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## Studies on Denim Fabrics for Their Market Size and Growth and Their Fabric Physical Properties

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**Abstract:** Denim is a fabric manufactured out of 100% cotton fibers and the woven fabric construction is in general of twill weave construction. The wearers, especially the youth, in cities beyond the metros and mini metros are growing exceptionally inspirational. that they are increasingly accepting denim as a core apparel category of fabric among the other varieties to be worn as an everyday casual garment. Traditionally, the denim fabric is blue denim constructed with a warp-faced twill in a 3 up 1 down construction. In general, coarse yarns spun from ring spinning system or in rotor spinning system are used for the denim fabric manufacture. The warp yarns are dyed with a solid colour like indigo dyes and the weft yarns are used without dyed. It means that there are more warp yarns than weft yarns appear on the face of the fabric and this gives a characteristic of the denim fabric a bluer face on the face of the fabric and moreover, much paler and almost white background on the back side of the fabric. The count of the yarns used for the manufacture of denim fabrics is in the range of Ne 10, Ne12, Ne 16 & Ne 20. Further more the warp and weft counts are different in character. i.e. Ne 12 warp yarn and Ne 10 weft yarn. In this study, few denim fabric samples were tested for their fabric properties like air permeability, fabric weight in gsm, EPI, PPI, count of warp & weft, crease recovery angles, water vapour permeability and thermal properties.

**Keywords:** Denim, Indigo dye, apparel, twill weave, water vapour permeability, gsm.

### I. INTRODUCTION

Denim is of the most prominent category in India's garment sector.. In 2015, the denim market of India was worth `18,500 Cr. which accounts for 7 percent of the total apparel market of the country. The market is projected to grow at a CAGR of 15 percent to become `29,200 Cr. market in 2018. The denim market in India is skewed towards men's segments with 80 percent contribution coming from it. Women's denim sector contributes 12 percent to the market and the children's wear contribute the rest 8 percent. The women's and kid's denim segments are expected to witness higher growth rates due to their lower level and increasing demand of brands and retailers on those segments. In general the western lifestyle and western fashion has boosted the trend of actual scenario across the globe. This trend has boosted the consumption of general fashion dresses like denims, casual shirts among both the gender consumers in developing countries including India. The mean number of denim items owned by Indian consumer is much lower in comparison to consuming market of the developed countries in the west. The number is even lower than countries like Brazil and China. This difference in the number demonstrates the huge potential that exists for denim in the domestic market. In India unbranded denim products dominate the market with around 65 percent share of the market. The share of brands in denim market stands at 35 percent. Many unbranded denim producers operate on the cheaper price segment of the market where awareness of quality of the fabric, design, treatment to the fabric in wet processing and washes, fit are relatively low. In India these cheap quality denim products dominate the market with around 60 percent share of the market. The contribution of branded items in denim market stands at 40 percent...

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Some of the key attributes for the denim market in India are:

- People with age group of 15 to 30 years with higher income than previous generations make 28 percent of the consuming population of the denim fabrics.
- Comfort and Style as perceived by a wide range of consumer segment.
- Young generation people prefer the denim as a product of versatile association.
- Increasing usage of denim products by women and youth in smaller cities and rural India

## II. Materials and Methods

Fabric samples were collected from the market from the leading brand manufacturers. The fabric samples were tested for their physical properties like air permeability, count of the warp and weft yarns used for the manufacture, ends per inch (EPI) and picks per inch (PPI), fabric weight, water vapour permeability and thermal resistance of the fabric.. The fabric samples were classified in to four varieties like light weight denim for children's wear, medium weight, heavy weight and light weight denim fabrics meant for jackets. All the fabric samples were tested in standard testing equipment.

## III. Results and Discussions

Fabric samples were tested for the following properties which will have an effect on aesthetic and comfort characteristics during the normal wear life of the fabric.

1. Air permeability
2. Ends per inch and Picks per inch
3. Areal density (fabric weight)
4. Water vapour permeability
5. Thermal resistance

### III. a. Air Permeability

The air permeability of the fabric is defined as the fabric's ability to allow the passage of air in to the interstices of the fabric. It is expressed in volume of air in litres per minute through 50 Cm<sup>2</sup> of the fabric. The reciprocal of air permeability is the air resistance. All the fabrics were manufactured from 100% cotton fiber. The test results of the air permeability of the four fabric samples expressed in l/min/50cm<sup>2</sup> is shown in Table 1.

Table 1: Air permeability values of the sample fabrics.

Fabric type	Fabric weight (g/m <sup>2</sup> )	Air permeability values (l/min/50cm <sup>2</sup> )
Light weight for children's wear	275	42.32
Medium weight	390	12.90
Heavy weight	420	12.45
Light weight for jackets	370	12.90

From the Table 1, it was observed that the air permeability values of the fabric depend on the compactness of the fabric. Higher the weight of the fabric expressed in grams/square meters, lesser the permeability of the air. It is due to the resistance offered by the constituent yarns in the warp and weft directions. Lower the fabric weight the air permeability is better.

### III b. Weave, Count of Warp & Weft, Ends per Inch and Picks per Inch of the Denim Fabrics

The sample fabrics were analysed for their weave construction, ends per inch in warp direction and picks per inch in weft direction of the fabric and the results are shown in Table2.

Table 2: Weave, count, Ends per inch and picks per inch of the denim fabrics.

Fabric type	Weave construction	Ends per inch	Picks per inch	Density (Sq.inches)	Warp count (Ne)	Weft count (Ne)	End use
Light weight	3/1 Twill	68	44	2992	16	2/24	Children's wear
Medium weight	3/1 Twill	76	42	3192	6	14 (with lycra)	Jeans

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Heavy weight	3/1 Twill	86	54	4644	6	8	Heavy trousers
Light weight	3/1 Twill	66	40	2640	8	12	Jackets

From the Table 2, the ends per inch, picks per inch of the sample fabrics show that the fabrics of heavy construction have more intersections in warp and weft directions. This means that heavy weight fabrics have lesser air permeability than the light weight fabrics which can allow more air to pass through the fabrics. The density of the fabrics is calculated by multiplying the ends per inch and picks per inch.

### III c. Water Vapours Permeability of the Fabrics

The water vapour permeability of the fabrics is an important property in clothing which is required during vigorous activity. The clothing should be able to remove the sweat produced and evaporate it during such activity. The clothing must be able to remove moisture and to provide comfort without reducing the thermal degradation of the fabric. It is generally calculated by expressing the water vapour permeability (WVP) of the fabric as a percentage of the (WVP) of a reference fabric. The water vapour permeability of the four samples tested is shown in Table 3.

Table 3: Water vapour permeability of the fabrics

Fabric type	Water vapour permeability Index (L)	Water vapour permeability (g/m <sup>2</sup> /day)	End use
Light weight	75.84	1833.20	Children's wear
Medium weight	73.54	1777.73	Jeans
Heavy weight	76.83	1857.22	Heavy trousers
Light weight	77.83	1873.85	Jackets

From the Table 3, it was observed that all the four fabric samples have better water vapour permeability which shows the denim fabric give good comfort during the period of high activity.

### III d. Thermal Resistance of the Fabrics

The heat transmission through a fabric occurs by both by radiation, conduction through the fiber. The thermal resistance of the fabric is the resistance offered by the fabric to the rate of heat flow per unit area. The thermal resistance of the four fabric samples is shown in Table 4.

Table 4: Thermal resistance of the fabrics

Fabric type	Thermal resistance (Rct) m <sup>2</sup> mk/w	End use
Light weight	66.1	Children's wear
Medium weight	68.06	Jeans
Heavy weight	70.72	Heavy trousers
Light weight	68.06	Jackets

From the Table, the amount of heat passing through the sample fabric in watts per square metre is measured from the power consumption of the test plate heater of the instrument. The measured thermal transmittance of the fabric consists of the thermal transmittance of the fabric plus the thermal transmittance of the air layer above the fabric. It means heavy weight fabric have better thermal resistance than its counter parts although the difference is marginal only.

## IV. Conclusions

The growth of the denim fabric usage all over the world is in increasing trend. It is due to the rugged construction and comfort to wear and hence it occupies a core market in the apparel industry. The fabric samples available in different categories were tested for their fabric properties. The air permeability of the fabrics is good for light weight fabrics is better by 69% than the medium and heavy weight fabrics as it is influenced by the ends per inch, picks per inch, fabric weight and also its thickness. The fabric density is more for heavy weight fabrics due to EPI and PPI. The water vapour permeability is good for all the fabric samples which show the denim wear conducts moisture transport to and away from the body. The thermal resistance of the heavy weight fabrics is better by 6% than the other fabrics due to the tightness of the weave.

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