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RESEARCH ARTICLE

EFFECT OF BLEND COMPOSITIONS ON WICKING BEHAVIOUR OF MICROPOLYESTER COTTON BLENDED YARNS

*Dr. Parveen Banu, K. and Dr. Lakshmi Manokari, S.

Department of Costume Design and Fashion, Kongu Arts and Science College, Erode, 638107, Tamilnadu, India

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ABSTRACT

In this study an attempt has been made to study the wicking behavior of micropolyester cotton blended yarns. 100% micropolyester, 65/35 micropolyester/cotton, 50/50 micropolyesrer/cotton, 35/65 micropolyester/cotton and 100% cotton were used for this study. The yarns were treated with hot water, dried and then subjected to wicking behavior in distilled water. Among the selected yarns, 100% micropolyester showed better wicking performance.

INTRODUCTION

Wicking is a spontaneous transport of a liquid driven into a porous system by capillary forces (Harnett and Mehta, 1984). Wickability describes the ability to maintain capillary flow on the other hand wettability describes the initial behavior of a fabric or yarn in contact with liquid (Ghali, Jones and Tracy, 1994; Kissa 1996). Minor *et al*. (1959) have studied a number of non aqueous solvents and a number of yarns made from different materials both natural and synthetic demonstrated that the work of Hollies *et al*. (1959) is generally valid. They used filament bundles as yarn bundles and studied the ease of wicking where the liquid available is limited. Lord (1974) studied the wicking behavior of rotor spun yarns and compared it with ring-spun yarns. He conducted limited tests, and concluded that the wicking height is not very sensitive to changes in the twist of the rotor- spun yarns. Wicking behavior of yarns was studied by Nyoni and Brook (2006) to highlight their use in many applications. Wicking is easy to measure and very simple equipment is needed. Ansari and Kish (2000) investigated the wicking behavior of polyester spun yarns by electrical resistance technique produced with different twist levels. Subramaniam *et al*. (2007) discussed the wicking behavior of regular ring, jet ring spun and cotton yarns. In a very interesting paper on wicking kinetics of liquid drops using a computerized imaging system Chen *et al*. (2001) studied the time needed for droplet disappearance as a function of droplet volume for various yarns and comparative analysis was made. Das *et al*. (2011) have developed a mathematical model to predict vertical wicking behaviour in yarns and fabrics.

Chattopadhyay and Chauhan (2004) studied the wicking behavior of ring and compact yarns and reported that coarser yarns wicked faster than fine yarns. One of the most important developments in synthetic fiber industry is absolutely producing extremely fine fibers which are named as microfibers and nanofibers (Kayanak and Babaarslan, 2011). Until today, there is no exact definition for microfibers. But common opinion is defining a fiber finer than 1 dtex or 1 denier as microfiber (Leadbetter and Dervan, 1992; Purane and Panigrahi, 2007; Basu, 2001; Mukhopadhyay.S., 2002; Falkai, 1991; Rupp and Yonenaga, 2000). 1 dtex polyester fiber has a fiber diameter of approximately 10 μm (Falkai, 1991). Due to their softer feel, good drape ability, moisture wicking property, water repellent characteristics, this fabric has become a popular choice for performance apparel, clothing and garments (Rupp and Yonenaga, 2000). They are widely used for making rain water, sportswear, men suits, kids clothing, inner wears, hosiery, evening wear, outer wear, sheeting, upholstery and many textile accessories. It is fast replacing cotton fabrics in production of these specialty clothing. As micrifiber wicks moisture away from the body, it keeps the wearer cool and dry, as such; it has come to occupy an important position in the category of moisture management fabrics (Anonymous, 2000).

***Corresponding author: Dr. Parveen Banu, K.**
Department of Costume Design and Fashion, Kongu Arts and Science College, Erode, 638107, Tamilnadu, India.

Many researchers carried out studies on properties of micro polyester and cotton blended yarns but so far no attempt been made to test the wicking behavior of micro polyester cotton blended yarns. Hence the investigator selected this study on "Effect of blend compositions on wicking behavior of micropolyester cotton blended yarns".

Objectives

The major objectives of the study are

- To select the micro polyester cotton blended yarns with different compositions of 100% MP, 65/35MP/C, 50/50 MP/C, 35/65 MP/C, 100% C in 30^s count.
- To examine the yarn count and twist for the selected yarns.
- To test the wicking behavior of micro polyester cotton yarns .
- To analyze the wickability of blended yarns.

Experimental procedure

The procedure adopted for the study consisted of the micro polyester cotton blended yarns with different compositions like 100%MP, 65/35MP/C, 50/50MP/C, 35/65MP/C and 100%C. The yarns were subjected to tests for selected quality parameters like yarn linear density and twist per inch (TPI). In order to remove the spin finishes, the yarns were treated in hot water and then subjected to wicking behavior and the wicking performance was analyzed by different methods.

Development of vertical wicking tester

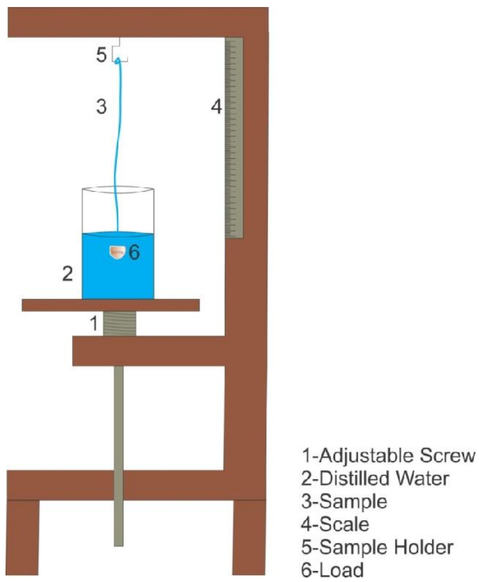

Fig 1. Vertical Wicking Apparatus

Vertical wicking test

This test was carried out at an atmospheric conditions of 65% ± 2% relative humidity and 27ºc ± 2ºC temperature for all the yarns using the longitudinal wicking 'strip' test method in accordance to DIN 53924 (1978).

Wicking procedure

The developed instrument is made up of a metal stand in which a steel ruler is attached on the right side of the apparatus to record the height of water travelled along the yarn. Figure 1 shows the instrument developed for examining the wicking of yarns. A sample holder is fixed on the wicking of yarns. A sample holder is fixed on the top of the material clamp holder in which a yarn length of 30cm was hung vertically and the other end tied with a weight of 0.015g/tex. There is an adjustable screw below the moveable plate for raising the beaker with distilled water upwards. Once the yarns were in contact with the distilled water, height was recorded for every 1min, 2min, 3min, 4min, ……10mins respectively. A magnifying lens was used to observe the capillary rise along the length of yarns. In a similar manner, the cotton yarn and micropolyester cotton yarns differing in blends were subjected to wicking behavior.

RESULTS AND DISCUSSION

From the above Figure 2, it is clear that 65/35 MP/C sample showed lower linear density compared to 50/50 MP/C with higher values.

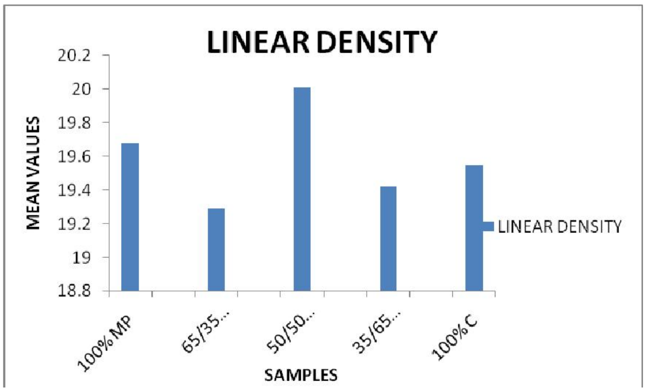

Fig 2. Yarn Linear Density

It is apparent from the Figure 3, 100% cotton showed higher values of TPI compared to 35/65 MP/C with lower values.

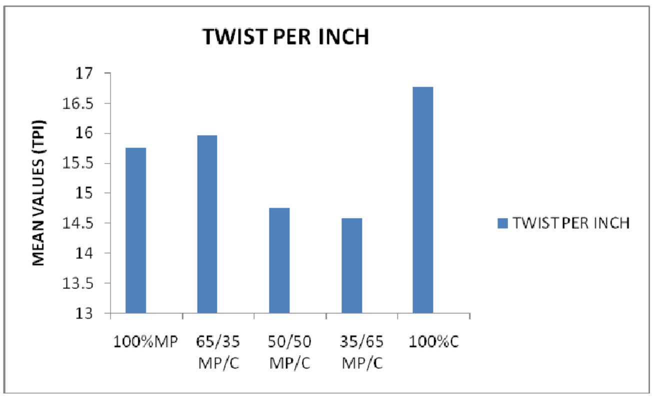

Fig 3. Twist Per Inch

Wicking behaviour of micro Polyester/cotton blended yarns - Height and Time

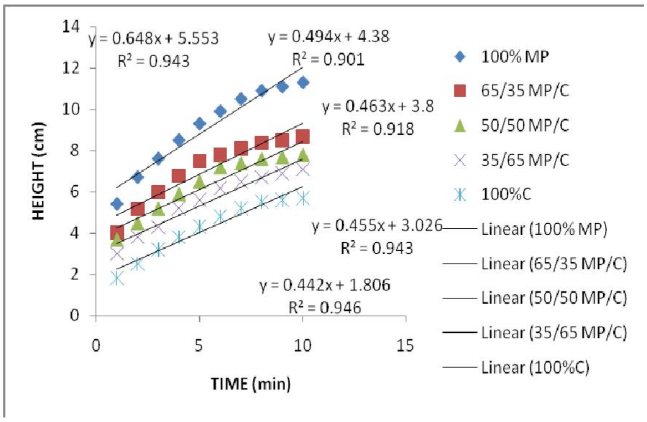

Fig 4. Height and Time

In this method of analyzing wicking, the wicking time was plotted against the wicking height and the correlation coefficient and regression equation were computed. Micropolyester yarn showed higher value of slope and intercept compared to other blends. This is due to the fact that the asterisk structure of micropolyester traps the liquid faster which enables higher moisture transport as shown Figure 5. As the component of cotton increases, there is a reduction in wickability. Higher the slope and intercept better the wickability and vice versa. The correlation between height and time was found to be good. The slopes obtained is plotted to illustrate the trend.

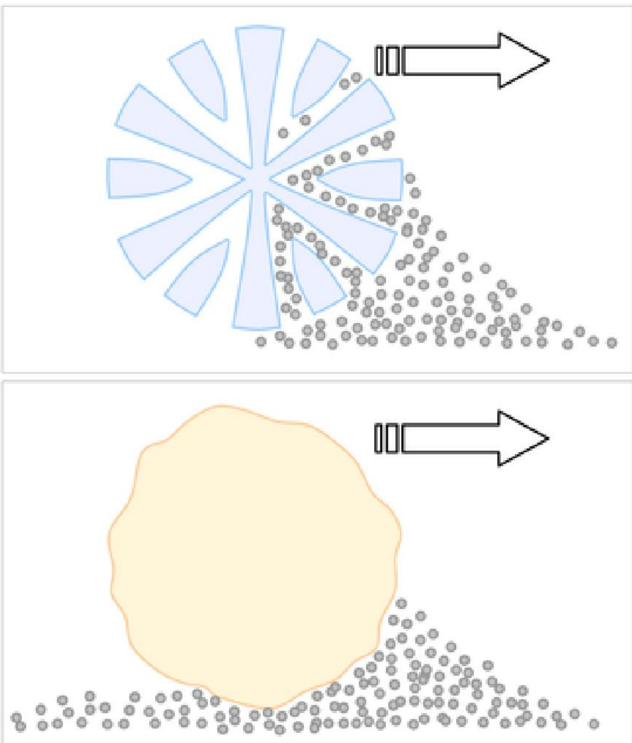

Fig 5. Cross section of microfiber and cotton yarn

Table 1. Regression and correlation coefficient values for micropolyester cotton blended yarns (height and time)

SAMPLE CODE	SLOPE (cm/min)	INTERCEPT (cm)	COEFFICIENT CORRELATION (R^2)
100% MP	0.648	5.553	0.943
65/35 MP/C	0.494	4.38	0.901
50/50 MP/C	0.463	3.8	0.918
35/65 MP/C	0.455	3.026	0.943
100% C	0.442	1.806	0.946

The slopes obtained were plotted to illustrate the trend as shown below.

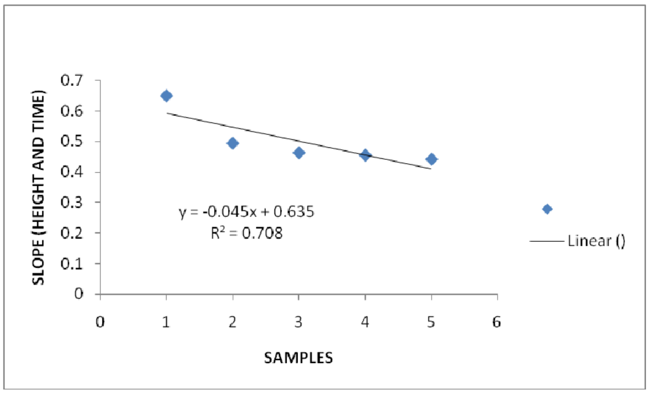

Fig 6. Relationship between slope values (Height and Time)

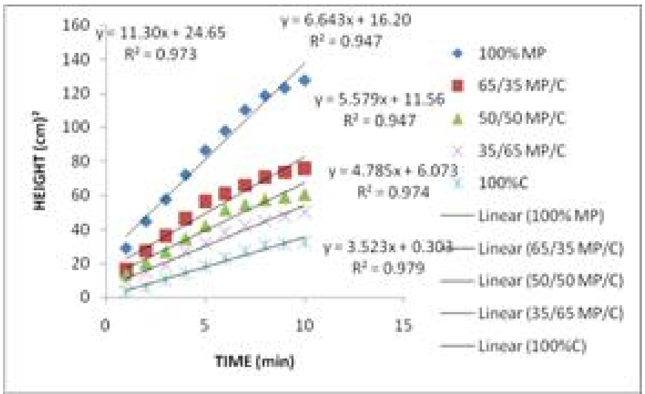

Fig. 7. Square of Height and Time

In this method, the wicking height square was plotted against the time (h^2/t) and the correlation coefficient and regression equation were computed. The trend followed is the same as before. Higher the slope and intercept better the wickability and vice versa. The correlation between square of height and time was found to be good. The slopes obtained is plotted to illustrate the trend.

In this method, the wicking height was plotted against the square root of time and the correlation coefficient and regression equation (Model assumed $Kt^{1/2}$ + constant, where K is the slope) were computed. Micropolyester yarn showed higher value of slope and intercept compared to other blends. As the component of cotton increases, there is a reduction in wickability. Higher the slope and intercept better the wickability and vice versa. The correlation between height and square root of time was found to be good. The slopes obtained is plotted to illustrate the trend.

Table 2. Regression values of the form h²/t and correlation coefficient of micropolyester cotton blended yarns

SAMPLE CODE	SLOPE (cm^2/min)	INTERCEPT (cm)	COEFFICIENT CORRELATION (R^2)
100% MP	11.30	24.65	0.973
65/35 MP/C	6.643	16.20	0.947
50/50 MP/C	5.579	11.56	0.947
35/65 MP/C	4.785	6.073	0.974
100% C	3.523	6.303	0.979

The slopes obtained were plotted to illustrate the trend as shown below.

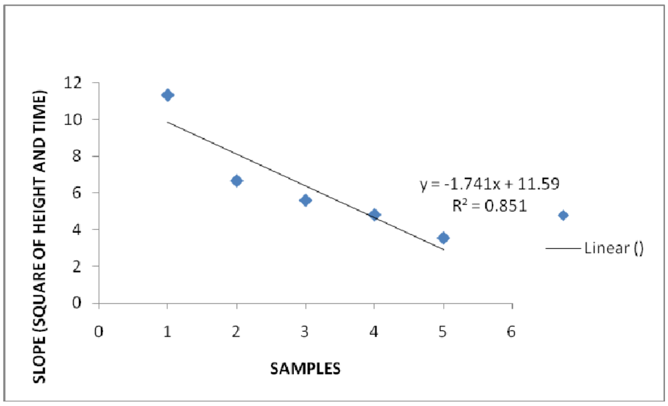

Fig 8. Relationship between slope values (square of height and time)

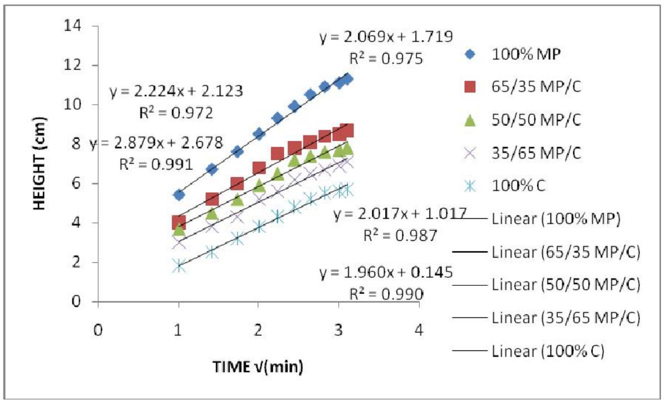

Fig. 9. Height and Square Root of Time

Table 3. Regression equation of the form $h=kt^{1/2}$ + constant and correlation coefficient for micropolyester cotton blended yarns

SAMPLE CODE	SLOPE (cm/√ (min))	INTERCEPT (cm)	COEFFICIENT CORRELATION (R^2)
100% MP	2.879	2.678	0.991
65/35 MP/C	2.224	2.123	0.972
50/50 MP/C	2.069	1.719	0.975
35/65 MP/C	2.069	1.017	0.987
100% C	1.960	0.145	0.990

The slopes obtained were plotted to illustrate the trend as shown below.

In the fourth method of analyzing wicking, the logarithm of wicking time was plotted against the logarithm of wicking height. Value of the time component (K) and intercept values were computed. Higher values of 'C' and lower values of 'K' indicate good wickability and vice versa. Slopes and intercepts obtained from log h- log + values were plotted to illustrate the trend. There was a negative correlation between slope K and intercept C as suggested by Laughlin and Davies (1961) which has to be considered for interpreting wickability. It is clear that there is an independency between K and C. Since the value of time exponent K is below 0.5, Washburn equation is obeyed well.

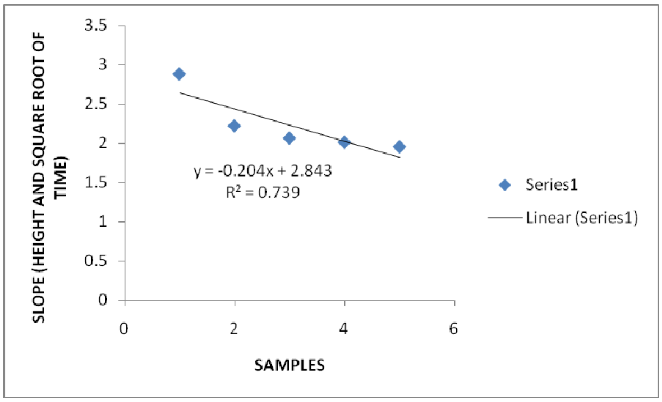

Fig. 10. Relationship between slope values (Height and Square Root of Time)

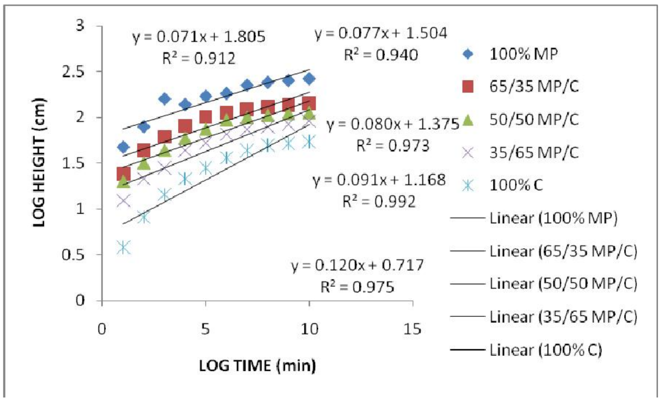

Fig. 11. Log Height and Log Time

Conclusion

From the analysis of the results, it may be concluded that 100% micropolyester yarns showed maximum wicking behavior compared with micropolyester cotton blended yarns. This statement agrees with the findings of Karolia and Paradkar (2005).

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