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ENTRADA EN FASE NACIONAL

1 SOLICITUD DE:
☒ Patente de Invención ☐ Patente de Modelo de Utilidad

☐ Capítulo I ☐ Capítulo II

2 SOLICITANTE (71)
Nombre: INTERNATIONAL PAPER COMPANY
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Nacionalidad o Domicilio Estados Unidos
Lugar de Construcción Estados Unidos
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C C ☐ NIT ☐
C E ☐ Otro ☐
Cual _____
Número _____

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Nacionalidad o Domicilio Estados Unidos

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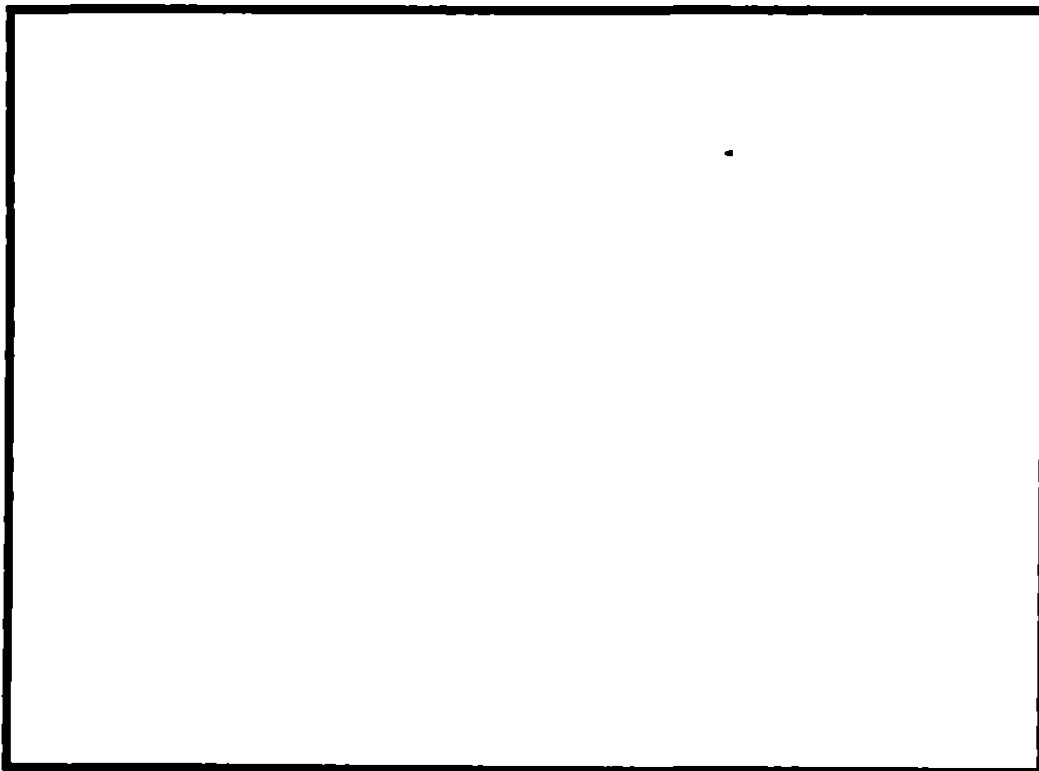
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Instrucciones para el diligenciamiento del presente formulario, ver reverso de esta página

- ☒ Comprobante de pago de la tasa de presentación de la solicitud \$378.000
- ☒ Comprobante de pago por reivindicación de prioridad. \$106.000
- ☐ Documento que acredite la existencia y representación legal cuando el solicitante sea persona jurídica.
- ☐ Poderes, si fuere el caso.
- ☐ Documento de cesión del inventor al solicitante o a su causante.
- ☐ Declaraciones
- ☒ Copia de la solicitud internacional. (Resumen, descripción, reivindicaciones, dibujos)
- ☒ Traducción de la solicitud internacional al castellano. (Resumen, descripción, reivindicaciones, dibujos)
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- ☐ Traducción del examen preliminar efectuado por la IPEA.
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- ☐ De ser el caso, certificado de depósito del material biológico.
- ☐ Arte final 12x12
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- ☐ Otros

11 FIGURA CARACTERÍSTICA:



12 Solicito la concesión de la patente

NOMBRE: RAMIRO CASTRO DUQUE

FIRMA:

C.C-170/322 de Bogotá, D.F. 1003 del C.S.A.

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RIGARD & CASTRO LTDA	CONSIGNACION	BANCO POPULAR	030-00110-6	5733575	16/07/2002	10,065,560.00

***** CONCEPTO *****

AMT. RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1 50005-01-01 SOLICITUDES	1 TRAMITES DE SOL. DE PATENTE DE IN	378,000.00
	TOTAL :	\$ 378,000.00

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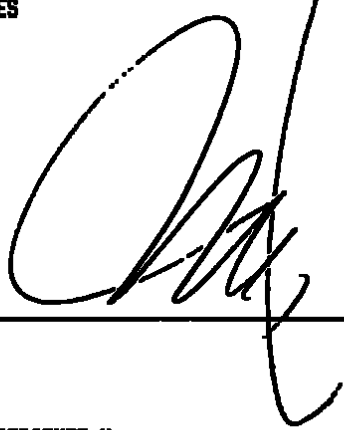
***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
BRIGARD & CASTRO LTDA	CONSIGNACION	BANCO POPULAR	050-00110-6	5733575	16/07/2002	10,065,560.00

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1	50005-01-01 SOLICITUDES	02 INVOCACION DE UNA PRIORIDAD EN NU	106,000.00
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PART 1

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From the

INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT COOPERATION TREATY

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AUG 27 2001

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LUEDEKA, NEELY, & GRAHAM, P.C.

NOTIFICATION OF RECEIPT
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PRELIMINARY EXAMINING AUTHORITY(PCT Rules 59.3(e) and 61.1(b), first sentence
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23 AUG 2001

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28 JAN 01

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Applicant

INTERNATIONAL PAPER COMPANY

1. The applicant is hereby notified that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

14 AUGUST 2001

2. That date of receipt is:

- ☒ the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
- ☐ the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
- ☐ the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. ☐ **ATTENTION:** That date of receipt is AFTER the expiration of 19 months from the priority date. Consequently, the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 30 months from the priority date (or later in some Offices) (Article 22). For details, see the PCT Applicant's Guide, Volume II.

- ☐ (If applicable) This notification confirms the information given by telephone, facsimile transmission or in person on:

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Assistant Commissioner for Patent
Box PCT
Washington, D.C. 20231 Attn:BO/US
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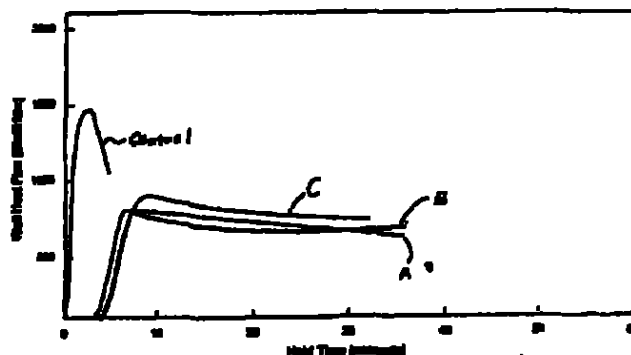
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(54) Title: LOW DENSITY PAPERBOARD ARTICLES



(57) Abstract: The invention provides a low density paperboard material and associated method for use in producing an insulated container, and is especially well-suited for making cups. The paperboard material comprises a paperboard web including wood fibers and expanded microspheres, and has a relatively low density ranging from about 6 to about 10 lb/3048F/m², a relatively high modulus ranging from about 24 to about 35 msi, and an internal bond strength of at least about 80 x 10⁻³ ft-lbf, preferably at least 100 x 10⁻³ ft-lbf. For applications such as cups the material is also coated on one or both sides with a barrier coating, preferably low density polyethylene, to limit liquid penetration into the web. The low density paperboard material of the invention is convertible for manufacture of containers, particularly cups, and exhibits insulative properties comparable to higher cost materials conventionally used to make cups. Also, the surface of the low density board may have a Sheffield smoothness of 30 SU or greater compared with the surface smoothness of 160 to 200 SU for conventional cupstock, the latter having been thought necessary for adequate print quality. However, it has been found that the low density board exhibits good printability on flexo printing machines despite its relatively rough surface, which is surprising and bonus effect realized along with the insulative and other properties of the board.

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LOW DENSITY PAPERBOARD ARTICLES**FIELD OF THE INVENTION**

This application is a continuation-in-part of copending provisional application Serial No. 60/178,214, filed January 26, 2000.

5 This invention relates generally to the production of articles from low density paper and paperboard and to insulated articles made therefrom, and in particular, relates to cups made of low density paper and paperboard.

BACKGROUND AND SUMMARY OF THE INVENTION

10 Insulated cups and containers are widely used for serving hot and cold beverages and other food items. Such articles may be made from a variety of materials including polystyrene foam, double-walled containers, and multi-layered paper-based containers such as paperboard containers containing an outer foamed layer. Paper-based containers are often more desirable than containers made from styrene-based materials because paper-based materials are generally more amenable to recycling, are
15 biodegradable and have a surface more acceptable to printing. However, multi-layered and multi-walled paper-based containers are relatively expensive to manufacture compared to polystyrene foam-based articles and often do not exhibit comparable insulative properties. Paperboard containers having an outer foam insulation layer are generally less expensive to produce than double-walled containers, but the outer surface
20 is less compatible with printing.

Attempts have been made to improve certain properties of paper by incorporating expanded as well as unexpanded microspheres within the paper. For example, U.S. Patent No. 3,556,934 to Meyer describes production of paper products for books, magazines, and the like wherein unexpanded microspheres are incorporated
25 into a papermaking furnish which is then formed into a web and dried. The

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microspheres expand on drying to produce a sheet said to have improved stiffness and caliper. However, the '934 patent deals with relatively low basis weight paper not suitable for insulated container manufacture, makes no mention of use of the product in the manufacture of paperboard containers having insulative properties, and gives no teaching as to how such a product could be produced so as to enable use of the product in fabricating insulative containers such as cups and the like.

Accordingly, there continues to be a need for paper-based materials which have good insulative properties and which can be produced on a competitive basis with polystyrene foam-based articles.

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SUMMARY OF THE INVENTION:

The present invention is directed to a low density paperboard material for use in producing insulated containers such as paper cups. In general, the paperboard material comprises a paperboard web that includes expanded microspheres and has a basis weight suitable for manufacturing an insulated container such as a paper cup, in which case the board preferably has a basis weight ranging from about 200 to about 220 lbs/3000 ft.² (3MSF). Low density paperboard according to the invention incorporates from about 0.25 to 10 wt.% (on a dry basis) expanded microspheres and has a relatively low apparent density ranging from about 6.0 to about 10 lb/3MSF/mil and a relatively high caliper ranging from about 24 to about 35 mil. These properties are especially well-suited for board products used to manufacture cups, particularly cups dimensioned to contain 16 ounces of fluid (Internal base diameter = 2 1/4 inches). However, it is to be appreciated that low density paperboard according to the invention may find utility in a wide range of applications and product dimensions where properties of low density/ thermal insulation are desirable.

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In cup applications where the product is intended to contain a liquid, it is preferred to include on the surface of the board to contact the liquid a barrier coating

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suitable for blocking passage of liquid into the board. A low density polyethylene coating is preferred for this purpose.

For cups and containers intended for heated fluids, it is generally only necessary to coat the surface of the board to be used on the inside of the container, and
5 for chilled fluids (i.e. iced or cold drinks) where outer condensation is an issue, to coat both surfaces.

For paperboard according to the invention within the aforementioned ranges of density and caliper destined for cup manufacture, it is preferred that the board also be formed so as to exhibit an average (i.e. average of MD and CD) internal bond
10 strength of at least about 100×10^{-3} ft-lbf. This minimum internal bond together with other board properties is believed necessary in order that the board may be successfully converted into cup shapes and similar articles without significant adverse effects caused by the converting operations. Among these adverse effects are so-called "buckles" which can appear along the height of a cup during the process of cup forming where
15 polyethylene-coated board develops small ripple-like deformations as a blank is wrapped around a mandrel to form a cup wall.

Other factors believed to influence development of buckles during conversion operations include the method of applying the coating onto the board and the weight of the coating. Thus, for conventional extruded polyethylene coating
20 conditions (speed and weight) the 100×10^{-3} ft-lbf minimum average internal bond is believed necessary for proper conversion, while lowering the extrusion speed by 25 percent below the conventional speed or increasing the coat weight in the neighborhood of about 50 percent above the conventional weight will ordinarily allow a corresponding reduction in the minimum average internal bond to about 80×10^{-3} ft-lbf.

25 According to one aspect of the invention, the uncoated low density board surface has a roughness substantially higher than conventional cupstock on the Sheffield smoothness scale which, quite surprisingly, results in comparable print

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quality in a flexo printing operation. Thus, for a typical low density board according to the invention suitable for cupmaking, the uncoated surface of the board exhibits a Sheffield smoothness of at least about 300SU and a PPS10 smoothness at or below about 6.5 microns.

5 The low density board of the invention is contrasted with conventional cupstock which is calendered to provide, among other things, a much higher density in the order of 11-12 lb/3MSF/mil, a much lower caliper in the range of 20 mil, and an associated relatively smooth surface in the range of from about 160 to about 200 SU believed necessary for acceptable print quality. This higher density/lower caliper board
10 has the effect of increasing the thermal conductivity of the board (i.e., decreased insulation).

 In another aspect, the invention provides a method for making a low density paperboard material suitable for use in producing insulated containers such as cups. The method includes providing a papermaking furnish containing cellulosic
15 fibers, and from about 0.25 to about 10 % by weight dry basis expandable microspheres, preferably from about 5 to about 7 wt %, forming a paperboard web from the papermaking furnish on a papermaking machine, and drying and calendering the web to an apparent density ranging from about 6.0 to about 10.0 lb/3MSF/mil, most preferably from about 6.5 to about 10.0 lb/3MSF/mil, and a caliper of from about 24
20 to about 35 mil, most preferably from about 28 to about 35 mil.

 In yet another aspect, the invention provides a method for making an insulated container such as a paper cup from a paperboard material. The method includes providing a papermaking furnish containing cellulosic fibers and from about
25 0.25 to about 10 wt% dry basis expandable microspheres, preferably from about 5 to about 7 % by weight, forming a paperboard web from the papermaking furnish on a paper machine, and drying and calendering the web to an apparent density ranging from about 6.0 to about 10.0 lb/3MSF/mil, preferably about 6.5 to about 10.0 lb/3MSF/mil,

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a caliper ranging from about 24 to about 35 mil, preferably from about 28 to about 35 mil, an internal bond of at least about 80×10^{-3} ft-lbf, preferably at least about 100×10^{-3} ft-lbf, and a Sheffield smoothness of at or above about 300 SU, and thereafter forming the web into a container such as a paper cup including the paperboard web at least for the sidewall portion of the cup.

Paperboard webs made according to the invention exhibit increased insulative properties compared to conventional single ply paperboard webs and are significantly less expensive to produce than multi-layered paperboard products or paperboard products containing a foamed outer coating. The low density paperboard material may therefore be converted into cups and other insulated containers on conventional processing equipment with minimal loss in machine speed, and a reduced tendency to form buckles and other irregularities in the converting operations.

A key feature of the invention is the use of expandable microspheres in the papermaking furnish and a resulting relatively low density/high caliper board containing the expanded spheres. Although the presence of microspheres in the papermaking furnish had been thought to adversely effect physical properties of the resulting materials for certain end use applications, it has now been found that by producing the materials according to the invention, the resulting board may be readily converted into containers such as insulated cups. Without desiring to be bound by theory, it is believed that suitable insulative paperboard products having strength properties required for cup converting operations may be produced by significantly increasing the caliper of the material and decreasing the density (compared to conventional board products) while maintaining a relatively high internal bond.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects and advantages of the invention will become further apparent by reference to the following detailed description of preferred

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embodiments when considered in conjunction with the accompanying drawings in which:

FIG. 1 which is a graphical representation of wall heat flux versus the amount of time a cup containing 190°F water can be held;

5 Fig. 2 is a diagrammatic view in perspective of an insulated paperboard cup made according to the invention;

Fig. 3 is a cross-sectional view of a wall portion of a paperboard cup made according to the invention;

10 Fig. 4 is a cross-sectional view of a connection between a bottom portion and a side wall portion of a cup according to the invention; and

Fig. 5 is a cross-sectional view of a top rim wall portion of a cup according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS:

15 Insulated containers such as cups are widely used for dispensing hot and cold beverages. Paperboard webs coated with an insulating layer often provide acceptable insulative properties, however, the outer layer is usually a foamed thermoplastic polymeric layer which raises the cost and is difficult to print. Corrugated and double-walled paperboard containers also generally provide suitable insulative
20 properties, but are more complex and expensive to manufacture than single ply containers. Until now, it has been difficult to produce an economical insulated container made substantially of paperboard which has the required strength for convertibility, exhibits insulative properties, and contains a surface which is receptive to printing.

25 The invention provides an improved low density paperboard material having insulative properties suitable for hot and cold beverage containers, and which has the strength properties necessary for conversion to cups in a cup forming operation.

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The low density paperboard material is made by providing a papermaking furnish containing hardwood fibers, softwood fibers, or a combination of hardwood and softwood fibers. A preferred papermaking furnish contains from about 60 to about 80 percent by weight dry basis hardwood fiber and from about 20 to about 40 percent by weight dry basis softwood fiber.

Preferably, the fibers are from bleached hardwood and softwood kraft pulp. The furnish also contains from about 0.25 to about 10 percent by dry weight basis expandable microspheres, preferably in an unexpanded state. Most preferably, the microspheres comprise from about 5 to about 7 percent by weight of the furnish on a dry basis. Other conventional materials such as starch, fillers, sizing chemicals and strengthening polymers may also be included in the papermaking furnish. Among the fillers that may be used are organic and inorganic pigments such as, by the way of example only, polymeric particles such as polystyrene latexes and polymethylmethacrylate, and minerals such as calcium carbonate, kaolin, and talc.

The production of paper containing expandable microspheres is generally described, for example, in U.S. Patent No. 3,556,934 to Meyer, the disclosure of which is incorporated by reference as if fully set forth herein. Suitable expandable microspheres include synthetic resinous particles having a generally spherical liquid-containing center. The resinous particles may be made from methyl methacrylate, methyl methacrylate, ortho-chlorostyrene, polyortho-chlorostyrene, polyvinylbenzyl chloride, acrylonitrile, vinylidene chloride, para-tert-butyl styrene, vinyl acetate, butyl acrylate, styrene, methacrylic acid, vinylbenzyl chloride and combinations of two or more of the foregoing. Preferred resinous particles comprise a polymer containing from about 65 to about 90 percent by weight vinylidene chloride, preferably from about 65 to about 75 percent by weight vinylidene chloride, and from about 35 to about 10 percent by weight acrylonitrile, preferably from about 25 to about 35 percent by weight acrylonitrile.

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The center of the expandable microspheres may include a volatile fluid foaming agent which is preferably not a solvent for the polymer resin. A particularly preferred foaming agent is isobutane which may be present in an amount ranging from about 10 to about 25 percent by weight of the resinous particles. Upon heating to a temperature in the range of from about 80° to about 190°C in the dryer unit of papermaking machine, the resinous particles expand to a diameter ranging from about 0.5 to about 50 microns.

Conventional pulp preparation (cooking, bleaching refining, and the like) and papermaking processes may be used to form paperboard webs from the furnish. However, one feature of the invention is that the low density web containing expanded microspheres is preferably produced in such a manner as to exhibit a minimum average internal bond (average of CD and MD internal bond) in conjunction with its decreased density and increased caliper in relation to conventional paperboard used to make insulative containers such as paper cups. To this end, those of ordinary skill are aware of various measures that alone or in combination may be taken to increase the internal bonding strength properties of paperboard webs for a given basis weight. These include, but are not limited to, increasing the addition of wet and/or dry strength agents such as melamine formaldehyde, polyamino-epichlorohydrine, and polyamide-epichlorohydrine for wet strength and dry strength agents such as starch, gums, and polyacrylamides for dry strength in the furnish, increasing the refining of the pulp, and increased pressing of the wet web in the press section of the papermachine. In addition to improving internal bond, increased wet pressing also reduces the moisture in the web and allows the paperboard to be dried at a faster speed than otherwise possible.

According to the invention, it is preferred that measures be taken sufficient to maintain a minimum average internal bond of at least about 100×10^{-3} ft-lbf. These measures are preferred, at least in regard to cupstock carrying a conventional weight of barrier coating applied in a conventional manner on one or both of its

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5 surfaces. However, the minimum internal bond strength may be relaxed somewhat for the heavier weight barrier coatings applied at the middle-upper end of the conventional 0.5 to 3.5 mil range of coating thicknesses. For example, at barrier coating thicknesses above about 1.5 mil a minimum internal bond of about 80×10^{-3} ft-lbf is believed sufficient for acceptable converting performance. Also, reduction in the extrusion processing speed in the order of about 25 percent allows relaxation of the internal bond requirement to about the same minimum level.

10 Among the various approaches for increasing average internal bond, it is preferred to accomplish the desired increase by increasing the refining the pulp furnish, increasing the level of internal starch and dry strength additives, the wet pressing of the wet web during papermaking to a level below sheet crushing, and increasing the amount of starch and other materials applied to the surface of the paper web as is done, for example, at the sizepress.

15 The inclusion of expandable microspheres in the papermaking furnish in an unexpanded state has the effect of lowering the apparent density of the resulting dried board. However, it has been found that reducing the density of paperboard by inclusion of expanded microspheres adversely affects the convertibility of the board into cups and other containers. In accordance with the invention, it has been determined that low density paperboard products containing expanded microspheres
20 produced in a relatively narrow range of densities and calipers in conjunction with the above-mentioned increased internal bond provides the physical properties necessary for processability in various converting operations. Such boards exhibit significantly improved insulation performance compared to conventional cupstock and double-walled containers and provide insulative properties comparable to containers having a foamed outer layer at a much lower cost. For example, low density board according
25 to the invention has been observed to exhibit an R value in the neighborhood of 0.0752 $\text{ft}^2\text{-}^\circ\text{F-hr/btu}$ compared to an R value in the order of about 0.03 $\text{ft}^2\text{-}^\circ\text{F-hr/btu}$ for

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conventional cupstock, all the while exhibiting good convertibility properties, print quality, and other advantages

Thus, in accordance with one embodiment of the invention, a paperboard web containing expandable microspheres is dried and calendered on the papermaking machine to an apparent density ranging from about 6.0 to about 10.0 lb/3MSF/ml and a caliper in the order of from about 24 to about 35 mil. As described above, the resulting web containing expanded microspheres interspersed among the fibers is preferably produced from a pulp and/or furnish treated in order to cause the web to exhibit an average internal bond of at least about 80×10^{-3} ft-lbf for more heavily coated board (i.e., above about 1.5 mil up to the maximum of about 3.5 mil) and at least about 100×10^{-3} ft-lbf for average for lightly coated board (i.e., from about 0.5 to 1.5 mil). Paperboard web containing expanded microspheres and having densities and calipers outside these ranges or, if within them, having an internal bond below about 80×10^{-3} ft-lbf, is not believed to be suitable for use in forming commercially insulated cups. The upper bound for the caliper is selected to provide paperboard webs which may be converted into cups on existing cup-making equipment with only minor or no modifications to the machines.

In terms of other physical properties needed for cup manufacture, low density paperboard webs according to the invention also preferably have a minimum tensile strength as determined by Tappi Standard Test T of about 30 lb/in, a minimum value for the average CD stretch of the substrate as determined by Tappi Standard Test T494 of about 3.3 percent.

It is an additional feature of the invention that the low density board has a roughness of at least about 300 on the Sheffield smoothness scale, while exhibiting comparable print quality in a flexo printing operation. The printability of the board is quite unexpected since conventional board such as cupstock is ordinarily calendered down to a caliper of about 20 mil in order to achieve a surface smoothness (uncoated)

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generally in the order of from about 125 to about 200 SU (from a pre-calendered smoothness in excess of 400 SU) believed necessary for acceptable print quality

Thus, in calendering the board of the invention down to a caliper ranging from only about 24 to about 35 mil (preferably from about 28 to about 35 mil) and a density of from about 6.0 to about 10 lb/3MSF/mil (preferably from about 6.5 to about 10 lb/3MSF/mil) leaving a relatively rough surface having a Sheffield smoothness (uncoated) of about 300 SU or higher (ordinarily from about 320 to about 350 SU) and a PPS10 smoothness less than about 6.5 microns, a surprising bonus effect is observed in terms of printability over and above the insulation value and convertibility of the board for cup manufacture. Without being bound by theory, it is believed the printability of the board is attributable to its relatively high compressibility, which enables improved performance on flexo printing machines.

As mentioned previously, board made according to the invention is especially well-suited for making cups that require good thermal insulation properties. Such cups are ordinarily made with cupstock that includes a barrier coating on one or both sides. Cups designed for hot beverages such as coffees, soups, and other heated material generally require a coating only on the inside surface, so cupstock according to the invention for making these products may be barrier-coated only on one side, with the other side often carrying printing indicia/ designs applied directly to its surface. In the assembled cup, the coated side is arranged interiorly.

Cups designed for cold beverages are ordinarily made from cupstock coated on both sides and any printing is applied to one of the coating layers. Accordingly, cupstock according to the invention for making these products may be barrier-coated on both sides, with the non-printed side arranged interiorly. In cups carrying chilled beverages, the exterior barrier coating helps prevent any condensation forming on the outside from penetrating and possibly weakening the board substrate.

Any suitable barrier coating may be used to complete the product for

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conversion into a thermally insulated container such as a cup. Although low density polyethylene coatings are used for many such products and are preferred for use in the invention, natural and synthetic chemical systems such as starch-based coatings and polyvinyl alcohol-based coatings may also be used as well as pigmented coatings containing inorganic or organic pigments such as clay, carbonate, and latexes, so long as they provide sufficient barrier or other properties for the intended application. The coating(s) may be applied by conventional means, and in the case of polyethylene may be applied to the low density board surface by an extrusion lamination or by laminating a pre-formed film. The thickness of the coating may generally range from about 0.5 to about 3.5 mil, and is preferably about 1.5 mil on the inside surface of the container or cup and about 1 mil when used on the outside surface.

As a specific and especially preferred low density board product according to the invention, a low density paperboard material comprises a paperboard web which includes expanded microspheres and has an apparent density of 7.0 lbs/3000ft³/mil, a caliper of 28 mil, Sheffield smoothness of at least 300 SU, PPS10 smoothness of 6.5 microns or less, tensile strength (cross direction) of 30 lb/in, and an internal bond (cross-direction) of 90×10^{-3} ft/lbf/mil. This board has a basis weight of 200lb/3000ft² and the microspheres constitute 5 to 6 wt.% dry basis of the web. A low density polyethylene is extrusion laminated to one, or both sides of the web in a thickness of about 1.5 mil. The resulting low density paperboard material is convertible into cups without significant problems and exhibits an R value in the order of 0.07 ft²-°F-hrs/btu.

Again, it is to be appreciated that low density board according to the invention may be used to make a range of potential products including, but not limited to, cups and other paperboard containers formed to hold warm, hot, or cold material where there is a need for insulation and at least short-term barrier properties. Also, when used to make cups (a primary intended application), the bottom section is

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normally a flat separate piece and may or may not be formed from low density insulated board made according to the invention, depending on economics and other factors.

Also, in forming cups it is a commercial reality that some conventional packaging machinery is designed to accommodate the use of only a narrow range of board calipers. Because insulated board according to the invention may be thicker than standard cupstock (for a given basis weight), the increased caliper may cause manufacturing issues potentially requiring new or modified tooling. The present invention may be used to advantage in these situations by exposing a portion of the paperboard (generally after having been cut to form a blank) to relatively high pressures (approximately 200 psi or greater), which will permanently compress the portion of the board allowing it to be used in conventional tooling.

An example is the sideseam of a package or cup. At a given basis weight the insulated board of the invention may have a significantly higher caliper than a standard board, creating a sideseam which may be too thick for some conventional converting applications. By exposing the side seam portion of the blank or the formed carton to high pressures, the thickness may be reduced to at or near conventional board caliper levels (generally about 20 mil). This processing step is generally referred to in the art as "crimping" and may be considered a pretreatment of the finished low density board (i.e., board that has been coated) to facilitate its use in forming cups and other paperboard containers having one or more lap seams.

The same sort of crimping operation may be performed on the portion of the blank to be used to make the rim of a cup or tub type of container to reduce the final rim thickness. This has the advantage of improving aesthetic appearances with a smaller diameter rim or allowing use of existing lids on a cup or tub container made of insulated board. The rim consists of an edge of the package being rolled into a cylinder. This is typically a 360 degree wrap of the board.

It is also to be noted that the minimum rim cylinder diameter is typically a function of the board thickness. Thus, for a conventional cup manufacturing process the rim diameter (the diameter of the cylinder form taken by the rolled-over part of the blank that forms the rim encircling and forming the top edge) is ordinarily about 7 times the board caliper. If the top portion of the rim is crimped to reduce the caliper, the diameter of rim cylinder may also be reduced. The portion of the blank that will form the rim may be crimped to reduce its entire diameter, or it may be crimped with a series of parallel scopes which will aid deformation.

The same crimping technology may be applied to sideseams after they are formed to reduce their overall thickness.

Further aspects, advantages and features of the invention may be seen by way of the following non-limiting examples. In these examples, the paperboard with a LDPE coating was used to form the sidewall blank for the cups on a cup-making machine, the cups having a sidewall seam. In the tables, the basis weight is of the paperboard itself without the polyethylene coating, which ordinarily adds in the neighborhood of about an additional 5 to 20 percent to the overall weight of the paperboard when, for example, LDPE material is extrusion laminated to one surface of the board at about 1.5 mil thickness.

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Example 1

In the following example, samples of low density board containing microspheres were produced and compared to a sample marked "control" which contained no microspheres. Expandable microspheres used in the furnish are available from Expancel, Inc. of Duluth, Georgia of under the trade name EXPANCEL. The targeted caliper for the samples was 19 mil to simulate conventional cupstock calipers. After producing the boards, they were taken off-machine to an extruder and extrusion

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coated with low density polyethylene at a rate of 14 lbs/3MSF to provide a barrier coating on one side having a thickness of about 1 mil. All of the samples except Sample D contained the polyethylene coating. Sample D had insufficient strength and was too brittle to be extrusion coated with polyethylene. The polyethylene-coated samples were converted to 16 oz. cups on a commercial cup machine. The insulative properties of the cups were determined by measuring the time a person could hold a cup filled with hot water having a temperature of 190°F. Relevant properties of the low density board samples are given in Table 1

Table 1

Properties	Control	Sample A	Sample D	Sample E	Sample G	Sample M
EXPANCEL microspheres (lb/ton)	0	60	240	603	100	100
Dry Strength additive (lb/ton) ¹	0	0	0	40	40	40
Basic weight (lb/3MSF)	216	173	196	179	140	139
Caliper (mil)	21.0	18.4	85.0	22.4	19.0	21.0
Density (lb/3MSF dry basis)	10.3	9.4	2.3	8.0	7.4	6.6
Stretch at Peak (%), MD	1.93	2.41	2.23	1.74	2.01	1.76
Stretch at Peak (%), CD	4.03	4.83	4.52	4.40	4.73	4.79
Tensile Strength (lb/in), MD	72.0	68.5	27.7	52.3	45.5	38.2
Tensile Strength (lb/in), CD	46.5	39.2	17.5	33.1	26.2	23.0
Wet Tensile Strength (lb/in), MD	4.03	3.28	3.05	3.96	2.87	2.64
Wet Tensile Strength (lb/in), CD	2.69	2.06	1.81	2.14	1.51	1.58
Internal Bond (1"E ² R-lbf), MD	68	94	48	77	90	96
Internal Bond (1"E ² R-lbf), CD	72	83	50	78	79	86
Internal Bond (1"E ² R-lbf), AVG	70.0	88.5	49.0	77.5	84.5	91.0
Sheffield Smoothness (SU), FS	285	275	478	300	311	327
Sheffield Smoothness (SU), WS	296	277	478	310	312	328

¹ The dry strength additive was an anionic polyacrylamide sold under the trade designation ACCOSTRENGTH available from BAYER of Leverkusen, Germany

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Cobb (g/m ²) FS	31.0	31.0	14.7	23.0	21.1	22.0
Cobb (g/m ²), WS	53.0	25.7	14.7	23.0	22.0	20.3
Taber Stiffness (gf-cm), MD	203	119	704	168	104	115
Taber Stiffness (gf-cm), CD	111	66.4	443	88.3	42.6	48.3
Tear strength (gf), MD	456	430	387	499	304	326
Tear strength (gf)	448	491	518	496	370	320
Sheffield Permeance (units/in. ²)	247	436	3580	688	1190	1240

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Of the foregoing samples, Sample G exhibited notably good insulative properties. The average time a person could hold a cup made from sample G was 29 seconds compared to 11 second for the control sample. While Sample G had excellent insulative properties, the lower basis weight of the board resulted in lower stiffness and consequently a cup made with the board had lower rigidity. Rigidity is an essential attribute for cups, accordingly it was necessary to improve the stiffness of the cupstock. Sample M having a density of 6.6 lb/3MSF/mil and an average internal bond strength of 91×10^{-3} ft-lbf could be processed on an extrusion line and converted to cups. The stiffness of the board was somewhat improved over the stiffness of Sample G. Sample M also had better insulative performance than the control sample, the latter having a density of 10.3 lb/3MSF/mil.

The internal bond of sample M was somewhat below the preferred internal bond of at least about 100×10^{-3} lb/3MSF/mil, but still was able to be converted. However, as mentioned earlier this somewhat lower internal bond may be deemed acceptable when extruder speed is reduced and/or the weight of the barrier coating is increased.

The density of Sample D was too low for web handling processes. The density of Sample D was 2.3 lb/3MSF/mil and the average internal bond strength was 49×10^{-3} ft-lbf. This bond strength was found to be too low for the web to be processed in an extrusion coater or to be used in a cup forming operation.

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The apparent thermal conductivity of the low density boards was measured by the Guarded Heat Flow Method (ASTM C177). The results showed an essentially linear relationship between density and conductivity with the higher density boards exhibiting higher conductivity (i.e., lower thermal insulation). Graphing the data, it was determined that the relationship between conductivity and density for the boards tested may be expressed by the following equation:

$$\text{Thermal Conductivity (ft}^2\text{-}^\circ\text{F-hr/btu)} = 0.494 \times \text{Density (lb/3MSF/ml)} + 0.313 \text{ (ft}^2\text{-}^\circ\text{F-hr/btu)}$$

Example 2

In the following example, two different low density board stocks were made having densities in the range of from about 6 to about 10 lb/3MSF/ml and from furnish containing expandable microspheres. The board stock thus made was converted to 16 oz. cups. The physical properties of the board stock are shown in Table 2. All of the samples in Table 2 were coated with low density polyethylene on an extrusion line and printed on an aqueous flexo press. The coating was applied to one side of the board at about 20 mil and the printing was applied to the other side.

The coated board indicated as Sample 19 was converted to cups on a commercial machine with existing tooling. The board indicated as Sample 32 was converted to cups using prototype tooling on a commercial cup machine. The rims of the cups formed using the prototype tooling were only partially formed. Modification of the tooling will enable completely formed cups.

Table 2

Properties	Control	Sample 27	Sample 19	Sample 32
Softwood fiber (wt.%)	30	30	30	30
Hardwood fiber (wt.%)	70	70	70	70
Wet end Starch (lb/ton)	10	10	10	10
ACCOSTRENGTH (lb/ton)	6.8	6.8	6.8	6.8

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EXPANCEL microsphere density (lb/ton)	0	106	114	120
Refiner (HPDT/ton)	3.8	4.1	4.1	4.1
Basis weight (lb/3MSF dry basis)	218.7	235.9	143.2	211.4
Caliper (mil)	18.71	26.97	18.21	30.22
Density (lb/3MSF/mil)	11.69	8.75	7.86	6.99
Internal Bond (1 s ² ft-lbf), MD	112	141	88	98
Internal Bond (1 s ² ft-lbf), CD	113	124	88	107
Taper Stiffness (gf-cm), MD	240	370	139	366
Taper Stiffness (gf-cm), CD	31	—	30	—
Instron Stretch at Peak, %, MD	1.79	1.49	1.74	1.36
Instron Stretch at Peak, %, CD	4.31	4.79	5.77	4.59
Instron Tensile Strength, (lb/in), MD	98.9	72.1	55.5	56.6
Instron Tensile Strength, (lb/in), CD	49.9	39.8	32.1	32.1
Instron Young's MOE, 1E+3 (lb/in ²), MD	596	321	348	225
Instron Young's MOE, 1E+3 (lb/in ²), CD	302	126	139	83.1
Roughness (Sheffield Units), FS	324	297	297	305
Roughness (Sheffield Units), WS	328	353	324	333
Brightness, Directional (GE, %), FS	78.9	80.5	81.8	81.9
Brightness, Directional (GE, %), WS	78.6	79.9	82.1	81.1
Air Permeance (Sheffield) (units/in ²)	319	377	858	851
Air Resistance (Gurley, s/100cc)	26.5	21.0	8.4	8.8

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Of the foregoing samples, Sample 32 exhibited notably good insulative properties. The average time a person could hold a cup made from Sample 32 was 37 seconds compared to 11 second for the control sample. Furthermore, the relatively high stiffness of the board of Sample 32 as indicated in the table resulted in suitable rigidity compared to standard board. The stiffness of Sample 32 was significantly greater than the stiffness of any of the samples of Example 1.

The insulative properties of a cup made from paperboard cup stock was determined by measuring the sidewall temperature of a cup containing a hot liquid. A maximum value of sidewall temperature for a cup containing a hot liquid is typically specified for an insulated cup. The sensory perception of heat is dictated by skin tissue

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exposed to the hot cup sidewalls for a period of time. Tissue temperature is a function of the heat flow to the tissue from the cup and the internal heat dissipation within the tissue. The heat flow to the tissue is a combination of several factors including the thermal properties of the board, the temperature of the liquid, and the contact resistance between the tissue and the outer wall of the cup. The cup rigidity and surface roughness (i.e. texture) is also believed to contribute to the sensory perception of heat by influencing the effective contact area between the cup sidewalls and the tissue.

Fig. 1 is a graphical representation of the wall heat flux over time for the cups containing 190°F water. The data shown in Fig. 1 was collected by applying pressure on the flux sensor. In the figure, Curve A is a cup made with Sample 32 (Table 2), Curve B is a cup made according to U.S. Patent No. 4,435,344 to Iioaka containing an outer insulating layer, Curve C is a conventional double-walled cup, and the Control curve is a conventional single-walled non-insulated cup

It is believed the data for Fig. 1 represents a relatively accurate measurement of heat flowing to tissue for cups being held under normal holding pressure. At the point excessive heat was perceived, data collection was terminated.

As shown by the curves of Fig. 1, a cup made with the paperboard of Sample 32 (Curve A) exhibited comparable thermal insulative properties to cups made according to U.S. Patent No. 4,435,344 to Iioaka (Curve B). In this regard, it is noted that the Curve B cups were produced by coating the outer wall of a cup with a thermoplastic resin which is subsequently foamed. However, the process for producing the Curve B cups requires additional capital equipment for the conversion and the thermoplastic coating adversely affects print quality and the hand-feel of the cups. In contrast, cups made using the paperboard stock of Sample 32 had no external thermoplastic coating (the coating was only on the interior surface) and an appearance and feel similar to that of conventional paper cups. The Sample 32 cups also exhibited

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better thermal insulative properties than the conventional double-walled cup of Curve C.

Example 3

In the following example, eight low density board stocks were made having densities in the range of from about 6 to about 10 lb/3MSF/mil and from furnish containing expandable microspheres. The board stock thus made was converted to 16 oz. cups. The physical properties of the board stock are shown in Table 3. All of the samples in Table 3 were coated with low density polyethylene on an extrusion line and printed on an aqueous flexographic press. The coating was applied to one side of the board at about 1.5 mil and the printing was applied to the other side directly on the paper surface.

Samples P1 and P2 were manufactured on a pilot papermachine and extruded on a pilot extruder whereas samples C1 through to C5 were manufactured on a commercial papermachine. In both cases, the papermaking furnish used to produced these samples contained a blend of hardwood and softwood pulps and wet-end chemicals, such as starch and dry strength additives, and a suitable amount of expandable microspheres to achieve a range of board densities. In each case, the refining energies and level of wet-end chemical addition was varied to achieve a range of internal bond strengths. Following polyethylene extrusion and conversion into cups, the samples were inspected and rated for the degree of MD buckling or wrinkles, which are a measure of the converting potential of the coated board. Samples with a severe degree of buckling would be unsuitable as a commercial product.

Table 3

	Sample	Sample	Sample	Sample	Sample	Sample	Sample
25	ID	P1	P2	C1	C2	C3	C4
	MD Buckling	Severe	None	Severe	Medium	None	None
	Caliper, mil	32.9	33.3	31.5	28.5	30.2	27.0
	Basis Weight (lb/3MSF)	187	331	202	196	211	236
30	Weight Percent of EXPANCEL, (%)	6.0	2.0	6.0	6.0	6.0	3.0
							4.0

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Apparent Density, (lb/3MSF/mil)	5.68	9.91	6.40	6.89	6.98	8.75	8.11
Internal Bond,	74	147	75	83	99	131	98
(IE-3 ft ² lb.), MD							
Internal Bond,	72	151	75	81	103	134	101
(IE-3 ft ² lb.), CD							
Sheffield Smoothness (SU), FS	352	297	313	304	333	297	294
Sheffield Smoothness (SU), WS	372	336	308	284	305	353	286
Tuber Stiffness (g ² cm), MD	377	637	335	358	366	370	436
Tuber Stiffness (g ² cm), CD	128	400	136	125	129	146	163

Samples P1 and C1 illustrate the condition wherein the internal bond strength is below the minimum of 80×10^{-3} lb/3MSF/mil. For these conditions, the samples showed severe MD buckling, indicating that they would not be suitable as a commercial product. Sample P2 illustrates the case where the density of the board is significantly lower than normal paperboard used in the production of cups but because of its high internal bond strength the product does not exhibit MD buckling. Sample C2 shows some degree of buckling because its internal bond strength of 81×10^{-3} lb/3MSF/mil is at the lower limit of the preferred range of internal bond strength. Samples C3, C4, and C5 illustrate the preferred levels of density and internal bond strength.

Samples P1 and C1 illustrate the condition wherein the polyethylene has a caliper of about 1.5 mil and the internal bond strength is below the minimum of 80×10^{-3} lb/3MSF/mil. For these conditions, the samples showed severe MD buckling, indicating that they would not be suitable as a commercial product. Sample P2 illustrates the case where the density of the board is significantly lower than normal paperboard used in the production of cups but because of its high internal bond strength the product does not exhibit MD buckling. Sample C2 shows some degree of buckling because its internal bond strength of 81×10^{-3} lb/3MSF/mil is at the lower limit of the preferred range of internal bond strength. Samples C3, C4, and C5 illustrate the preferred levels of density and internal bond strength.

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Sample C6 illustrates how an increase polyethylene coat weight in the order of about 20 percent can compensate for the low internal bond strength.

The foregoing examples demonstrate that within the apparent density range of about from about 6 to about 10 lb/3MSF/mil and calipers ranging from about 24 to about 35 in conjunction with a relatively high internal bond above at least about 80 ft-lbf the physical properties of the low density board are suitable to enable processing of cupstock to make insulated cups.

Cups are typically shipped in sleeves of 50. In order to prevent the cups from interlocking in the sleeve, the cup is ordinarily designed so that the outer bottom edge of one cup rests on the inner bottom of the cup below it. This requirement along with the desired interior volume of the cup and the aesthetic needs of the cup place additional constraints on the allowable board thickness. For example, it is preferable that the caliper of the basestock for 16 ounce cups not exceed about 35 mil. Accordingly, the upper limit of caliper for a 16 ounce cup is preferably about 32 mil

In the web forming process, webs containing the expandable microspheres were preferably pressed to a higher solids content than webs which do not contain the microspheres.

Once the web is pressed and dried it is calendared to a thickness which provides the desired density/caliper within the ranges set forth for low density board according to the invention. The calendaring machine may be a conventional multi-roll calender, but is preferably a heated extended nip, long nip, or shoe nip calendaring machine which provides an improved microsmoothness at an extended dwell time and reduced pressure. Accordingly, the calendaring machine may contain one or more extended nips having a dwell time in the range of from about 2 to about 10 microseconds and a peak nip pressure of less than about 1200 psi.

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With reference to Figs. 2-5, one embodiment of a cup 10 made with the low density insulated paperboard material of the invention is illustrated in the form of an inverted truncated cone. The cup 10 includes a generally cylindrical wall portion 12 having a vertical lap seam 14 joining the end edges 16 and 18 of a paperboard web forming the wall portion 12. The end edges 16 and 18 may be affixed to one another using conventional methods such as adhesives, melt-bonding thermoplastic coatings thereon or other means known in the art. The cup 10 also includes a circular, rolled rim 20 and a separate substantially circular bottom portion 22 which is attached and sealed to the wall portion 12 along the periphery thereof. Fig. 4 described below illustrates a method for attaching the bottom portion 22 to the wall portion 12 and Fig. 5 illustrates a rolled rim 20 of a cup according to the invention.

As seen in Fig. 3, the wall portion 12 of the cup 10 is made from a low density insulated paperboard material according to the invention which contains expanded microspheres 24 dispersed within the fibrous matrix of the paperboard. The microspheres 24 are preferably substantially hollow and provide insulative properties to the wall and bottom portions 12, 22 of the cup 10. However, bottom 22 may be a conventional coated board material in order to improve the economics of the product, since heating of the bottom is not generally an issue as the cup is not typically held by a user on the bottom.

Because of the increased caliper of the paperboard material used to form the wall and bottom portions 12, 22 of the cup 10, modifications to the converting equipment and/or the board itself may be necessary to achieve the folds and rolls required for assembling the cup portions together. Pretreatment measures of modifying the caliper of portions of the board (i.e. "crimping") have already been described above in order to facilitate conversion/assembly of the cups

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As seen in Fig. 4, the bottom end 26 of the wall portion 12 is folded along fold seam 28 to provide a generally V-shaped pocket 30. End 32 of the bottom portion is folded along seam 34 to provide a substantially right angle flap 36 (which may be crimped in a pretreatment step) received in the pocket 30. The flap 36 may be sealed in the pocket 30 in a similar manner to the formation of seam 14 described above.

Circular top end 38 of wall portion 12 (which may be crimped in pretreatment step) is preferably rolled as shown in Fig. 5 to provide a circular, rolled rim 20. Tooling required to form rolled rim 20 may also need to be modified because of the increased caliper of the paperboard material used to make wall portion 12, especially if top end area 33 used to make the rim 20 is not crimped or compressed in a pretreatment step. Rolled rim 20 provides reinforcement to the upper portion of the cup in order to maintain a substantially open cup for retaining liquids, to limit dripping, and to provide a more comfortable edge from which to drink.

It will again be appreciated that the interior and, optionally, the exterior of the cup 10, may contain conventional barrier coatings to reduce the porosity of the cup so that liquids will not soak into the paperboard substrate of the wall and bottom portions 12, 22. The coatings may be one or more layers of polymeric materials such as polyethylene (preferably low density), EVOH, polyethylene terephthalate, and the like which are conventionally used for such applications.

The foregoing description of certain exemplary embodiments of the present invention has been provided for purposes of illustration only, and it is understood that numerous modifications or alterations may be made in and to the illustrated embodiments without departing from the spirit and scope of the invention.

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h**WHAT IS CLAIMED IS:**

- 1 A paperboard material useful in the manufacture of paperboard containers such as paper cups comprising a paperboard web including wood fibers and expanded microspheres dispersed within the fibers and having an apparent density of from about 6.0 to about 10 lb/3MSF/mil and a caliper of from 24 to about 35 mil with an internal bond of at least about 80×10^{-3} ft-lbf
2. The paperboard material of claim 1 wherein the density of the web is at least about 6.5 lb/3MSF/mil and the caliper of the web is at least about 28 mil
3. The paperboard material of claim 2 wherein the average bond of the web is at least about 100×10^{-3} ft-lbf.
4. The paperboard of claim 1 wherein the average internal bond of the web is at least about 100×10^{-3} ft-lbf.
5. The paperboard of claim 1 wherein the average internal bond of the web is at least about 80×10^{-3} ft-lbf
6. The paperboard material of claim 1 further comprising a barrier coating on at least one of the surfaces of the web.
7. The paperboard material of claim 6 wherein the barrier coating is present only on a surface of the web to be placed interiorly of a cup.
- 8 The paperboard material of claim 6 wherein the barrier coating has an average thickness of from about 0.5 to about 3.5 mil.

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9. The paperboard material of claim 6 wherein the barrier coating comprises a coating material selected from the group consisting of polyethylene, EVOH, and polyethylene terephthalate having an average thickness ranging from about 0.5 to about 3.5 mil.

10 The paperboard material of claim 6 wherein the barrier coating comprises a low density polyethylene having an average thickness of from about 1 to about 3 mil

11 The paperboard material of claim 6 wherein a barrier coating is present on both surfaces of the web.

12. The paperboard material of claim 1 wherein the web has a Sheffield smoothness of at least about 300 SU.

13. The paperboard material of claim 1 wherein the web has a surface with a Sheffield smoothness of at least about 300 SU and the material contains printing directly on the surface.

14 The paperboard material of claim 1 wherein the web has a surface with a Sheffield smoothness of at least about 300 SU and a PPS10 smoothness of about 6.5 microns or less and carries printing on the surface.

15. The paperboard material of claim 1 wherein the cellulosic fibers in the web comprise from about 20 to about 40% by weight dry basis softwood fibers and from about 60 to about 80% by weight dry basis hardwood fibers

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16 The paperboard material of claim 1 wherein the expanded microspheres in the web comprise synthetic polymeric microspheres and comprise from about 0.25 to about 10 wt.% of the total weight of the web on a dry basis.

17. The paperboard material of claim 1 wherein the expanded microspheres in the web comprise synthetic polymeric microspheres and comprise from about 5 to about 7 wt.% of the total weight of the web on a dry basis.

18 A paperboard material useful in the manufacture of insulated containers such as cups which comprises a paperboard web including wood fiber and from about 5 to about 10 wt.% dry basis expanded synthetic polymer microspheres based on the total weight of the web dispersed within the fibers, an apparent density of from about 6.0 to about 10 lb/3MSF/mil, a caliper of from about 24 to about 35 mil, an average internal bond of at least about 80×10^{-3} ft-lbf, a Sheffield smoothness of about 300 SU or greater, and a barrier coating having a thickness of from about 0.5 to about 3.5 mil on at least one surface of the web.

19. The paperboard material of claim 16 further comprising printing applied directly to at least one surface of the web

20 An assembled paper container which comprises a sidewall and a bottom sealably joined together wherein the sidewall is provided by a paperboard material which comprises a paperboard web including wood fiber and from about 5 to about 10 wt.% dry basis expanded synthetic polymer microspheres based on the total weight of the web dispersed within the fibers, an apparent density of from about 6.0 to about 10 lb/3MSF/mil, a caliper of from about 24 to about 35 mil, an average internal bond of at least about 80×10^{-3} ft-lbf, a Sheffield smoothness of

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about 300 SU or greater, and a barrier coating having a thickness of from about 0.5 to about 3.5 mil on at least one surface of the web.

21. An assembled paper cup which comprises a sidewall and a bottom sealably joined together wherein the sidewall is provided by a paperboard material which comprises a paperboard web including wood fiber and from about 5 to about 10 wt. % dry basis expanded synthetic polymer microspheres based on the total weight of the web dispersed within the fibers, an apparent density of from about 6.0 to about 10 lb/3MSF/mil, a caliper of from about 24 to about 35 mil, an average internal bond of at least about 80×10^{-3} ft-lbf, a Sheffield smoothness of about 300 SU or greater, and a barrier coating having a thickness of from about 0.5 to about 3.5 mil on at least one surface of the web.

22. A method for making a low density paperboard material suitable for use in producing an insulated container such as a cup comprising providing a papermaking furnish containing cellulosic fibers and from about 0.25 to about 10 % by weight dry basis expandable microspheres, forming a paperboard web from the papermaking furnish, drying the web, and calendaring the web to a caliper of from about 24 to about 35 mils and a density ranging from about 200 to about 220 lb/3MSF.

23. The method of claim 22 wherein the density of the web is at least about 6.5 lb/3MSF/mil and the caliper of the web is at least about 28 mil.

24. The method of claim 23 wherein the internal bond of the web is at least about 100×10^{-3} ft-lbf.

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PCT/US01/02777

25 The method of claim 22 wherein the internal bond of the web is at least about 100×10^{-3} ft-lbf.

26. The method of claim 22 wherein the internal bond of the web is at least about 80×10^{-3} ft-lbf.

27. The method of claim 22 further comprising applying a barrier coating on at least one of the surfaces of the calendered web.

28. The method of claim 27 wherein the barrier coating is present only on a surface of the web to be placed interiorly of a container

29. The method of claim 27 wherein the barrier coating has an average thickness of from about 0.5 to about 3.5 mil.

30 The method of claim 27 wherein the barrier coating comprises a coating material selected from the group consisting of polyethylene, EVOH, and polyethylene terephthalate having an average thickness ranging from about 0.5 to about 3.5 mil

31. The method of claim 30 wherein the barrier coating comprises a low density polyethylene having an average thickness of from about 1 to about 3 mil.

32 The method of claim 27 wherein a barrier coating is present on both surfaces of the web.

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33. The method of claim 22 wherein the web exhibits a Sheffield smoothness of at least about 300 SU

34. The method of claim 22 wherein the web is calendered so as to exhibit a Sheffield smoothness of at least about 300 SU and the method further comprises printing directly on the surface.

35. The method of claim 22 further comprising printing directly on a surface of the web to be positioned on the exterior of the container and wherein the surface that carries the printing exhibits a Sheffield smoothness of at least about 300 SU and a PPS10 smoothness of about 6.5 microns or less.

36. The method of claim 22 wherein the furnish comprises from about 5 to about 7 wt.% dry basis expandable microspheres.

37. A method for making an insulated paperboard-based cup having a sidewall and a bottom which comprises providing a paperboard material comprising a paperboard web including from about 0.25 to about 10 % by weight dry basis of expanded polymeric microspheres, a caliper of from about 24 to about 35 mils, an apparent density of from about 6.5 to about 10 lb/3MSF/mil, an internal bond of at least about 80×10^{-3} ft-lbf, and a Sheffield smoothness of at least about 300 SU, and a barrier coating on at least one surface of the web having a thickness of from about 0.5 to about 3.5 mil, forming at least the sidewall of the cup from the web with a surface of the web containing the barrier coating facing interiorly of the cup and the other surface of the web facing exteriorly of the cup, and sealably joining the sidewall to the bottom.

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38. The method of claim 37 wherein the web has barrier coatings on both of its surfaces facing interiorly and exteriorly of the cup.

39 The method of claim 38, wherein the web has printing on the barrier coating on the surface positioned exteriorly of the cup

40. The method of claim 37, wherein the web has a barrier coating only on its surface facing interiorly of the cup and the web has printing on its surface facing exteriorly of the cup.

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LIMONKA, NIKOLAY A. GRAHAM

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PC/DMM/BJT/77

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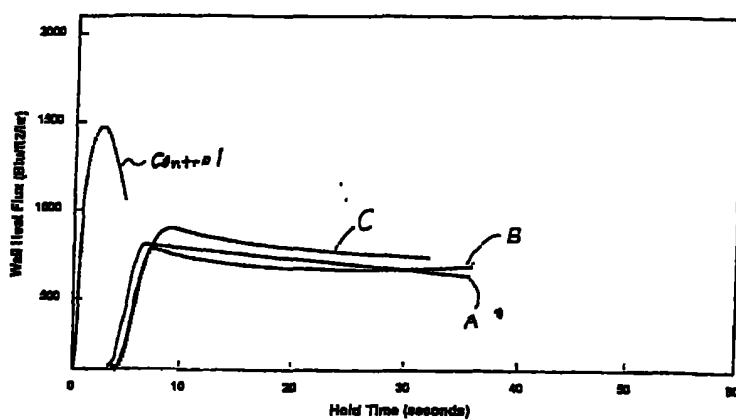


Figure 1

39

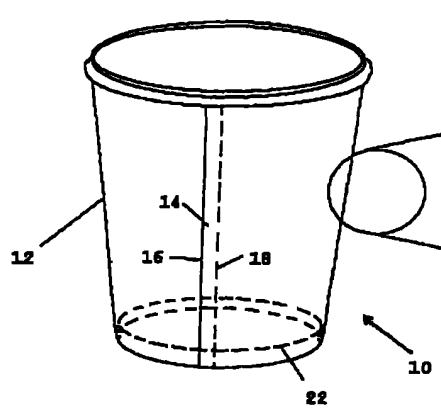


Fig. 2

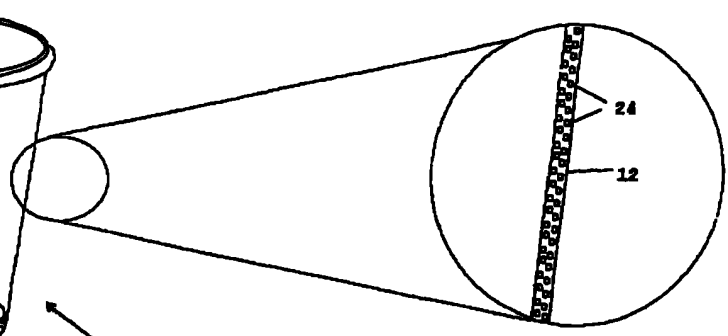


Fig. 3

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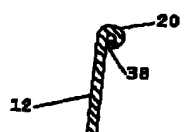


Fig. 5

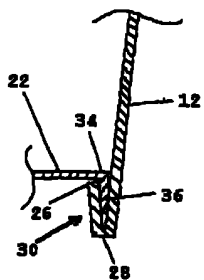


Fig. 4

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LURDEKA, NEELY, & GRAHAM

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PART 2

43 

"Express Mail" Mailing Label No. EL 751 344 755 US
Date of Deposit: May 7, 2001

EL 751 344 755 US PCT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant INTERNATIONAL PAPER COMPANY
Intl Appln. No PCT/US01/02777
Filed 26 January 2001
For LOW DENSITY PAPER AND PAPERBOARD
ARTICLES
Atty Docket: 54821 T1/ C-3520 0

REQUEST FOR CORRECTION OF NAMED INVENTORS
UNDER RULE 92 bis

BOX PCT - Attn. RO/US
Assistant Commissioner for Patents
Washington, D C 20231

Copy (w/o encl) via Facsimile to
International Bureau of WIPO
(41 22.740 14 35)

Sir

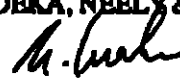
Pursuant to Rule 92 bis, Applicant hereby requests that the named inventors in the above application PCT application be amended

The Request as filed on January 26, 2001, names International Paper Company as the sole Applicant and names Kosaraju Krishna Mohan and Alexander A Koukoulas as inventors only

The Request should be amended to name Peter Matthew Pross and David Verd Reed as inventors as well as Messrs Mohan and Koukoulas International Paper Company remains the sole Applicant. Replacement page 2 in the Request and a replacement title page naming the correct inventors are enclosed

Respectfully submitted,

LUEDEKA, NEELY & GRAHAM, P C

By. 

Mark S Graham
Registration No 32,355

MSG JDG lal
P:\GK\1171_request-correction-inventors.wpd

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Date. 7/24/02

P O. Box 1871
Knoxville, Tennessee 37901
(423) 546-4305

Enclosure. Replacement Page 2 in Request
Replacement Title Page

Sheet No. 2.

PC US01/02777
Invention Page

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
If none of the following sub-items is used, this sheet should not be included in the request.	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the applicant indicated in this box is the applicant's State (that is, country) of residence if no State of residence is indicated below.) Alexander A. Koukoulas 242 West Glen Avenue Ridgewood, NJ 07450	This person is: ☐ applicant only ☐ applicant and inventor ☒ inventor only (if this check-box is marked, do not fill in below.)
State (that is, country) of nationality US	State (that is, country) of residence US
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the applicant indicated in this box is the applicant's State (that is, country) of residence if no State of residence is indicated below.) Peter Matthew Froass 11 Valley Court Chester, NY 10918	This person is: ☐ applicant only ☐ applicant and inventor ☒ inventor only (if this check-box is marked, do not fill in below.)
State (that is, country) of nationality US	State (that is, country) of residence US
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the applicant indicated in this box is the applicant's State (that is, country) of residence if no State of residence is indicated below.) David Verd Reed 2044 Hunt Road Blanchester, OH 45107	This person is: ☐ applicant only ☐ applicant and inventor ☒ inventor only (if this check-box is marked, do not fill in below.)
State (that is, country) of nationality US	State (that is, country) of residence US
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the applicant indicated in this box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	This person is: ☐ applicant only ☐ applicant and inventor ☐ inventor only (if this check-box is marked, do not fill in below.)
State (that is, country) of nationality	State (that is, country) of residence
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box	
☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.	

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PCT/US01/02777
Replacement Page

Docket No. 54821.T1

PATENT APPLICATION

of

KOSARAJU KRISHNA MOHAN

ALEXANDER A KOUKOULAS

PETER MATTHEW FROASS

and

DAVID VERD REED

for

LOW DENSITY PAPER AND PAPERBOARD ARTICLES

LUEDEKA, NEELY & GRAHAM, P C
P O Box 1871
Knoxville, Tennessee 37901
Telephone (865) 546-4305

PATENT COOPERATION TREATY

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JUL 26 2004

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LUEDEKA, NEELY, & GRAHAM, PC

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To

GRAHAM, Mark, S
Luedeka, Neely & Graham, PC
P O Box 1871
Knoxville, TN 37801
ETATS-UNIS D'AMERIQUE

Date of mailing (day/month/year) 17 July 2001 (17 07.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference	
International application No. PCT/US01/02777	International filing date (day/month/year) 28 January 2001 (28 01.01)

1 The following indications appeared on record concerning
☐ the applicant ☒ the inventor ☐ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person ☒ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address FROASS, Peter, Matthew REED, David, Verd	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:
Additional inventors.

4. A copy of this notification has been sent to:

☒ the receiving Office ☐ the designated Offices concerned
☒ the International Searching Authority ☐ the elected Offices concerned
☐ the International Preliminary Examining Authority ☐ other

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 28, Switzerland	Authorized officer Philippe Bécard
Facsimile No. (41-22) 746.14.35	Telephone No. (41-22) 336.83.38

Form PCT/IB/308 (March 1994)

NO NEW DATES DOCKETED

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ATTY: _____

"Express Mail" Mailing Label No EL 751 344 959 US
Date of Deposit March 12, 2001

PCT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant. INTERNATIONAL PAPER COMPANY
Init Appln No PCT/US01/02777
Filed. 26 January 2001
For LOW DENSITY PAPER AND PAPERBOARD
ARTICLES
Atty Docket 54821 T1/ C-3520 0

RESPONSE TO INVITATION TO CORRECT DEFECTS

BOX PCT - Attn RO/US
Assistant Commissioner for Patents
Washington, D C 20231

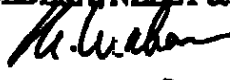
Copy (w/o encl) via Facsimile to
International Bureau of WIPO
(41 22 740 14 35)

Sir

In response to the Invitation To Correct Defects in the International Application dated 20 February 2001, please substitute the enclosed three (3) sheets of formal drawings (Fig. 1 - Fig. 5) for the informal drawings submitted with the application. These drawings conform to the requirements noted in Annex C1 in the Invitation To Correct Defects

Respectfully submitted,

LUEDEKA, NEELY & GRAHAM, P.C.

By 

Mark S. Graham
Registration No 32,355

Date 3/12/2001
W:\uv.correct defects.wpd

P O. Box 1871
Knoxville, Tennessee 37901
(423) 546-4305

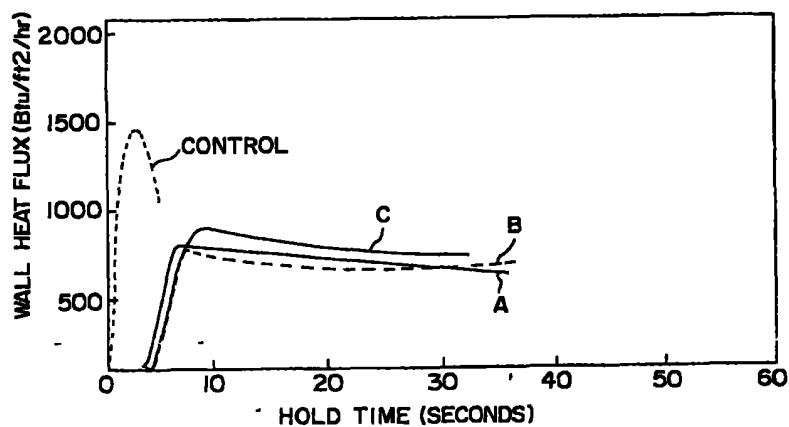


FIG. 1

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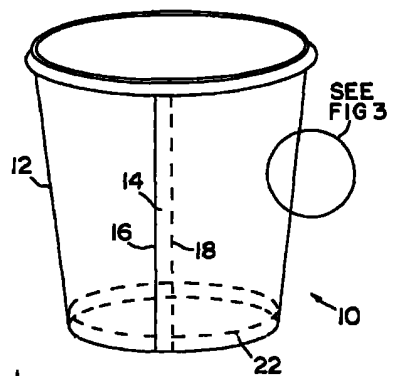


FIG. 2

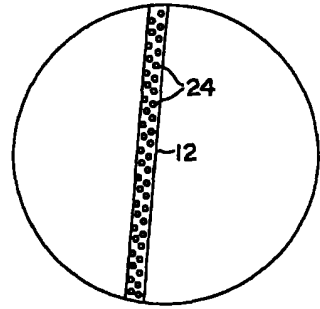


FIG. 3

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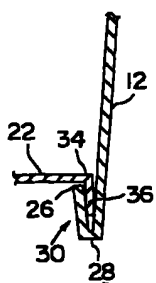


FIG. 4

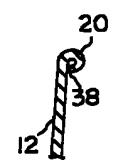


FIG. 5

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 15 and Rules 43 and 44)

Applicant's or agent's file reference 34821 P1	FOR FURTHER ACTION	no Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as when applicable, Item 3 below.
International application No. PCT/US01/02777	International filing date (day/month/year) 26 January 2001 (26.01 2001)	(Earliest) Priority Date (day/month/year) 26 January 2000 (26.01 2000)
Applicant INTERNATIONAL PAPER COMPANY		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the Report

A. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23 (b)).

B. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ Certain claims were found unsearchable (See Box G)

3. ☐ Unity of invention is lacking (See Box G)

4. With regard to the title,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the abstract,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 34.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No. 3



as suggested by the applicant.



None of the figures



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/02777

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

The invention provides a low density paperboard material (12) and associated method for use in producing an insulated container, and is especially well-suited for making cups (10). The paperboard material (12) comprises a paperboard web including wood fibers and expanded microbubbles (24), and has a relatively low density ranging from about 6 to about 100lb/3300F/m², a relatively high caliper ranging from about 24 to about 35 mil, and an internal bond strength of at least about 80 x 10⁻³ lbf-in. For applications such as cups the material is also coated on one or both sides with a barrier coating, preferably low density polyethylene, to limit liquid penetration into the web. The low density paperboard material of the invention is convertible for manufacture of containers, particularly cups, and exhibits insulative properties comparable to higher cost materials conventionally used to make cups. Also, the surface of the low density board may have a Sheffield smoothness of 300 SU or greater compared with the surface smoothness of 160 to 200 SU for conventional cupstock, the latter having been thought necessary for adequate print quality. However, it has been found that the low density board exhibits good printability on flexo printing machines despite its relatively rough surface, which is surprising and bonus effect realized along with the insulative and other properties of the board.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/03777

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) B32B 5/24
US CL 428/311 11

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)

US 162/13 109; Z20/02 2, 229/400, 403, 428/34.2, 35.6, 311 11

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 practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
Y	US 3,334,934 (MEYER) 19 January 1971 (19.01.1971), columns 1-2	1-40
Y	US 3,819,470 (HAWK et al) 25 June 1974 (25.06.1974), abstract, columns 2-4.	1-40
Y	US 4,179,546 (GARNER et al) 18 December 1979 (18.12.1979), abstract, columns 2-4.	1-40
Y	US 4,324,733 (CHU) 13 April 1982 (13.04.1982), abstract, columns 3-4.	1-40
Y	US 4,619,734 (ANDERSON) 28 October 1986 (28.10.1986), abstract, columns 3-4	1-40
A	US 4,988,478 (HELD) 29 January 1991 (29.01.1991), abstract, columns 2-8.	1-40
A	US 5,125,996 (CAMPBELL) 30 June 1992 (30.06.1992), abstract, columns 2-5.	1-40
Y	US 5,800,676 (ROIKS et al) 01 September 1999 (01.09.1999), abstract, columns 2-3	1-40

☐ Further documents are listed in the continuation of Box C☐ See patent family union.

Special categories of cited documents:

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

T earlier application or patent published on or after the international filing date

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

U 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 substantiate the principle or theory underlying the invention

T

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

T

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

A

document member of the same patent family

Date of the actual completion of the international search

04 June 2001

Date of mailing of the international search report

08 AUG 2001

Name and mailing address of the ISA/US

Consultant of Patent and Trademarks

Box PCT

Washington, D.C. 20531

Facsimile No 703-305-5436

Signature of examiner

Mark L. ...

Telephone No. 703-305-4331

54/55

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C-3520.0
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PATENT COOPERATION TREATY

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AUG 27 2001

PCT

LUEDEKA, NEELY, & GRAHAM, P.C.

NOTIFICATION OF RECEIPT
OF DEMAND BY COMPETENT INTERNATIONAL
PRELIMINARY EXAMINING AUTHORITY(PCT Rules 59.3(e) and 61.1(b), first sentence
and Administrative Instructions, Section 601(a))To:
MARK B. GRAHAM
LUEDEKA, NEELY & GRAHAM, PC
P O BOX 1871
KNOXVILLE, TN 37901Date of mailing
(day/month/year)

23 AUG 2001

Applicant's or agent's file reference
54821 P1

IMPORTANT NOTIFICATION

International application No.
PCT/US01/02777International filing date (day/month/year)
28 JAN 01Priority date (day/month/year)
28 JAN 00Applicant
INTERNATIONAL PAPER COMPANY

- 1 The applicant is hereby notified that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

14 AUGUST 2001

- 2 That date of receipt is:

- ☒ the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
- ☐ the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
- ☐ the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

- 3 ☐ **ATTENTION:** That date of receipt is AFTER the expiration of 19 months from the priority date. Consequently, the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the PCT Applicant's Guide, Volume II.

- ☐ (If applicable) This notification confirms the information given by telephone, facsimile transmission or in person on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA/
Assistant Commissioner for Patent
Box PCT
Washington, D.C. 20231 Attn: RQUS
Facsimile No. 202-305-3290
Form PCT/IPEA/402 (July 1998)Authorized officer
Georganna Hill

Telephone No. 202-305-3740

Stacia Caplan

NO NEW DATES DOCKETED
ATTY: MEL

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OCT 15 2001

LUEDEKA, NEELY, & GRAHAM, P.O.

PATENT COOPERATION TREATY

PCT/US01/02777
54821.77
C-3520.0
M86

From the INTERNATIONAL BUREAU

To:

GRAHAM, Mark, S.
Luedeka, Neely & Graham, PC
P.O. Box 1871
Knoxville, TN 37901
ETATS-UNIS D'AMERIQUEINFORMATION CONCERNING ELECTED
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

Date of mailing (day/month/year) 01 October 2001 (01.10.01)		IMPORTANT INFORMATION	
Applicant's or agent's file reference			
International application No. PCT/US01/02777	International filing date (day/month/year) 28 January 2001 (28.01.01)	Priority date (day/month/year) 28 January 2000 (28.01.00)	
Applicant INTERNATIONAL PAPER COMPANY			

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR
National : AU, BG, CA, CN, CZ, DE, GB, IL, JP, KP, KR, MN, NO, NZ, PL, RO, RU, SE, SK

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

AP : GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW
EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM
OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG
National : AL, AM, AT, AZ, BA, BB, BR, BY, CH, CU, DK, EE, ES, FI, GD, GE, GH, GM, HR, HU, ID, IN, IS, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MW, MX, PT, SD, SG, SI, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW

3. The applicant is reminded that he must enter the "national phase" before the expiration of 30 months from the priority date before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 39(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

The entry into the European regional phase is postponed until 31 months from the priority date for all States designated for the purposes of obtaining a European patent.

ALL DATES PREVIOUSLY
DOCKETED
ATTY: _____

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 23, Switzerland Facsimile No. (41-22) 740.14.38	Authorized officer: Sangeeta JAIYA Telephone No. (41-22) 338.83.38
--	--



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Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER
OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

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JULY 18, 2001

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LUEDEKA, NEELY & GRAHAM, P C
MARK S. GRAHAM
P.O. BOX 1871
KNOXVILLE, TN 37901



101704564A

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RECORDATION DATE: 04/26/2001

REEL/FRAME: 011755/0968
NUMBER OF PAGES 3

BRIEF. ASSIGNMENT OF ASSIGNOR'S INTEREST (SEE DOCUMENT FOR DETAILS)

ASSIGNOR

MOHAN, KOSARAJU KRISHNA

DOC DATE: 04/11/2001

ASSIGNOR.

KOUKOULAS, ALEXANDER A.

DOC DATE 03/20/2001

ASSIGNEE:

INTERNATIONAL PAPER COMPANY
TWO MANHATTANVILLE ROAD
A NEW YORK CORPORATION
PURCHASE, NEW YORK 10577-2196

SERIAL NUMBER- 09770340
PATENT NUMBER-

FILING DATE 01/26/2001
ISSUE DATE

TARA WASHINGTON, EXAMINER
ASSIGNMENT DIVISION
OFFICE OF PUBLIC RECORDS



Patent and Trademark Office

101704564

To the Assistant Commissioner for Patents: Please record the attached original documents or copy thereof

1 Name of conveying party(ies):

Kosaraju Krishna Mohan and
Alexander A. KoukoulasAdditional name(s) of conveying party(ies) attached? ☐ Yes ☒ No

3 Nature of conveyance:

- ☒ Assignment ☐ Merger
☐ Change of Name ☐ Other
☐ Security Agreement

Execution Date: 4/11/2001; 3/20/2001

2 Name and address of receiving party(ies).

Name:
INTERNATIONAL PAPER COMPANY
a New York Corporation
Street Address:
Two Manhattanville Road
Purchase, New York 10577-2196

4 Application number(s) or patent number(s)

If this document is being filed together with a new application, the execution date of the application is:

A. Patent Application Note

09/770,340

B. Patent Note

406

Additional number(s) attached? ☐ Yes ☒ No

5 Name and address of party to whom correspondence concerning document should be mailed:

Mark S. Graham, Esq.
LUEDEKA, NEELY & GRAHAM, P.C
P. O. Box 1871
Knoxville, TN 37901

6 Total number of applications and patents involved

1

7 Total fee (37 CFR 3.41) \$ 40.00

☒ Enclosed☐ Please charge to deposit account any
missing or additional fee

8 Deposit Account No 12-2355

DO NOT USE THIS SPACE

9 Statement and signature

To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Mark S. Graham

Name of Person Signing

Signature

Date

Total number of pages including cover sheet: 03

F:\54821\IP1.assignment.cvr wpd

*** CERTIFICATE OF MAILING ***

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on 4/23/2001
Date

Mark S. Graham, Esq. 32.355

Docket No. 54821 P1/ C-3520 0

Assignment

We, Kosaraju Krishna Mohan, a citizen of India, having a mailing address of 5201 Summerhull Road, Apartment 1110, Texarkana, Texas 75503 and Alexander A. Koukoulas, a citizen of the United States, having a mailing address of 242 West Glen Avenue, Ridgewood, New Jersey, for good and valuable consideration, receipt of which is hereby acknowledged, have assigned and do hereby assign to INTERNATIONAL PAPER COMPANY, a New York corporation, having its principal place of business at Two Manhattanville Road, Purchase, New York 10577-2196, its successors, assigns and legal representatives, the entire right, title and interest throughout the world in and to all subject matter invented by us and disclosed in the application identified below

Title. LOW DENSITY PAPER AND PAPERBOARD ARTICLES

U S Application No. 09/770,340

Filed January 26, 2001

Inventor(s). Kosaraju Krishna Mohan

4/11/2001

Date of Execution of Declaration

Alexander A. Koukoulas

20 March 2001

Date of Execution of Declaration

and in and to all Letters Patent and all Convention and treaty rights of all kinds, in all countries throughout the world, for all such subject matter. We agree to sign all papers necessary to secure all said Letters Patent to the above assignee in accordance with the Assignment.

4/11/2001

Date of Execution of Assignment

K Krishna Mohan

Kosaraju Krishna Mohan

20 March 2001

Date of Execution of Assignment

Alexander A. Koukoulas

Alexander A. Koukoulas

New York
STATE OF ~~TEXAS~~)

COUNTY OF *Orange*)

I hereby certify that before me appeared Kesaraju Krishna Mohan, personally known by me, who then and there was duly sworn by me, and under oath acknowledged that the foregoing assignment was duly signed, sealed and delivered by him on the date appearing at the foot thereof.

Date: *April 11, 2001*

Jeanne McCabe

Notary Public

My Commission Expires:

JEANNE McCABE
Notary Public, State of New York
4828895

Qualified in Orange County
My Commission Expires *4/30/2002*

STATE OF NEW YORK)

COUNTY OF ORANGE)

I hereby certify that before me appeared Alexander A. Koukoulas, personally known by me, who then and there was duly sworn by me, and under oath acknowledged that the foregoing assignment was duly signed, sealed and delivered by him on the date appearing at the foot thereof.

Date: *March 20, 2001*

Jeanne McCabe

Notary Public

My Commission Expires:

JEANNE McCABE
Notary Public, State of New York
4828895

Qualified in Orange County
My Commission Expires *4/30/2002*

VF-54821VUSASG



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER
OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

OCTOBER 30, 2001

PTAS

LUEDEKA, NEELY & GRAHAM, P C.
MARK S. GRAHAM, ESQ.
P O BOX 1871
KNOXVILLE, TN 37901



101829547A

UNITED STATES PATENT AND TRADEMARK OFFICE
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PLEASE REVIEW ALL INFORMATION CONTAINED ON THIS NOTICE. THE INFORMATION CONTAINED ON THIS RECORDATION NOTICE REFLECTS THE DATA PRESENT IN THE PATENT AND TRADEMARK ASSIGNMENT SYSTEM IF YOU SHOULD FIND ANY ERRORS OR HAVE QUESTIONS CONCERNING THIS NOTICE, YOU MAY CONTACT THE EMPLOYEE WHOSE NAME APPEARS ON THIS NOTICE AT 703-308-9723. PLEASE SEND REQUEST FOR CORRECTION TO: U S PATENT AND TRADEMARK OFFICE, ASSIGNMENT DIVISION, BOX ASSIGNMENTS, CG-4, 1213 JEFFERSON DAVIS HWY, SUITE 320, WASHINGTON, D.C 20231.

RECORDATION DATE 08/27/2001

REEL/FRAME 012107/0866
NUMBER OF PAGES 3

BRIEF. ASSIGNMENT OF ASSIGNOR'S INTEREST (SEE DOCUMENT FOR DETAILS)

ASSIGNOR

FROASS, PETER MATTHEW

DOC DATE: 06/14/2001

ASSIGNOR

REED, DAVID VERD

DOC DATE: 08/06/2001

ASSIGNEE:

INTERNATIONAL PAPER COMPANY, A NEW
YORK CORP
TWO MANHATTANVILLE ROAD
PURCHASE, NEW YORK 10577-2196

SERIAL NUMBER 09770340
PATENT NUMBER

FILING DATE 01/26/2001
ISSUE DATE

SEDLEY FYNE, EXAMINER
ASSIGNMENT DIVISION
OFFICE OF PUBLIC RECORDS

FORM PT-1585

06-30-2001

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

62

To the Assistant Commissioner for Patents:

101829547

parts or copy thereof

1. Name of conveying party(ies).

Peter Matthew Froass and
David Verd ReedAdditional names of conveying party(ies) attached? ☐ Yes ☒ No

3. Nature of conveyance:

- ☐ Assignment ☐ Merger
☐ Change of Name ☐ Other
☐ Security Agreement

2. Name and address of receiving party(ies):

Name:
INTERNATIONAL PAPER COMPANY
 in New York Corporation
 Street Address:
 Two Manhattanville Road
 Purchase, New York 10577-2196

AUG 27 2001

Execution Date: 6/14/2001, 8/6/2001

4. Application number(s) or patent number(s):

If this document is being filed together with a new application, the execution date of the application is:

A. Patent Application Note

09/770,340

B. Patent Note

Additional numbers attached? ☐ Yes ☒ No

5. Name and address of party to whom correspondence concerning document should be mailed:

Mark S. Graham, Esq.
 LUEDEKA, NEELY & GRAHAM, P.C.
 P. O. Box 1871
 Knoxville, TN 37901

6. Total number of applications and patents involved

1

7. Total fee (37 CFR 3.41) \$ 40.00

☒ Enclosed☐ Please charge to deposit account any missing or additional fee

8. Deposit Account No 12-2355

1/30/2001 MHEB1 00000010 09770340

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9. Statement and signature

To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Mark S. Graham

Name of Person Signing

M. Graham

Signature

8/24/2001

Date

Total number of pages including cover sheet: 01

F:\54821\VP1 Assignment.cvr 2nd.wpd

*** CERTIFICATE OF MAILING ***

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on 8/24/2001

Date

M. Graham

Mark S. Graham, Reg. 52,355

63
2/6

Docket No. 54821 P1/ C-3520.0

Assignment

We, Peter Matthew Froass, a citizen of the United States, having a mailing address of 11 Valley Court, Chester, New York 10918 and David Verd Reed, a citizen of the United States, having a mailing address of 2044 Hunt Road, Blanchester, Ohio 45107, for good and valuable consideration, receipt of which is hereby acknowledged, have assigned and do hereby assign to INTERNATIONAL PAPER COMPANY, a New York corporation, having its principal place of business at Two Manhattanville Road, Purchase, New York 10577-2196, its successors, assigns and legal representatives, the entire right, title and interest throughout the world in and to all subject matter invented by us and disclosed in the application identified below

Title: LOW DENSITY PAPER AND PAPERBOARD ARTICLES

U S Application No 09/770,340

Filed January 26, 2001

Inventor(s). Peter Matthew Froass

David Verd Reed

6/14/01

Peter M. Froass
Date of Execution of Declaration

David Verd Reed 6/4/01
Date of Execution of Declaration

and in and to all Letters Patent and all Convention and treaty rights of all kinds, in all countries throughout the world, for all such subject matter We agree to sign all papers necessary to secure all said Letters Patent to the above assignee in accordance with the Assignment

6/14/01

Date of Execution of Assignment

6/6/01

Date of Execution of Assignment

Peter M. Froass
Peter Matthew Froass

David Verd Reed
David Verd Reed

6/2/01

STATE OF NEW YORK)
)
 COUNTY OF ORANGE)

I hereby certify that before me appeared Peter Matthew Froass, personally known by me, who then and there was duly sworn by me, and under oath acknowledged that the foregoing assignment was duly signed, sealed and delivered by him on the date appearing at the foot thereof.

Date: 6/14/01

[Signature]
 Notary Public

My Commission Expires 1/31/02
 My Commission Expires 1/31/02
 My Commission Expires 1/31/02
 My Commission Expires 1/31/02

STATE OF OHIO)
)
 COUNTY OF CLERHANT

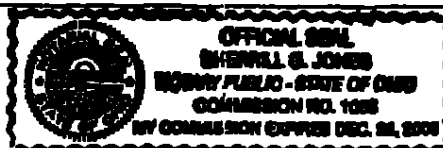
I hereby certify that before me appeared David Verd Reed, personally known by me, who then and there was duly sworn by me, and under oath acknowledged that the foregoing assignment was duly signed, sealed and delivered by him on the date appearing at the foot thereof

Date: July 16, 2001

[Signature]
 Notary Public

My Commission Expires:

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UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
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OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

OCTOBER 30, 2001

PTAS

LUEDEKA, NEELY & GRAHAM, P C.
MARK S GRAHAM
P O BOX 1871
KNOXVILLE, TN 37901



101829548A

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RECORDATION DATE 08/27/2001

REEL/FRAME. 012107/0872
NUMBER OF PAGES: 3

BRIEF- ASSIGNMENT OF ASSIGNOR'S INTEREST (SEE DOCUMENT FOR DETAILS)

ASSIGNOR:

FROASS, PETER MATTHEW

DOC DATE: 06/14/2001

ASSIGNOR:

REED, DAVID VERD

DOC DATE- 08/06/2001

ASSIGNEE:

INTERNATIONAL PAPER COMPANY
TWO MANHATTANVILLE ROAD
PURCHASE, NEW YORK 10577-2196

SERIAL NUMBER. 60178214
PATENT NUMBER.FILING DATE. 01/26/2000
ISSUE DATE:

TONYA LEE, EXAMINER
ASSIGNMENT DIVISION
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Form PTO-1585

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Patent and Trademark Office

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To the Assistant Commissioner for Records: *101829548* documents or copy thereof

1. Name of conveying party(ies).

Peter Matthew Froass and
David Verd ReedAdditional names of conveying party(ies) attached? ☐ Yes ☒ No

2. Name and address of receiving party(ies):

Name:
INTERNATIONAL PAPER COMPANY
in New York Corporation
Street Address:
Two Manhattanville Road
Purchase, New York 10577-2196

AUG 27 2001

3. Nature of conveyance:

- ☒ Assignment ☐ Merger
☐ Change of Name ☐ Other
☐ Security Agreement

Execution Date: 6/14/2001; 8/6/2001

4. Application number(s) or patent number(s):

If this document is being filed together with a new application, the execution date of the application is.

A. Patent Application No(s).

60/178,214

B. Patent No(s)

Additional numbers attached? ☐ Yes ☒ No

5. Name and address of party to whom correspondence concerning document should be mailed:

Mark S. Graham, Esq.
LUEDEKA, NEELY & GRAHAM, P.C.
P. O. Box 1871
Knoxville, TN 37901

6. Total number of applications and patents involved:

1

7. Total fee (\$7 CFR 3.40) \$ 40.00

- ☒ Enclosed
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missing or additional fee

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Mark S. Graham

Name of Person Signing

Signature

Date

Total number of pages including cover sheet: 03

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20/2001 RARE01 00000011 60178214

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335, Washington, D.C. 20231

on 8/7/2001
Date

Mark S. Graham, Esq. 32.555

Docket No. 54821 PR/C-3520 0

Assignment

We, Peter Matthew Froass, a citizen of the United States, having a mailing address of 11 Valley Court, Chester, New York 10918 and David Verd Reed, a citizen of the United States, having a mailing address of 2044 Hunt Road, Blanchester, Ohio 45107, for good and valuable consideration, receipt of which is hereby acknowledged, have assigned and do hereby assign to INTERNATIONAL PAPER COMPANY, a New York corporation, having its principal place of business at Two Manhattanville Road, Purchase, New York 10577-2196, its successors, assigns and legal representatives, the entire right, title and interest throughout the world in and to all subject matter invented by us and disclosed in the application identified below

Title. LOW DENSITY PAPER AND PAPERBOARD ARTICLES

U S Application No.: 60/178,214

Filed January 26, 2000

Inventor(s) Peter Matthew Froass

6/14/01

Date of Execution of Declaration

David Verd Reed

6 August 2001

Date of Execution of Declaration

and in and to all Letters Patent and all Convention and treaty rights of all kinds, in all countries throughout the world, for all such subject matter We agree to sign all papers necessary to secure all said Letters Patent to the above assignee in accordance with the Assignment.

6/14/01

Date of Execution of Assignment

6 August 2001

Date of Execution of Assignment

Peter M. Froass

Peter Matthew Froass

David Verd Reed

David Verd Reed

STATE OF NEW YORK)
)
COUNTY OF ORANGE)

I hereby certify that before me appeared Peter Matthew Froese, personally known by me, who then and there was duly sworn by me, and under oath acknowledged that the foregoing assignment was duly signed, sealed and delivered by him on the date appearing at the foot thereof.

Date. 6/14/01

Notary Public

My Commission Expires **AMEL NORTON**
 Notary Public, State of New York
 Qualified in Orange County
 #4700803 1/31/11
 Term Expires _____

◆ ◆ ◆ ◆ ◆

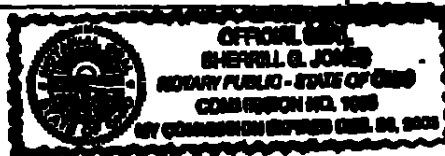
STATE OF OHIO)
)
COUNTY OF CLERMONT)

I hereby certify that before me appeared David Verd Reed, personally known by me, who then and there was duly sworn by me, and under oath acknowledged that the foregoing assignment was duly signed, sealed and delivered by him on the date appearing at the foot thereof.

Date: August 6, 2001

Notary Public

My Commission Expires





UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER
OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

JULY 18, 2001

PTAS

LUEDEKA, NEELY & GRAHAM, P C.
MARK S. GRAHAM, ESQ
P O. BOX 1871
KNOXVILLE, TN 37901



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RECORDATION DATE- 04/26/2001

REEL/FRAME 011750/0937
NUMBER OF PAGES 3

BRIEF- ASSIGNMENT OF ASSIGNOR'S INTEREST (SEE DOCUMENT FOR DETAILS)

ASSIGNOR:

MOHAN, KOSARAJU KRISHNA

DOC DATE 04/11/2001

ASSIGNOR

KOUKOULAS, ALEXANDER A.

DOC DATE: 03/20/2001

ASSIGNEE-

INTERNATIONAL PAPER COMPANY
TWO MANHATTANVILLE ROAD
(A NEW YORK CORPORATION)
PURCHASE, NEW YORK 10577-2196

SERIAL NUMBER. 60178214
PATENT NUMBER

FILING DATE 01/26/2000
ISSUE DATE

SHAREILL COLES, EXAMINER
ASSIGNMENT DIVISION
OFFICE OF PUBLIC RECORDS

FD-501 (Rev. 1-1995)



101704499

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Patent and Trademark Office

69-70

To the Assistant Commissioner for Patents: Please record the attached original documents or copy thereof

1. Name of conveying party(ies):

Koseraju Krishna Mohan and
Alexander A. KoukoulasAdditional names of conveying party(ies) attached? ☐ Yes ☒ No

3. Nature of conveyance:

☒ Assignment ☐ Merger☐ Change of Name ☐ Other☐ Security Agreement

2. Name and address of receiving party(ies):

Name:
INTERNATIONAL PAPER COMPANY
a New York Corporation
Street Address:
Two Manhattanville Road
Purchase, New York 10577-2196

Execution Date: 4/11/2001, 3/20/2001

4. Application number(s) or patent number(s):

If this document is being filed together with a new application, the execution date of the application is:

A. Patent Application No(s).

60/178,214

B. Patent No(s).

Additional numbers attached? ☐ Yes ☒ No

5. Name and address of party to whom correspondence concerning document should be mailed:

Mark S. Graham, Esq
LJEDKA, NEELY & GRAHAM, P.C.
P. O. Box 1871
Knoxville, TN 37901

6. Total number of applications and patents involved:

1

7. Total fee (37 CFR 3.41).....\$ 40.00

☒ Enclosed☐ Please charge to deposit account any
missing or additional fee

B. Deposit Account No. 12-2355

DO NOT USE THIS SPACE

9. Statement and signature

To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Mark S. Graham

Name of Person Signing

M. Graham

Signature

4/23/2001

Date

Total number of pages including cover sheet: 10

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on 4/23/2001

Date

M. Graham

Mark S. Graham, Reg. 52,855

71

Docket No 54821 P1/C-3520.0

Assignment

We, Kosaraju Krishna Mohan, a citizen of India, having a mailing address of 5201 Summerhill Road, Apartment 1110, Texarkana, Texas 75503 and Alexander A. Koukoulas, a citizen of the United States, having a mailing address of 242 West Glen Avenue, Ridgewood, New Jersey, for good and valuable consideration, receipt of which is hereby acknowledged, have assigned and do hereby assign to INTERNATIONAL PAPER COMPANY, a New York corporation, having its principal place of business at Two Manhattanville Road, Purchase, New York 10577-2196, its successors, assigns and legal representatives, the entire right, title and interest throughout the world in and to all subject matter invented by us and disclosed in the application identified below:

Title: LOW DENSITY PAPER AND PAPERBOARD ARTICLES

U.S. Application No.: 60/178,214

Filed: January 26, 2000

Inventor(s). Kosaraju Krishna Mohan

4/11/2001

Date of Execution of Declaration

Alexander A. Koukoulas

20 March 2001

Date of Execution of Declaration

and in and to all Letters Patent and all Convention and treaty rights of all kinds, in all countries throughout the world, for all such subject matter We agree to sign all papers necessary to secure all said Letters Patent to the above assignee in accordance with the Assignment

4/11/2001

Date of Execution of Assignment

K. Krishna Mohan

Kosaraju Krishna Mohan

20 March 2001

Date of Execution of Assignment

Alexander A. Koukoulas

Alexander A. Koukoulas

72
X
A

STATE OF TEXAS)
COUNTY OF Orange)

I hereby certify that before me appeared Kosaraju Krishna Mohan, personally known by me, who then and there was duly sworn by me, and under oath acknowledged that the foregoing assignment was duly signed, sealed and delivered by him on the date appearing at the foot thereof.

Date: April 11, 2001

Jeanne McCabe
Notary Public

My Commission Expires

JEANNE McCABE
Notary Public, State of New York
4828888
Qualified in Orange County
My Commission Expires 4/30/2002

STATE OF NEW YORK)
COUNTY OF ORANGE)

I hereby certify that before me appeared Alexander A. Koukoulas, personally known by me, who then and there was duly sworn by me, and under oath acknowledged that the foregoing assignment was duly signed, sealed and delivered by him on the date appearing at the foot thereof.

Date: 3/20/01

Jeanne McCabe
Notary Public

My Commission Expires

JEANNE McCABE
Notary Public, State of New York
4828888
Qualified in Orange County
My Commission Expires 4/30/2002

P. TENT COOPERATION TREATY

MAR - 8 2002

C-3540.0
178673
AFrom the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY
LUEDEKA, NEELY, & GRAHAMTo:
MARK S. GRAHAM
LUEDEKA, NEELY & GRAHAM, PC
P O BOX 1871
KNOXVILLE, TN 37901

PCT

NOTIFICATION OF TRANSMITTAL OF
INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

(PCT Rule 71.1)

Date of Mailing
(day/month/year)

04 MAR 2002

Applicant's or agent's file reference

54821.P1

IMPORTANT NOTIFICATION

International application No.

International filing date (day/month/year)

Priority date (day/month/year)

PCT/US01/02777

26 January 2001 (26.01.2001)

26 January 2000 (26.01.2000)

Applicant

INTERNATIONAL PAPER COMPANY

- 1 The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
- 2 A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
- 3 Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
- 4 REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301)

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/US

Comptroller of Patents and Trademarks

Box PCT

Washington, D.C. 20531

Facsimile No. (703) 305-3230

Form PCT/IPEA/416 (July 1992)

Authorized officer

John H. Hurd

Telephone No. (703) 308-0661

NO NEW DATES DOCKETED
ATTY: M6

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 34021 P1	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US01/02777	International filing date (day/month/year) 26 January 2001 (26.01.2001)	Priority date (day/month/year) 26 January 2000 (26.01.2000)
International Patent Classification (IPC) or national classification and IPC IPC(7): B32B 5/24 and US Cl. 428/311.11		
Applicant INTERNATIONAL PAPER COMPANY		
1 This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36 2 This REPORT consists of a total of <u>3</u> sheets, including this cover sheet. ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT) These annexes consist of a total of <u>0</u> sheets.		
3 This report contains indications relating to the following items: I ☒ Basis of the report II ☐ Priority III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability IV ☐ Lack of unity of invention V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement VI ☐ Certain documents cited VII ☐ Certain defects in the international application VIII ☐ Certain observations on the international application		
Date of submission of the demand 14 August 2001 (14.08.2001)	Date of completion of this report 08 February 2002 (08.02.2002)	
Name and mailing address of the IPEA/US Commissioner of Patents and Trademark Box PCT Washington, D.C. 20531 Facsimile No. (703) 305-3230	Authorized officer  Byron Harris Telephone No. (703) 305-0661	

Form PCT/IPEA/409 (cover sheet) (July 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International Application No.
PCT/US81/02777

I. Basis of the report

1 With regard to the elements of the international application:

- ☒ the international application as originally filed
- ☒ the description
 pages 1-24 as originally filed
 pages NONE filed with the demand
 pages NONE filed with the letter of _____
- ☒ the claims
 pages 25-31 as originally filed
 pages NONE as amended (together with any statement) under Article 19
 pages NONE filed with the demand
 pages NONE filed with the letter of _____
- ☒ the drawings
 pages 1-3 as originally filed
 pages NONE filed with the demand
 pages NONE filed with the letter of _____
- ☐ the sequence listing part of the description
 pages NONE as originally filed
 pages NONE filed with the demand
 pages NONE filed with the letter of _____

2 With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item. These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3 With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4 ☒ The amendments have resulted in the cancellation of

- ☒ the description, pages none
- ☒ the claims, Nos. none
- ☒ the drawings, sheets/fig none

5 ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)) **

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US01/02772

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting each statement

1 STATEMENT

Novelty (N)

Claims 1-40

YES

Claims NONE

NO

Inventive Step (IS)

Claims 1-40

YES

Claims NONE

NO

Industrial Applicability (IA)

Claims 1-40

YES

Claims NONE

NO

2 CITATIONS AND EXPLANATIONS

With regards to claims 1-40, the cited prior art fails to teach or suggest a paperboard material or method of making said paperboard material, including wood fibers and expanded microspheres and composition thereof with the physical properties recited by applicant in claims 1-40.

NEW CITATIONS

Sheet No. ...

Box No. V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-box; at least one must be marked):

Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Cote d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line)

- | | |
|--|--|
| ☒ AL Albania | ☒ LS Lesotho |
| ☒ AM Armenia | ☒ LT Lithuania |
| ☒ AT Austria | ☒ LU Luxembourg |
| ☒ AU Australia | ☒ LV Latvia |
| ☒ AZ Azerbaijan | ☒ MD Republic of Moldova |
| ☒ BA Bosnia and Herzegovina | ☒ MG Madagascar |
| ☒ BB Barbados | ☒ MK The former Yugoslav Republic of Macedonia |
| ☒ BG Bulgaria | |
| ☒ BR Brazil | ☒ MN Mongolia |
| ☒ BY Belarus | ☒ MW Malawi |
| ☒ CA Canada | ☒ MX Mexico |
| ☒ CH and LI Switzerland and Liechtenstein | ☒ NO Norway |
| ☒ CN China | ☒ NZ New Zealand |
| ☒ CU Cuba | ☒ PL Poland |
| ☒ CZ Czech Republic | ☒ PT Portugal |
| ☒ DE Germany | ☒ RO Romania |
| ☒ DK Denmark | ☒ RU Russian Federation |
| ☒ EE Estonia | ☒ SD Sudan |
| ☒ ES Spain | ☒ SE Sweden |
| ☒ FI Finland | ☒ SG Singapore |
| ☒ GB United Kingdom | ☒ SI Slovenia |
| ☒ GD Grenada | ☒ SK Slovakia |
| ☒ GE Georgia | ☒ SL Sierra Leone |
| ☒ GH Ghana | ☒ TJ Tajikistan |
| ☒ GM Gambia | ☒ TM Turkmenistan |
| ☒ HR Croatia | ☒ TR Turkey |
| ☒ HU Hungary | ☒ TT Trinidad and Tobago |
| ☒ ID Indonesia | ☒ UA Ukraine |
| ☒ IL Israel | ☒ UG Uganda |
| ☒ IN India | ☐ US United States of America |
| ☒ IS Ireland | |
| ☒ JP Japan | ☒ UZ Uzbekistan |
| ☒ KE Kenya | ☒ VN Viet Nam |
| ☒ KG Kyrgyzstan | ☒ YU Yugoslavia |
| ☒ KP Democratic People's Republic of Korea | ☒ ZW Zimbabwe |
| ☒ KR Republic of Korea | |
| ☒ KZ Kazakhstan | |
| ☒ LC Saint Lucia | |
| ☒ LK Sri Lanka | |
| ☒ LR Liberia | |

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet.

Provisional Designation Statement. In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

77 78

Industria y Comercio
SUPERINTENDENCIA

REQUISITOS NECESARIOS PARA PRESENTACIÓN Y AGILIZACIÓN DEL TRAMITE

	USUARIO	RADICADOR
PATENTE DE INVENCION []		
MODELO DE UTILIDAD []		
• Indicación de que se solicita la concesión de una patente	[]	[]
• Datos de identificación del solicitante o de la persona que presenta la solicitud	[]	[]
• Descripción de la invención	[]	[]
• Dibujos de ser estos pertinentes	[]	[]
• Comprobante de Pago de las tasas establecidas	[]	[]
COMPLETA []		
INCOMPLETA []		

DISEÑO INDUSTRIAL []		
• Indicación de que se solicita el registro de Diseño Industrial.	[]	[]
• Datos de identificación del solicitante o de la persona que presenta la solicitud.	[]	[]
• Representación gráfica y foto gráfica del Diseño Industrial o muestra del material que incorpora el diseño.	[]	[]
• Comprobante de pago de las tasas establecidas.	[]	[]
COMPLETA []		
INCOMPLETA []		

ESQUEMA DE TRAZADO []		
• Indicación de que se solicita el registro de un Esquema de trazado.	[]	[]
• Datos de identificación del solicitante o de la persona que presenta la solicitud.	[]	[]
• Representación gráfica del esquema de trazado	[]	[]
• Comprobante de pago de las tasas establecidas.	[]	[]
COMPLETA []		
INCOMPLETA []		

Firma Responsable

SUPERINTENDENCIA Y COMERCIO
Radicación : 02044949 00000000

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Tramite : 002 PATENTES D 1 REGISTRO/ 411 PRESENTAC

Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

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Bogotá D.C. - Colombia

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
2 August 2001 (02.08.2001)

PCT

(10) International Publication Number
WO 01/54988 A2

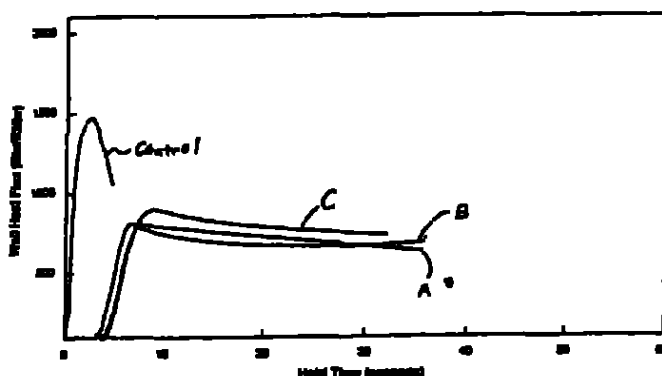
- (51) International Patent Classification: B65D
- (21) International Application Number: PCT/US01/02777
- (22) International Filing Date: 26 January 2001 (26.01.2001)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data
60/178,214 26 January 2000 (26.01.2000) US
- (71) Applicant: INTERNATIONAL PAPER COMPANY [US/US], 2 Manhattanville Road, Purchase, NY 10577-2196 (US).
- (74) Agents: GRAHAM, Mark, S., Lucetka, Neely & Graham, PC, P.O. Box 1871, Knoxville, TN 37901 et al. (US).
- (81) Designated States (national): AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, 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, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

— without international search report and to be republished upon receipt of that 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: LOW DENSITY PAPERBOARD ARTICLES



(57) Abstract: The invention provides a low density paperboard material and associated method for use in producing an insulated container, and is especially well-suited for making cups. The paperboard material comprises a paperboard web including wood fibers and expanded microspheres, and has a relatively low density ranging from about 6 to about 10 lb/3MSF/m², a relatively high caliper ranging from about 24 to about 35 mil, and an internal bond strength of at least about 80 x 10⁻³ ft-lbf, preferably at least 100 x 10⁻³ ft-lbf. For applications such as cups the material is also coated on one or both sides with a barrier coating, preferably low density polyethylene, to limit liquid penetration into the web. The low density paperboard material of the invention is convertible for manufacture of containers, particularly cups, and exhibits insulative properties comparable to higher cost materials conventionally used to make cups. Also, the surface of the low density board may have a Sheffield smoothness of 30 SU or greater compared with the surface smoothness of 160 to 200 SU for conventional cupstock, the latter having been thought necessary for adequate print quality. However, it has been found that the low density board exhibits good printability on flexo printing machines despite its relatively rough surface, which is surprising and bonus effect realized along with the insulative and other properties of the board.

WO 01/54988 A2

2020
Bogotá, D C

Doctor(a)
RAMIRO CASTRO DUQUE

Oficio No
14323

REFERENCIA.	Radicación	02-64949
	Trámite	002
	Evento	001
	Actuación	430
	Folios	001

Como resultado del examen de forma, realizado con fundamento en el artículo 38 de la Decisión 486 de la Comisión de la Comunidad Andina, se le comunica que

- La solicitud no puede tratarse como una solicitud internacional que entra a fase nacional, puesto que la fecha de presentación de la solicitud internacional es la del 26 de enero del 2001, fecha en la cual Colombia no pertenecía al PCT y por lo tanto no podía ser designada dentro de los estados contratantes. La solicitud podrá tratarse como una solicitud nacional, si desea continuar con este trámite debe cumplir con los requisitos estipulados en la legislación. Por lo tanto,
- Allegar el poder otorgado al abogado que aparece en la solicitud como apoderado, adicionalmente, deberá presentar el documento que acredita la existencia y representación legal de la sociedad solicitante
- Debe allegar copia del documento en que consta la cesión del derecho a la patente otorgado por el inventor al solicitante o a su causante (art. 26-k, Dec 486/2000)
- Aportar la traducción de la solicitud presentada como solicitud colombiana
- Diligenciar los formatos establecidos en la circular única para el trámite correspondiente

En cumplimiento del artículo 39 de la Decisión 486, se le requiere para que dentro del término de dos (2) meses siguientes a la fecha de notificación del presente oficio, complete los requisitos anteriormente enunciados. En caso de no dar cumplimiento al presente requerimiento, la solicitud se considerará abandonada y perderá su prelación

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única No 10 de 2001

ALIX CARMENZA CÉSPEDES DE VERGEL
Jefe de la División de Nuevas Creaciones

El anterior requerimiento fue notificado por fijación en lista de fecha 29 ABR. 2002