters a press section, which can be a series of heavy rotating cylinders, which
press the water from the paper, further compacting it and reducing its water content. Subsequent to pressing the paper enters a drying section. Hot air or steam-heated cylinders contact both sides of the paper, evaporating the water to a low level. The paper optionally passes through a sizing liquid to make it less porous and to help printing inks remain on the surface instead of penetrating the paper. The paper can go through additional dryers that evaporate the liquid in the sizing and coating. Calendars or polished steel rolls make the paper even smoother and more compact. While most calenders add gloss, some calenders are used to create a dull or matte finish.

[0031] The steps of the present invention consist of subjecting a web, preferably after the web has been dried to sufficient dryness to impair reasonable mechanical strength on the web, to an untreated smooth roll. The roll may be of any diameter. The only condition that the surface of the roll is smooth. The roll may be suitably formed from mild steel. In the process of the present invention, the web may have two opposite surfaces and the process comprises subjecting both web surfaces to the untreated smooth roll.

[0032] The smoothing according to the invention is carried out by contacting one or both surfaces of the paper/board web with the untreated smooth roll in such a manner as to cause enough friction force to generate heat and thereby melt the surface fiber of the paper/board. Thus, the speed difference between the roll and paper/board to be smoothed should be sufficient to cause enough friction force to generate heat. The best way to do it is to arrange the web to be running either in the opposite direction from the web, or in the same direction but with different speed. The critical speed difference depends on the wood or pulp quality from which the paper/board has been made.

[0033] In the process of the present invention, it may be efficacious to use a backing roll, running at the same speed and direction as the web, on the opposite side of the web from the smooth roll, in order to make sure there is good, even contact of the surface with the smooth roll. The pressure exerted on the web can vary within a wide range as long as no significant compression of the paper/board takes place. Generally, the surface pressure should be about 0.01 to 1000 kPa, preferably about 1 to 500 kPa. The speed and pressure should be kept on a level where local heating will happen to the extent that the surface fibers melt. The heat generation is naturally dependent on the specific fibrous web and the pressure. In order to ensure that, for example, the roll does not heat up too much, internal or external cooling may be used for adjustment of the temperature.

[0034] Rotation of the roll is effected by conventional driving means. Thus, the movement of the rolls can be carried out by any actuator and operative mechanism such as pneumatic and hydraulic cylinders and electric motors. For example, a pulley-mounted endless belt system coupled to a prime mover, such as an electrical motor, provides a conveniently smooth, variable-speed drive means for the roll without requiring a complex gearing system.

[0035] Thus, the present invention comprises retrofitting existing facilities by driving papermachine rolls or dryer cans in a direction opposing the direction of web travel. The present invention may also be carried out by fitting an untreated smooth roll to a frame the axes for the roll being pivotally mounted to rails and adapted for moving the roll. By moving the rolls transversally against the web the apparatus can be controlled and, at the same time, the web tension can be adjusted. The direction of movement of the rolls does not have to be transverse to the web but the rolls can be moved for example by turning the shafts obliquely or along a circular path with relation to the web. By the movements of the rolls it is also possible to regulate the distance, in other words, for how long the web runs over the roll shell. Regulation of the smoothing force can be carried out, for example, by contacting the uncoated smooth roll with a web having a predetermined web tension and by adjusting the final web tension by regulating the position of the roll or by changing the angle between the web and the roll.

[0036] Further processing of the paper/board treated according to the present invention may be carried out either directly on the smooth surface or after sizing or coating of the smooth surface. The further processing normally comprises polishing, light calendering or renewed drying of the smooth surface, or a combination of all these. For coating purposes the paper/board can be provided with a polymer layer, a barrier layer, a lacquer or with normal coating colours. These paper/boards are particularly suitable for printing and writing and ink jet printing. Untreated optionally glossy-quality products are also suitable for packaging, wrapping and bagging purposes.

[0037] In a preferred embodiment of the present invention the roll is an untreated smooth roll, that is, a roll with no treatment of the surface with abrasive materials. In another preferred embodiment, the untreated smooth roll is formed by subjecting a metallic surface, which has been made smooth by standard manufacturing techniques that would be used for any roll that is being prepared for a papermachine. The untreated smooth roll may be a simple mild steel roll or chrome plated roll. Preferably the roll is a simple mild steel roll.

[0038] In a preferred embodiment according to the present invention, the speed difference between the untreated smooth roll and the fibrous web should be sufficiently different so as to cause friction thereby generate enough heat to melt the surface fiber of the paper/board.

[0039] In another preferred embodiment of the present invention, the paper/board may be coated paper/board, uncoated foorsheet, light weight coated paper/board, linerboard, or other grades of uncoated fibrous material. Preferably, the process of the present invention is used on a paper/board before coating, size press treatment, or calendering. In some situations, calendering may not be necessary.

[0040] In the preferred embodiments one or more rolls may be used for smoothing of one surface of the paper/board. The rolls can be rotated in the opposite direction or the same direction to the moving direction of the paper/board. It is essential only that there is a speed difference between the web and the uncoated smooth roll.

[0041] The present invention provides a simply economical process for smoothing a paper/board in that it opens the opportunity to simply retrofit existing facilities by driving papermachine rolls or dryer cans in a direction opposing the direction of web travel. The present invention thus eliminates the need for a special abrasive roll and the need for
special dust removal equipment used to capture dust and debris liberated during the grinding process. Further, in previous method using an abrasive roll, paper grades with low abrasion resistance delaminate and fail during treatment. The present invention eliminates the need for high surface strength. Further, the process of the present invention further reduces the steps required by calendering.

Trials were conducted to compare the action of a smooth roll and an abrasive roll. The board used in these trials was solid bleached sulfate (SBS) basestock made on a papermachine in the Southeastern US. It was made with similar smoothness improvement compared to the abrasive roll before coating on solid bleached sulfate (SBS). The whiskers represent the 95% confidence limits of the averages of the smoothness improvement over the nip pressures in the trials, and the squares and circles represent the averages themselves. FIG. 3 shows what would be expected based on what is known in the art, and what would be expected by one skilled in the art. That is, that a smooth would not be expected to change the surface roughness, hence the difference in smoothness between the board before and after treatment would be zero.

TABLE 1

<table>
<thead>
<tr>
<th>Source</th>
<th>Roll Type</th>
<th>Active Roll Speed, mm/min</th>
<th>Nip Length, mm</th>
<th>Sheffield before treatment</th>
<th>Sheffield board after treatment</th>
<th>Delta Sheffield smoothness improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBS 274</td>
<td>Abrasive</td>
<td>-650</td>
<td>25</td>
<td>220</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Abrasive</td>
<td>-650</td>
<td>20</td>
<td>213</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Abrasive</td>
<td>-650</td>
<td>25</td>
<td>197</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Abrasive</td>
<td>-650</td>
<td>30</td>
<td>192</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Abrasive</td>
<td>-1000</td>
<td>30</td>
<td>178</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Abrasive</td>
<td>-1000</td>
<td>25</td>
<td>178</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Abrasive</td>
<td>-1000</td>
<td>20</td>
<td>184</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Smooth</td>
<td>-650</td>
<td>13.5</td>
<td>218</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Smooth</td>
<td>-650</td>
<td>21</td>
<td>218</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Smooth</td>
<td>-650</td>
<td>31.5</td>
<td>209</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Smooth</td>
<td>-650</td>
<td>31.5</td>
<td>198</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Smooth</td>
<td>-650</td>
<td>21</td>
<td>195</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Smooth</td>
<td>-650</td>
<td>13.5</td>
<td>195</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Smooth</td>
<td>-1000</td>
<td>13.5</td>
<td>202</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Smooth</td>
<td>-1000</td>
<td>21</td>
<td>192</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>SBS 274</td>
<td>Smooth</td>
<td>-1000</td>
<td>31.5</td>
<td>191</td>
<td>76</td>
<td></td>
</tr>
</tbody>
</table>

Sheffield measures smoothness of the surface. Higher numbers signify a rougher surface, and lower numbers a smoother surface. Delta Sheffield is the difference between the initial smoothness number and the final smoothness number. It represents, therefore, a value for the smoothness improvement, with higher numbers meaning more smoothness improvement, a better outcome.

Roll Speed and Nip Length are two variables that refer to process variables as we have implemented it in this case. Roll speed, in meters per minute, is the speed of the surface of the roll where it touches the paper. Nip length is a measure of the pressure in the nip. Higher pressures give more deformation of the soft backing roll that is on the other side of the paper from the abrasive or smooth roll. The MD length of this nip is measured in mm.

minimal calendering, uncoated. The pilot equipment used 50 cm wide basestock. The abrasive roll was coated with tungsten carbide with the HVOF process, and had a final roughness average (R,) of approximately 175 micrometers. The smooth roll was simply a steel roll which was manufactured to normal tolerances for operation on a papermachine, not polished excessively or coated with any functional coating. In this device, the paper web is held against the functional or “active” roll with a backing roll. The backing roll runs at the same speed as the web. The backing roll is made of very soft rubber, in this case, had an HSA value of 50. The pressure exerted to deform the backing roll to achieve the desired result is very small, typically in the range of 3-10 pounds per linear inch (pli). These low pressures are much lower than what the paper would see in a normal calender stack, and they do not result in caliper loss on the scale that would be seen in a calender stack. The web speed in the trials was typically between 300 and 400 meters per minute (mm/min). Table 1 shows that a completely smooth roll gives almost the same smoothness as an abrasive roll. FIG. 1 corresponds to the data found in table 1. FIG. 2 shows that the smooth uncoated roll of the present invention gives

[0043] It is apparent that other variations and modifications may be made without departing from the present invention. Accordingly, it should be understood that the forms of the present invention described above and shown in the accompanying drawings are illustrative only and not intended to limit the scope of the invention.

What is claimed is:

1. A process for increasing the smoothness of the surface of a fibrous web surface of paper or paperboard comprising:

   subjecting the web surface to a smooth untreated roll, wherein the difference between the rotating speed of said roll and the rotating speed of the web is sufficient enough so as to generate heat by friction and thereby plasticize the top fibers in the mat.

2. The process according to claim 1, comprising reducing the roughness of the web surface by a maximum of 125 Sheffield units.

3. The process according to claim 1, wherein the web has two opposite surfaces and the process comprises subjecting both web surfaces to the smooth roll.

4. The process according to claim 1, wherein the smooth uncoated roll is a simple steel roll.
5. The process according to claim 1, wherein the roll rotates in the same direction as the web.
6. The process according to claim 1, wherein the roll rotates in a direction opposite from that of direction of the web.
7. The process according to claim 1, wherein the paper or paperboard is for printing, packaging or wrapping.
8. The process according to claim 1, wherein the web is subjected to the smooth uncoated roll before coating, size press or calendering.
9. The process according to claim 1, which process uses a soft backing roll.
10. The process according to claim 11, wherein the soft backing roll runs at the same speed and direction as the web.
11. A process for treating a surface of a fibrous web of paper or board for printing, packaging or wrapping, without substantially increasing the density of the web comprising:
   subjecting the web surface to a smooth untreated roll, wherein the difference between the rotating speed of said roll and the rotating speed of the web is sufficient enough so as to generate heat by friction and thereby plasticize the top fibers in the mat.
12. The process according to claim 12, comprising reducing the roughness of the web surface by a maximum of 125 Sheffield units.
13. The process according to claim 12, comprising contacting the web surface with a smooth roll moving with a sufficiently velocity relative to the web surface such that surface fibers on said web surface melts.
14. The process according to claim 12, wherein the web has two opposite surfaces and the process comprises subjecting both web surfaces to the smooth roll.
15. The process according to claim 12, wherein the smooth uncoated roll is a simple steel roll.
16. The process according to claim 12, wherein the roll rotates in the same direction as the web.
17. The process according to claim 12, wherein the roll rotates in a direction opposite from that of direction of the web.
18. The process according to claim 12, wherein the web is subjected to the smooth uncoated roll before coating, size press or calendering.
19. The process according to claim 12, wherein the web comprises:
   subjecting the web surface to an untreated smooth roll in a dry state; and
   bringing the web in contact with said roll, wherein the difference between the rotating speed of said roll and the rotating speed of the web is sufficient enough so as to generate heat by friction and thereby plasticize the top fibers in the mat.
20. The process according to claim 12, which process uses a soft backing roll.
21. The process according to claim 20, wherein the soft backing roll runs at the same speed and direction as the web.
22. A process for increasing the smoothness of the surface of a fibrous web of paper or board without loss of bulk comprising:
   subjecting the web surface to an untreated smooth roll in a dry state; and
   bringing the web in contact with said roll, wherein the difference between the rotating speed of said roll and the rotating speed of the web is sufficient enough so as to generate heat by friction and thereby plasticize the top fibers in the mat.
23. The process according to claim 22, comprising reducing the roughness of the web surface by a maximum of 125 Sheffield units.
24. The process according to claim 22, comprising contacting the web surface with a smooth roll moving with a sufficiently velocity relative to the web surface such that surface fibers on said web surface melts.
25. The process according to claim 22, wherein the web has two opposite surfaces and the process comprises subjecting both web surfaces to the smooth roll.
26. The process according to claim 22, wherein the smooth uncoated roll is a simple steel roll.
27. The process according to claim 22, wherein the roll rotates in the same direction as the web.
28. The process according to claim 22, wherein the roll rotates in a direction opposite from that of direction of the web.
29. The process according to claim 22, wherein the paper or paperboard is for printing, packaging or wrapping.
30. The process according to claim 29, wherein the web is subjected to the smooth uncoated roll before coating, size press or calendering.