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Effects of Yarn Count on Crimp% and Take-Up% of 2/1(S) Twill Woven Fabric

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Abstract- In this experiment, we have attempted to investigate the effects of yarn count on crimp% and take-up% of $\frac{2}{1}$ (S) twill weave design. Experimental studies were conducted by woven fabrics with five different yarn count. For this purpose five woven fabric samples, each of $\frac{2}{1}$ (S) twill designs with different count, were made on same rapier weaving machine by keeping all parameters constant with same atmospheric condition. Crimp% and take-up% was calculated by dividing the difference between uncrimped length and crimped length of yarn by crimped length of yarn and uncrimped length of yarn respectively. It was observed that when the count of yarn changes the crimp% and take-up% of yarns are affected. Finally found that, as expected, with increase of yarn count the crimp% and take-up% of warp yarn decreases while crimp% and take-up% of weft yarn increases.

Keywords: *crimp, uncrimp, take-up, count, Ne, twill weave, R.H., interlacing field, contact point.*

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1. INTRODUCTION

The warp and weft crimp is an important aspect of the design and production planning of woven fabrics. In order to predict the quantity of warp and weft yarns required to obtain a certain fabric dimension, the relationship between the yarn dimensions and the fabric parameters should be known (Yukhin & Yukhina, 1996). The parameters determining warp and weft crimps of the grey fabric are the yarn linear densities, fabric thread densities, reed count, and the weave design. Other factors which may affect the warp and weft crimp include weaving conditions such as the loom type, warp and weft tension etc. (Yukhin & Yukhina, 1996). [1]

The waviness or distortion of a yarn owing to interlacing in the fabric is called crimp. In woven fabric, the crimp is measured by the relation between the length of the fabric test specimen and the corresponding length of yarn when it is removed from there and straightened under suitable tension. The crimp may then be expressed numerically as a percentage or as a ratio, i.e. the ratio of yarn length to fabric length. In both methods, fabric length is the basis. [2]

According to Random House Kernerman Webster's College Dictionary, crimp is the waviness of a

fiber, either natural, as in sheep wool or produced by weaving, plaiting, or other processes. [3]

Crimp Percentage is defined as the mean difference between the straightened thread length and the distance between the ends of the thread while in cloth, expressed as a percentage. [4]

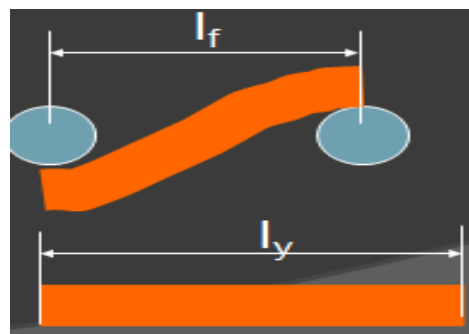
$$\text{Crimp\%, } C = \frac{L-p}{p} \times 100$$

$$= \frac{\text{Straighten length} - \text{Crimped length}}{\text{Crimped length}} \times 100$$

Besides, the crimp is defined as one less than the ratio of the yarn's actual length to the length of fabric it traverses. Crimp levels influence fiber volume fraction, thickness of fabric, and mechanical performance of fabric.

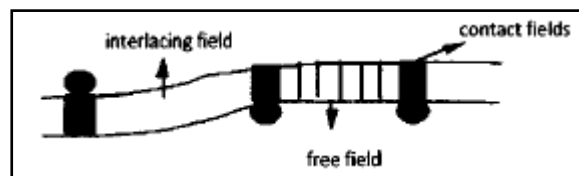
Crimp is defined as the ratio of excess length of yarn in a fabric to the length of the fabric

$$C = l_y / l_f - 1$$



l_y = Uncrimped length, l_f = Crimped length [5]

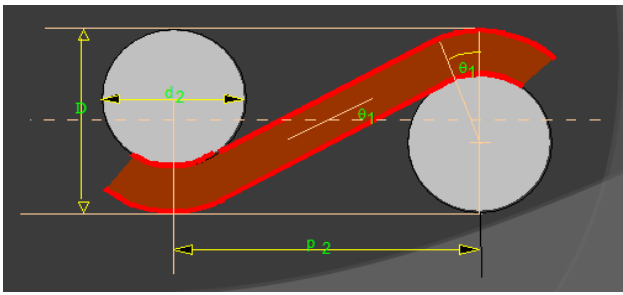
Crimp is determined by the texture of the weave, the yarn size, interlacing field, contact points etc. The contact points are the points where warp and weft crossing each other at right angle. Interlacing fields are the points where a yarn of one system of threads changes its position in relation to the other system. [6]



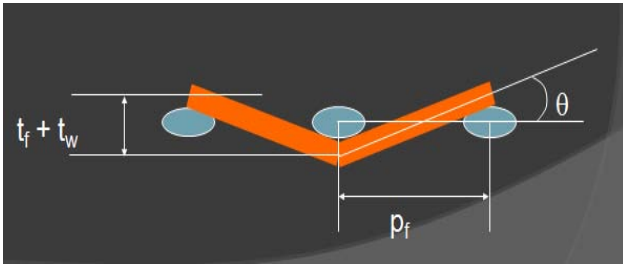
Various models of crimp exist, the most rigorous developed by Pierce in the 1930s.

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- $p_i = (l_i - D q_i) \cos q_i + D \sin q_i$
- $h_i = (l_i - D q_i) \sin q_i + D(1 - \cos q_i)$
- $c_i = (l_i / p_i) - 1$
- $h_1 + h_2 = d_1 + d_2 = D$
- ✓ Where p_i = Thread spacing; l_i = Modular length; c_i = Yarn crimp; d_i = Yarn diameter; h_i = Modular height; q_i = Weave angle D = Scale factor; sum of warp and weft diameters
- ✓ i, j = warp and weft directions.
Simplified crimp calculations: assume triangle wave shape
 - $\tan q = (t_f + t_w) p_f$
 - $C = 1 / \cos q - 1$ [5]



A crimp will normally give values ranging from 0.01 to 0.14 i.e. (1% to 14%). Crimp is related to many aspects of the fabric. It affects the cover, thickness, softness and

hand of the fabric. When it is not balanced it also affects the wear behavior and balance of the fabric, because the exposed portions tend to wear at a more rapid rate than the fabric. The crimp balance is affected by the tensions in the fabric during and after weaving. If the weft is kept at low tension while the tension in warp directions is high, then there will be considerable crimp in the weft and very little in the warp. [7]

Take up percentage

Take up percentage or crimp rigidity is a measure of the ability of textured yarn to receive from stretch and is related to the bulking properties of the yarn before weaving and the length of yarn in the fabric after weaving, expressed as a percentage of the length of yarn before weaving.

$$\text{Take up percentage, } T = \frac{L_2 - L_1}{L_2} \times 100$$

Where,

T = Take up percentage

L = Length of yarn before weaving

p = Length of yarn in fabric after weaving [8]

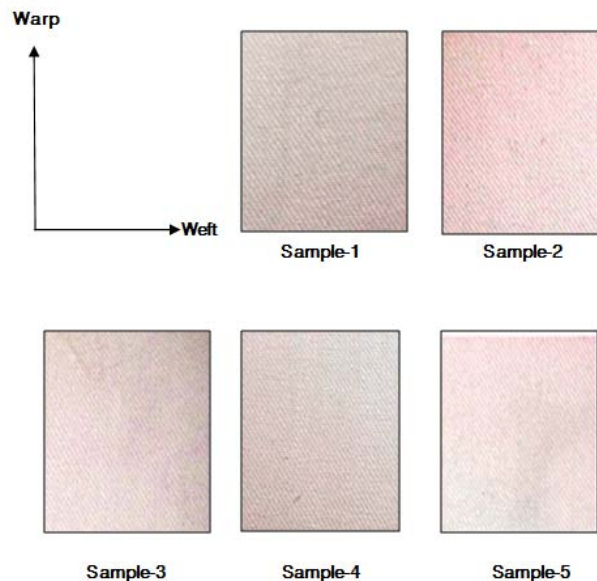
There is a relationship between Crimp% and Take-up% of the woven fabric as follow:

$$\text{Take-up\%, } T = \frac{100C}{100+C} \text{ Where, } C = \text{Crimp\% [9]}$$

II. MATERIALS AND METHOD

a) Materials

The samples used in this experiment are of 100% cotton fabric having same EPI (110), PPI (70), warp and weft tension, weave type $\frac{2}{1}(S)$ twill but different counts (20Ne, 30Ne, 40Ne, 50Ne, 60Ne). These samples are produced from same yarn type. Rapier loom (Dobby shedding) was used for this purpose.



b) Sample Preparation

Rectangular strips are carefully marked on the cloth and each strip is cut in the form of a flap. From each 10 threads are been removed having length 250mm in the cloth. The central part of the first thread is separated from the flap by means of a needle, but the two extreme ends are left secured. One end is then removed and placed in the clamp of the tester and the other end is removed and placed in the second clamp. By this method, there is no loss in the twist of the yarn and also due to minimum handling; there is no stretch in the yarn.

c) Method

Crimp of the samples is tested by MAG AccuCrimp tester and Take-up% is measured by using the formula $\frac{L2-L1}{L2} \times 100$. The experiment is carried out at 65% relative humidity (R.H.) and 20°C temperatures.



The MAG AccuCrimp tester provides means to measure yarn length accurately under known tension. The instrument is of 3 feet model. The tension range used is by means of a dual scale having 0-35 and 0-175 gram.

The tension arm oscillates on a 'V' grooved pivot fixed on the body of the instrument. A rider moves on the arm to be set according to the tension to be applied. The rider should be kept at the tension value marked on the tension scale. The tension to be applied is calculated using the formula,

$$\text{Tension} = \text{Tex} \div 2$$

The tension arm is fitted with A1. Moveable rider and corresponding balancing weight is mounted on the other side of the arm. This weight is the scale range of 0-35 gram. Additional two brass weights are given separately for the range of 0-175gram scale. When the higher range scale is used fix these two additional weights to the rider and other weight should be added to the balancing weight.

d) Testing Procedure

Hold the tension arm vertically. Slowly slide the knife-edge under the plate just above the 'v' grooved pivot. Place the knife-edge over the 'v' groove. The arm should oscillate freely over the pivot groove.

Place the instrument on a horizontal surface. See, through the mirror provided at the left hand side, whether the reference lines coincide. If not, adjust the leveling screw at the right extreme end till the reference marks coincide.

1. Mark a known length L1 on the fabric, the crimp of which is to be tested. The marking should be done in such a way that the mark is visible on the yarn removed from the fabric.
2. Set the rider against the calculated tension.
3. Fix the one end of the yarn, at the mark, on jaw of the tension arm.
4. Fix the other of the jaw provided on the sliding unit.
5. Move the sliding unit over the scale, seeing the reference marks through the mirror. Stop moving the rider when the reference marks coincide. Note the scale reading under RED mark of the Sliding unit. This is the extended length L2.

Now the crimp percentage,

$$C = \frac{(L2-L1) \times 100}{L1} = \frac{\text{Difference in length}}{\text{Original length}} \times 100$$

Where,

C = Crimp percentage

L1 = Original length in fabric from

L2 = Uncrimped yarn

Repeat the test as many times required.

III. EXPERIMENTAL DATA

Measurement of Crimp% and Take-up% for Warp yarn:

Table 1: Data for Warp way crimp% and take-up% due to count variation.

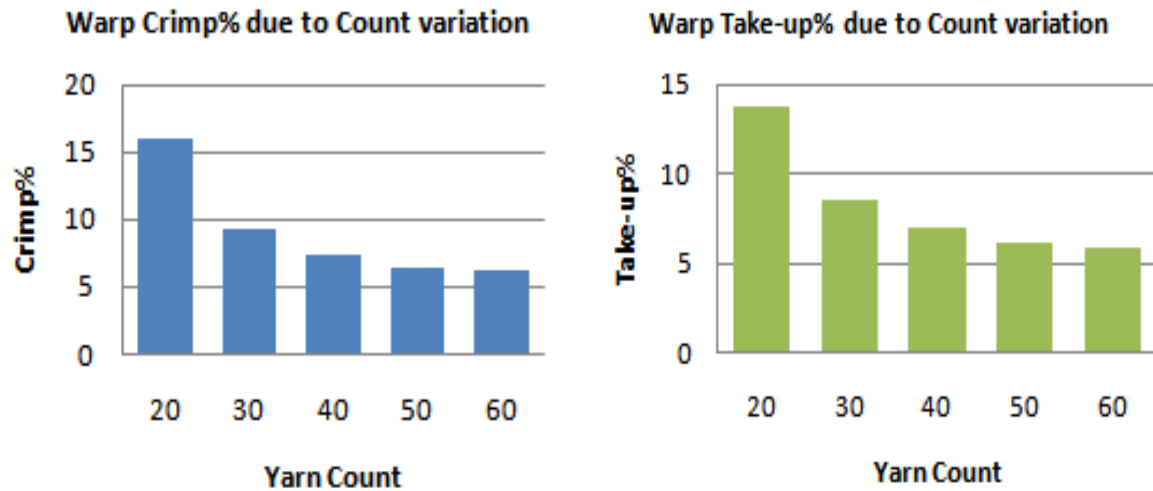
Sample No.	Warp and Weft count	Crimp%	Take-up%
1	20	16.00	13.79
2	30	9.32	8.33
3	40	7.40	6.89
4	50	6.40	6.02
5	60	6.20	5.84

Measurement of Crimp% and Take-up% for Weft yarn:

Table 2: Data for Weft way crimp% and take-up% due to count variation.

Sample No.	Warp and Weft count	Crimp%	Take-up%
1	20	9.74	8.88
2	30	11.32	10.17
3	40	13.64	12.00
4	50	13.75	12.09
5	60	13.86	12.17

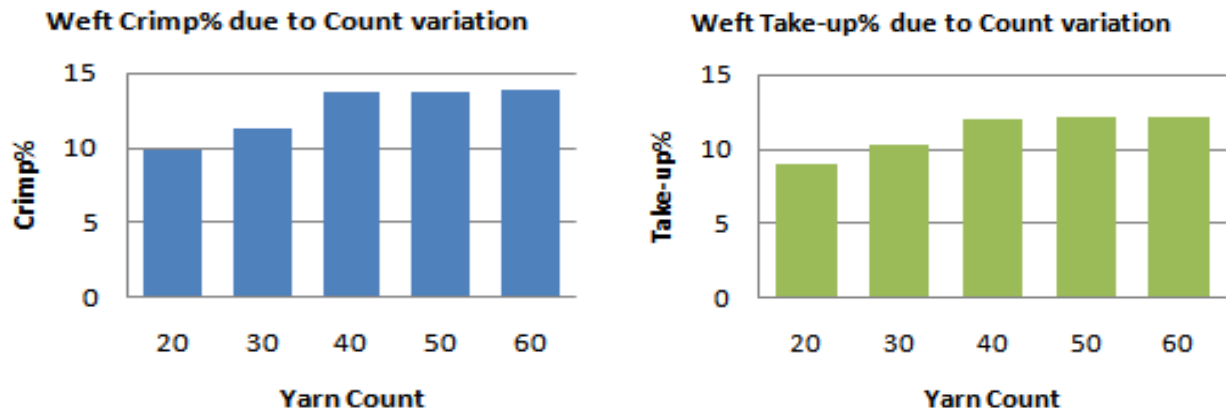
IV. DISCUSSION ON RESULT



Graph-1 : Effects of yarn count on Warp yarn Crimp% and Take-up%

Table-1 shows that with the increase of yarn count, the crimp% and take-up% of the warp yarn is decreased. It may be because of less interlacing field and less contact points (as PPI=70) in finer yarn, the warp yarns make little waviness resulting lower crimp%

as well as take-up%. It is notable that a significant change is found both for warp crimp% and take-up% while using lower yarn count. But with the higher count of yarn, changes are less evident.



Graph-2 : Effects of yarn count on Weft yarn Crimp% and Take-up%

Table-2 shows that with the increase of yarn count, the crimp% and take-up% of the weft yarn is increased. It probably because of less interlacing field but more contact points (as EPI=110) in finer yarn, the warp yarns make more waviness resulting higher crimp% as well as take-up%.

on the fabric properties such as resistance to abrasion, shrinkage, fabric behavior during tensile strength, faults in fabric, fabric design, fabric costing etc. [10] It is hoped that the result of this study will play an important role in the woven fabric sector.

V. CONCLUSION

In this investigation, we have found an indicative relationship between the yarn count and the crimp% & take-up%. The study shows with the increase of yarn count, the crimp% & Take-up% of warp yarn is reduced whereas it is increased for weft yarn. Warp and weft crimp percentages are two factors which have influence

VI. ACKNOWLEDGEMENTS

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