

Description

This invention relates to fabrics, particularly fabric used to make surgical gowns, surgical scrub suits, sterilization wrappers (CSR wrap), cover gowns, isolation gowns, hamper bags, jump suit, work aprons, laboratory coats and the like. The fabric is especially suited as a barrier to prevent or control the spread of infectious microorganisms. The invention also includes processes for making such fabrics.

There are currently two types of medical fabrics -- disposable and reusable. Disposable fabrics are typically constructed from nonwovens made from light weight synthetic fibers or synthetic fibers blended with natural fibers. Performance of disposable nonwoven fabrics in terms of liquid repellency and flame retardancy are quite acceptable. Reusable fabrics are woven and may be constructed from cotton or cotton/polyester blends of a high thread count to provide a physical barrier to prevent or reduce the spread of infectious materials and vectors. While reusable woven fabrics offer more comfort in terms of drapeability, breathability, transmission of heat and water vapor, stiffness, etc., and improved (reduced) cost per use, they lack the liquid repellency and flame retardancy the market has come to expect on the basis of experience with the disposables, especially after repeated launderings and/or steam (autoclave) sterilizations.

This invention provides a woven, reusable, direct finished single layer medical fabric made of 100% polyester fiber. The fabric exhibits the desirable properties of both the nonwoven disposables and woven reusable fabrics. The fabric has very low lint or particle generation, is a barrier with improved alcohol repellency, improved soil and oil repellency, is a generally more robust, abrasion-resistant fabric, yet has a soft hand, antimicrobial and antistatic properties, flame resistant, increased repellency to water, yet durably finished to be fully launderable and, if necessary, also autoclave sterilizable for numerous cycles. Procedures for finishing such fabric and finishing solutions for use in such procedures are also described.

DESCRIPTION OF THE INVENTION

According to a first embodiment of the invention there is provided a woven, reusable, launderable and sterilizable polyester fabric constructed from polyester yarn of from about 50 to 150 denier and a sum of the ends and picks of at least 39 per cm (at least 100 per linear inch) having the following properties initially and following 100 laundering cycles:

	Initial	After 100 Cycles
linting (INDA 160-0-83) particles	at most 5,000	at most 2,000
flammability (NFPA 702)	Class II	Class II
antimicrobial activity (CTM-0923)	no growth	no growth
for <i>Klebsiella pneumoniae</i>		
Suter hydrostatic resistance.	at least 20.0	at least 10.0
(AATCC-127) centimeters		
spray rating (AATCC-22-1980)	at least 70.0	at least 50.0
air permeability (FTM 5450,	at most 2.54 cm ³ /s/cm ² (at most 5 cfm)	at most 5.08 cm ³ /s/cm ²
Frazier method)		(at most 10 cfm)

According to a second embodiment of the invention, there is provided a woven, reusable, launderable and sterilisable polyester fabric, which is a medical fabric, constructed from polyester yarn of from about 50 to 150 denier and a sum of ends and picks of at least 39 per cm (at least 100 per linear inch) having the following properties initially and following 100 laundering and steam sterilisation cycles:

	Initial	After 100 Cycles
5 linting (INDA 160-0-83, particles)	at most 5,000	at most 2,000
flammability (NFPA 702)	Class II	Class II
steam penetration	yes	yes
antimicrobial activity (CTM-0923)	No growth	No growth
10 Suter hydrostatic resistance (AATCC-127)	at least 35.0	at least 10.0
spray rating (AATCC-22-1980)	at least 70.0	at least 50.0
15 air permeability (FMT 5450, Frazier method)	at most 2.54 cm ³ /s/cm ² (at most 5 cfm)	at most 5.08 cm ³ /s/cm ² (at most 10 cfm)

According to a third embodiment of the invention, there is provided a woven, reusable, launderable and sterilizable polyester fabric, which is a medical fabric, constructed from polyester yarn of from about 50 to 150 denier and a sum of ends and picks of at least 39 per cm (at least 100 per linear inch) having the following properties initially and following 100 laundering cycles:

	Initial	After 100 Cycles
25 linting (INDA 160-0-83) particles	at most 5,000	at most 5,000
flammability (NFPA 702)	Class II	Class II
antimicrobial activity (CTM-0923)	no growth	no growth
for <i>Klebsiella pneumoniae</i>		
Suter hydrostatic resistance	at least 45.0	at least 20.0
(AATCC-127) centimeters/minutes		
30 spray rating (AATCC-22-1980)	at least 50.0	at least 20.0
air permeability (FTM 5450 Frazier method)	at most 2.54 cm ³ /s/cm ² (at most 5 cfm)	at most 5.08 cm ³ /s/cm ² (at most 10 cfm)

To be competitive in the marketplace, woven reusable surgical barrier fabrics must meet or exceed the current criteria for National Fire Protection Association (NFPA-99) and the Association of Operating Room Nurses (AORN) "Recommended Practices - Aseptic Barrier Material for Surgical Gowns and Drapes" used in constructing operating room wearing apparel, draping and gowning materials. To be effective, the fabric must be resistant to blood and aqueous fluid (resist liquid penetration); abrasion resistant to withstand continued reprocessing; lint free to reduce the number of particles and to reduce the dissemination of particles into the wound; drapeable; sufficiently porous to eliminate heat buildup; and flame resistant. Reusable fabrics should withstand multiple laundering and, where necessary, sterilization (autoclaving) cycles; non-abrasive and free of toxic ingredients and non-fast dyes; resistant to tears and punctures; provide an effective barrier to microbes, preferably bacteriostatic in their own right; and the reusable material should maintain its integrity over its expected useful life.

The products of this invention, measured against the recommendations and standards listed above, have the following properties assessed initially and after 100 institutional laundering or laundering and sterilization cycles.

1. Hydrostatic resistance, a measure of the fabric's resistance to penetration by blood and aqueous solutions, is measured using the Suter hydrostatic resistance test. Preferably initial readings are at least 20.0 (absolute) and 10.0 after 100 cycles and preferably an initial reading of at least 35.0 and at least 20.0 after 100 cycles.

2. Linting - barrier medical fabrics should be as lint free as possible to reduce the dissemination of lint particles into wounds and into the surrounding environment. Linting is measured by the International Nonwovens and Disposables Association (INDA) test 160-0-83 (1.0 micron, 10 minutes) with initial values of less than 5,000 lint particles and less than 2,000 lint particles after 100 laundering/sterilizing cycles.

3. Flame resistance is a desirable, but not an essential (in some cases) property of barrier fabrics. Flame resistance is measured according to NFPA 702. This test measures the time a material takes to burn up a 45° incline; a longer time indicates a less flammable fabric. The fabric must be classified by this test

as Class II initially and following 100 laundry/sterilization cycles.

4. Oil repellency, an indicator of soil release properties, is measured according to INDA 80.8 with initial values preferably in the 3-8 range, more preferably about 4. The fabric may lose its oil repellency as the fluorocarbon water repellent and other treating agents are leached out of the fabric over time.

5. Steam penetration - while a high thread count, tightly woven fabric is desirable in medical fabrics for its barrier properties, the fabric must also be amenable to steam sterilization both initially and following 100 cycles. This is especially true of medical fabrics such as surgical gowns, sterilization wrappers, surgical drapes and covers and other fabric products used in a sterile environment.

6. Colorfast - when a fabric is dyed to provide an attractive nonglare color that minimizes distortion from reflected light, the dye must remain on the fabric, be crock free and retain its color (fastness) following multiple launderings and, optionally, steam sterilizations. The fabrics of this invention have a colorfastness following 50 cycles of at least 2.5 according to AATCC 8-1981.

7. Antimicrobial activity of the fabric is assessed using CTM-0923. There is no growth initially, and preferably at least a 90% kill, and no growth after 100 cycles.

8. Spray ratings - another way to assess water repellency is using the AATCC-22-1980 spray test in which the fabric initially has a water spray of an absolute value of at least 70 (on a scale 0 to 100). Water resistance diminishes following multiple launderings eventually to 50.

9. Alcohol repellency is another desirable, but not essential, property and this is measured using INDA 80.9. Initial values should be an absolute value of at least 6 (on a scale of 0-10) but can be expected to decrease following multiple launderings.

10. Air permeability - Frazier method - is used to assess the barrier properties of the fabric usually during production. Air permeability of at most 2.54 cm³/s/cm² initially and at most 5.08 cm³/s/cm² at most 5 initially and at most 10 cubic feet per minute per square foot) of fabric sample at 12.7 mm (0.5 inch) water after 100 laundry cycles measured according to Federal Test Method FTM 5450.

These and related properties may be assessed using diverse testing methods and quantification procedures, and evaluations may be made following any given number of washing/drying or laundry/sterilization cycles.

The medical fabric of this invention may have essentially two performance levels. Medical garments or products subjected to institutional washing and drying operations constructed from medical fabrics of this invention are quite satisfactory and represent an advancement when their water repellency is a minimum of 20 as tested on Suter hydrostatic test AATCC 127 initially. Other types of medical products and apparel require a higher level (on the order of 30 cm Suter hydrostatic test) to provide a satisfactory level of repellency.

After 100 laundering and autoclave sterilization cycles, these values are as follows:

	Initial	After 100 Cycles
Linting (INDA 160-0-83)	5000 Max.	2000 Max
Flammability (NFPA 702)	Class II	Class II
Oil Repellency* (INDA 80.8)	at least 3	0
Antimicrobial Activity (CTM-0923) <i>Klebsiella</i>	No Growth	No Growth
<i>Pneumoniae</i>		
Alcohol Repellency* (INDA 80.9)	at least 6	0
Suter Hydrostatic (AATCC-127), cm.	at least 20.0	at least 10.00
Spray Rating* (AATCC-22-1980)	at least 70	at least 50
Frazier Air Permeability (FTM 5450) (cm ³ /s/cm ² @ 12.7 mm H ₂ O (cfm/ft ² @ 1/2" H ₂ O)	at most 2.54 (at most 5)	at most 5.08 (at most 10)

* optional properties

Fabric construction is important to a successful product. The medical fabric used in this invention is woven from 100% polyester filament yarn (nylon lacks durability and is unsuited to this invention) with an optimum, predetermined fabric density. Fabric density is a function of the fabric construction in which yarn denier, number of ends and number of picks (thread count) per linear cm are the essential variables. For general purposes, the yarn denier will fall in the range of from 50 to 150 in combination with a sum of the ends and picks (sometimes called a "round count") of at least 39 per cm (at least 100 per inch). The following Table will provide guidance for appropriate range of fabric construction.

	Denier	Ends*	Picks*
Max.	50	64 (162)	43 (108)
Min.	50	43 (108)	28 (72)
Max.	70	54 (137)	75 (191)
Min.	70	75 (190)	24 (60)
Max.	100	46 (116)	30 (76)
Min.	100	30 (76)	20 (50)
Max.	150	37 (94)	24 (62)
Min.	150	24 (62)	17 (42)

* per cm (per inch)

The woven fabric prior to finishing, has a weight of from about 67.8 to 339 g/m² (about 2 to 10 ounces per square yard), preferably 67.8 to 101.7 g/m² (2 to 3 ounces per square yard) with 84.8 (2.5) the most desired value.

Prior to treating, we recommend washing, drying and otherwise removing any lint that may be attached to or embedded in the fabric.

The polyester woven fabric of appropriate construction is finished with a treatment bath which may be applied using any convenient textile finishing operation and textile finishing equipment. Our equipment and experiences are specific to applying the treatment from a pad bath followed by subsequent processing in open width as explained in more detail below. Other methods of application including spraying, brushing, exhaust, etc., readily recognized by those skilled in this art may be used.

In overview, the pad bath contains the following types of ingredients; some listed below are optional ingredients, as indicated:

Ingredient	Amount (wt. %)
non-rewetting surfactant	.025 - 2.0
fluorocarbon water repellent	2.0 - 15.0
flame retardant*	1.0 - 20.0
antimicrobial agent	0.5 - 5.0
antistatic compound*	0.5 - 10.0
citric acid*	0.01 - 1.0
disperse dye*	0.01 - 3.0
pad pickup (owf)	40 ~ 100%

* optional

Components of the pad bath serve various purposes and are readily available from several commercial sources.

Surfactants, to lower the surface tension of the water, a major ingredient of the bath, suited to the invention are of the non-rewetting type. The following surfactants are suggested: fatty acid amines, Mykon NRW3 (Sequa); alcohols, Penetrant KB (Burlington Industries, Chemical Division); nonionic emulsions, Alkanol 6112 and Avitex 2153 (DuPont).

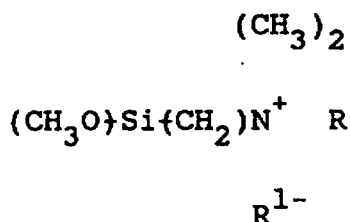
The fluorocarbon water repellent component is typically a dispersion of fluoropolymer in water (see generally Fluorine-Containing Polymers, Encyclopedia of Polymer Science & Technology, pp. 179-203, Interscience, 1967, the disclosure of which is hereby incorporated by reference). The fluoropolymer component may be selected from a host of commercially available products including DuPont's Zonyl NWG, Zonyl NWN, Zepel 6700, and 3-M's FC-834, FC-461 and FC 232. It is the fluorocarbon component that provides the water and fluid repellency to the finished fabric. One will select a repellent fluorocarbon component that is compatible with the system, i.e., the other bath components and processing conditions, is economical and provides the required degree of liquid repellency. A wax extender for the fluorocarbon may be incorporated in the formulation as required.

Flame retardants may be included in the formulation to impart flame resistance to the treated fabric. A variety of flame retardants are commercially available for cotton, synthetic and cotton/synthetic blended fabrics. We find those flame retardants convenient that can be added to a single finish formulation and do not require a separate processing step or steps to attach the flame retardant to the fibers. A preferred class

of flame retardants are the cyclic phosphonate esters, a group of known flame retardants as described in U.S. Patent Nos. 3,789,091 and 3,849,368. Antiblaze 19 and Antiblaze 19T are commercially available cyclic phosphonate ester flame retardants from Albright & Wilson. Other flame retardants suitable for this invention are Glo-Tard NTB (Glo-Tex) and Flameproof #1525 (Apex); all are organophosphates.

An antimicrobial agent is included in the treatment formulation for its obvious properties of preventing infectious substances and vectors from contaminating patients and others. As a class, members of the organosilicones (a preferred group of antimicrobial agents) exhibit antimicrobial activity and have the required regulatory clearances for use in hospital and medical fabrics.

The preferred organosilicone antimicrobial is 3-(trimethoxysilyl)-propyloctadecyldimethyl ammonium chloride. A class of suitable bioactive organosilicone compounds have the formula:



in which R is a C₁₁₋₂₂ alkyl group and R¹ chlorine or bromine. The preferred silicone quaternary amine is 3-(trimethoxysilyl)-propyloctadecyl dimethyl ammonium chloride (R = C₁₈H₃₈, R¹ = Cl) which is described in U.S. Patent No. 3,730,701, the disclosure of which is hereby incorporated by reference, and is available as a 42% active solids in methanol from Dow Corning Corporation of Midland, Michigan under the designation DC-5700 or Sylgard 5700. This material is well accepted in commerce and has been approved not only as a bacteriostatic textile treatment but also as a bactericidal component for medical device/non-drug applications. Another suitable antimicrobial is Sanitized Plus (Sandoz) also an organosilicone.

The quantity of antimicrobial agent included in the pad bath formulation is dependent upon its durability to laundering and the degree of antimicrobial protection desired. Generally, the amount will be in the range of from about 0.5 to about 5.0% calculated on the weight of the entire mix.

Antistatic compounds may be included in the pad bath to enable the treated fabric to dissipate static electricity, particularly in surgical environments where combustible gases are present. Suitable antistats are quaternary ammonium compounds, such as Aerotex CSN (American Cyanamid), and the alkyl amines, such as Aston 123 (Hi-Tek Polymers).

Medical fabrics are usually dyed to give them a pleasing appearance and to color code the level of use to which the product is suited. Dyes present in the pad bath must remain on the fabric and resist crocking and bleeding even following multiple institutional laundering and autoclaving. Disperse dyes satisfy these requirements. Citric acid may be used in the bath to lower the pH and thus to assist dyeing.

The above is a typical pad bath formulation. The amount of bath of this general formulation applied to and taken up by the fabric is usually in the range of from about 40% to about 100% and is expressed on the weight of the fabric. For the above formulation, the ingredients are added to the required quantity of water in the following order: citric acid, surfactant, disperse dye, organosilicone compound (previously pre-diluted 50%), antistatic compound, fluorocarbon water repellent and flame retardant.

After the fabric is treated with the aqueous formulation, it is dried to remove moisture before further processing.

The dried treated fabric is then passed between a set of heated (about 149°C to 204°C - about 300° to 400°F) steel rolls and pressed with force sufficient to lower the air permeability of the fabric. Calendering gives the polyester yarn permanent mechanical properties, makes the fabric more dense thereby lowering air permeability without adding to the cost of construction. It closes the interstitial pores and flattens the fabric surface. The effect of calendering is measured by air permeability of the treated fabric. An air permeability of between about 0.254 and 1.016 cm³/s/cm² (between about 0.5 and 2.0 cfm) (Frazier method) is required for most fabric applications. Calendering is an optional but cost saving process, and enables the use of a less densely constructed fabric. Calendering temperatures must exceed the washing, drying and autoclaving temperatures the finished medical fabric will experience in use. Generally the fabric must be exposed to a temperature of at least 149°C (at least 300°F); the upper limit is set by the melting point of the polyester fibers or the scorch point of the applied finish. As a practical matter, the upper limit will be about 232°C (about 450°F).

Pressure applied to the fabric during calendering usually falls within the range of about 89 to 716 kg per linear cm (about 500 to 4,000 pounds per linear inch), preferably about 179 to about 375 kg per linear cm (about 1,000 to about 2,000 pounds per linear inch), and generally the higher pressure the better. Generally, two calendering passes are used. The necessity for calendering for a specific fabric construction is determined by satisfying the target Frazier air permeability values, as explained above.

EXAMPLE

A woven medical fabric suitable for making an isolation gown was prepared from woven 70 denier, 34 filament 100% polyester yarn woven in a plain weave pattern with a final construction of 57 ends and 33 picks per cm (146 ends and 85 picks per inch) and a weight of 83.7 g/m² (2.47 ounces per sq. yard). The greige fabric was washed, processed to remove all foreign substances and debris, then dried. The fabric was padded and treated in a pad bath containing:

water	50%
citric acid	45 g (0.1 lb.)
isopropyl alcohol	1812 g (4 lb.)
disperse dye Pananil Yellow P-6G	113 g (0.25 lb.)
Dow-Corning 5700 antimicrobial (prediluted with water 1:1)	1812 g (4 lb.)
Aerotex CSN (American Cyanimid) antistat	1812 g (4 lb.)
Zonyl NWG (DuPont)	9060 g (20 lb.)

to make 189 litres (50 gallons). The pad bath was applied at ambient temperature at a speed of 54.8 metres (60 yards) per minute with a wet pick-up of 55% calculated on the weight of the fabric.

The fabric was then dried in a single pass in a tenter frame with a dwell time of from 30 to 60 seconds at about 218°C (about 425°F). Next the treated fabric was calendered at a speed of 36.6 metres (40 yards) per minute in a double nip steel over fiber roll with a surface temperature at about 177°C (about 350°F) and at a pressure of about 26787 kg/m (about 1,500 pounds per linear inch).

The finished isolation gown fabric had the following properties:

Fabric Construction	
width cm (inches)	160.3 (63.1)
weight g/m ² (oz/yd ²)	83.7 (2.47)
picks per cm (inch)	33 (85)
ends per cm (inch)	57 (146)

Properties			
tensile, warp g (lbs)		74292 (164)	ASTM 1682
tensile, fill g (lbs)		52095 (115)	ASTM 1682
air porosity cm ³ /s/cm ² (cfm)		0.44 (0.87)	FTM-5450
Suter hydrostatic (cm)		35.5	AATCC-127
spray		90	AATCC-22-1980
oil repellency		4	INDA 80.8
alcohol repellency		9	INDA 80.9
water impact (g.)		0.25	AATCC 42-1974
bioactivity		100%	Dow Corning-CTM-0963
static decay, (sec.),	warp fill	(+)0.13 (-)0.11 (+)0.21 (-)0.18	NFPA 99 NFPA 99
crockfastness	wet dry	5.0 5.0	AATCC-8-1980 AATCC-8-1980
flammability	warp fill	Class II Class II	NFPA-702 NFPA-702

Claims

1. A woven, reusable, launderable and sterilizable polyester fabric constructed from polyester yarn of from about 50 to 150 denier and a sum of the ends and picks of at least 39 per cm (at least 100 per linear inch) having the following properties initially and following 100 laundering cycles:

	Initial	After 100 Cycles
linting (INDA 160-0-83) particles	at most 5,000	at most 2,000
flammability (NFPA 702)	Class II	Class II
antimicrobial activity (CTM-0923) for <i>Klebsiella pneumoniae</i>	no growth	no growth
Suter hydrostatic resistance (AATCC-127) centimeters	at least 20.0	at least 10.0
spray rating (AATCC-22-1980)	at least 70.0	at least 50.0
air permeability (FTM 5450, Frazier method)	at most 2.54 cm ³ /s/cm ² (at most 5 cfm)	at most 5.08 cm ³ /s/cm ² (at most 10 cfm)

2. The woven fabric of claim 1, in which the fabric has a Suter hydrostatic resistance of at least 35.0 initially and at least 20.0 after 100 cycles.
3. A woven, reusable, launderable and sterilisable polyester fabric, which is a medical fabric, constructed from polyester yarn of from about 50 to 150 denier and a sum of ends and picks of at least 39 per cm (at least 100 per linear inch) having the following properties initially and following 100 laundering and steam sterilization cycles:



Properties			
tensile, warp g (lbs)		74292 (164)	ASTM 1682
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flammability	warp fill	Class II Class II	NFPA-702 NFPA-702

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	Initial	After 100 cycles
5 linting (INDA 160-0-83) particles	at most 5,000	at most 2,000
flammability (NFPA 702)	Class II	Class II
steam penetration	yes	yes
antimicrobial activity (CTM-0923)	No growth	No growth
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flammability (NFPA 702)	Class II	Class II
antimicrobial activity (CTM-0923)	no growth	no growth
for <i>Klebsiella pneumoniae</i>		
30 Suter hydrostatic resistance (AATCC-127) centimeters/minutes	at least 45.0	at least 20.0
spray rating (AATCC-22-1980)	at least 50.0	at least 20.0
air permeability (FTM 5450 Frazier method)	at most 2.54 cm ³ /s/cm ² (at most 5 cfm)	at most 5.08 cm ³ /s/cm ² (at most 10 cfm)

- 35 5. The woven fabric of any one of the preceding claims in which the fabric has an initial Suter hydrostatic resistance of at least 50.0.
- 40 6. The woven fabric of any one of the preceding claims in which the fabric has an initial oil repellency (INDA 80.8) of at least 3.
7. The woven fabric of any one of the preceding claims in which the fabric has an initial alcohol repellency (INDA 80.9) of at least 6.
- 45 8. The woven fabric of any one of the preceding claims, in which the initial antimicrobial activity of the fabric is sufficient to kill at least 90% of *Klebsiella pneumoniae*.
- 50 9. A woven isolation gown, surgical gown, surgical scrub suit, sterilization wrapper, cover gown, hamper bag, jump suit, work apron or laboratory coat constructed of the fabric of claim 1 or 2, or claim 6, 7 or 8 when appendant to claim 1 or 2.
- 55 10. A woven, reusable, launderable and sterilizable isolation gown, surgical gown, surgical scrub suit, sterilization wrapper, cover gown, hamper bag, jump suit, work apron or laboratory coat constructed of the medical fabric of claim 3 or any one of claims 5 to 8 when appendant to claim 3.
11. A woven, reusable, launderable and sterilizable isolation gown, surgical gown, surgical scrub suit, sterilization wrapper, cover gown, hamper bag, jump suit, work apron or laboratory coat constructed of the medical fabric of claim 4 or any one of claims 5 to 8 when appendant to claim 4.



12. A process for the manufacture of a fabric according to any one of claims 1 to 8 which process comprises the steps of:

- (1) applying to a woven polyester fabric constructed from polyester yarn of from about 50 to 150 denier and a sum of the end and picks of at least 39 per cm (at least 100 per linear inch), an aqueous finish composition containing a fluorocarbon water repellent, a flame retardant, and an antimicrobial agent, and
- (2) drying the fabric.

13. The process of claim 12 including the additional step of (3) calendering the fabric at a temperature of at least 149 °C (at least 300 °F) with a force sufficient to reduce the air permeability of the fabric to at most 1.02 cm³/s/cm² (at most 2.0 cubic feet per minute per square foot) (Frazier method).

14. The process of claim 13, in which the fabric is calendered at a pressure of from about 89 to about 716 kg per linear cm (from about 500 to about 4,000 pounds per linear inch).

15. The process of claim 13, in which the fabric is calendered at a pressure of about 179 to about 357 kg per linear cm (from about 500 to about 2,000 pounds per linear inch).

Patentansprüche

1. Gewebtes, wiederverwertbares, waschbares und sterilisierbares Polyestererzeugnis, hergestellt aus Polyestergergarn von etwa 50 bis 150 Denier und einer Summe der Kett- und Schußfäden von wenigstens 39 pro cm (wenigstens 100 pro linearem Zoll), welches die folgenden Eigenschaften zu Beginn und nach 100 Waschzyklen aufweist:

	Beginn	nach 100 Zyklen
Flusenteilchen (INDA 160-0-83)	höchstens 5.000	höchstens 2.000
Entflammbarkeit (NFPA 702)	Klasse II	Klasse II
antimikrobielle Wirksamkeit (CTM-0923) für <i>Klebsiella pneumoniae</i>	kein Wachstum	kein Wachstum
Hydrostatischer Widerstand nach Suter (AATCC-127) Zentimeter	wenigstens 20,0	wenigstens 10,0
Sprühwert (AATCC-22-1980)	wenigstens 70,0	wenigstens 50,0
Luftdurchlässigkeit (FTM 5450, Frazier-Verfahren)	höchstens 2,54 cm ³ /s/cm ² (höchstens 5 cfm)	höchstens 5,08 cm ³ /s/cm ² (höchstens 10 cfm)

2. Gewebtes Erzeugnis nach Anspruch 1, worin das Erzeugnis einen hydrostatischen Widerstand nach Suter von wenigstens 35,0 zu Beginn und von wenigstens 20,0 nach 100 Zyklen aufweist.

3. Gewebtes, wiederverwertbares, waschbares und sterilisierbares Polyestererzeugnis, welches ein Sanitärgegewebe ist, hergestellt aus Polyestergergarn von etwa 50 bis 150 Denier und einer Summe der Kett- und Schußfäden von wenigstens 39 pro cm (wenigstens 100 pro linearem Zoll), welches die folgenden Eigenschaften zu Beginn und nach 100 Waschzyklen aufweist:



		Beginn	nach 100 Zyklen
5	Flusenteilchen (INDA 160-0-83)	höchstens 5.000	höchstens 2.000
	Entflammbarkeit (NFPA 702)	Klasse II	Klasse II
	Dampfpenetration	ja	ja
	antimikrobielle Wirksamkeit (CTM-0923)	kein Wachstum	kein Wachstum
10	Hydrostatischer Widerstand nach Suter (AATCC-127)	wenigstens 35,0	wenigstens 10,0
	Sprühwert (AATCC-22-1980)	wenigstens 70,0	wenigstens 50,0
15	Luftdurchlässigkeit (FTM 5450, Frazier-Verfahren)	höchstens 2,54 cm ³ /s/cm ² (höchstens 5 cfm)	höchstens 5,08 cm ³ /s/cm ² (höchstens 10 cfm)

4. Gewebtes, wiederverwertbares, waschbares und sterilisierbares Polyestererzeugnis, welches ein Sanitär-
gewebe ist, hergestellt aus Polyestergergarn von etwa 50 bis 150 Denier und einer Summe der Kett-
und Schußfäden von wenigstens 39 pro cm (wenigstens 100 pro linearem Zoll), welches die folgenden
Eigenschaften zu Beginn und nach 100 Waschzyklen aufweist:

		Beginn	nach 100 Zyklen
25	Flusenteilchen (INDA 160-0-83)	höchstens 5.000	höchstens 5.000
	Entflammbarkeit (NFPA 702)	Klasse II	Klasse II
	antimikrobielle Wirksamkeit (CTM-0923) für Klebsiella pneumoniae	kein Wachstum	kein Wachstum
30	Hydrostatischer Widerstand nach Suter (AATCC-127) Zentimeter/Minute	wenigstens 45,0	wenigstens 20,0
	Sprühwert (AATCC-22-1980)	wenigstens 50,0	wenigstens 20,0
	Luftdurchlässigkeit (FTM 5450, Frazier-Verfahren)	höchstens 2,54 cm ³ /s/cm ² (höchstens 5 cfm)	höchstens 5,08 cm ³ /s/cm ² (höchstens 10 cfm)

5. Gewebtes Erzeugnis nach einem der vorhergehenden Ansprüche, worin das Erzeugnis einen Suter
hydrostatischen Widerstand von wenigstens 50,0 zu Beginn aufweist.

6. Gewebtes Erzeugnis nach einem der vorhergehenden Ansprüche, worin das Erzeugnis eine Ölstoß-
ung (INDA 80.8) von wenigstens 3 zu Beginn aufweist.

7. Gewebtes Erzeugnis nach einem der vorhergehenden Ansprüche, worin das Erzeugnis eine Alkoholab-
stoßung (INDA 80.9) von wenigstens 6 zu Beginn aufweist.

8. Gewebtes Erzeugnis nach einem der vorhergehenden Ansprüche, worin die antimikrobielle Wirksamkeit
des Erzeugnisses zu Beginn ausreichend ist, um wenigstens 90 % der Klebsiella pneumoniae zu töten.

9. Gewebte(r) Isolationskittel, Operationskittel, chirurgischer Reinigungsanzug, Sterilisationshülle, Über-
ziehkittel, Schmutzwäschesack, Overall, Arbeitsschürze oder Labormantel, hergestellt aus dem Erzeug-
nis von Anspruch 1 oder 2 oder Anspruch 6, 7 oder 8, sofern diese von Anspruch 1 oder 2 abhängen.

10. Gewebte(r), wiederverwertbare(r), waschbare(r) und sterilisierbare(r) Isolationskittel, Operationskittel,
chirurgischer Reinigungsanzug, Sterilisationshülle, Überziehkittel, Schmutzwäschesack, Overall, Arbeits-
schürze oder Labormantel, hergestellt aus dem Sanitärerzeugnis von Anspruch 3 oder einem der
Ansprüche 5 bis 8, sofern diese von Anspruch 3 abhängen.



11. Gewebe(r), wiederverwertbare(r), waschbare(r) und sterilisierbare(r) Isolationskittel, Operationskittel, chirurgischer Reinigungsanzug, Sterilisationshülle, Überziehkittel, Schmutzwäschesack, Overall, Arbeits-schürze oder Labormantel, hergestellt aus dem Sanitärerzeugnis von Anspruch 4 oder einem der Ansprüche 5 bis 8, sofern diese von Anspruch 4 abhängen.

12. Verfahren zur Herstellung eines Erzeugnisses nach einem der Ansprüche 1 bis 8, welches Verfahren die Schritte umfaßt:

(1) Anwenden von einer wässrigen Appreturzusammensetzung, enthaltend ein Flourkohlenstoff-Wasser-abstoßendes Mittel, ein flammenhemmendes Mittel und ein antimikrobielles Mittel, auf ein gewebtes Polyestererzeugnis, hergestellt aus Polyestergergarn von etwa 50 bis 150 Denier und einer Summe der Kett- und Schußfäden von wenigstens 39 pro cm (wenigstens 100 pro linearem Zoll), und

(2) Trocknen des Erzeugnisses.

13. Verfahren nach Anspruch 12, umfassend den zusätzlichen Schritt (3) des Kalanderns des Erzeugnisses bei einer Temperatur von wenigstens 149 °C (wenigstens 300 °F) mit einer Kraft, welche ausreichend ist, um die Luftdurchlässigkeit des Erzeugnisses auf höchstens 1,02 cm³/s/cm² (höchstens 0,2 Kubikfuß/Minute/Quadratfuß) zu reduzieren (Frazier-Verfahren).

14. Verfahren nach Anspruch 13, worin das Erzeugnis bei einem Druck von etwa 89 bis etwa 716 kg pro linearem cm (von etwa 500 bis etwa 4000 Pfund pro linearem Zoll) kalandert wird.

15. Verfahren nach Anspruch 13, worin das Erzeugnis bei einem Druck von etwa 179 bis etwa 357 kg pro linearem cm (von etwa 500 bis etwa 2000 Pfund pro linearem Zoll) kalandert wird.

Revendications

1. Etoffe en polyester tissée, réutilisable, qui peut passer au blanchissage et stérilisable, fabriquée à partir d'un fil en polyester d'environ 50 à 150 deniers et d'un total d'extrémités et de duites d'au moins 39 par cm (au moins 100 par pouce linéaire) ayant les propriétés suivantes, initialement et après 100 cycles de blanchissage :

	Initialement	Après 100 cycles
Particules de formation de peluches (INDA 160-0-83)	au plus 5 000	au plus 2 000
Inflammabilité (NFPA 702)	Classe II	Classe II
Activité antimicrobienne (CTM-0923) pour <i>Klebsiella pneumoniae</i>	aucune croissance	aucune croissance
Résistance hydrostatique de Suter (AATCC-127) en cm	au moins 20,0	au moins 10,0
Taux de vaporisation (AATCC-22-1980)	au moins 70,0	au moins 50,0
Perméabilité à l'air (FTM 5450, procédé de Frazier)	au plus 2,54 cm ³ /s/cm ² (au plus 5 cfm)	au plus 5,08 cm ³ /s/cm ² (au plus 10 cfm)

2. Etoffe tissée selon la revendication 1, pour laquelle l'étoffe a une résistance hydrostatique de Suter d'au moins 35,0 initialement et d'au moins 20,0 après 100 cycles.

3. Etoffe en polyester tissée, réutilisable, qui peut passer au blanchissage et stérilisable, qui est une étoffe médicale, fabriquée à partir d'un fil en polyester d'environ 50 à 150 deniers et d'un total d'extrémités et de duites d'au moins 39 par cm (au moins 100 par pouce linéaire) ayant les propriétés suivantes, initialement et après 100 cycles de blanchissage et de stérilisation à la vapeur :



	Initialement	Après 100 cycles
5	au plus 5 000	au plus 2 000
	Classe II	Classe II
	oui	oui
	aucune croissance	aucune croissance
10	au moins 35,0	au moins 10,0
	au moins 70,0	au moins 50,0
15	au plus 2,54 cm ³ /s/cm ² (au plus 5 cfm)	au plus 5,08 cm ³ /s/cm ² (au plus 10 cfm)

4. Etoffe en polyester tissée, réutilisable, qui peut passer au blanchissage et stérilisable, qui est une étoffe médicale, fabriquée à partir d'un fil en polyester d'environ 50 à 150 deniers et d'un total d'extrémités et de duites d'au moins 39 par cm (au moins 100 par pouce linéaire) ayant les propriétés suivantes, initialement et après 100 cycles de blanchissage :

	Initialement	Après 100 cycles
25	au plus 5 000	au plus 2 000
	Classe II	Classe II
	aucune croissance	aucune croissance
30	au moins 45,0	au moins 20,0
	au moins 50,0	au moins 20,0
35	au plus 2,54 cm ³ /s/cm ² (au plus 5 cfm)	au plus 5,08 cm ³ /s/cm ² (au plus 10 cfm)

5. Etoffe tissée selon l'une quelconque des revendications précédentes, pour laquelle l'étoffe a une résistance hydrostatique de Suter initiale d'au moins 50,0.
6. Etoffe tissée selon l'une quelconque des revendications précédentes, pour laquelle l'étoffe a un caractère oléofuge initial (INDA 80,8) supérieur ou égal à 3.
7. Etoffe tissée selon l'une quelconque des revendications précédentes, pour laquelle l'étoffe a un caractère alcoolofuge initial (INDA 80,9) supérieur ou égal à 6.
8. Etoffe tissée selon l'une quelconque des revendications précédentes, pour laquelle l'activité antimicrobienne initiale de l'étoffe est suffisante pour tuer au moins 90 % de *Klebsiella pneumoniae*.
9. Blouse isolante, blouse de chirurgien, tenue chirurgicale, enveloppe de stérilisation, blouse protectrice, poche de panier en osier, combinaison de saut, tablier d'atelier ou blouse de laboratoire tissé, fabriqué à partir de l'étoffe selon la revendication 1 ou 2, ou selon la revendication 6, 7 ou 8 lorsqu'elle dépend de la revendication 1 ou 2.
10. Blouse isolante, blouse de chirurgien, tenue chirurgicale, enveloppe de stérilisation, blouse protectrice, poche de panier en osier, combinaison de saut, tablier d'atelier ou blouse de laboratoire tissé, réutilisable, qui peut passer au blanchissage et stérilisable, fabriqué à partir de l'étoffe médicale selon la revendication 3 ou selon l'une quelconque des revendications 5 à 8 lorsqu'elles dépendent de la



revendication 3.

5 11. Blouse isolante, blouse de chirurgien, tenue chirurgicale, enveloppe de stérilisation, blouse protectrice, poche de panier en osier, combinaison de saut, tablier d'atelier ou blouse de laboratoire tissé, réutilisable, qui peut passer au blanchissage et stérilisable, fabriqué à partir de l'étoffe médicale selon la revendication 4 ou selon l'une quelconque des revendications 5 à 8 lorsqu'elles dépendent de la revendication 4.

10 12. Procédé de production d'une étoffe selon l'une quelconque des revendications 1 à 8, lequel procédé comprend les étapes consistant à :

(1) appliquer à une étoffe en polyester tissée, fabriquée à partir d'un fil en polyester d'environ 50 à 150 deniers et d'un total d'extrémités et de duites d'au moins 39 par cm (au moins 100 par pouce linéaire), une composition aqueuse d'apprêt contenant un agent hydrofuge fluorocarboné, un agent retardateur de combustion et un agent antimicrobien et

15 (2) sécher l'étoffe.

20 13. Procédé selon la revendication 12, comprenant l'étape supplémentaire consistant à (3) calandrer l'étoffe à une température supérieure ou égale à 149°C (supérieure ou égale à 300°F) avec une force suffisante pour réduire la perméabilité à l'air de l'étoffe à au plus 1,02 cm³/s/cm² (au plus 2,0 pied cube/min/pied carré) (procédé de Frazier).

25 14. Procédé selon la revendication 13, dans lequel l'étoffe est calandree à une pression comprise entre environ 89 et environ 716 kg par cm linéaire (entre environ 500 et environ 4 000 livres par pouce linéaire).

30 15. Procédé selon la revendication 13, dans lequel l'étoffe est calandree à une pression comprise entre environ 179 et environ 357 kg par cm linéaire (entre environ 500 et environ 2 000 livres par pouce linéaire).

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