Decorative Warp-Knitted Net Curtains

Prof. Dr. R.A.M. Abd El-Hady

Abstract— Curtain, in interior design, decorative fabric commonly hung to regulate the admission of light at windows and to prevent drafts from door or window openings. Net curtains made of a thin light mesh fabric of cotton, nylon, or other fiber. Warp- knitted net curtains belong to a wide group of decorative products which characterized by both aesthetic (motive, stitch type, pattern repeat, thickness of the knitted material) and functional features. The functionality of the knitted curtains depends on the fabric construction parameters. The aim of the research was to analyze the aesthetic and functional properties through decorative warp knitted net curtains in correlation with fabric construction parameters, depending on the curtain structure and pattern. The tests results indicate that by changing the curtains construction parameters it is possible to influence both the aesthetic and functional features of the curtain.

Keywords—: Aesthetic features, Decorative curtain, lace structure, Raschel machine.

1 INTRODUCTION

A curtain is a piece of cloth intended to block or obscure light, or drafts, or water in the case of a shower curtain [1]. From evidence found in excavation sites at Olynthus, Pompeii and Herculaneum, portieres appear to have been used as room dividers in classic antiquity. Mosaics from the 2nd to 6th century show curtains suspended from rods spanning arches [2]. A sheer or net curtain is one that is made from translucent fabric, such as a loosely polyester voile or a cotton lace. Sheer curtains allow a majority of light to be transmitted through it, fabric structure providing a basic level of UV protection while retaining maximum visibility outward through the curtain. Sheer curtains are sometimes referred to as "privacy curtains" in reference to their screening abilities; during the day most sheer fabrics will allow people inside the home to see the outside view while preventing people outside the home from seeing directly into the home. Due to the loose structure in sheer fabrics, these types of curtains offer very little in the way of heat insulation [3]. Curtains can be used to give a room a focal point. There are at least twenty different styles of curtains and draperies which can be used in window treatment [4].

Window fashions for the coming years feature brightly colored, glowing, creatively draped, open-meshed, different yarn constructions, delicate, sometimes crushed or embroidered voile fabrics and attractive structured jacquard net curtains decorated with striking motifs, the result is an elegant look achieved by warp knitting technology [5]. Warp knitting represents the fastest method of producing fabric from yarns. Warp knitting differs from weft knitting in that each needle loops its own yarn. The needles produce parallel rows of loops simultaneously that are interlocked in a zigzag pattern. Fabric is produced in sheet or flat form using one or more sets of warp yarns.

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The yarns are fed from warp beams to a row of needles extending across the width of the machine [6].A warp knitted structure is made up of two parts. The first is the stitch itself, which is formed by wrapping the yarn around the needle and drawing it through the previously knitted loop. This wrapping of the yarn is called an overlap. The second part of stitch formation is the length of yarn linking together the stitches and this is termed the under lap, which is formed by the lateral movement of the yarns across the needles. The length of the under lap is defined in terms of needle spaces. The longer the underlap, the more it lies at right angles to the fabric length axis. The longer the underlap for a given warp the greater the increase in lateral fabric stability, conversely a shorter under lap reduces the width-wise stability and strength and increases the lengthways stability of the fabric. The stitch formed has an open or closed character according to the direction of the underlap and overlap motions [7].

Net or netting is an open mesh form of fabric construction that is held together by knots or fused thermoplastic yarns at each point where the yarn cross one another. Mesh structures can be produced by pillar stitch/inlay, which may be used alone or as the ground for designs produced by pattern bars. The overlaps and underlaps of the front guide bar knitting the mesh will hold (on the technical back of the fabric) the inlay pattern threads of guide bars behind it at each course. There are several types of mesh; they are square, hexagonal, and octagonal. Mesh structures may be used alone or as the ground for designs produced by pattern bars. The range of mesh sizes is from coarse and opens to fine and share. Netting may be made of any kind of fiber and may be given a soft or stiff sizing, its characteristics can vary from durable to not durable. Air can easily pass through the holes, which allows breathability that doesn't trap bacteria, and remain impermeable to pests and insects [8].

In recent years most light nets have been constructed on either Tricot or Raschel warp knitting machines, so the yarns are only interloped and not knotted. These knitted

nets lack the stability of those constructed by knotting. Their primary use is in apparel, although some are used as decorative window curtains. Many factors have contributed to the success of warp knitting in the production of lace, curtain-net [9]:

- The inability of the slow, traditional lace and net machines to meet rapidly expanding demands for these types of fabrics.
- An availability of fine, strong, uniformly regular, continuous filament yarns ideally suitable for high-speed warp knitting, such as nylon for lace, polyester for curtaining, and elastomeric yarns for elastic laces.
- The greater suitability of the Raschel machine for utilising synthetic filament yarn than traditional lace machinery, with higher productivity. It offers the benefits of low capital costs, reduced requirements for ancillary equipment, less operative supervision, and simpler pattern-changing facilities.
- Ability to achieve satisfactory imitations of mesh constructions such as tulle and marquisette by pillar inlay lapping movements.
- Development of specific purpose machines with higher speeds and greater atterning capabilities encouraged by the introduction of the multi-guide bar lace Raschel .
- Improvements in patterning techniques such as jacquard. These have provided sophisticated design potential for a widening range of end-uses beyond the confines of conventional guide bar lapping facilities.

Three-course tulle is the standard mesh for Raschel lace, producing three courses on each wale with the inlay reinforcement lapping in unison. When the pillar and inlay lap in opposition, a square mesh known as cross tulle or bridal veil net is produced. Five-course tulle produces larger mesh. Sometimes, more elaborate grounds are produced by varying the inlay movements of partly-threaded bars or a jacquard-controlled guide bar whilst employing a fully-threaded guide bar to make a ground pillar stitch. On the latest electronic machines, the jacquard head has been replaced by a computer control that is simply linked by a cable to the combined selection element and jacquard guide, which are one unit. There are no jacquard harness cords for lifting and guide displacement which would restrict the use of the conventional guide bar swinging movement [10].

The aim of the research was to analyze the aesthetic and functional properties through decorative warp-knitted net curtains in correlation with fabric construction parameters.

2 MATERIAL AND METHODS

This paper concerns with producing net wrap structures suitable for decorative curtains. In this study, Several samples were produced using polyester, nylon and cotton yarns with warp knitting technique. Patterns produced on two type of multi bars jacquard Raschel machines; The RJPC and JL 29/1 B.

Curtain Jacquard Raschel machine with fall plate for producing net curtains with jacquard patterns. The RJPC 4 F-NN is designed to produce coarse fabrics with a hand-made look, as well as delicate, lightweight, filigree curtains. This machine can be used to produce a range of styles, from rustic café curtains to bordered types with trendy, all-over patterns, as well as tablecloths and in-betweens. In combination with three- and four-needle patterning technology, this innovative net curtain jacquard Raschel machine with all its equipment can produce a wide variety of net curtains with various, eye-catching fabric grounds. Another specialty of the net curtain jacquard Raschel machines is the various tulle grounds they can work.

Jacquard Lace patterns will be best-sellers in the coming interior design season. The JL 29/1 B is ideal for efficiently producing distinctively structured, all-over plain goods with a wide range of motifs. The patterns have clear, raised contours and fine graduations on the jacquard ground. The transitions from the pronounced structured areas to the smooth, fine, flat areas are smooth and gentle. This wide variety of pattern options is the result of a well-thought-out machine configuration.

Warp knitting is the sequential formation and interlinking of loops in an axial direction on a lateral array of needles with at least one separate yarn being supplied to each needle. The loops are joined together in a width-wise direction by moving the yarns back and forth between adjacent needles. Net warp knitting structures have a wide range of end-uses, one of their main uses is in decorative curtains. Table (1) shows the specification of the produced warp knitted decorative curtains.

Several tests were carried out in order to evaluate the produced curtains, these are:

1- Thickness test, this test was carried out according to the ASTM D1777- 96(2011) e1[11].

2- Weight test, this test was carried out according to the ASTM D3776 / D3776M - 09a [12].

3. Air Permeability test, this test was carried out according to the ASTM D737 - 04(2012) [13].

4. Bursting Strength test, this test was carried out according to the ASTM D3786 / D3786M – 13[14]

Table (1) The Specification of Produced Warp Knitted Decorative Curtains

Sample No.	Machine Type	Machine Model	Fabric Design	Fabric Composition	Fabric Weight	Fabric Thickness
1	curtain jacquard Raschel machine	RJPC 4 F-NN		100% polyester	86	0.34
2				100% polyester	81	0.3
3				100% nylon	98	0.41
4				100% cotton	115	0.47
5	Lace jacquard Raschel machine	JL 29/1 B		100% cotton	79	0.29
6				100% polyester	58	0.16
7				100% polyester	50	0.13

8				100% nylon	68	0.21

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3 RESULTS AND DISCUSSIONS

Curtain, in interior design, decorative fabric commonly hung to regulate the admission of light at windows and to prevent drafts from door or window openings. There are specific textile properties that may be measured in an effort to predict the functional properties of decorative net curtains such as ; thickness, weight, absorption, air penetration and bursting strength.

3.1. The Weight of Decorative Net Curtains

Figure (1) shows the relation between the weight values (gm/m²) and the thickness values (mm) of produced curtains.

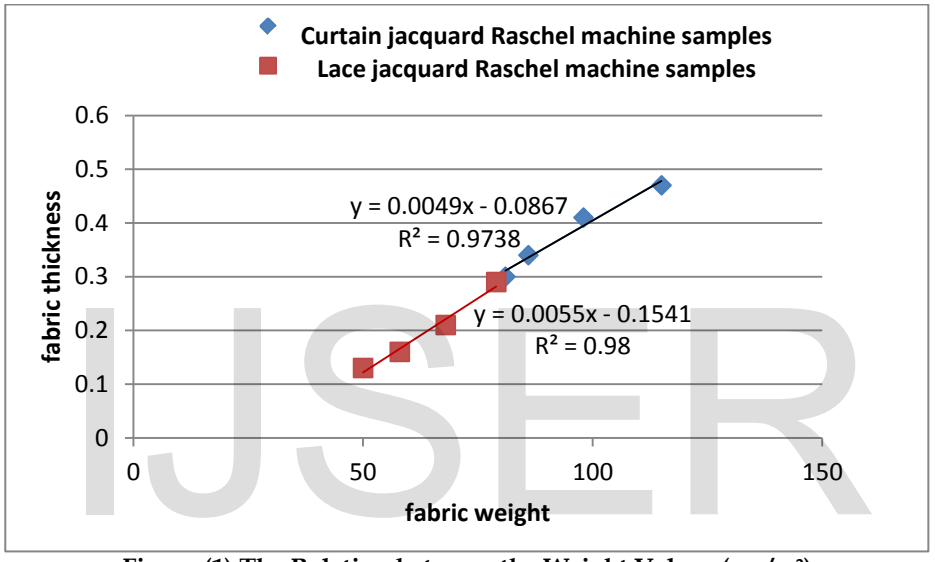

Figure (1) The Relation between the Weight Values (gm/m²) and the Thickness Values (mm) of Produced Curtains

From Figure (1), the results indicate that the length of the underlap influences the curtains weight. According to curtain design, when knitting with a longer underlap, more yarn has to be supplied to the knitting needles. The underlap crosses and covers more wales on its way, with the result that the curtain becomes heavier, thicker and denser. Since the underlap is connected to the root of the stitch, it causes a lateral displacement in the root of the stitch due to the warp tension. The reciprocating movements of the yarn, therefore, cause the stitch of each knitted course to incline in the same direction, alternately to the left and to the right.

$$y = 0.0049x - 0.0867 \quad (1)$$
$$y = 0.0055x - 0.1541 \quad (2)$$

From equations (1) and (2), it is clear that the curtain weight (gm/m²) is a function of curtain thickness (mm). Figure (1) shows a positive correlation between weight (g/m²) and the thickness (mm) as the rate of curtain weight is increased by increasing the curtain thickness (R^2= 0.9738, R^2 = 0.98) for produced curtains.

3.2. The Air permeability Properties of Decorative Net Curtains

Air permeability is a measure of how well air is able to flow through a fabric. The passage of air is of importance for a number of fabric end uses including curtains. Air can easily pass through the curtains holes, which allows breathability that doesn't trap bacteria, and remain impermeable to pests and insects. This test was carried out for all samples; Figure (2) shows the relation between air permeability values (cm³/cm²/s) and the thickness (mm) of produced curtains. Curtains thickness values, plays an important role in the other properties evaluation, such as curtain weight, air permeability and bursting strength

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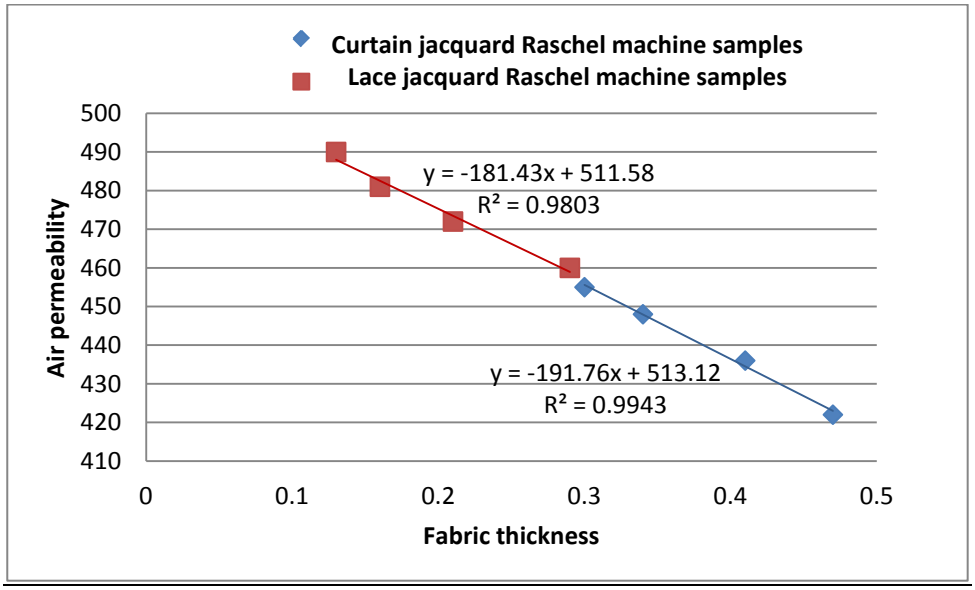

Figure (2) The Relation between Air Permeability Values ($cm^3/cm^2/s$) and the Thickness (mm) of Produced Curtains

$$y = -191.76x + 513.12 \quad (3)$$
$$y = -181.43x + 511.58 \quad (4)$$

From equations (3) and (4), it is clear that air permeability values ($cm^3/cm^2/s$) is a function of curtain thickness (mm). Figure (4) shows a negative correlation between air permeability values ($cm^3/cm^2/s$) and the thickness (mm) as air permeability is inversely related with curtain thickness ;it decreased with increase of thickness due to increase of compactness and decrease of air space (R^2= 0.9943, R^2 = 0.9803).

3.3. The Bursting Strength Properties of Decorative Net Curtains

Figure (3) shows the relation between the weight values (gm/m^2) and the bursting strength values ($Kg.f/cm^2$) of produced curtains. Bursting Strength is a measure of the coherence of a fabric, and is governed by numerous factors including the fiber type, yarn count, fabric thickness and knitted structure.

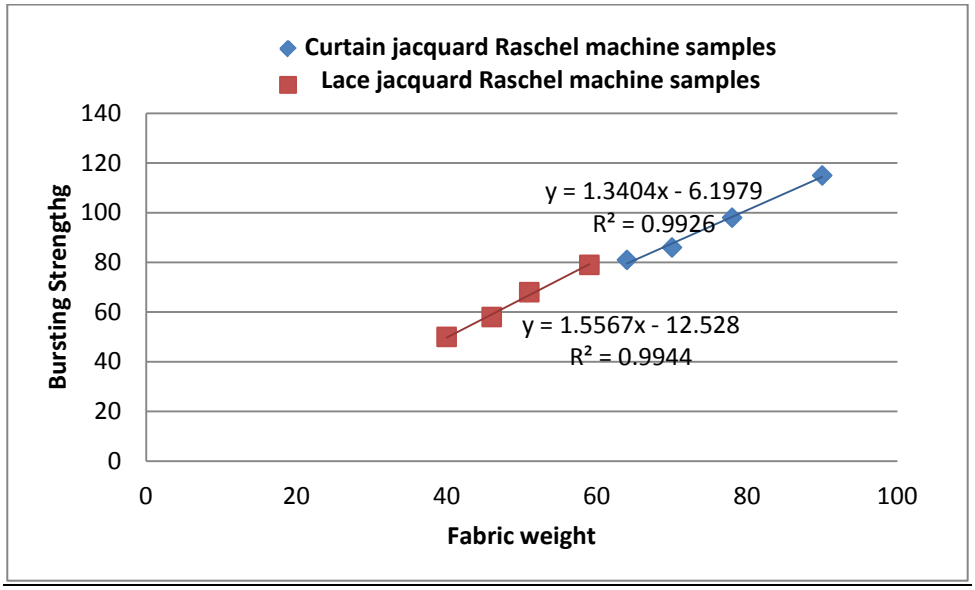

Figure (3) The Relation between the Weight Values (gm/m^2) and the Bursting Strength Values ($Kg.f/cm^2$) of Produced Curtains

$$y = 1.3404x - 6.1979 \quad (5)$$
$$y = 1.5567x - 12.528 \quad (6)$$

For the model curtains, higher weight and thickness provided higher bursting strength and tension strengths. Each increase in the extent of the underlap tends to make the structure stronger, more opaque and heavier. The increasing float of the underlap has a more horizontal appearance, while overlaps produced by the same yarn will be separated from each other at successive courses by an extra wale in width. From equations (5) and (6), it is clear that the curtain weight (gm/m^2) is a function of bursting strength ($Kg.f/cm^2$). Figure (3) shows a positive correlation between weight (g/m2) and bursting strength (Kg.f/cm2) as the rate of curtain weight is increased by increasing the curtain bursting strength (R^2= 0.9926, R^2 = 0.9944) for produced curtains.

Conclusions

The huge variety of modern textiles requires the focusing of attention on different aspects and certain specific conditions during production. Jacquard decorative knitted curtains are characterized by a great variety of patterns and the capacity of shaping construction parameters. Analysis of the relation between the construction parameters (fabric composition, fabric structure, fabric weight and thickness) and functional properties was carried out for many variants of knitted curtains and has proven an unequivocal correlation between the functional properties (bursting strength and air permeability) and the construction parameters. The tests results indicate that by changing the curtains construction parameters it is possible to influence both the aesthetic and functional features of the curtain.

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