DESIGN AND DEVELOPMENT OF COTTON/LYCRA BLENDED GARMENT WITH RESISTANCE BAND FOR SPORTS APPLICATION

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ABSTRACT

Sports are an essential component of living a better and more balanced life. The progression of innovation had expanded the bar for sportswear. Individuals seek performance and clothing comfort in addition to durability, design, and being fashionable. Fabrication of textiles suitable for sports and other practical wear had became increasingly important in recent years due to the potential market. The diverse textile substrate production was focused not only on the discovery of new fibres, but also on yarn and fabric production innovation. Moisture management, thermal behaviour, and breathability were all important characteristics of any sport fabric. In our sportswear we had blended two fibres such as cotton and lycra to accomplish extra calorie burning properties, to provide comfort to the wearer, and to absorb sweat.

First, we had selected organic cotton and lycra yarn for blending, and we created three fabric samples using those cotton and lycra yarns: rib with a ratio of (95:5), single jersey with a ratio of (95:5), and rib with a ratio of (96:4). At that point we ran two tests to see which blend would be best for our article of clothing: the tests were water drop test and colour fastness to hot pressing test. Amid those testing, we had found that single jersey with a proportion of (95:5) is superior for our clothing. We had also ran two further tests to see if the Single jersey fabric sample was compatible, including a stretch and recovery test and a bursting strength test. Those tests were also passed by the cloth sample.Then, to combat sweat odour during activities, which was a problem with most sportswear, we had given our clothing a lavender aroma finish. During workouts, the user will feel refreshed and inspired thanks to that finish. After completion, the cloth was stitched using an interlock machine by adding a medium-level resistance band to the fabric's sides. The key feature of our project was the addition of resistance band, which allows the garment to have more flexibility and a tighter grasp, allowing it to burn more calories compared to other sportswear.

Keywords: sportswear, cotton, lycra, fragrance finish

INTRODUCTION

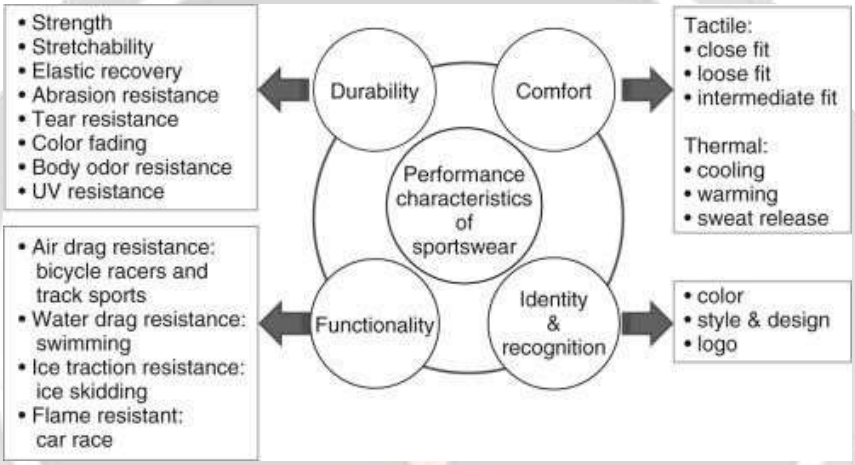
Sports apparels are sport-specific garments worn by the general public for physical activity. In addition, Indian celebrities frequently promote various sports brands, which fuels the Indian Sports Apparel Market's growth over the projection period. Modern organised retail is a systematic strategy to distribution and logistics management that targets both urban and rural populations, hence promoting market growth in the coming years.

Mizuno, a Japanese firm, is a significant sportswear manufacturer worldwide. Nivia is the biggest sportswear company in India. The Indian sports apparel market was valued at USD 498.68 million in FY2020, and it is expected to grow at a 16.06 percent annual pace. The market is projected to rise as people's health worries and disposable income increase. Furthermore, benefits of sports gear such as better durability, increased range of motion, material breathability, and superior comfort are some of the major factors driving the Indian sports apparel sector forward.

Sportswear, often known as activewear, is clothing that is worn for sports or physical activity. For common sense, consolation, or security reasons, sport-specific attires is mostly used in physical exercises and other sports activities. Sports textures are innovative textures that offer assistance the

wearer remain comfortable whereas working out. The sort of cloth utilized will be decided by the exercises and activities concentrated. Long-distance running attire with awesome dampness wicking characteristics will keep the wearer comfortable by permitting sweat to travel from the interior to the exterior of the piece of clothing. Winter or snow sports execution attire ought to be made of breathable textures with fabulous protection characteristics.

Fabrics for sportswear are made up of both natural and synthetic fibres. Spandex and lycra are the foremost predominant textures utilized in gym and sports. Typically, due to the clothing's tall stretchability, which makes it agile and comfortable to move in. In reality, the fabric has been known to extend 100 times its unique measure, making it a well-known choice for athletic apparel. Cotton, on the other hand, will continuously be the wearers to begin with choice since it gives various benefits to the person who wears it. Its main feature is that it is more absorbent, allowing it to absorb sweat and provide comfort to the wearer. The focus of sportswear is on the wearer's comfort and performance. Specialty fibres and yarns are employed to meet their moisture management, elongation, and recovery needs, with softeners used only to enhance or supplement the benefits. Moisture management is the process of wicking liquid moisture or perspiration away from the skin's surface and then evaporating it to keep the wearer dry.



Our garment was designed to have a higher calorie burning capacity and provide more flexibility to the wearer. As a result, we concentrated on each stage from beginning to end. The steps are as follows:

*Cotton and lycra yarn blend

*Three sample preparation

*Testing to find best sample (2 tests)

*Testing to the selected sample (2 tests)

*Fragrance finish

*Stitching with Resistance Band

The benefits of cotton lycra mixed gym wear or sportswear for the wearer are numerous. It contains sweat-absorbing characteristics and provides extra comfort for the wearer. The wearer benefits from the suppleness of

the resistance band. This is the primary motivation behind our decision to design and produce a cotton-lycra blend clothing with a resistance band for use as gym or sportswear. [1] [2] [3]

2. MATERIALS AND METHODS

- SELECTION OF YARN
  ORGANIC COTTON YARN
  LYCRA YARN
- CHOICE OF RESISTANCE BAND
- MACHINE DETERMINATIONS
- SELECTION OF BLENDING PROCESS
  COTTON / LYCRA BLEND
  TESTING
- TEST RESULTS
- FRAGRANCE FINISH

SELECTION OF YARN

1. ORGANIC COTTON YARN

Organic cotton was chosen because it contains many advantages for farmers and also for the wearers.

- Combats worldwide warming.
- Water was conserved and protected.
- Helps agriculturists in giving nourishment for their families
- Farmers, not GM firms, have power.
- Synthetic insecticides are no longer used.

Cotton that had been grown without the use of toxic pesticides, chemicals, or Synthetic fertilisers was known as organic cotton. Organic cotton farming methods and materials enhance soil fertility while reducing negative impacts on rivers and fresh water source around cotton plantations. [4]

Organic Cotton

2. LYCRA YARN

When we think of sportswear, one term that comes to intellect is without a doubt Lycra. Lycra has a lot of flexibility, which is great for athletes. Lycra was a heat resistant synthetic that had quickly become a popular addition to heat-sensitive synthetics such as polyester and nylon.Lycra was the trademark name for Dupolyurethane pont's or spandex fibre. It was essentially a grafted polymeric fibre with a very high extensibility (up-to 400 percent). [5]

Lycra

SELECTION OF RESISTANCE BAND

Ladies and gents both utilise resistance bands as muscle-building equipment. However, in our project, we had stitched resistance band into the sides of a cotton lycra blended garment, which will give the garment more elasticity and allow the wearer to burn more calories**.** Its benefits incorporate madestrides utilitarian capacity, expanded quality and continuance with expanded muscle a ctuation, and moved forward body composition, strength, and quality of life.1–9 In expansion, it is down to earth to utilize, being moo fetched and able to be utilized in several places. [6]

Resistance Band

2.1 MACHINE DETERMINATIONS:

The Circular Knitting machine was the machine that was utilised for the blending or fabricating process. UNITEX was the name of the machine model. Unitex was dedicated to the creation of high-quality, user-friendly machinery. Unitex was now one of the most well-known names in the knitting industry. The headquarters of this company was in Singapore. The company had a strong foothold in India, Turkey, and other fleece and jersey fabric markets. The distance across of this machine which had utilized for the blending prepare was 30. It features a total of 90 feeders or feeding systems for the yarn feeded. It had

totally 2330 needles in it, which were utilised in the blending process. Finally, this machine rotated at a rate of 20 revolutions per minute (RPM).

Table 1. Machine Determinations

DETERMINATION	SPECIFICATION
Machine type	Circular knitting machine
Machine model	Unitex
Machine diameter	30
Gauge	24
No. Of. Feeders	90
No. Of. Needles	2330
Revolution per minute (rpm)	20

SELECTION OF BLENDING PROCESS

1. **COTTON/LYCRA BLEND:-**

Cotton Lycra fabric was a combination of cotton and Lycra. Cotton was a well-known natural fibre, whereas Lycra was a stretchy, synthetic fibre with greater elasticity that goes by the brand name 'Spandex.' These were commonly utilised to provide comfort in everyday wear and sport clothing. Cotton Lycra was known for its extraordinary stretchability and wrinkle resistance. Cotton Lycra had combined the benefits of natural and synthetic fibres to deliver the comfort of skin-friendly breathability and well-fitting without oppression. Lycra was a type of elastomer that adds flexibility to a fabric while also improving its recovery and form retention. [7]

Cotton Lycra Blend

3. TESTING:

For sports article of clothing we had done few tests.. That tests were as mentioned below.

- **Stretch and recovery**
  Stretchable texture can be expanded within the course in which constrain was connected without/before breaking by two-way extend (extended in the crosswise direction) or four-way stretch extended in both directions, crosswise and lengthwise. Stretch woven fabrics are popular because of their agreeable qualities, such as formability, fit to the human body, and shape retention after use. [8]

- **Water permeability**
  The ability of a fabric to allow perspiration in its vapour or liquid form (which relies on the entire clothing system) to travel through it is measured by its water permeability. Several indexes, such as water vapour permeability, water repellence, and water resistance, are commonly used to assess this ability.

- **Bursting strength**
  The capacity of a fabric (such as a paper or material) or question (such as a metal pipe) to preserve in coherence when subjected to weight broadly : the weight frequently communicated in pounds per square inch required to crack such a fabric or question beneath inflexibly controlled conditions. When a fabric is compressed, it begins to expand in all directions at the same moment. After reaching a pressure limit, the fabric begins to break as the applied pressure progressively increases. Burst quality is the title given to this weight limit. [9]

- **Colour fastness to hot-pressing**
  The resistance of coloured and printed textile items to ironing and processing on hot cylinders is determined by performing a hot-pressing fastness test on them. Different tests are carried out on the cloth when it is dry, moist, or damp. [10]

- **Water drop test**
  Fabrics' water absorption is assumed to be impacted by their texture and density, the degree of thread twisting, the percentage of synthetic fibres blended in, and the physical qualities of fibres themselves. Water is thought to be retained in only three places by a fabric:
  (1) In the weave intersections' designated spaces ("fabric" water).
  (2) Between individual fibres in a yarn's capillary space ("yarn" water).
  (3) Within the fibre itself ("fibre" water). [11]

4. TEST RESULTS :

1.WATER DROP TEST

1st sample;-(Rib)

Result :

We had started with the first step in water drop test, with the test of proportion 95:5 Rib was taken. Then the sample had undergone in the test named (DS 263-VERSION 4). Test started at 9am and ended at 9pm with the temperature of 21°C and with the RH% of 65%. Sample test was kept on a level surface and water beads was set on the test for five times one by one. Each droplet took a minimum of 1.0 sec to penetrate into the fabric and each droplet covered a distance of 2.1cm. Then the CV% of time in seconds was noted as 4.4% and CV% of distance in cm was noted as 3.4%. After we had completed the water drop test the report mentioned that the (95:5 ratio) Rib sample was OK(suitable for sportswear).

1.WATER DROP TEST:

TEST METHQD :DS 263-V

ERSION 4

CONDITION TIME IN :9.00 AM TEMPERATURE :21.C

CONDITION TIME 1N :9.00 PM RH% :65%

S.NO		TIME IN SECONDS (D)	DISTANCE IN CM (L)	
	1	1.2 SEC	1.8 CM	
	2	1.3 SEC	1.6 CM	
	3	1.9 SEC	1.7 CM	
	4	1.7 SEC	1.9 CM	
	5	1.6 SEC	1.8 CM	
AVERAGE		1.5 SEC	1.8 CM	
SD OF D		0.28	_	
CV% OF D		18.07%	_	
SD OF L		_	0.11	
CV% OF L		_	6.5%	

Water drop test results for the 1st sample of ratio (95:5) Rib.

2nd Sample:- (SINGLE JERSEY)

Results:

As the second step in water drop test, second sample of ratio 95:5 Single jersey was taken. Then the sample undergone in the test named (DS 263-VERSION 4). Test started at 9am and ended at 9pm with the temperature of 21°C and with the RH% of 65%. Fabric sample was kept on a flat surface and water droplets was placed on the sample for five times one by one. There each droplet took exact 1sec and showed variance in milliseconds and distance covered varied from 1.6cm to 1.8cm. Then the CV% of time in seconds was noted as 18.07% and CV% of distance in cm was noted as 6.5%. After completing the water drop test the report had mentioned that the (95:5 ratio) Single jersey sample was OK(suitable for sportswear).

1.WATER DROP TEST:

TEST METHQD :DS 263-V

ERSION 4

CONDITION TIME IN :9.00 AM TEMPERATURE :21.C

CONDITION TIME 1N :9.00 PM RH% :65%

S.NO		TIME IN SECONDS (D)	DISTANCE IN CM (L)	
	1	1.2 SEC	1.8 CM	
	2	1.3 SEC	1.6 CM	
	3	1.9 SEC	1.7 CM	
	4	1.7 SEC	1.9 CM	
	5	1.6 SEC	1.8 CM	
AVER AGE		1.5 SEC	1.8 CM	
SD OF D		0.28	_	
CV% OF D		18.07%	_	
SD OF L		_	0.11	
CV% OF L		_	6.5%	

Water drop test results for the 2nd sample of ratio (95:5) Single jersey.

3rd Sample:- (RIB)

Results:

As the thrid step in water drop test, third sample of ratio 96:4 Rib was taken. Then the sample undergone in the test named (DS 263-VERSION 4). Test started at 9am and ended at 9pm with the temperature of 21°C and with the RH% of 65%. Fabric sample was kept on a flat surface and water droplets was placed on the sample for five times one by one. The droplets took more than 1min to penetrate into the sample. After completing the water drop test the report mentioned that the (96:4 ratio) Rib sample was NOT OK(not suitable for sportswear).

1.WATER DROP TEST:

TEST METHQD :DS 263-V

ERSION 4

CONDITION TIME IN :9.00 AM TEMPERATURE :21.C

CONDITION TIME 1N :9.00 PM RH% :65%

S.NO		TIME IN SECONDS (D)	DISTANCE IN CM (L)	
	1	Above 1 min	-	
	2	Above 1 min	-	
	3	Above 1 min	-	
	4	Above 1 min	-	
	5	Above 1 min	-	
AVER AGE		Above 1 min	-	
SD OF D		-	-	
CV% OF D		-	-	
SD OF L		_	-	
CV% OF L		_	-	

Water drop test results for the 3rd sample of ratio (96:4) Rib.

2.COLOUR FASTNESS TO HOT PRESSING TEST METHOD:ISO 105 X-11:1994

1st Sample:- (RIB)

The three samples were taken for the second test named colour fastness to hot pressing. This test method was termed as (105 X-11:1994). There in that test the samples were undergone the test in three ways named Dry, Damp and Wet. We started with dry squeezing, a warm plate was utilized to press the dry texture sample. Secondly we damp pressed the sample which is soaked in water and after it was squeezed by placed it on a dry specimen, after heat plate was used to press the sample. Then in wet pressing the sample was soaked in water, after it was pressed and placed on a dry cotton cloth and heat pressing was done.

The first sample of ratio (95:5) Rib was taken and it undergone dry pressing. There in dry pressing the results we noted for colour change was 4-5 and for staining on cloth was also 4-5. At that point it was taken for wet pressing, then came the colour alter was 4-5 and recolouring on cloth was 4. At last, the damp pressing, there the results that came for colour alter was 4-5 and recolouring on cloth was 4. The requirement needed to pass the test was 3-4.

PARAMETER	RESULTS	REQUIREMENTS	CONCLUSION
DRY			
Colour Change	4--5	4	
Staining On Cotton	4--5	3--4	
DAMP			
Colour Change	4--5	4	
Staining On Cotton	4	3--4	
WET			
Colour Change	4--5	4	
Staining On Cotton	4	3--4	

2nd Sample:- (SINGLE JERSEY)

The second sample of ratio (95:5) Single jersey was taken and it undergone dry pressing. There in dry pressing the results for colour change was 4-5 and for staining on cloth was also 4-5. Then it was taken for damp pressing, the results for colour change was 4-5 and staining on cloth was 4. Finally the wet pressing, there the results for colour change was 4-5 and staining on cloth was 4. The requirement needed to pass the test was 3-4. We found that this sample had a higher possibility for being a sports garment.

	RESULTS	REQUIREMENTS	CONCLUSION
DRY			
Colour Change	4--5	4	
Staining On Cotton	4--5	3--4	
DAMP			
Colour Change	4--5	4	M
Staining On Cotton	4	3--4	
WET			
Colour Change	4--5	4	
Staining On Cotton	4	3--4	
PARAMETER	RESULTS	REQUIREMENTS	CONCLUSION
DRY			
Colour Change	4--5	4	

3rd Sample:- (RIB)

The third sample of ratio (96:4) Rib was taken and it undergone dry pressing. Here in dry pressing the results that came for colour alter was 4-5 and for recolouring on cloth was additionally 4-5. Then it was taken for damp

pressing, the results for colour change was 4-5 and staining on cloth was noted as 4. Finally, the wet pressing, there the results for colour change was 4-5 and staining on cloth was 4. The requirement needed to pass the test was 3-4. This sample had not possessed qualities for being a sports garment.

PARAMETER	RESULTS	REQUIREMENTS	CONCLUSION
DRY			
Colour Change	4--5	4	
Staining On Cotton	4--5	3--4	
DAMP			M
Colour Change	4--5	4	
Staining On Cotton	4	3--4	
WET			
Colour Change	4--5	4	
Staining On Cotton	4	3--4	

Based on the three samples that undergone the water drop test and the colour fastness to hot pressing test, the sample Single jersey with a proportion of (95:5) was chosen as the leading texture for our outfit. It had more sportswear related features than the other samples. It was put through two more tests to see if it could be used as a sportswear the tests were stretch & recovery and bursting strength

2] (BURSTING STRENGTH & STRETCH AND RECOVERY TEST)

Results:

The selected sample of ratio (95:5) Single jersey was taken for the third test named Stretch and recovery. Method used was (.ASTMD 3107-07-2019.). In this test the fabric sample was stretched lengthwise for 30min with 4 lbs tension applied and the fabric growth as well as the fabric recovery was noted in different time intervals such as 30 seconds, 30 minutes, and 30 hours. Then the sample was stretched width wise for 30min with 4 lbs tension applied. There also, the fabric growth and fabric recovery is noted for 30 seconds, 30 minutes and 30 hours.

1.STRETCH AND RECOVERY:

TEST METHOD .ASTMD 3107-07-2019.

LENGTH WISE

Fabric stretches after 4 lbs tensioning for 30 min :

Fabric Growth after 4 lbs tensioning for 30 sec 4.0%

relaxation : 9.8%

FABRIC GROWTH AFTER STRETCHING TO 39.7 CM

After 30 sec Relaxation % : 2.6%

After 30 min Relaxation % : 2.5%

After 30 hours Relaxation % : 2.0%

FABRIC RECOVERY AFTER STRETCHING TO 39.7 cm

After 30 sec Relaxation % : 97.4%

After 30 min Relaxation % : 97.5%

After 30 hours Relaxation % : 98.0%

WIDTH WISE

Fabric stretches after 4 lbs tensioning for 30 min :

Fabric Growth after 4 lbs tensioning for 30 sec 39.4%

relaxation : 10.2%

FABRIC GROWTH AFTER STRETCHING TO 39.7 CM

After 30 sec Relaxation % : 2.4%

After 30 min Relaxation % : 2.6%

After 30 hours Relaxation % : 2.7%

FABRIC RECOVERY AFTER STRETCHING TO 39.7 CM

After 30 sec Relaxation % : 97.6%

After 30 min Relaxation % : 97.4%

After 30 hours Relaxation % : 97.3%

2. BURSTING STRENGTH

IS0.13938-Part 1:2019

Then the selected sample of ratio (95:5) Single jersey was taken for fourth test named Bursting strength test. Testing method used was (IS0.13938-Part 1:2019).The sample was clamped over an expandable diaphragm. The diaphragm was extended by liquid weight to the point of example break. The difference between the total pressure required to rupture the specimen and the pressure required to inflate the diaphragm was noted. The results we got after the bursting strength test was 75.6 Psi and the required result was 60 Psi. So, sample passed the test.

PARAMETER	RESULTS	REQUIREMENTS	CONCLUSION
BURSTING STRENGTH	75.6 Psi	60 Psi	M

So, these were the test results. We found out that (95:5)ratio Single jersey was more suitable for our garment. After evaluating, the selected garment was taken into fragrance finish.

4.FRANGRANCE FINISH:-

Textile fragrance finishing was a technique in which we add incentives to a product to increase its worth. The global marketplace was constantly evolving, and so was people's demand. Every individual yearns for a change. i.e., something new and different. Change must be implemented successfully and effectively in the market. The fabric we had took was used by our team to manufacture a sportswear item. Most of the sports person, athletes and gym goers were having the discomfort for sweat odour. After sweat was retained by their clothing, they were bothered by a sweat-soaked smell in their sportswear. To solve this problem, we had given our fabric a fragrance finish. This fragrance will aid people who undertake workouts and

sports activities by raising their mood by preventing sweat smell. We had chosen lavender for the fragrance finish and applied it to the outfit. Lavender functions as a refreshing agent for those who wear the clothing and helps to prevent perspiration odour. This was performed using the exhaust method, which involved mixing of 300ml lavender fragrance in water. The fabric was then immersed in the mixture for minutes. After 40 minutes, the fabric was removed and placed in the dryer for 1.30 hours to achieve a nice lavender fragrance and we had achieved good lavender fragrance in our garment. [12] [13]

4.1 PROPERTIES OF FRAGRANCE FINISH:-

Our fabric keeps the wearer fresh and gives off a pleasing smell, which maintains the fabric fresh and natural for a long time, even in particular environments. It also keeps fresh and gives off a pleasing smell, which keeps the fabric fresh and natural for a long time.

CONCLUSION:

People nowadays were rushing to find work in order to obtain financial independence, but no one was concerned about their physical fitness. Jogging, walking, and working out maintain our bodies in shape and protect us from a variety of ailments. So, based on the three samples that undergone the water drop test and the colour fastness to hot pressing test, the test Single jersey with a proportion of (95:5) was chosen as the leading texture for our outfit. It had more sportswear related features than the other samples. It was put through two more tests to see if it could be used as a sportswear the tests were stretch & recovery and bursting strength. The sample passed those two tests as well.
Followed all the testing, the fabric is subjected to a fragrance finish, and completed which helped to reduce perspiration odour and allowed the wearer to focus more on their exercises. Our garment was designed to provide additional calorie burning options, as well as a fragrance finish that helped the wearer to reduce perspiration odour and improved their mood during exercises.

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