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SUPERINDUSTRIA Y COMERCIO

Radicación : 0101056 0000005 Folios: 2

Fecha (H): 2002-12-16 16:02:32

AS: 84.338

Trámite : 002 PATENTES D 1 REGISTRO/ 536 PETICION

Dependencia: 2026 DIVISION DE NUEVAS CREACIONES

Señores
SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISION DE NUEVAS CREACIONES
E. S. D.

REF.: Expediente No. 01 018.858 solicitud de Patente a nombre de
KIMBERLY – CLARK WORLDWIDE, INC.

RAMIRO CASTRO DUQUE, vecino de Bogotá, portador de la tarjeta profesional No. 1003 del Consejo Superior de la Judicatura, obrando como apoderado de la Sociedad **KIMBERLY – CLARK WORLDWIDE, INC.**, según lo acredita el documento de poder protocolizado en la Secretaría General bajo el No. 17397, de acuerdo con el Artículo 44 de la Decisión 486 de la Comisión de la Comunidad Andina, me permito solicitar que se examine si la invención contenida en la solicitud en referencia es patentable.

De acuerdo con lo anterior, me permito anexar el recibo oficial de caja No. 02-80,156 por valor de \$318.000.

Señor Superintendente,

RAMIRO CASTRO DUQUE
C.C. No. 170.322 de Bogotá
Código 340
T.P. No.1003 del C.S.J.
Cra. 7 No. 16-56 Piso 9

Diciembre 16, 2002
CPB/hsr

NIT : 300176909-2

Industria y Comercio
SUPERINTENDENCIA

SUPERINDUSTRIA Y COMERCIO

Folios: 2

Radicacion : 0101056 00000005
Fecha (AMD): 2002-12-16 16:02:32

Trámite : 002 PATENTES D 1 REGISTRO/ 530 PETICION

Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PAGO	Gr. PAGO
BRIGARD & CASTRO LTDA	CONSIGNACION	BANCO POPULAR	050-00110-6	5773463	28/11/2002	7,700,000.00

***** C O N C E P T O *****

CANT. HISTORICO	CONCEPTO	TOTAL CONCEPTO
1 50005-01-01 SOLICITUDES	112 PTC CAP-I EXAMEN DE PATENTABILIDAD	310,000.00
	TOTAL :	310,000.00

SOM: TRESCIENTOS DIEZ Y OCHO MIL PESOS

RESPONSABLE : _____

RECIBO DE CASH APLICADO AL EXPEDIENTE No. _____

Carrera 13 No. 27-00 Pisos 5, 7 y 10
Conmutador 382 0840
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Bogotá, D.C., Colombia

**SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISION DE NUEVAS CREACIONES**

2020

Bogotá, D.C., 12 de diciembre de 2005

Doctor
RAMIRO CASTRO DUQUE
Apoderado

Oficio No. **13463**

ASUNTO	Radicación	01-18858
	Trámite	002
	Evento	001
	Actuación	430
	Folios	015

Como resultado del examen de fondo, realizado con fundamento en el artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le comunica:

1. Documentos estudiados

- Para el presente estudio se tuvo en cuenta el capítulo descriptivo que se encuentra en los folios 7 a 37, los dibujos que se encuentran en los folios 122 a 127 y el capítulo reivindicatorio que se encuentra en los folios 38 a 42 que comprende veintidós (22) reivindicaciones.
- De acuerdo con el folio 128 de la solicitud en estudio, se considerará la prioridad reivindicada sobre la solicitud de Estados Unidos No. 09/525, 547 del 14 de marzo de 2000.

2. Objeto de la Invención

- La invención propuesta se relaciona con composiciones de polímero biodegradables que reaccionan al agua y a películas, fibras y artículos que comprenden tales composiciones. La presente invención incluye métodos para hacer y variar la respuesta al agua de tales composiciones. Las composiciones de la presente invención comprenden una mezcla de poli(alcohol vinílico) y un poliláctido. En una incorporación, el poliláctido es injertado con un monómero de vinilo polar.

En la reivindicación Independiente 1 se define un artículo para el cuidado personal que comprende una película o una tela no tejida, dicha película o tela no tejida comprende una mezcla de poli(alcohol vinílico) y de un poliláctido.

En la reivindicación Independiente 15 se define un artículo para el cuidado personal que comprende un poli(alcohol vinílico) y un poliláctido modificado que comprende una columna de poliláctido con una pluralidad de monómeros polares, oligómeros, polímeros o una mezcla de los mismos injertados en dicha columna de poliláctido.

En la reivindicación Independiente 16 se define un método para variar la respuesta al agua de una composición que comprende los pasos de:

- a) Seleccionar una cantidad específica de un poli(alcohol polivinílico) y una cantidad específica de un poliláctido;
 - b) Mezclar la cantidad específica del poli(alcohol vinílico) con la cantidad específica del poliláctido y
 - c) Formar un artículo para el cuidado personal o un componente del artículo para el cuidado personal de la mezcla.
- Se afirma que además de la necesidad de composiciones de polímero que sean altamente estables, y por tanto, adecuadas para el uso regular en la mayoría de los artículos absorbentes, hay una necesidad simultánea de tales composiciones de polímero que responden al agua. Lo que se requiere por tanto, es un material que puede ser utilizado para la fabricación de artículos desechables y el cual responde al agua. Tal material debe ser versátil y barato de producir. El material debe ser estable en forma suficiente para el uso intentado pero debe someterse a la degradación bajo condiciones predeterminadas. Además hay un énfasis incrementado en los recubrimientos y materiales ambientalmente seguros. Estos recubrimientos reducen el uso de recubrimientos a base de solvente y descansan en un grado siempre en aumento, de recubrimientos polares, tal como un material a base de agua. La utilidad de los copolímeros de injerto de ésta invención incluye, pero no se limitará a materiales que tienen una afinidad mayor para un recubrimiento polar.
 - El objeto de la invención definido se catalogó como A61L 15/22, según la Clasificación Internacional de Patentes (IPC).

3. Claridad de la solicitud

El artículo 30 de la Decisión 486 de la Comisión de la Comunidad Andina establece que: "Las reivindicaciones definirán la materia que se desea proteger mediante la patente. Deben ser claras y concisas y estar enteramente sustentadas por la descripción.

Las reivindicaciones podrán ser independientes o dependientes. Una reivindicación será independiente cuando defina la materia que se desea proteger sin referencia a otra reivindicación anterior. Una reivindicación será dependiente cuando defina la materia que se desea proteger refiriéndose a una reivindicación anterior. Una reivindicación que se refiera a dos o más reivindicaciones anteriores se considerará una reivindicación dependiente múltiple".

- El capítulo reivindicatorio contiene intervalos numéricos precedidos por la expresión "alrededor" la cual no le confiere claridad ni precisión a la definición de la invención. Por lo tanto, se recomienda eliminar dicha expresión.
- En conclusión, el capítulo reivindicatorio no cumpliría con el requisito de claridad de acuerdo con el artículo 30 de la Decisión 486.

4. Determinación del estado de la técnica

El artículo 16 de la Decisión 486 de la Comisión establece: "El estado de la técnica comprenderá todo lo que haya sido accesible al público por una descripción escrita u oral, utilización, comercialización o cualquier otro medio antes de la fecha de presentación de la solicitud de patente o, en su caso, de la prioridad reconocida.

Sólo para el efecto de la determinación de la novedad, también se considerará dentro del estado de la técnica, el contenido de una solicitud de patente en trámite ante la oficina nacional competente, cuya fecha de presentación o de prioridad fuese anterior a la fecha de presentación o de prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido esté incluido en la solicitud de fecha anterior cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40."

- Se consultaron las bases de datos con que cuenta y tiene acceso la entidad y se consideró el 14 de marzo de 2000 como fecha para investigar el estado de la técnica.
- De acuerdo con lo establecido en el artículo 16 se determinó el estado de la técnica y se encontró el siguiente antecedente:

No.	Documento No.	Título	Fecha de Publicación
1	US5945480	"WATER-RESPONSIVE BIODEGRADABLE FIBERS COMPRISING POLYLACTIDE MODIFIED POLYLACTIDE AND POLYVINYL ALCOHOL, AND METHOD FOR MAKING THE FIBERS"	31 de agosto de 1999

5. Evaluación de los requisitos de patentabilidad

El artículo 14 de la Decisión 486 de la Comisión de la Comunidad Andina establece: "Los Países Miembros otorgarán patentes para las invenciones, sean de producto o de procedimiento, en todos los campos de la tecnología, siempre que sean nuevas, tengan nivel inventivo y sean susceptibles de aplicación industrial."

En cumplimiento con este artículo, se procedió a evaluar los requisitos de novedad, nivel inventivo y aplicación industrial con el fin de establecer la patentabilidad de la invención reivindicada en la solicitud en estudio.

Evaluación de la Novedad

El artículo 16 de la Decisión 486 de la Comisión de la Comunidad Andina establece: "Una invención se considerará nueva cuando no está comprendida en el estado de la técnica." "El estado de la técnica comprenderá todo lo que haya sido accesible al público por una descripción escrita u oral, utilización, comercialización o cualquier otro medio antes de la fecha de presentación de la solicitud de patente o, en su caso, de la prioridad reconocida.

Sólo para el efecto de la determinación de la novedad, también se considerará dentro del estado de la técnica, el contenido de una solicitud de patente en trámite ante la oficina nacional competente, cuya fecha de presentación o de prioridad fuese anterior a la fecha de presentación o de prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido esté incluido en la solicitud de fecha anterior cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40."

Respecto al estado de la técnica:

- **US5945480** es un documento que divulga una invención patentada cuyo titular es la industria Kimberly-Clark Worldwide, Inc. y sus inventores son James Hongxue Wang, David Michael Schertz, Dave Allen Soerens y Hannong Rhim.

- En el documento **US5945480** (llamado D1 de aquí en adelante) se divulga la existencia de mezclas poliméricas y fibras que responden al agua. Las mezclas comprenden polivinil alcohol y un poliláctido y un método para elaborar tales fibras. En una modificación de la invención, la invención es una fibra que comprende una mezcla de polivinil alcohol y poliláctido modificado. Los productos obtenidos son desechables y degradables.

Respecto a la solicitud en estudio:

- Dado que la evaluación de novedad implica una comparación elemento por elemento de la materia de la invención, a continuación se realiza un cuadro en el cual se analizan las reivindicaciones de la solicitud respecto al documento que forma parte del arte previo y que se denomina D1.

D1	Solicitud en estudio
"La presente invención es una fibra que comprende una mezcla de alcohol polivinílico y un poliláctido [...]" (Resumen) "La presencia de PLA o PLA modificado en mezclas usadas para elaborar fibras y películas reduce la sensibilidad al agua del PVOH puro. [...] Es posible usar mezclas para hacer otras formas diferentes a fibras o películas [...]" (Columna 7, líneas 37 – 44)	"Un artículo para el cuidado personal que comprende una película o una tela no tejida, dicha película o tela no tejida comprende una mezcla de pol(alcohol vinílico) y de un poliláctido" (Reivindicación independiente 1)
"En una modificación preferida de la invención, la invención es una fibra que comprende una mezcla de alcohol polivinílico y poliláctido modificado [...]" (Resumen)	"El artículo para el cuidado personal [...] caracterizado porque dicho poliláctido es modificado" (Reivindicación dependiente 2)
"El PLA Injertado puede contener [...] monómeros polares, oligómeros o polímeros [...]" (Columna 6, líneas 39 – 41)	"El artículo para el cuidado personal [...] caracterizado porque dicho poliláctido está injertado con un monómero polar, oligómero o polímero o una combinación de los mismos" (Reivindicación dependiente 3)
"Monómeros etilénicamente insaturados preferidos contienen un grupo funcional polar incluido el 2-hidroxiethyl metacrilato (HEMA) y polietilenglicol metacrilato (PEG-MA) [...]" (Columna 6, líneas 33 – 36) "El PLA Injertado puede contener de 1 a 20% de monómeros polares, oligómeros o polímeros [...]" (Columna 6, líneas 39 – 44) "Monómeros etilénicamente insaturados contienen un grupo funcional polar, tal como hidroxilo, carboxilo, amino, carbonil, halo, tiol, sulfónico, sulfonato, etc., son apropiados para la invención [...]" (Columna 6, líneas 30 – 33)	"El artículo para el cuidado personal [...] caracterizado porque dicho monómero polar, oligómero o polímero es seleccionado del grupo que consiste de 2-hidroxiethyl metacrilato, polietilenglicol, metacrilatos, polietilenglicol etil éter metacrilato, polietilenglicol acrilatos, polietilenglicol etil éter acrilato, [...]" (Reivindicación dependiente 4)
	"El artículo para el cuidado personal [...] caracterizado porque dicho poliláctido es un copolímero de injerto de un poliláctido y de desde alrededor de 1% por peso a alrededor de 30% por peso de un monómero polar, oligómero o polímero o una combinación de los mismos en relación al peso del poliláctido" (Reivindicación dependiente 5)
	"El artículo para el cuidado personal [...] caracterizado porque dicho monómero polar es un monómero etilénicamente insaturado que contiene por lo menos un grupo funcional polar o dicho oligómero o dicho polímero es un oligómero o un polímero polimerizado de un monómero etilénicamente insaturado que contiene por lo menos un grupo funcional polar." (Reivindicación dependiente 6)
	"El artículo para el cuidado personal [...] caracterizado porque dicho por lo menos un grupo funcional polar es un grupo hidroxilo, carboxilo o sulfonato o una combinación de los mismos" (Reivindicación dependiente 7)
	"El artículo para el cuidado personal [...] caracterizado porque dicho por lo menos un grupo funcional polar es un grupo hidroxilo" (Reivindicación dependiente 8)

Continuación...

D1	Solicitud en estudio
"Es esperado que un amplio rango de monómeros de vinilo polares puedan ser capaces de impartir los mismos efectos que el HEMA y el PEG-MA a las resinas de poliálctido y puedan ser monómeros efectivos para Injertado" (Columna 6, líneas 36 - 39)	"El artículo para el cuidado personal [...] caracterizado porque dicho monómero polar es un monómero de vinilo polar" (Reivindicación dependiente 9)
"Monómeros etilénicamente insaturados preferidos contienen un grupo funcional polar incluido el 2-hidroxiethyl metacrilato (HEMA) y poliethylenglicol metacrilato (PEG-MA) [...]" (Columna 6, líneas 33 - 36)	"El artículo para el cuidado personal [...] caracterizado porque dicho monómero polar, oligómero o polímero es seleccionado del grupo que consiste de 2-hidroxiethyl metacrilato y de poliethylenglicol metacrilato y derivados de los mismos" (Reivindicación dependiente 10)
	"El artículo para el cuidado personal [...] caracterizado porque dicho monómero polar, oligómero o polímero es seleccionado del grupo que consiste de 2-hidroxiethyl metacrilato y de sus derivados" (Reivindicación dependiente 11)
"La invención además divulga un método para controlar la respuesta al agua de las fibras por variar la cantidad de alcohol polivinílico desde alrededor de 1 a alrededor de 99% por peso de una mezcla y variar la cantidad de poliálctido desde 1 a alrededor del 99% por peso de la mezcla" (Columna 5, líneas 50 - 56)	"El artículo para el cuidado personal [...] caracterizado porque dicha mezcla comprende alrededor de 1 a alrededor de 99% por peso de poli(alcohol vinílico) y alrededor de 99 a alrededor de 1% por peso de poliálctido" (Reivindicación dependiente 12)
"[...] Las fibras dispersables en agua comprenden alrededor de 1 a alrededor de 40% por peso de poliálctido y alrededor de 60 a alrededor de 99% por peso de alcohol polivinílico" (Columna 12, líneas 52 - 55)	"El artículo para el cuidado personal [...] caracterizado porque dicha mezcla comprende alrededor de 1 a alrededor de 40% por peso de poliálctido y es dispersable en agua" (Reivindicación dependiente 13)
"Las fibras son usadas como componentes de productos de cuidado personal desechables tales como pañales, fibras no tejidas para cubiertas exteriores, etc." (Columna 5, líneas 57 - 59)	"El artículo para el cuidado personal [...] caracterizado porque dicho artículo para el cuidado personal es seleccionado del grupo que consiste de pañales, productos para la incontinencia, calzoncillos de aprendizaje, almohadillas para la mujer y forros para bragas" (Reivindicación dependiente 14)
"El término "copolímero injertado" significa un copolímero producido por combinación de dos o más cadenas de diferentes características de constitución o de configuración, una de las cuales sirve como columna y por lo menos una de las cuales es unida a algunos puntos a lo largo de dicha columna y constituyen una cadena lateral" (Columna 7, líneas 61 - 67)	"Un artículo para el cuidado personal que comprende un poli(alcohol vinílico) y un poliálctido modificado que comprende una columna de poliálctido con una pluralidad de monómeros polares, oligómeros, polímeros o una mezcla de los mismos injertados en dicha columna de poliálctido" (Reivindicación Independiente 15)
"La invención además discute un método para controlar la respuesta al agua de las fibras por variación de la cantidad de alcohol polivinílico [...] y poliálctido [...]" (Columna 5, líneas 50 - 55) "Un método para elaborar fibras comprende los pasos de: a) mezclar un alcohol polivinílico con un poliálctido, [...]; b) formar una fibra desde la mezcla que comprende alcohol polivinílico y poliálctido" (Columna 12, líneas 32 - 40)	"Un método para variar la respuesta al agua de una composición que comprende los pasos de: a) Seleccionar una cantidad específica de un poli(alcohol polivinílico) y una cantidad específica de un poliálctido; b) Mezclar la cantidad específica del poli(alcohol vinílico) con la cantidad específica del poliálctido y c) Formar un artículo para el cuidado personal o un componente del artículo para el cuidado personal de la mezcla" (Reivindicación Independiente 16)

Continuación...

D1	Solicitud en estudio
"El método [...] donde dicho poliláctido es injertado previo al mezclado con el alcohol polivinílico" (Columna 12, líneas 41 – 42)	"El método [...] caracterizado porque dicho poliláctido es modificado antes del mezclado con el poli(alcohol vinílico)" (Reivindicación dependiente 17)
"El método [...] donde dicho poliláctido es injertado por los pasos de: a) combinar un poliláctido y una mezcla que comprende un monómero polar, oligómero, o polímero en un recipiente de reacción; y b) proporcionar suficiente energía para la combinación de dicho poliláctido y dicho monómero polar, oligómero, o polímero para modificar dicha composición de poliláctido" (Columna 12, líneas 48 – 51)	"El método [...] caracterizado porque dicho poliláctido es modificado por los pasos que comprenden: a) combinar un poliláctido y un monómero polar, oligómero o polímero en un recipiente de reacción; y b) proporcionar energía suficiente a la combinación de dicho poliláctido y de dicho monómero polar, oligómero, o polímero a fin de modificar dicha composición de poliláctido" (Reivindicación dependiente 18)
"El método [...] donde la fibra dispersable comprende alrededor de 1 a alrededor de 40% por peso de poliláctido y alrededor de 60 a alrededor de 99% por peso de alcohol polivinílico" (Columna 12, líneas 52 – 55)	"El método [...] caracterizado porque la película es dispersable en agua y comprende alrededor de 1 a alrededor de 40% por peso de poliláctido y alrededor de 60 a alrededor de 99% por peso de poli(alcohol vinílico)" (Reivindicación dependiente 19)
"El método [...] donde la fibra es debilitable y comprende alrededor de 40 a alrededor de 60% por peso de poliláctido y alrededor de 40 a alrededor de 60% por peso de alcohol polivinílico" (Columna 12, líneas 56 – 59)	"El método [...] caracterizado porque la película es debilitable en agua y comprende alrededor de 40 a alrededor de 60% por peso de poliláctido y alrededor de 40 a alrededor de 60% por peso de poli(alcohol vinílico)" (Reivindicación dependiente 20)
"El método [...] donde la fibra es estable en agua y comprende alrededor de 60 a alrededor de 99% por peso de poliláctido y alrededor de 1 a alrededor de 40% por peso de alcohol polivinílico" (Columna 12, líneas 60 – 63)	"El método [...] caracterizado porque la película es estable en agua y comprende alrededor de 60 a alrededor de 99% por peso de poliláctido y alrededor de 1 a alrededor de 40% por peso de poli(alcohol vinílico)" (Reivindicación dependiente 21)
"El método [...] donde el mezclado es desarrollado por extrusión de fundido" (Columna 12, líneas 64 – 65)	"El método [...] caracterizado porque el mezclado se lleva a cabo mediante extrusión de fundido" (Reivindicación dependiente 22)

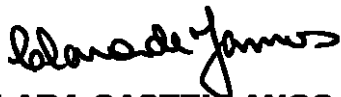
- De acuerdo con la comparación anterior se puede concluir que artículos para cuidado personal elaborados con fibras o películas tales como las definidas en las reivindicaciones de la solicitud, son conocidos. De la misma manera, el método para variar la respuesta del agua de una composición y el método para modificar el poliláctido son conocidos y se demuestra porque todos y cada uno de los elementos se encuentran incluidos en D1 que forma parte del estado de la técnica.
- En conclusión, las invenciones definidas en las reivindicaciones 1 a 22 se encontrarían afectadas en el requisito de novedad de acuerdo con el artículo 16 de la Decisión 486.
- Los requisitos de patentabilidad de la presente solicitud se encuentran afectados así:

No.	Documento	Reivindicaciones Afectadas	Requisito que afecta
1.	US5945480	1 – 22	Novedad

Se anexan los apartes principales de las anterioridades en el documento adjunto.

En cumplimiento del artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le indica que debe dar respuesta dentro del término de sesenta días contados a partir de la fecha de notificación de la presente comunicación. En caso de no dar respuesta al presente requerimiento, o si a pesar de la respuesta subsistieran los impedimentos para la concesión, se denegará la patente.

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.



CLARA CASTELLANOS DE JAIMES
Jefe de División de Nuevas Creaciones (E)

22 Dic. 2011

El anterior requerimiento fue notificado por fijación en lista, de fecha _____

CONCEPTO TECNICO No. 1979	EXAMINADOR TECNICO Código No. 202042
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44



US005945480A

United States Patent [19]
Wang et al.

[11] Patent Number: 5,945,480
[45] Date of Patent: Aug. 31, 1999

134

[54] WATER-RESPONSIVE, BIODEGRADABLE FIBERS COMPRISING POLYLACTIDE MODIFIED POLYLACTIDE AND POLYVINYL ALCOHOL, AND METHOD FOR MAKING THE FIBERS
[75] Inventors: James Hongxue Wang, Appleton, Wis.; David Michael Schertz, Atlanta, Ga.; Dave Allen Soerens, Neenah, Wis.; Hannong Rhim, Roswell, Ga.
[73] Assignee: Kimberly-Clark Worldwide, Inc., Neenah, Wis.

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5,300,576 4/1994 Nemphos et al. .
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5,417,983 5/1995 Nagase et al. .
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5,470,944 11/1995 Rosignore .
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[58] Field of Search 525/58

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[57] ABSTRACT

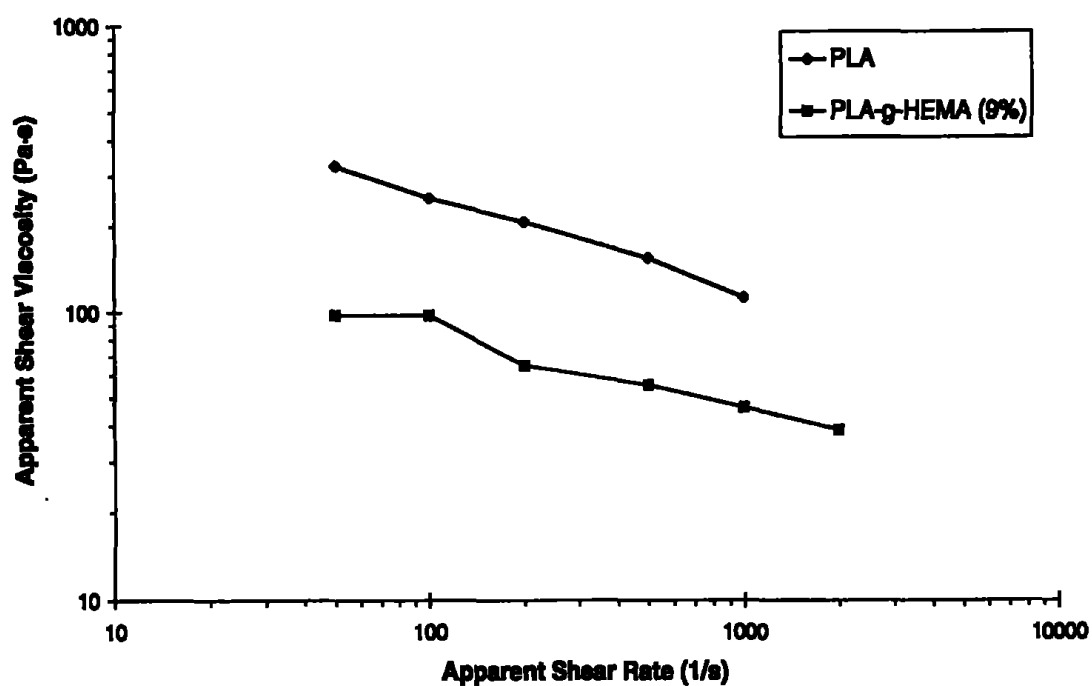
The present invention is a water-responsive fiber. More particularly, the present invention is a fiber comprising a blend of a polyvinyl alcohol and a polylactide and a method of making such fibers. In a preferred embodiment, the invention is a fiber comprising a blend of polyvinyl alcohol and modified polylactide and a method of making such fibers. The fibers are useful as a component in flushable and degradable articles.

20 Claims, 1 Drawing Sheet

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Figure 1. Melt Rheology at 180°C for PLA and HEMA Grafted PLA



WATER-RESPONSIVE, BIODEGRADABLE FIBERS COMPRISING POLYLACTIDE MODIFIED POLYLACTIDE AND POLYVINYL ALCOHOL, AND METHOD FOR MAKING THE FIBERS

FIELD OF THE INVENTION

The present invention relates to water-responsive, biodegradable blends and fibers and a method of making such fibers. More particularly, the present invention relates to fibers made from a blend comprising poly(vinyl alcohol) and a modified or unmodified polylactide and a method of making such fibers a method of making such fibers water-dispersible, water-weakened or water-stable.

BACKGROUND OF THE INVENTION

Even though the amount of plastics, hereinafter polymers, used in a variety of consumer goods, packaging and medical articles has not significantly increased over the past twenty years, the common perception is that more and more non-degradable plastics are filling up our limited landfill space. Despite this perceived disadvantage, polymers continue to be used in the manufacture of consumer goods, packaging and medical articles because plastics offer many advantages over the more traditional materials: wood, glass, paper, and metal. The advantages of using polymers include decreased manufacturing time and costs, improved mechanical and chemical properties, and decreased weight and transportation costs. It is the improved chemical resistance properties of the majority of plastics that result in their non-degradability.

Disposal of waste materials, including food waste, packaging materials and medical waste, into a typical landfill provides a relatively stable environment in which none of these materials is seen to decompose at an appreciable rate. Alternative waste disposal options have been increasingly discussed and utilized to divert some fractions of waste from the landfill. Examples of these alternatives include municipal solid waste composting, anaerobic digestion, enzymatic digestion, and waste water sewage treatment.

Much controversy is associated with the disposal of medical waste. Both government agencies and members of the private sector have been increasingly directing in-depth scrutiny and funds toward this subject. Admittedly, concerns over the fate of materials contaminated with infectious substances are valid and proper measures to insure the safety of health care workers and the general public should be taken.

Currently, medical waste can be categorized as either reusable and disposable. Categorization as to whether certain waste is reusable or disposable is customarily determined according to the material from which the article was constructed and the purpose for which the article was used.

After use, reusable medical articles are cleaned and sterilized under stringent conditions to ensure disinfection. In comparison, disposable medical articles are usually only used once. Even then, disposing procedures are not straightforward, rather they often involve several steps to safeguard against potential hazards. Typically, after use, disposable medical articles must be disinfected or sterilized, adding a significant cost prior to disposal into a specially designated landfill or waste incinerator. As a result, the disposal cost for the contaminated single use articles is quite high.

Despite the high cost of disposal, single use medical articles are desirable because of the assurance of clean, and

uncontaminated equipment. Many times in the medical context, sterilization procedures conducted improperly can result in detrimental effects such as the transmission of infectious agents from one patient to another. Improper sterilization can also be disastrous in a laboratory setting, where, for example, contaminated equipment can ruin experiments resulting in tremendous costs of time and money.

Currently, disposable medical fabrics are generally composed of thermoplastic fibers such as polyethylene, polypropylene, polyesters, polyamides and acrylics. These fabrics can also include mixtures of thermoset fibers such as polyamides, polyarimides and cellulose. They are typically 10-100 grams per square yard in weight and can be woven, knitted or otherwise formed by methods well known to those in the textile arts while the non-wovens can be thermobonded, hydroentangled, wet laid or needle punched and films can be formed by blow or cast extrusion or by solution casting. Once used, these fabrics are difficult and costly to dispose of and are non-degradable.

The use of polymers for various disposable articles is widespread and well known in the art. In fact, the heaviest use of polymers in the form of film and fibers occurs in the packaging and the disposable article industries. Films employed in the packaging industry include those used in food and non-food packaging, merchandise bags and trash bags. In the disposable article industry, the general uses of polymers occurs in the construction of diapers, personal hygiene articles, surgical drapes and hospital gowns, instrument pads, bandages, and protective covers for various articles.

In light of depleting landfill space and inadequate disposal sites, there is a need for polymers which are water-responsive. Currently, although polymers such as polyethylene, polypropylene, polyethylene terephthalate, nylon, polystyrene, polyvinyl chloride and polyvinylidene chloride are popular for their superior extrusion and film and fiber making properties, these polymers are not water-responsive. Furthermore, these polymers are generally non-compostable, which is undesirable from an environmental perspective.

Polymers and polymer blends have been developed which are generally considered to be water-responsive. These are polymers which purportedly have adequate properties to permit them to breakdown when exposed to conditions which lead to composting. Examples of such arguably water-responsive polymers include those made from starch biopolymers and polyvinyl alcohol.

Although materials made from these polymers have been employed in film and fiber containing articles, many problems have been encountered with their use. Often the polymers and articles made from these polymers are not completely water-responsive or compostable. Furthermore, some water-responsive polymers may also be unduly sensitive to water, either limiting the use of the polymer or requiring some type of surface treatment to the polymer, often rendering the polymer non water-responsive. Other polymers are undesirable because they have inadequate heat resistance for wide spread use.

Personal care products, such as diapers, sanitary napkins, adult incontinence garments, and the like are generally constructed from a number of different components and materials. Such articles usually have some component, usually the backing layer, constructed of a liquid repellent or water-barrier polymer material. The water-barrier material commonly used includes polymer materials such as poly-

ethylene film or copolymers of ethylene and other polar and nonpolar monomers. The purpose of the water-barrier layer is to minimize or prevent absorbed liquid that may, during use, exude from the absorbent component and soil the user or adjacent clothing. The water-barrier layer also has the advantage of allowing greater utilization of the absorbent capacity of the product.

Although such products are relatively inexpensive, sanitary and easy to use, disposal of a soiled product is not without its problems. Typically, the soiled products are disposed in a solid waste receptacle. This adds to solid waste disposal accumulation and costs and presents health risks to persons who may come in contact with the soiled product. An ideal disposal alternative would be to use municipal sewage treatment and private residential septic systems by flushing the soiled product in a toilet. Products suited for disposal in sewage systems are termed "flushable". While flushing such articles would be convenient, prior art materials do not disintegrate in water. This tends to plug toilets and sewer pipes, frequently necessitating a visit from a plumber. At the municipal sewage treatment plant, the liquid repellent material may disrupt operations by plugging screens and causing sewage disposal problems. It therefore is necessary, although undesirable, to separate the barrier film material from the absorbent article prior to flushing.

In addition to the article itself, typically the packaging in which the disposable article is distributed is also made from a water-barrier, specifically water-resistant, material. Water-resistivity is necessary to prevent the degradation of the packaging from environmental conditions and to protect the disposable articles therein. Although this packaging may be safely stored with other refuse for commercial disposal, and especially in the case of individual packaging of the products, it would be more convenient to dispose of the packaging in the toilet with the discarded, disposable article. However, where such packaging is composed of a water-resistant material, the aforementioned problems persist.

The use of lactic acid and lactide to manufacture a water-stable polymer is well known in the medical industry. Such polymers have been used in the past for making water-stable sutures, clamps, bone plates and biologically active controlled release devices. Processes developed for the manufacture of such polymers to be utilized in the medical industry have incorporated techniques which respond to the need for high purity and biocompatibility in the final product. These processes, however, are typically designed to produce small volumes of high dollar-value products, with less emphasis on manufacturing cost and yield.

It is generally known that lactide polymers or poly (lactides) are unstable. However, the consequence of this instability has several aspects. One aspect is the biodegradation or other forms of degradation which occur when lactide polymers, or articles manufactured from lactide polymers, are discarded or composted after completing their useful life. Another aspect of such instability is the degradation of lactide polymers during processing at elevated temperatures as, for example, during melt-processing by end-user purchasers of polymer resins.

In the medical area there is a predominant need for polymers which are highly stable and therefore desirable for use in medical devices. Such a demand has historically been prevalent in the high value, low volume medical specialty market, but is now also equally prevalent in the low value, high volume medical market.

As described in U.S. Pat. No. 5,472,518, compositions comprised of multilayer polymer films are known in the art.

The utility of such structures lies in the manipulation of physical properties in order to increase the stability or lifetime during use of such structure. For example U.S. Pat. No. 4,826,493 describes the use of a thin layer of hydroxybutyrate polymer as a component of a multilayer structure as a barrier film for diaper components and ostomy bags.

Another example of use of multilayer films is found in U.S. Pat. No. 4,620,999 which describes the use of a water soluble film coated with, or laminated to, a water insoluble film as a disposable bag. The patent describes a package for body waste which is stable to human waste during use, but which can be made to degrade in the toilet, at a rate suitable for entry into a sewage system without blockage, by adding a caustic substance to achieve a pH level of at least 12. Such structures are usually consist of a polyvinyl alcohol film layer coated with polyhydroxybutyrate.

A similar excretion-treating bag allowing discarding in flush toilet or sludge vessel is disclosed in JP 61-42127. It is composed of an inner layer of water-resistant water-dispersible resin such as polylactide and an outer layer of polyvinyl alcohol. As disclosed in this patent, there are many examples of multilayer films that are utilized in disposable objects. Most of these examples consist of films or fibers which are comprised of external layers of an environmentally degradable polymer and an internal layer of water-responsive polymer. Typically, the external layers are comprised of polycaprolactone or ethylene vinyl acetate and the internal layer is comprised of polyvinyl alcohol. These examples, however, are all limited to compositions consisting of multilayers of different polymers, and do not encompass actual blends of different polymers.

A family of patents, EP 241178, JP 62-223112 and U.S. Pat. No. 4,933,182, describes a controlled release composition for treating periodontal disease. The controlled release compositions are comprised of a therapeutically effective agent in a carrier consisting of particles of a polymer of limited water solubility dispersed in a water soluble polymer. Although, the carrier of these inventions includes the use of more than one polymer, the disclosed carrier is not a blend because the water soluble polymer of limited solubility is incorporated in the water soluble polymer as particles ranging in average particle size from 1 to 500 microns.

The use of polymers for use in water-responsive articles is disclosed in U.S. Pat. No. 5,506,101, U.S. Pat. No. 5,567,510, and U.S. Pat. No. 5,472,518. This group of patents discloses a series of water-responsive compositions comprising a hydrolytically degradable polymer and a water soluble polymer. The compositions of this group, however, consist of articles constructed from polymers which are first formed into fibers or films and then combined. As such, the compositions are actually mini-layers of the individual polymer films or fibers. Therefore, although the fibers and films of the polymers of such compositions are considered to be in very close proximity with one another, they are not actual blends. The dispersion of one polymer within another in these compositions, is not viewed as approximately uniform since the individual polymers are essentially distinct and separate fibers or films.

U.S. Pat. No. 5,525,671 to Ebato et al. discloses a method of making a linear lactide copolymer from a lactide monomer and a hydroxyl group containing monomer. The polymer disclosed by Ebato is a linear lactide copolymer produced by reacting two monomers to form a linear polymer with a block or random structure. Ebato does not disclose graft copolymers.

Polymer blend compositions for making fibers and films that are optimally combined are desirable because they are

highly stable. Optimal combination of polymers means that the polymers are connected as closely as possible without the requirement of co-polymerization. Although blended polymer compositions are known, improved polymer blends wherein the fibers and films are more intimately connected are desirable since the resulting composition is then more stable, pliable and versatile.

In addition to the need for polymer compositions that are highly stable, and therefore, suitable for regular use in most disposable articles, there is a simultaneous need for such polymer compositions to be water-responsive. What is needed therefore, is a material that may be utilized for the manufacture of disposable articles and which is water-responsive. Such material should be versatile and inexpensive to produce. The material should be stable enough for intended use but subject to degradation under predetermined conditions.

Moreover, there is an increased emphasis on environmentally safe materials and coatings. These coatings reduce the use of solvent-based coatings and rely, to an ever increasing degree, on polar coatings, such as water-based material. The utility of the graft copolymers of this invention includes, but would not be limited to, materials have a greater affinity for a polar coating.

Therefore, it is an object of this invention to make biodegradable polymer blends and fibers.

Another object of this invention is to make thermally processable polymer blends and fibers.

Another object of this invention is to make commercially viable polymer blends and fibers.

Another object of this invention is to make thermally processable, biodegradable polymer blends and fibers which is more compatible with polar polymers and other polar substrates.

Another object of this invention is to make a water-responsive, biodegradable polymer.

Another object of this invention is to make a water-responsive, biodegradable polymer with improved mechanical and physical properties.

Another object is to develop a method of making water-responsive blends and films which may be tailored to be water-dispersible, water-weakenable or water-stable.

SUMMARY OF THE INVENTION

This invention discloses water-responsive and biodegradable fibers containing polyvinyl alcohol and polylactide. The water-responsive fibers disclosed have a wide range of water-responsiveness ranging from water-dispersible, to water-degradable and to water-stable. The invention also discloses a method of controlling the water-responsiveness of the fibers by varying the amount of polyvinyl alcohol from about 1 to about 99 weight percent of the blend and varying the amount of polylactide from about 1 to about 99 weight percent of the blend. The composition ranges responsible for each type of water-responsiveness are disclosed.

The fibers are useful as components of flushable personal care products such as liners for diapers, spunbonded non-wovens for clothlike outer covers, etc. The water-responsive fibers disclosed in this invention have the unique advantage of being biodegradable so that the fibers and articles made from the fibers can be degraded in aeration tanks, by aerobic degradation, and anaerobic digesters, by anaerobic degradation, in waste water treatment plants. Therefore, articles made from the fibers of this invention will not significantly increase the volume of sludge accumulated at waste water treatment plants.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a plot of the viscosity versus the shear rate of a grafted polylactide in accordance with the present invention and an ungrafted polylactide, demonstrating the decrease in viscosity of grafted polylactide versus ungrafted polylactide.

DETAILED DESCRIPTION OF THE INVENTION

Polylactide (PLA) resins are produced by different, synthetic methods, such as ring-opening polymerization of lactide or direct condensation polymerization from lactic acid. Both methods of polymerization are useful for this invention. PLA is a biodegradable polymer and has the chemical structure:



The PLA compositions described in the following Examples were made by using a reagent grade PLA purchased from Aldrich Chemical Company of Milwaukee, Wis. (Aldrich Catalog number 42,232-6). The PLA purchased from Aldrich Chemical Company is biodegradable and has number-average molecular weight of approximately 60,000 and a weight-average molecular weight of approximately 144,000. This PLA is made up primarily of the L-isomer and has a glass transition temperature (T_g) of 60°C. Any PLA can be selected for use in this invention, and the molecular weights of the PLA may vary depending on the desired properties and use.

Ethylenically unsaturated monomers containing a polar functional group, such as hydroxyl, carboxyl, amino, carbonyl, halo, thiol, sulfonic, sulfonate, etc. are appropriate for this invention. Preferred ethylenically unsaturated monomers containing a polar functional group include 2-hydroxyethyl methacrylate (HEMA) and poly(ethylene glycol) methacrylate (PEG-MA). It is expected that a wide range of polar vinyl monomers would be capable of imparting the same effects as HEMA and PEG-MA to polylactide resins and would be effective monomers for grafting. The grafted PLA may contain from 1 to 20% of grafted polar monomer, oligomer, or polymer. Preferably, the grafted PLA contains 2.5 to 20% of grafted polar monomer, oligomer, or polymer, and most preferably 2.5 to 10% of grafted polar monomer, oligomer, or polymer.

Both the HEMA (Aldrich Catalog number 12,863-8) and the PEG-MA (Aldrich Catalog number 40,954-5) used in the Examples were supplied by Aldrich Chemical Company. The PEG-MA purchased from Aldrich Chemical Company was poly(ethylene glycol) ethyl ether methacrylate having a number average molecular weight of approximately 246 grams per mol.

The method for making the grafted polylactide compositions has been demonstrated by a reactive-extrusion process. The grafting reaction can also be performed in other reaction devices as long as the necessary mixing of PLA and HEMA and/or PEG-MA and any other reactive ingredients is achieved and enough energy is provided to effect the grafting reactions.

Other reactive ingredients which may be added to the compositions of this invention include initiators such as Lupersol 101, a liquid, organic peroxide available from RIF Atochem North America, Inc. of Philadelphia, Pa. Free radical initiators useful in the practice of this invention include acyl peroxides such as benzoyl peroxide; dialkyl; diaryl; or alkyl peroxides such as di-t-butyl peroxide; dicumyl peroxide; cumyl butyl peroxide; 1,1 di-t-butyl peroxy-3,5,5-trimethylcyclohexane; 2,5-dimethyl-2,5-di(t-

butylperoxy) hexane; 2,5-dimethyl-2,5-bis (t-butylperoxy) hexyne-3 and bis(a-t-butyl peroxyisopropylbenzene); perox-
yesters such as t-butyl peroxyvalerate; t-butyl peroctoate;
t-butyl perbenzoate; 2,5-dimethylhexyl-2,5-di(perbenzoate)
t-butyl di(perphthalate); dialkyl peroxydicarbonates and
peroxydicarbonates; hydroperoxides such as t-butyl
hydroperoxide, p-methane hydroperoxide, pinane hydroper-
oxide and cumene hydroperoxide and ketone peroxides such
cyclohexanone peroxide and methyl ethyl ketone peroxide.
Azo compounds such as azobisisobutyronitrile may also be
used.

Furthermore, other components known in the art may be
added to the graft polymers of this invention to further
enhance the properties of the final material. For example,
polyethylene glycol may be further added to improve melt
viscosity. Additives of other types may also be incorporated
to provide specific properties as desired. For example,
anti-static agents, pigments, colorants and the like may be
incorporated in to the polymer composition. Additionally,
processing characteristics may be improved by incorporat-
ing lubricants or slip agents into blends made from polymers
of the invention. All of these additives are generally used in
relatively small amounts, usually less than 3 weight percent
of the final composition.

The mixture of the polylactide and the polar monomer,
oligomer, or polymer is subjected to mechanical deforma-
tion in a suitable mixing device, such as a Brabender
Plasticorder, a roll mill, a single or multiple screw extruder,
or any other mechanical mixing device which can be used to
mix, compound, process or fabricate polymers. A particu-
larly desirable reaction device is an extruder having one or
more ports. In a preferred embodiment, the reaction device
is a co-rotating, twin-screw extruder, such as a ZSK-30
twin-screw compounding extruder manufactured by Werner
& Pfleiderer Corporation of Ramsey, N.J. This extruder
allows multiple feeding and venting ports.

The presence of PLA or modified PLA in blends used to
make fibers and films reduces the water sensitivity of pure
PVOH in use. PLA grafted with a polar monomer or a
mixture of monomers is preferred for enhanced compatibil-
ity with PVOH in order to obtain superior processing and
mechanical and physical properties. It is possible to use the
blends to make other shapes than fibers or films and to
thermally form the blends into complex shapes.

As used herein, the term "water-dispersible" means that
the composition dissolves or breaks into pieces smaller than
a 20 mesh after being immersed in water for approximately
five minutes. The term "water-disintegratable" means that
the composition breaks into multiple pieces within five
minutes of immersion in water and that some of the pieces
will be caught by a 20 mesh screen without slipping through
in the same manner as a thread through the eye of a needle.
The term "water-weakenable" means that the composition
remains in one piece but weakens and loses rigidity after five
minutes of immersion in water and becomes drapable, i.e.
it bends without an external force applied thereto when it is
held by one side at a horizontal position. The term "water-
stable" means that the composition does not become drap-
able after five minutes of immersion in water and remains in
one piece after the water response test.

As used herein, the term "graft copolymer" means a
copolymer produced by the combination of two or more
chains of constitutionally or configurationally different
features, one of which serves as a backbone main chain, and
at least one of which is bonded at some point(s) along the
backbone and constitutes a side chain. The molar amount of
grafted monomer, oligomer or polymer, i.e. side-chain

species, may vary but should be greater than molar amount
of the parent species. The term "grafted" means a copolymer
has been created which comprises side chains or species
bonded at some point(s) along the backbone of a parent
polymer. The term "blend" as applied to polymers means an
intimate combination of two or more polymer chains of
constitutionally or configurationally different features which
are not bonded to each other. Such blends may be homog-
enous or heterogeneous. (See Sperling, I. H., *Introduction
to Physical Polymer Science* 1986 pp. 44-47 which is herein
incorporated by reference in its entirety.) Preferably, the
blend is created by combining two or more polymers at a
temperature above the melting point of each polymer.

The present invention is illustrated in greater detail by the
following specific Examples. It is to be understood that these
Examples are illustrative embodiments and that this inven-
tion is not to be limited by any of the Examples or details in
the description. Rather, the claims appended hereto are to be
construed broadly within the scope and spirit of the inven-
tion.

EXAMPLES

Example 1

A co-rotating, twin-screw extruder, ZSK-30 manufac-
tured by Werner & Pfleiderer Corporation of Ramsey, N.J.
was used to manufacture the modified PLA of the Examples.
The diameter of the extruder was 30 mm. The length of the
screws was 1388 mm. This extruder had 14 barrels, num-
bered consecutively 1 to 14 from the feed hopper to the die.
The first barrel, barrel #1, received the PLA and was not
heated but cooled by water. The vinyl monomer, HEMA,
was injected into barrel #5 and the Lupersol 101 peroxide by
Atochem was injected into barrel #6. Both the monomer and
the peroxide were injected via a pressurized nozzle injector.
A vacuum port for devolatilization was included at barrel
#11. The die used to extrude the modified PLA strands had
four openings of 3 mm in diameter which were separated by
7 mm. The modified PLA strands were then cooled in a cold
water bath and then palletized.

The PLA was fed into the extruder with a volumetric
feeder at a throughput of 20 lb/hr. The HEMA and the
peroxide were injected into the extruder at throughputs of
1.8 lb/hr and 0.09 lb/hr, respectively. The screw speed was
300 rpm.

The following extruder barrel set temperatures were used
during the extrusion run:

Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
180° C.	180° C.	180° C.	180° C.	180° C.	170° C.	160° C.

The vacuum was turned on for devolatilization at barrel #11
and the process was allowed to stabilize. The extruded
HEMA grafted PLA (PLA-g-HEMA) strands were cooled in
a cold water bath and then palletized.

Melt rheology tests were performed on the modified and
unmodified PLA on a Goettfert Rheograph 2000 available
from Goettfert in Rock Hill, S.C. The modified PLA of this
Example was prepared with 9 weight percent HEMA and
0.45 weight percent Lupersol. The weight percentages of the
HEMA and Lupersol were based on the weight of the PLA.

The melt rheology tests were performed at 180° C. with
a 30/1 (length/diameter) mm die. The apparent melt visco-
sity was determined at apparent shear rates of 50, 100, 200,

500, 1000, and 2000 l/s. A rheology curve was plotted for each material of the apparent viscosity versus the apparent shear rates below.

Sample Concentr. App. Shear Rate (l/s)	PLA, Aldrich Extruded Control App. Shear Visc. (Pa s)	PLA-g-HEMA (9%, 0.45%) Grafted PLA App. Shear Visc. (Pa s)
49.997	325.7	97.71
99.994	252.42	97.71
199.99	207.63	65.14
499.97	154.71	35.369
1000	112.35	46.407
2000	82.235	38.675

The apparent melt viscosities at the various apparent shear rates were plotted and rheology curves for the unmodified PLA and the modified PLA of the above Example were generated as shown in FIG. 2. The rheology curve of the modified PLA demonstrates the unexpected, reduced viscosities of the modified PLA when compared to the unmodified PLA. These reduced viscosities of the modified PLA result in improved processability of the PLA. The grafting of polar monomers, oligomers or polymers onto PLA results in improved compatibility with both polar materials and polar substrates.

Example 2

Fibers Made From Blends Comprising PVOH and Modified PLA or Unmodified PLA

The water-responsive fibers of the following Example are comprised of a melt blend of polyvinyl alcohol (PVOH) and either unmodified PLA or PLA as modified in Example 1. The range of the compositions for water-responsive fibers varies from about 1 to about 99 weight percent of unmodified or modified PLA in the blend. The modified PLA used in the blends is as described above in Example 1 and the unmodified PLA used in the blends was that as supplied by Aldrich Chemical Company. The PVOH used in the blends was Ecomatry AX10000 supplied by Nippon Gohsei, Japan and is a cold-water soluble polymer synthesized from partially hydrolyzed polyvinyl acetate and containing side chain branches. The melt flow rate of the PVOH used was 100 g/10 min. at 230° C. and 2.16 kg.

Extrusion Process for Polymer Blending

Water-responsive blend compositions were prepared by a melt extrusion process. It is preferred to blend or mix the two components in an extruder such as a twin-screw or even a single screw extruder under appropriate temperature and shear/pressure conditions. The blending process can also be performed in a batchwise mixing device, such as a melt mixer or a kneader, which is discussed in the next section. Both PVOH and unmodified or modified PLA can be fed to an extruder either simultaneously or in sequence to minimize any adverse effects on the polymers such as degradation or discoloration.

In this Example, the extrusion process of the blends was performed using a Haake TW-100, a counter-rotating, twin screw extruder. The extrusion set temperatures for the four heating zones were 170, 180, 180 and 168° C. The screw speed was 150 rpm. A resin mixture of PLA or modified PLA and PVOH was fed into the extruder at a rate of 10 lb/hr. The melt was extruded, air-cooled and then palletized.

Extruded blend compositions which contained 20, 30, and 40 weight percent of either PLA or modified PLA of

Example 1 and 80, 70, and 60 weight percent PVOH, respectively, were produced and used for fiber-spinning.

Melt Mixing Process for Polymer Blending

Water-responsive blend compositions were also prepared by a melt mixing process. In this Example, the melt mixing process was performed using a Haake Rheomix® 600, a counter-rotating, twin roller mixer. The mixer set temperature was 180° C. The screw speed was 150 rpm. 70 grams of total resin mixture was fed into the mixer and blended for five minutes. The melt was removed from the mixer and then cooled in air.

Melt mixer compositions which contained 50 and 60 weight percent of either PLA or modified PLA of Example 1 and 50 and 40 weight percent of PVOH were produced and used for fiber-spinning.

Fiber Processing of the Blends

The fibers were made on a small-scale fiber spinning processing equipment. The device consists of a vertically mounted cylinder heated by cartridge heaters. A vertically mounted Worm Gear Jactuator (Model: PKN-1801-3-1, manufactured by Duff-Northon Company, Charlotte, N.C.) was used to extrude the materials into fibers.

The fibers were spun from a spin plate with 3 openings of 0.356 mm. The fibers exiting the die were wound on a drum having both reciprocating and rotary movements to collect fiber samples.

Fibers were prepared with varying amounts of PVOH and the unmodified PLA or modified PLA of Example 1.

Example A) PLA/PVOH 20/80 weight ratio fibers.

The temperature of the cylinder was set at 360° C. At this temperature, soft fibers were made from this polymer blend which was comprised of unmodified polylactide and polymer vinyl alcohol. The fibers were slightly yellowish.

Example B) PLA-g-HEMA/PVOH 20/80 weight ratio fibers.

This sample was made from the HEMA grafted PLA and polyvinyl alcohol. The temperature of the barrel was also set at 360° C. This polymer blend was made into fibers of less color than the fibers made from the unmodified blend above. These fibers were nearly colorless. This polymer blend exhibited substantially higher melt strength than the blend containing unmodified PLA, presumably due to the improved compatibility of the HEMA grafted PLA with PVOH. As a result, the fibers could be extruded at a higher extrusion rate than from the blends containing unmodified PLA. Fibers could be produced in a temperature range from 353 to 371° C.

Example C) PLA/PVOH 30/70 weight ratio fibers.

This blend composition was also spun into fibers. Some melt fracture occurred.

Example D) PLA-g-HEMA/PVOH 30/70 weight ratio fibers.

Soft and nearly colorless fibers were made from this blend composition. This blend showed improved processability over the unmodified PLA/PVOH 30/70 blend.

Example E) PLA/PVOH 40/60 weight ratio fibers.

Example F) PLA-g-HEMA/PVOH 40/60 weight ratio fibers.

Example G) PLA/PVOH 50/50 weight ratio, mixer blended fibers.

Example H) PLA-g-HEMA/PVOH 50/50 weight ratio, mixer blended fibers.

Example I) PLA/PVOH 60/40 weight ratio, mixer blended fibers.

Example J) PLA-g-HEMA/PVOH 60/40 weight ratio, mixer blended fibers.

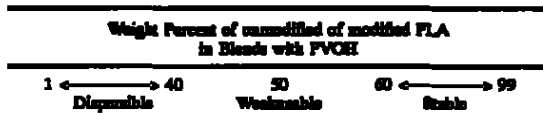
The blends containing HEMA grafted PLA had lower viscosities than the blends containing unmodified PLA and

thus could be extruded at higher rates and exhibited improved processability. Additionally, the fibers from the blends containing modified PLA exhibited less discoloration than fibers from the blends containing unmodified PLA, suggesting improved compatibility of the modified PLA. All of the blends containing HEMA grafted PLA exhibited higher melt strength and better fiber processability than those containing unmodified PLA blends at the same weight ratios.

Water Response Test of the HEMA grafted PLA/PVOH Fibers

For each of the above compositions, a section of the prepared fiber was cut measuring about one inch long. The diameter of the fiber was measured and recorded. The water-response test involved using a pair of tweezers to hold the section of the fiber, immersing it into a scintillation vial filled with 20 milliliters of water and holding it there for five minutes. After five minutes, the cap was placed on the scintillation vial and the vial was placed in a Model 75 Shaker (available from Burrell Corp., Pittsburgh, Pa.). The vial was shaken for 30 seconds with the shaker set at maximum speed. If the fiber began to disperse or disintegrate, the contents of the scintillation vial were emptied through a 20 mesh screen (20 mesh U.S.A. Standard Testing Sieve, ASTM B-11 Specification, No. 20). The vial was then rinsed with 20 milliliters of water from a squeeze bottle to remove any remaining fiber pieces and emptied through the sieve. If the fiber did not disperse or disintegrate, the fiber was observed for any loss in rigidity.

Water Response Map for Extruder and Mixer Blended Fiber Compositions



Fibers made from blend compositions were water-dispersible up to about 40 weight percent of modified or unmodified PLA in the blend. The fibers made from blends with about 60 or greater weight percent of unmodified or modified PLA were water-stable. The fibers made from blends between these two ranges should be considered water-weakenable. The fibers made from blends with about 50 weight percent of unmodified or unmodified PLA were water-weakenable.

It is to be understood that these Examples are illustrative embodiments and that this invention is not to be limited by any of the Examples or details in the description. Rather, the claims appended hereto are to be construed broadly within the scope and spirit of the invention. Particularly, it is to be understood that the invention includes multilayer fibers or articles in which the claimed fiber is a layer or a component in the final structure.

We claim:

1. A fiber comprising a melt blend comprising a poly(vinyl alcohol) and a polylactide, wherein said polylactide is grafted with a polar monomer, oligomer, polymer or a combination thereof.
2. The fiber of claim 1, wherein said polylactide is a 2-hydroxyethyl methacrylate grafted polylactide grafted with from 1 to 20 weight percent 2-hydroxyethyl methacrylate.
3. The fiber of claim 1, wherein said polylactide is a grafted with a polar monomer.
4. The fiber of claim 1, wherein said polar monomer is an ethylenically unsaturated monomer containing at least one

polar functional group or said oligomer or said polymer is an oligomer or a polymer polymerized from an ethylenically unsaturated monomer containing at least one polar functional group.

5. The fiber of claim 4, wherein said at least one polar functional group is a hydroxyl, carboxyl or sulfonate group or a combination thereof.

6. The fiber of claim 5, wherein said at least one polar functional group is a hydroxyl group.

7. The fiber of claim 4, wherein said polar monomer is a polar vinyl monomer.

8. The fiber of claim 7, wherein said polar monomer is selected from the group consisting of 2-hydroxyethyl methacrylate and its derivatives.

9. The fiber of claim 1, wherein said polar monomer, oligomer, or polymer is selected from the group consisting of 2-hydroxyethyl methacrylate and polyethylene glycol methacrylate and derivatives thereof.

10. The fiber of claim 1, wherein said blend comprises about 1 to about 99 weight percent poly(vinyl alcohol) and about 1 to about 99 weight percent polylactide.

11. The fiber of claim 10, wherein said blend comprises about 40 to about 80 weight percent poly(vinyl alcohol) and about 20 to about 60 weight percent polylactide.

12. The fiber of claim 10, wherein said blend comprises about 1 to about 40 weight percent polylactide and is water-dispersible.

13. The fiber of claim 10, wherein said blend comprises about 40 to about 60 weight percent polylactide and is water-weakenable.

14. A method of making fibers comprising the steps of:

- a) blending a poly(vinyl alcohol) with a polylactide, wherein said polylactide is grafted with a polar monomer, oligomer, polymer or a combination thereof; and

- b) forming a fiber from the blend comprising poly(vinyl alcohol) and polylactide.

15. The method of claim 14, wherein said polylactide is grafted prior to blending with the poly(vinyl alcohol).

16. The method of claim 15, wherein said polylactide is grafted by the steps comprising:

- a) combining a polylactide and a mixture comprising a polar monomer, oligomer, or polymer in a reaction vessel; and

- b) providing sufficient energy to the combination of said polylactide and said polar monomer, oligomer, or polymer in order to modify said polylactide composition.

17. The method of claim 14, wherein the fiber is water-dispersible and comprises about 1 to about 40 weight percent polylactide and about 60 to about 99 weight percent poly(vinyl alcohol).

18. The method of claim 14, wherein the fiber is water-weakenable and comprises about 40 to about 60 weight percent polylactide and about 40 to about 60 weight percent poly(vinyl alcohol).

19. The method of claim 14, wherein the fiber is water-stable and comprises about 60 to about 99 weight percent polylactide and about 1 to about 40 weight percent poly(vinyl alcohol).

20. The method of claim 14, wherein the blending is performed by melt extrusion.

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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

RADICACIÓN: 1-18858

EDICTO No. 6991

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LA SECRETARÍA GENERAL AD-HOC
HACE SABER:

Que esta Superintendencia profirió Resolución No. 8031 de 30-MAR-2006. Que el contenido de la parte resolutiva es como sigue: El Superintendente de Industria y Comercio.

RESUELVE

ARTICULO PRIMERO: Negar el privilegio de patente de invención para la solicitud correspondiente a "COMPOSICIONES BIODEGRADABLES QUE RESPONDEN AL AGUA Y PELICULAS Y ARTICULOS QUE COMPRENDEN UNA MEZCLA DE POLILACTIDO Y ALCOHOL POLVINILICO Y METODOS PARA LA FABRICACION DE LOS MISMOS".

ARTICULO SEGUNDO: Notificar personalmente el contenido de la presente resolución al doctor Ramiro Castro Duque, o a quien haga sus veces, en su calidad de apoderado de Kimberly - Clark Worldwide, Inc., entregándole copia de la misma, advirtiéndole que contra ella procede el recurso de reposición interpuesto ante el Superintendente de Industria y Comercio, al momento de la notificación o dentro de los 5 días hábiles siguientes a ésta.

NOTIFÍQUESE Y CUMPLASE

Dada en Bogotá, D.C., a los 30 MAR. 2006

EL SUPERINTENDENTE DE INDUSTRIA Y COMERCIO.


JAIME RUBIO ESCOBAR

Para notificar a los interesados, se fija el presente EDICTO en lugar visible al público en la SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO, por el término de (10) diez días hábiles contados a partir de las 8:30 a.m. de hoy.

Secretaría General Ad-Hoc 08-MAY-2006
Secretaría General Ad-Hoc
EDICTO No. 6991

Este edicto se desliza hoy 19-MAY-2006 a las cinco (5:00 p.m.)