

Detailed Investigation of Weft Knitted Interlock Fabrics for Comfort Properties to Suit for Active and Sportswear Application.

S. Sundaresan, K. J. Sivanganam, A. Selva Kumar

Abstract: Vast growth has been noticed in the current years toward the use of fibres and clothing in the sportswear garment sector. Comfort properties of sports garments has been considered as one of the main function in developing the sports garment. Lot of research work and ideas are taken care by garment manufacturers in making sportswear garments. Many more development in fabrics used for making sports garments especially for athletics were taken place in recent years. Mostly knitted fabrics are mainly used to make sportswear garments, which throws more scope of research and development in developing new knitted fabric structure with related high performance fibres. New development of knitted fabric using the interlock construction leads to more space of developing knitted fabric with high comfort properties. Interlock fabrics made with separate kind of yarn in face, back and inlay with various structures enhances to produce knitted fabric with more comfort properties in sportswear. Knitted fabric is produced using different face, back and in lay yarn using interlock weft knitted structure has been carried out in this work and also their properties were studied thoroughly. To achieve more comfort and essential properties in weft knitted interlock fabric to suit sportswear, the fabric in this research work has been produced using yarn made up of cotton, polyester and viscose. Various Knitted fabrics has been produced by altering fabric structure, yarn linear density (Yarn count). The properties of fabric have been analyzed with respect to its air permeability, moisture management and thermal conductivity.

Key Words: Interlock fabric, comfort properties, linear density, air permeability, thermal conductivity, moisture management, weft knitting, multi-layer jersey fabric.

I. INTRODUCTION

In garment sector the sportswear garment manufacturing plays an important role and the market for this type of garment shows a raising trend in the current years. Sportswear garment with specific functional requirement like comfort properties to be taken for consideration in making this type of garments. Lot of research work is undertaken in this field by leading sportswear garment manufacturing industries. Fabric with more functional properties made with high performance fibrosis most suited for athletics activities. Due to the low cost of production and ample of design opportunities weft knitted fabric is mostly used to produce sportswear garments. interlock weft knitted fabrics with various material in face, back and inlay with multiple structures improves the properties of knitted fabric.

This leads to take research activities in this sector using interlock structures. This research work has been done to find the role of various materials and structures used in the production of weft knitted interlock fabrics and its properties. Various weft knitted interlock fabric samples has been developed using cotton, polyester and viscose yarn of different counts. Fabric properties like air permeability, moisture management and thermal conductivity of weft knitted interlock fabrics has been studied.

II. LITERATURE REVIEW

As per the research findings of Barker (2002) comfort properties of fabric is based on physical properties of fibres and fabric parameters. Air permeability of fabric plays more important role in deciding the comfort nature of fabric. The air permeability of fabric depends on the fineness of fabric. (Gozde et al 2011). Comfort and handle property of fabric is mainly affected by the moisture behaviour of material used in the fabric (Manshahia & Das, 2014). Material made up of 100% cotton gives more ease and comfort for the wearer in sports activities (Bliss, 2005). N.Anbumani et al (2008) found that knitted fabric made by using bi layer concepts found most suited for sportswear. Sampath, et al (2011) in their research work found that the comfort properties of knitted fabric is directly proportional to filament fineness of yarn. Asta et al (2014) in their work reveals that fibre used in yarn, fabric structure, yarn loop length and tightness factor of knitted fabric has a direct influence in deciding the air movement in the knitted fabric. Ajmeri et al (2013) found that thermal comfort properties of knitted fabrics made of cotton is higher when compared with fabric made up of modal fibres. Abd El-Hady (2011) in his research work found that weft knitted fabrics made from Micro denier polyester have better comfort properties when compared to normal denier polyester knitted fabrics. ERTEKİN et al (2011) found that knitted fabric made by using mono filament spacer yarn gives higher thermal insulation and property. Asta et al (2012) in research work founds that stated that type of fibre, yarn structure fabric dynamics and finishing applications plays a major role in deciding the comfort and handle value of knitted fabric.

Detailed Investigation of Weft Knitted Interlock Fabrics for Comfort Properties to Suit for Active and Sportswear Application.

III. MATERIALS AND METHODS

The materials used for this investigation and its properties are listed in table 3.1 given below. Combed cotton yarns with identical parameters were used for producing the knitted fabric. 24/1, 30/1 and 36/1 Ne cotton yarn and in case of

polyester 155denier, 100denier, 80 denier used for the study. This range of cotton counts and polyester yarns are largely used by the knitwear industry due to the better coverage of wide range of areal density in circular knitting machines.

Table -1 Materials used

S.No	Yarn Number / Count	Actual Count (Ne)	Count CV%	CSP	TPI
1.	24/1 Ne cotton	23.7	1.25	2460	15.68
2.	30/1 Ne cotton	29.5	1.01	2472	17.52
3.	36/1 Ne cotton	35.2	1.2	2520	19.2
4.	155 D / polyester (N-Normal)	34 f /4.55 dpf			
5.	100 D / polyester (N-Normal)	34 f /2.94 dpf			
6.	80 D polyester (N-Normal)	34 f / 2.35 dpf			
7.	155 D / polyester (M-Micro)	288 f / 0.53 dpf			
8.	100D/ (Micro)polyester	144 f / 0.69 dpf			
9.	80 D polyester (M-Micro)	108 f / 0.74 dpf			

Table 2: Specifications of weft knitting machine

Machine details	Specification
Type	Circular double jersey weft knitting machine with interlock gaiting
Make	Pailung, Taiwan.
Diameter (inch)	20
Gauge	20
Feeders	50
Feeder type	Positive
Needles	1130
Cam tracks	Cylinder: 2 / Dial : 2
Machine speed (rpm)	30



3.1 Fabric Production

A series of double jersey interlock samples with three identical structures were knitted from yarns described in table 1, using machine details described in

table 2. The figure1 show the diagrammatic representation of the structures.

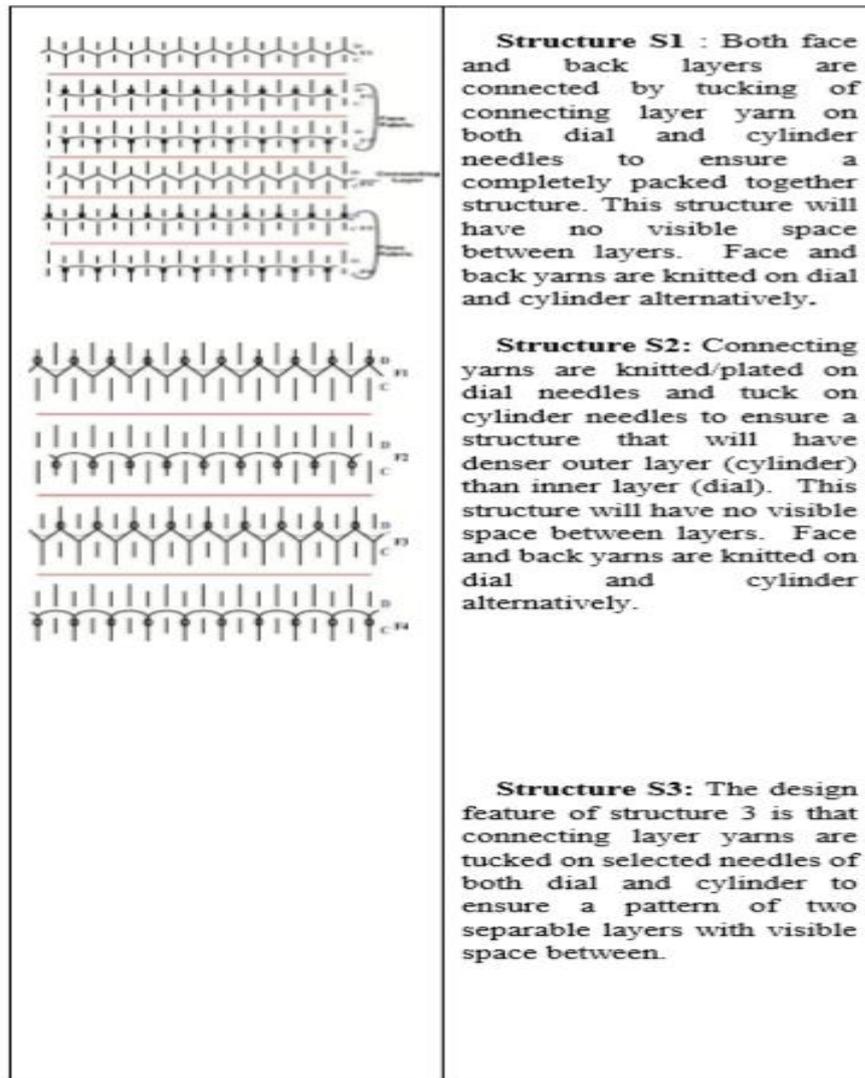


Figure1- Diagrammatic representation of the structures

Table 3-Sample details and code numbers

Details of materials layering (Face yarn / Connecting yarn / Back yarn)	Structure -1 S1	Structure- 2 S2	Structure -3 S3
30 Ne Cotton on Face / Back with			
connecting yarn 24 Cotton Ne	S ₁ C ₁ M ₁	S ₂ C ₁ M ₁	S ₃ C ₁ M ₁
connecting yarn 30 Cotton Ne	S ₁ C ₂ M ₁	S ₂ C ₂ M ₁	S ₃ C ₂ M ₁
connecting yarn 36 Cotton Ne	S ₁ C ₃ M ₁	S ₂ C ₃ M ₁	S ₃ C ₃ M ₁
30 Ne Cotton on Face / Back with			
connecting yarn 155D M polyester	S ₁ C ₁ M ₂	S ₂ C ₂ M ₂	S ₃ C ₁ M ₂

Detailed Investigation of Weft Knitted Interlock Fabrics for Comfort Properties to Suit for Active and Sportswear Application.

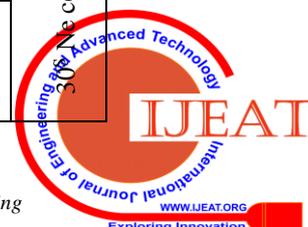
connecting yarn 100D M polyester	S ₁ C ₂ M ₂	S ₂ C ₂ M ₂	S ₃ C ₂ M ₂
connecting yarn 80 D M polyester	S ₁ C ₃ M ₂	S ₂ C ₃ M ₂	S ₃ C ₃ M ₂
30 Ne Cotton on Face / Back with			
connecting yarn 155D N polyester	S ₁ C ₁ M ₃	S ₂ C ₂ M ₃	S ₃ C ₁ M ₃
Connecting yarn 100D N polyester	S ₁ C ₂ M ₃	S ₂ C ₂ M ₃	S ₃ C ₂ M ₃
connecting yarn 80 D N polyester	S ₁ C ₃ M ₃	S ₂ C ₃ M ₃	S ₃ C ₃ M ₃
S – Structure, C – Inlay yarn count, M- inlay material, N-Normal, M-Micro			

Table 4-Yarn Arrangements in Fabric Structure

S.No	Sample code	Structure	Face yarn	In lay yarn	Back yarn
1	S ₁ C ₁ M ₁	Structure S1	30 ^S Ne Cotton	24/1 cotton Ne	30 ^S Ne Cotton
2	S ₁ C ₂ M ₁			30/1 cotton Ne	
3	S ₁ C ₃ M ₁			36/1 cotton Ne	
4	S ₂ C ₁ M ₁	Structure S2	30 ^S Ne cotton	24/1 cotton Ne	30 ^S Ne cotton
5	S ₂ C ₂ M ₁			30/1 cotton Ne	
6	S ₂ C ₃ M ₁			36/1 cotton Ne	
7	S ₃ C ₁ M ₁	Structure S3	30 ^S Ne cotton	24/1 cotton Ne	30 ^S Ne cotton
8	S ₃ C ₂ M ₁			30/1 cotton Ne	
9	S ₃ C ₃ M ₁			36/1 cotton Ne	
10	S ₁ C ₁ M ₂	Structure S1	30 ^S Ne cotton	155 D / polyester (Normal)	30 ^S Ne cotton
11	S ₁ C ₂ M ₂			100 D / polyester (Normal)	
12	S ₁ C ₃ M ₂			80 D polyester (Normal)	



S.No	Sample code	Structure	Face yarn	In lay yarn	Back yarn
13	S ₂ C ₁ M ₂	Structure S2	30 ^S Ne cotton	155 D / polyester (Normal)	30 ^S Ne cotton
14	S ₂ C ₂ M ₂			100 D / polyester (Normal)	
15	S ₂ C ₃ M ₂			80 D polyester (Normal)	
16	S ₃ C ₁ M ₂	Structure S3	30 ^S Ne cotton	155 D / polyester (Normal)	30 ^S Ne cotton
17	S ₃ C ₂ M ₂			100 D / polyester (Normal)	
18	S ₃ C ₃ M ₂			80 D polyester (Normal)	
19	S ₁ C ₁ M ₃	Structure S1	30 ^S Ne cotton	155 D / polyester (Micro)	30 ^S Ne cotton
20	S ₁ C ₂ M ₃			100 D / polyester (Micro)	
21	S ₁ C ₃ M ₃			80 D polyester (Micro)	
22	S ₂ C ₂ M ₃	Structure S2	30 ^S Ne cotton	155 D / polyester (Micro)	30 ^S Ne cotton
23	S ₂ C ₂ M ₃			100 D / polyester (Micro)	
24	S ₂ C ₃ M ₃			80 D polyester (Micro)	
25	S ₃ C ₁ M ₃	Structure S3	30 ^S Ne cotton	155 D / polyester (Micro)	30 ^S Ne cotton
26	S ₃ C ₂ M ₃			100 D / polyester (Micro)	
27	S ₃ C ₃ M ₃			80 D polyester (Micro)	



Detailed Investigation of Weft Knitted Interlock Fabrics for Comfort Properties to Suit for Active and Sportswear Application.

Table -5 MEASUREMENTS OF FABRIC PARAMETERS

Test parameters	Test method
	ASTM D
Yarn count	1907
CPI, WPI and structural Cell Stitch Length (SCSL):	3887
Fabric Thickness:	1777
Areal density:	3776
Determination of air permeability	737-04
Moisture management testing	AATCC 195-2009

3.2 Design of experiment

For the the design of experiment is carried out by using Taguchi methodology using Design Expert-7 Software. The main objective of this method is to optimize the process variables that influences the process outcome. Since three controllable factors and three levels of each factor are considered L9 Orthogonal Array is selected for this study.

Table -6 TAGUCHI'S L9 ORTHOGONAL ARRAY

Order	Parameters		
	S	C	M
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

According to the above fashion the experiments were executed. It is essential to keep some minimum of trails on each experiment to minimize the sampling error. In this aspect five minimum run were done on each experiment, based on that trail's S/N ratio have been obtained for all the measured mechanical properties. For each factor, the level corresponding to the higher S/N ratio is chosen as it optimum level. Subsequent to this stage the factors that have a significant effect on the response is calculated through analysis of variance (ANOVA) of the S/N ratio

Table 7 Experimental outcome of Air permeability

Table 9 Analysis of variance table [Classical sum of squares – Type II]

Source	Sum of squares	df	Mean square	F value	p-value Prob > F
Model	2.981870456	6	0.496978	6.743214411	0.1348
A-Double knit structure	2.422981589	2	1.211491	16.43802232	0.0573
B-Inlay count	0.052823823	2	0.026412	0.358368047	0.7362
C-Inlay fibre	0.506065044	2	0.253033	3.433252867	0.2256

Experiment No	Parameters			Air permeability	S/N ratio, dB
	S	C	M		
1	1	1	1	230.6	37.60799
2	1	2	2	276.8	38.40106
3	1	3	3	245.2	37.8746
4	2	1	2	247.6	37.91691
5	2	2	3	209.8	37.19745
6	2	3	1	207	37.1391
7	3	1	3	187.6	36.71173
8	3	2	1	184.4	36.63701
9	3	3	2	188.6	36.73482

The above table shows that the average air permeability values and its corresponding S/N ratios calculated. The average effects of each on the multiple quality characteristic at different levels were also calculated. The sum of all S/N ratios corresponding to a factor at a particular level divided by number of repetitions of the factor level and it is tabulated as follows.

3.3 RESPONSE ANALYSIS OF AIR PERMEABILITY

Table 8 Response table for the S/N ratio towards Air permeability

Factors	Average S/N of Air permeability dB		
	Level 1	Level 2	Level 3
A-Double knit structure	37.96122	37.41782	36.69452
B-Inlay count	37.41221	37.41184	37.24951
C-Inlay fibre	37.12804	37.68426	37.26126

ANOVA was performed for S/N ratios using Design Expert software 7.0. A F-test value at 95 % confidence level is used to decide the significant factors affecting the process. Larger F- value indicates that the variation of process parameters considered to makes a big change on the performance.



Residual	0.14740104	2	0.073701
Cor Total	3.129271496	8	

In order to find out statistical Significance of various factors like Double knit Structure (A), In lay count (B), and Inlay fibre (C), and their interactions on Thermal conductivity, analysis of variance is performed on experimental data. Table 4.4 shows the results of the ANOVA for S/N ratio. The last column of the table indicates p-value for the individual control factors. The 'p-value' plays an important role in this analysis. It is known that smaller the p-value, greater the significance of the factor. Table 7 indicates that, the Double knit structure (p=0.0573), In lay yarn count (p=0.7362) and Inlay fibre types (p=0.2256). In this order are the most significant control factor is double knit structure.

Percent contribution:

Percent contribution to the total sum of square can be used to evaluate the importance of a change in the process parameter on these quality characteristics. Percent contribution is calculated by the following equation:

$$\text{Percent contribution (P)} = (\text{SS}'A / \text{SST}) * 100 \text{ --- (1)}$$

Table 10 shows individual % contribution of parameters under study.

Table 10 Percentage contribution

S. No	Factors	level description	R ank	Contributi on %
1	A-structure	37.96122	1	77.42957401
2	B-Inlay count	37.41184	3	1.688054969
3	C-Inlay fibre	37.68426	2	16.17197628

3.3.1 Verification of experiment

A verification experiment is the final stage of the experimental design. The objective of this method is to verify the optimum condition suggested by the matrix experiment do indeed give the improvement projected. This analysis is performed by conducting a test with optimal setting of the factors arrived from the above experiments. The predicted value of the multiple S/N ratio at the optimum level is calculated by the following formula

$$\eta_0 = \eta_m + (\eta_{A2} - \eta_m) + (\eta_{B2} - \eta_m) + (\eta_{C1} - \eta_m) \text{---(2)}$$

Where η_0 is the optimum S/N ratio, η_m is the overall mean of S/N values, η_{A2} the average value of S/N at the second level of yarn count, η_{B2} the average value of S/N at the second level of fabric density and η_{C1} the average value of S/N at the first level of laying angle.

Substituting these values of various terms in the above equation

$$\begin{aligned} \eta_0 &= 37.35785 + (37.96122 - 37.35785) + \\ & (37.41184 - 37.35785) + (37.68426 - 37.35785) \\ &= 31.341 \text{ (dB) --- (3)} \end{aligned}$$

3.3.2 Influence of knitting structural parameters on overall moisture management characteristics

Table 11. Parameters and their level of Double-knit structure with face and back yarn count is 30^s Ne

Parameter	Designation	Levels		
		1	2	3
Structure	S	1	2	3
Inlay count	C	24	30	36
Inlay fibre	M	cotton	Polyester	Polyester mic.

The double-knit fabrics were produced according to the Taguchi's L₉ orthogonal design.

Table 12 Experimental outcome of Air permeability

Expe rime nt No	Parameters			OMMC	S/N ratio, dB
	S	C	M		
1	1	1	1	0.223	7.478001
2	1	2	2	0.4558	10.51538
3	1	3	3	0.5129	11.10303
4	2	1	2	0.4072	10.09238
5	2	2	3	0.3744	9.652017
6	2	3	1	0.0961	4.273238
7	3	1	3	0.2808	8.494194
8	3	2	1	0.0134	-4.55312
9	3	3	2	0.3246	9.161907

The above table shows that the average air permeability values and its corresponding S/N ratios calculated using the formula-2. Subsequently the next stage is to find out the average effects of each on the multiple quality characteristic at different levels. This is nothing but the sum of all S/N ratios corresponding to a factor at a particular level divided by number of repetitions of the factor level and it is tabulated as follows

3.4 RESPONSE ANALYSIS OF OMMC

Table 13 Response table for the S/N ratio towards OMMC

Factors	Average S/N of OMMC dB		
	Level 1	Level 2	Level 3
A-Double knit structure	9.698806	8.00588	4.36766
B-Inlay count	8.688193	5.20476	8.179393



Detailed Investigation of Weft Knitted Interlock Fabrics for Comfort Properties to Suit for Active and Sportswear Application.

C-Inlay fibre	2.399373	9.923225	9.749749
---------------	----------	----------	----------

3.4.1 Analysis of Variance (Anova)

This tool is extensively used to detect differences in average performance of groups of items under investigation. ANOVA tool is used to investigate the experimental design parameters and to indicate the influence of that process parameter on the

output variable. In the analysis the sum of squares and variance are calculated. Anova was performed for S/N ratios using Design Expert 7.0. An F-test value at 95 % confidence level is used to decide the significant factors affecting the process.

Table 14 Analysis of variance table [Classical sum of squares - Type II]

Source	Sum of squares	df	Mean square	F value	p-value Prob > F
Model	176.4318383	6	29.40531	3.618706625	0.2323
A-Double knit structure	44.52375959	2	22.26188	2.739614777	0.2674
B-Inlay count	21.24161883	2	10.62081	1.307029177	0.4335
C-Inlay fibre	110.6664599	2	55.33323	6.80947592	0.1280
Residual	16.25183218	2	8.125916		
Cor Total	192.6836705	8			

In order to find out statistical Significance of various factors like Double knit Structure (A), In lay count (B), and Inlay fibre (C), and their interactions on Thermal conductivity, analysis of variance (ANOVA) is performed on experimental data. Table 13 shows the results of the ANOVA for S/N ratio. The last column of the table indicates p-value for the individual control factors. The 'p-value' plays an important role in this analysis. It is known that smaller the p-value, greater the significance of the factor. Table 14 indicates that, the Double knit structure (p=0.2674), In lay yarn count (p=0.4335) and Inlay fibre types (p=0.1280). In this order are the no process parameter influences the outcome of the response.

value of the multiple S/N ratio at the optimum level is calculated by the following formula

$$\eta = \eta_m + \sum_{i=1}^j (n_i - n_m) \dots \dots \dots (5)$$

Where J is the number of factors, n_m the mean value of multiple S/N ratios in our experimental runs, and n_i are the multiple S/N ratio corresponding to optimum factor levels (Ross et al,1996)

The S/N calculated for the optimum level is as follows

$$\eta_0 = \eta_m + (\eta_{A2} - \eta_m) + (\eta_{B2} - \eta_m) + (\eta_{C1} - \eta_m) \dots \dots \dots (6)$$

Where η_0 is the optimum S/N ratio, η_m is the overall mean of S/N values, η_{A2} the average value of S/N at the second level of yarn count, η_{B2} the average value of S/N at the second level of fabric density and η_{C1} the average value of S/N at the first level of laying angle.

Substituting these values of various terms in the above equation

$$\eta_0 = 7.357449 + (9.698806 - 7.357449) + (8.688193 - 7.357449) + (9.749749 - 7.357449) = 13.42 \text{ (dB)} \dots \dots (7)$$

If the S/N ratio is known and then back transform the S/N ratio to find the expected performance value. Since the value is 13.41(dB) is placed in to the formula, the tensile strength value obtained is 0.87952. Furthermore, the new fabric was produced according to the optimum design (A1B1C3). The air permeability of the fabric was measured at 5 different places. The average of the result was determined as 0.881 This reading is very close to that estimated by Taguchi Design.

3.4.2 Percent contribution:

Percent contribution is calculated by the following equation:

$$\text{Percent contribution (P)} = \left(\frac{SS'A}{SST} \right) * 100 \dots \dots \dots (4)$$

Table 15 shows individual % contribution of parameters under study.

Table 15 Percentage contribution

S. No	Factors	level description	Ra nk	Contributi on %
1	A-structure	9.698806	2	23.10717846
2	B-Inlay count	8.688193	3	11.02408874
3	C-Inlay fibre	9.749749	1	57.43427017

3.4.3 Verification of experiment

A verification experiment is the final stage of the experimental design. The objective of this method is to verify the optimum condition suggested by the matrix experiment do indeed give the improvement projected. This analysis is performed by conducting a test with optimal setting of the factors arrived from the above experiments. The predicted

3.5 Influence of knitting structural parameters on thermal characteristics



Table 16 Experimental outcome of Air permeability

Experiment No	Parameters			Avg. Thermal Conductivity	S/N ratio, dB
	S	C	M		
1	1	1	1	2.38	17.74517
2	1	2	2	2.002	16.99404
3	1	3	3	1.738	16.3799
4	2	1	2	1.664	16.19093
5	2	2	3	1.486	15.69959
6	2	3	1	1.304	15.13218
7	3	1	3	0.886	13.45374
8	3	2	1	0.958	13.79306

9	3	3	2	0.855	13.29906
---	---	---	---	-------	----------

3.5.1 Response Analysis of Thermal Conductivity

Table 17 Response table for the S/N ratio towards Thermal conductivity

Factors	Average S/N of thermal conductivity dB		
	Level 1	Level 2	Level 3
A-Double knit structure	17.0397	15.67423	13.51528
B-Inlay count	15.79661	15.49556	14.93705
C-Inlay fibre	15.5568	15.49468	15.17774

Table 18 Analysis of variance table [Classical sum of squares - Type II]

Source	Sum of squares	df	Mean square	F value	p-value Prob > F
Model	20.33651374	6	3.389419	28.86686228	0.0339
A-Double knit structure	18.94708875	2	9.473544	80.6838884	0.0122
B-Inlay count	1.141430719	2	0.570715	4.86064481	0.1706
C-Inlay fibre	0.24799427	2	0.123997	1.056053639	0.4864
Residual	0.234831131	2	0.117416		
Cor Total	20.57134487	8			

In order to find out statistical Significance of various factors like Double knit Structure (A), In lay count (B), and Inlay fibre (C), and their interactions on Thermal conductivity, analysis of variance (ANOVA) is performed on experimental data. Table 18 shows the results of the ANOVA for S/N ratio. The last column of the table indicates p-value for the individual control factors. The 'p-value' plays an important role in this analysis. It is known that smaller the p-value, greater the significance of the factor. Table 18 indicates that, the Double knit structure (p=0.0122), In lay yarn count (p=0.1706) and Inlay fibre types (p=0.4864). In this analysis, the Double knit structure has significantly influenced the response

3.5.2 Percent contribution:

Percent contribution is calculated by the following equation:

$$\text{Percent contribution (P)} = \frac{\text{SS}'A}{\text{SST}} * 100 \text{----- (8)}$$

Table 19 shows individual % contribution of parameters under study.

Table 19 Percentage contribution

S.No	Factors	level description	Rank	Contribution %
1	A-structure	17.0397	1	92.1042784
2	B-Inlay count	15.79661	2	5.548644128
3	C-Inlay fibre	15.17774	3	1.205532608

3.5.3 Verification of experiment

The S/N calculated for the optimum level is as follows
 $\eta_0 = \eta_m + (\eta_{A2} - \eta_m) + (\eta_{B2} - \eta_m) + (\eta_{c1} - \eta_m) \text{---- (9)}$

Where η_0 is the optimum S/N ratio, η_m is the overall mean of S/N values, η_{A2} the average value of S/N at the second level of yarn count, η_{B2} the average value of S/N at the second level of fabric density and η_{c1} the average value of S/N at the first level of laying angle.

Substituting these values of various terms in the above equation

$$\eta_0 = 15.40974 + (17.0397 - 15.40974) + (15.79661 - 15.40974) + (15.17774 - 15.40974) = 17.1954 \text{ (dB) --- (10)}$$

SUMMARY AND CONCLUSIONS

SUMMARY

A comprehensive investigation on comfort properties of weft knitted interlock fabrics were produced through three different structures with varying inlay yarn count and inlay fibre composition has done. There has been a good amount of research already one on weft knitted single jersey fabrics and double-faced jersey fabrics without inlay yarn. However, a smaller number of researches were done on double faced jersey fabrics with inlay yarn parameters. To full fill the above research gaps this investigation work has been done to understand the influence of inlay yarn and other structural parameters on comfort properties of weft knitted interlock structures.

CONCLUSIONS

The weft knitted interlock



Detailed Investigation of Weft Knitted Interlock Fabrics for Comfort Properties to Suit for Active and Sportswear Application.

fabric samples were produced with the selected experimental parameters were inlay yarn count (24^s Ne, 30^s Ne and 36^s Ne) fibre composition of inlay yarn (cotton, normal polyester and polyester microfiber) and weft knitted interlock structures (structure -1, structure-2 and structure-3).

- The Taguchi's L₉ orthogonal array followed for 3 different parameters with the support of S/N ratio value.
- S/N ratio towards Air permeability was calculated and it was observed that the sample S1C1M1 has resulted with the maximum air permeability. Succeeding to that the researcher conducted a verification experiment to validate the outcome. The predicted air permeability value for in the optimized experiment was 273.037 against the actual value of 276.8. This predicted result is very close to the actual value.
- Analysis of variance (ANOVA) technique has adopted to find the significance of various factors like knit structure (S), In lay count (C), and Inlay fibre (M), and their interactions on air permeability,. It was observed that structure has highly influenced the process response.
- S/N ratio towards OMMC was calculated and it was observed that the sample S1C1M3 has resulted with the maximum air permeability. Succeeding to that the researcher conducted a verification experiment to validate the outcome. The predicted air permeability value for in the optimized experiment was **0.87952** against the actual value of 0.881. This predicted result is very close to the actual value
- S/N ratio towards **thermal conductivity** was calculated and it was observed that the sample S1C1M1 has resulted with the maximum air permeability. Succeeding to that the researcher conducted a verification experiment to validate the outcome. The predicted air permeability value for in the optimized experiment was 2.09 against the actual value of **2.38**. This predicted result is very close to the actual value.
- By using ANOVA the significance of factors like Double knit Structure (A), In lay count (B), and Inlay fibre (C), and their interactions on Thermal conductivity has been analyzed on experimental data. It has been proved that the Double-knit structure has statically significant influence on the response
- To understand the influence of basic knitting parameter on the Thermal conductivity of the weft knitted interlock fabric, a pilot study was conducted with the prepared samples. It was observed that the relationship between the machine tightness factor to thermal conductivity gets positively correlated. Since the p value <0.05, it is concluded that the strength of the relationship is statistically significant. It was further observed that the relationship between the fabric thickness to thermal conductivity also gets positively correlated. Since the p value <0.05, it was also concluded that the strength of the relationship is statistically significant.
- It has been found that the relationship between the machine tightness factor to thermal conductivity is a weak correlation. Since the p value >0.05, it is concluded that the strength of the relationship is statistically insignificant.

It was further observed that the relationship between the fabric thickness to air permeability also gets a weak correlation. Since the p value >0.05, it was also concluded that the strength of the relationship is statistically insignificant.

- From the experimental work it was noticed that the relationship between the machine tightness factor to OMMC is a weak correlation. Since the p value >0.05, it is concluded that the strength of the relationship is statistically insignificant. It was further observed that the relationship between the fabric thickness to OMMC also gets a weak correlation. Since the p value >0.05, it was also concluded that the strength of the relationship is statistically insignificant.

REFERENCES

1. Barker, R. L. (2002) From Fabric Hand to Thermal Comfort: The Evolving Role of Objective Measurements in Explaining Human Comfort Response to Textiles, International Journal of Clothing Science and Technology, 14, 181–200.
2. Gözde Ertekin “The Effect of Heat-Setting Conditions on the Performance Characteristics of Warp Knitted Spacer Fabrics” Journal of Engineered Fibers and Fabrics, Volume 11, Issue 3 – 2016
3. M Manshahia & A Das “High active sportswear – A critical review” Indian Journal of Fibre & Textile Research Vol. 39, December 2014, pp. 441-449
4. M.B.Sambath “Analysis of thermal comfort characteristics of moisture management finished knitted fabrics made from different yarns” Journal of Industrial Textiles 42(1):19-33 · July 2012
5. N Anbumani “Comfort properties of bi-layer knitted fabrics” Indian Textile Journal, August 2008.
6. J. R. Ajmeri “Comparative analysis of the thermal comfort properties of knitted fabrics made of cotton and modal fibres” International Journal of Textile and Fashion Technology (IJTFT) ISSN 2250-2378 Vol. 3, Issue 1, Mar 2013, 1-10.
7. R. A. M. Abd El-Hady “Enhancing the functional properties of weft knitted fabrics made from polyester microfibers for apparel use” International Design Journal Volume 4 Issue 2 PP 219-227
8. Gözde Ertekin “Heat, air and water vapor transfer properties of circular knitted spacer fabrics” Tekstil ve Konfeksiyon 21(4):369-373 · October 2011
9. Asta Bivainytė “Influence of the Knitting Structure of Double-Layered Fabrics on the Heat Transfer Process” FIBRES & TEXTILES in Eastern Europe 2012; 20, 2(91): 40-43.