

# APPLICATION OF ZINC FIBRES IN IMPROVING PROPERTY AND USE OF STOCKINETTE

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## **ABSTRACT**

The project on “Study of the effect of inclusion of Zinc in enhancement of properties of Medical Textiles” deals with the study of the effect of a type of fabric in which the fibres blended with normal textile fibres are zinc fibres which are used to impart antimicrobial nature to the fabric. The main motto for this study is to have a proper knowledge about where, how and when to use such fabric and to examine the effect of this fabric, when used.

The end uses of this fabric is the main thing to ponder about its properties i.e. being antimicrobial and also a property of anti-odour and stain repellence. The fabric so made can be efficiently used in many forms under the hospitals, laboratories and sanitary purposes as the substitutes of the fabrics used under medical textiles. Our main framework with this fabric is its application in orthopaedic and daily based used product i.e. Stockinette.

The aspire to create and manufacture this type of fabric is to modernize the fraternity of the fabrics used under medical textiles.

**Keywords-** Zinc Fibres, Zinc Blended Fabric, Stockinette, Antimicrobial, Antiodour, and Stain Repellence.

## **INTRODUCTION**

### **TECHNICAL TEXTILE**

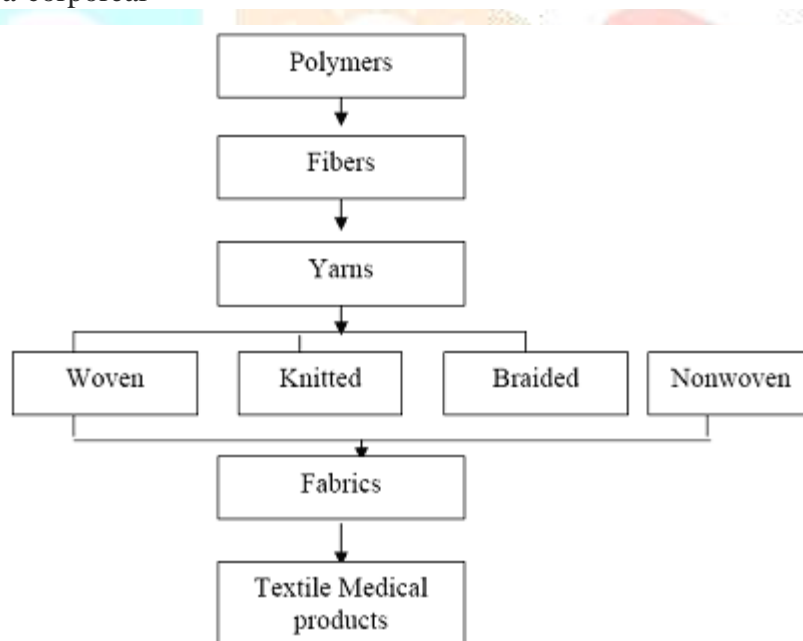
A **technical textile** is a textile product manufactured for non-aesthetic purposes, where function is the primary criterion. Technical textiles include textiles for automotive applications, medical textiles (e.g., implants), geotextiles (reinforcement of embankments), agro textiles (textiles for crop protection), and protective clothing (e.g., heat and radiation protection for fire fighter clothing, molten metal protection for welders, stab protection and bulletproof vests, and spacesuits).

It is a large and growing sector and supports a vast array of other industries. The global growth rates of technical textiles is about 4% per year greater than the growth of home and apparel textiles, which are growing at a rate of 1% per year. Currently, technical textile materials are most widely used in filter clothing, furniture, hygiene medicals and construction material.

## MEDICAL TEXTILE

Combination of textile technology and medical sciences has resulted into a new field called medical textiles. New areas of application for medical textiles have been identified with the development of new fibres and manufacturing technologies for yarns and fabrics. Development in the field of textiles, either natural or manmade textiles, normally aimed at how they enhance the comfort to the users. Development of medical textiles can be considered as one such development, which is really meant for converting the painful days of patients into the comfortable days.

- Medical textiles are manufactured a goods which includes textile stuff used in hygiene, healthiness and private care as well as surgical end use. The Medical textiles products are obtainable in woven, knitted and non-woven structure based on the area of application.
- Increasingly, synthetic fibre is being utilized in the manufacturing of these products.
- Depending upon the area of purpose, medical textiles are classify as under:
  1. Non- implantable
  2. Healthcare & Hygiene products
  3. Implantable
  4. Extra-corporeal



## APPLICATIONS

Some application of zinc blended antimicrobial and anti-odour fabric are as listed:-

- Stickinette
- Aprons & Hospital Uniform
- Hospital Linen
- Bed sheets
- Privacy Curtains
- Bandage Fabrics

- Diabetic Socks
- Anti-Radiation Maternity Brief
- Pillow Cover

## **TYPES OF FIBRES USED**

1. **ZINC FIBRES**
2. **COTTON**
3. **POLYESTER**
4. **VISCOSE**
5. **WOOL**

**Zinc fibres are so versatile in blending with approx. every normal textile fibre.**

## **ZINC FIBRES**

Why zinc? Zinc is a real elixir of life. It has a decisive influence on our well-being like few other nutrients. It is present everywhere in the body and is of critical importance for the core functions of the body. It strengthens the immune system (the body's defences) but also sensory functions and fertility.

Textiles containing novel zinc fibres allow natural, soft and pure skin care with an additional antibacterial, odour-reducing effect – which can be used in all textiles. The antibacterial and protective effects of zinc incorporated in a natural fibre: smartcel™ sensitive – is the antibacterial, protective fibre the textile industry has been waiting for! smartcel™ sensitive is a completely natural fibre and can be used for all types of textiles including wool. The patented fibre production method completely dispenses of chemicals which would otherwise be necessary to make the effect of the zinc on the skin possible. The incorporated snow-white zinc oxide allows textiles to be dyed in all colours, including white! The incorporation of zinc elements in the smartcel™ sensitive fibre also means that the build-up of odor and bacteria is kept decisively at bay. The antibacterial effect of zinc is based on the “oligo dynamic effect“, which describes a disruption in the bacterial metabolism. The cell membrane is altered and the exchange of substances with the environment is made more difficult. smartcel™ sensitive: Effective with all textile blends, including wool The antibacterial effect is triggered when the skin gives off moisture (sweat), and an active exchange is produced between the fibres and the skin. smartcel™ sensitive is also wash fast, effective over a long period and meets international standards on purity.



The advantages of smartcel™ sensitive-fibres at a glance:

- The first antibacterial fibre with the essential trace element zinc.
- Protects and cares for the skin.
- No nanotechnology, no aggressive chemicals.
- Even works with wool blends.
- Washes very well and can be dyed in all colours, including white.
- Constant release of zinc onto the skin.

### MANUFACTURING OF ZINC FIBRES

Zinc fibre is an innovative fibre based on natural cellulose, which includes the essential trace element zinc. Zinc has perhaps a greater impact on our wellbeing than any other trace element. It is vital for our immune system, sensory functions and metabolism as well as skin regeneration and protection.

Special high graded zinc is melted and oxidised which results in a white powder of pure zinc oxide that is incorporated into a cellulose fibre.

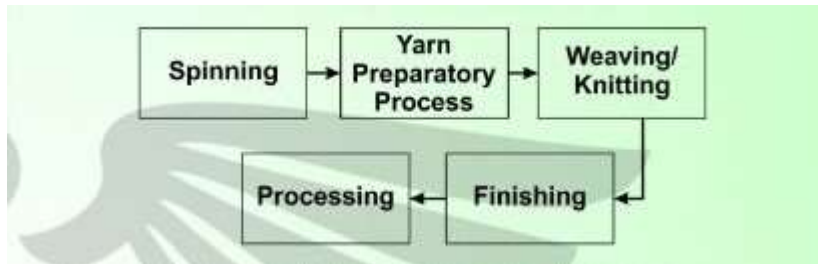
#### ➤ Fibre Preparation Constituents and process



Using only high-quality, pharmaceutical grade 4 zinc oxide, smartcel™ sensitive combines zinc's regenerative and skin protective effects with its hygienic and antibacterial elements. The fibre is produced without the use of aggressive chemicals and is made solely from renewable raw materials, making it both eco-friendly and fully biodegradable. Zinc oxide also acts as a shield against harmful UVA and UVB radiation, which can damage our skin cells. Depending on the percentage of smartcel™ sensitive used in any garment, it can provide up to 50 SPF. Further to this, zinc oxide possesses strong antibacterial properties, especially against odour causing bacteria, which helps to make garments stay fresh longer.

Zinc fibres is produced using the Lyocell Process, an innovative and eco-friendly production method. Production takes place in a closed loop with no chemicals released. This meets the expectations of our industry both today and in the future.

### MANUFACTURING OF ZINC BLENDED FABRIC



**Note:** The only change in weaving process is at its first stage i.e. Spinning. As the first stage of spinning carries blow room stage, the normal textile fibres along with zinc fibres are added to blow room so as to produce a blend. All other stages remains similar including carding, draw frame, ring frame and speed frame.

Normally the yarn of 20s count is produced for manufacturing of such fabric.

### WHAT IS STOCKINETTE?

Stockinette is a soft, loosely knitted stretch fabric, formerly used for making underwear and now used for cleaning, wrapping, or bandaging. Stockinette is a great knit fabric because it's simple, easy to increase and decrease in because you can't mess up the pattern, and it gives you handknits that look like many classic machine-knit, store-bought pieces.

One of the perils of Stockinette Stitch is that it tends to [curl](#) when left to its own devices. Some yarns show this tendency more than others, but it's a fact of the structure of the stitch that you can't always predict.

### **What's new?**

On changing the fraternity of normal stockinette, our stockinette is made of the fabric in which the zinc fibres are introduced. On preliminary steps of making fabric, the zinc fibres are blended with other fibres like cotton and/or polyester in blow room stage of spinning. By doing this, the fabric which is to be made into stockinette gets an inherent property of being antimicrobial. Side-by-side, it also has a property of anti-odour, and stain repellence.



This zinc blended stockinette has very versatile applications use for:

- 1) Orthopaedic Patients
- 2) Sportsperson
- 3) During Gym workout
- 4) To avoid tanning of skin
- 5) Workers

- Orthopaedic Patients can use it as in intermediate layer between plaster and skin. As during any injury, rashes or blood comes out of skin due to which bacteria develops and hence by the use of this stockinette those bacteria will not develop and hence skin can start healing and will not get damaged.
- During gym workout and sportsperson can use this stockinette for hand as well as for knees in case of any injury or infection. This can also be used to swipe up sweat as this fabric has well anti odour and stain repellence property.
- Workers can use this stockinette for hand to let hand not come in contact with any bacteria and stay healthy.
- And as zinc acts as good shields for UV rays, this stockinette can be wore while driving bike or anywhere when we are in direct exposure of sunlight.

### **TESTING OF FABRICS**

In order to manufacture best quality of fabrics, to be used under medical textiles are to be tested according to its physical and aesthetic quality.

There are mainly two types of tests which are to be carried out for proper surveillance of the quality of fabric which are:

- 1) Physical Testing
- 2) Pathology Testing
- 3) Other Manual Tests

- I. Milk Odour Test
- II. Odour Test - 2
- III. Stain Repellence Test

### **1. Physical Testing of Fabric**

The first broad class of factors that affect the performance of fabrics are factors that influence the test results. Testing of fabrics to the above influphysical agents and influences. These may be further subdivided into mechanical deformation and degradation, tactile and associated visual properties of fabrics (such as wrinkling, buckling, drape and hand) after their use and manufacture, and their response to heat, liquids and static charge. The testing of fabrics to mechanical deformation is very important and refers to fabrics that are subjected to variable and complex modes of deformation. Some of the physical tests to be carried out on the fabric are:

- 1. Tearing test**
- 2. Tensile test**
- 3. Air permeability test**
- 4. Water permeability test**
- 5. Stiffness test**
- 6. Drape test**
- 7. Fire-resistance test**
- 8. Piles test**
- 9. Various defects test**
- 10. Crease recovery test**

### **2. Micro-Biology Testing**

Micro-Biology tests are the tests from medical specialist. Here, the fabric samples are made to undergo biological tests. Microbiology tests mainly concerns with studying the counts of bacteria before and after the use of the fabric and calculating the %efficiency of the fabric in depleting the bacteria's. We made a report for the stockinette from Biotech Testing Services, Mumbai to closely examine the nature of our product property and get results about the same.



## TEST REPORT

LAB NO. : 14862/ 1

DATE: 11/04/2018

**NAME OF CUSTOMER** : M/S. DHRUV VALJIBHAI RAMANI  
**ADDRESS** : B-2, Vrundavan Apartments,  
158 Nehru Park, Nr. Vastrapur Lake,  
Vastrapur Ahmedabad, Gujarat, INDIA  
**REFERENCE** : Letter Ref. Nil dated April 09, 2018  
**DATE OF RECEIPT** : 09/04/2018  
**DATE OF INITIATION** : 09/04/2018  
**DATE OF COMPLETION** : 11/04/2018  
**SAMPLE DESCRIPTION** : Fabric Sample labeled as - (Samples Attached)  
**1. Off White Color Fabric Sample**  
**Untreated – Lab Control**



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**Name of Test:**

Evaluation of Antimicrobial Activity by JIS L 1902: 2015 – Quantitative Absorption Method

**ANTIBACTERIAL ACTIVITY****1. Off White Color Fabric Sample**

Test Bacteria	Staphylococcus aureus		Klebsiella pneumoniae	
Strain Number	ATCC 6538		ATCC 4352	
Concentration of inoculum (cfu/ml)	1.90 x 10 <sup>5</sup>		2.00 x 10 <sup>5</sup>	
Difference of Extremes for three control specimens (log) (Condition < 1)	Immediately after inoculation	Immediately after incubation	Immediately after inoculation	Immediately after incubation
	0.028	0.085	0.007	0.068
Difference of Extremes for three Test specimens (log) (Condition < 2)	Immediately after inoculation	Immediately after incubation	Immediately after inoculation	Immediately after incubation
	0.016	00	0.004	0.301
Growth value of F (F = log C <sub>1</sub> - log C <sub>0</sub> )	+1.537 : (log C <sub>1</sub> : +6.56, Log C <sub>0</sub> : +5.02)		+1.534 : (log C <sub>1</sub> : +6.57, Log C <sub>0</sub> : +5.03)	
Growth value of G (G = log T <sub>1</sub> - log T <sub>0</sub> )	-4.025 : (log T <sub>1</sub> : +<1, Log T <sub>0</sub> : +5.02)		-3.432 : (log T <sub>1</sub> : +1.60, Log T <sub>0</sub> : +5.03)	
Antibacterial activity value (A = F - G)	>5.56		4.96	
Measuring Method	Plate Count Method			
Type of Sample Material	White Color Fabric Sample			
Sterilisation Method	Autoclave			
Incubation Time	20 hrs.			

**Antimicrobial Efficacy:**

Antibacterial Value A	Antibacterial Efficacy
2.0 ≤ A < 3.0	Effect
A ≥ 3.0	Full effect

**COMMENT:**

When tested as specified, Fabric labeled as Off White Color Fabric Sample has shown Full Effect Antimicrobial Efficacy by Quantitative Assessment of activity for Staphylococcus aureus and Klebsiella pneumoniae by JIS L 1902: 2015 Test Method.

For BIOTECH TESTING SERVICES



*Shilpa U. Nair*  
Dr Shilpa U. Nair  
Quality Manager  
(Authorized Signatory)

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### 3. OTHER MANUAL TESTS

#### I. Milk Odour Test

The Zinc blended has a supreme property of being antimicrobial. Therefore it can be best tested by putting drop of milk on both the fabric samples i.e. one drop on normal stockinette fabric and one drop on zinc blended stockinette fabric.

Putting milk drop on both samples.



As bacteria develop very quickly on milk, therefore the fabric samples are put in a jar separately to analyse the bacteria growth by its stinking levels.



**Result:** The bacteria developed on the normal knitted fabric can easily be analysed by smelling both the jars. The jar containing normal knitted fabric stink so badly while the jar containing zinc blended fabric stink very less.

#### II. Odour Test - 2

As the zinc blended fabric also has a property of anti-odour, this manual test can also be done independently. The test can be carried out as:

The stockinette fabric samples is to be taken one of normal and other with zinc blended, both given to 2 sportsperson while playing football in sunlight. They were called to play for an hour with stockinette wore on their hand. They were recommended to wear stockinette on their hand so that they could swipe sweat on it and can save their skin from tanning. And then the fabric sample is exposed to normal atmosphere to be dried and after that the fabric is smelled.

### Result:

The normal stockinette would stink much more bad while zinc blended stockinette would stink comparatively lesser (like <10% stink as compared to normal socks.).And as zinc oxide also acts as a shield against harmful UVA and UVB radiation, therefore it would not lead the skin to be tanned.

### III. Stain Repellence Test

Ensuring the stain repellence property of the zinc blended fabric, we used grease to test the same. For this, we did apply grease on both the samples i.e. on normal and zinc blended stockinette fabric. This fabric samples were allowed to dry for 6 hours. And then both the samples were washed and the stain retained on the fabric after washing was noted.

### Result:



The stain retained more in the case of normal fabric while the stain on zinc blended fabric was nearly washed off which proved good stain repellence property of zinc blended fabric.

**The above mentioned tests are some of the tests which are to be done to make proper inspection of quality of fabric and its aesthetic properties.**

### REFERENCES

➤ **Mr. Paresh Patel, Surgicot Fab. Tex. Pvt. Ltd.**

[surgicot@gmail.com](mailto:surgicot@gmail.com)

➤ **CN103757914A:** Preparation method of wear proof and antibacterial blended fabric

<https://patents.google.com/patent/CN103757914A/en?q=Zinc&q=Blended+facric&oq=Zinc+Blended+f+acric>

➤ **US4199322A:** Antibacterial textile finishes utilizing zinc

<https://patents.google.com/patent/US4199322A/en?q=Zinc&q=fabric&oq=Zinc+in+fabric>

