INFLUENCE OF LOOP POSITION IN WARP-KNITTED PLAIN STITCHES ON STRUCTURAL PROPERTIES OF KNITTED FABRICS

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Abstract

This paper presents the structure of a new group of warp-knitted interlock stitches. The difference between them and generally-known warp-knitted stitches is emphasised. We describe an alternative method of manufacturing knitted fabrics with the above-mentioned stitchesusing a warp-knitting machine equipped with a tuck pressure. This paper describes an estimation of the structural properties of the warp-knitted fabrics manufactured by means of interlock and traditional stitches.

Introduction

In warp knitted stitches so far, the loops are positioned in two perpendicular systems consisting of courses and wales. As results from the traditional technology of warp-knitted fabrics, the succeeding loop courses are manufactured along the wales, which gives the effect of a loop arrangement with one loop over the other, and one beside the other.

A different structural loop group is the group of warp-knitted double plain stitches, also known as interlock stitches. The nomenclature of this new group of stitches arises from a certain analogy to the weft-knitted interlock stitches, characterised by formation of the succeeding loops in the course on every second needle. A characteristic structural feature of this new group of loops is the mutual location of loops in adjoining courses. Every second loop in the course is displaced along the wale axis at half of the lop height. The new stitches can be manufactured from one or many yarn systems, similar to other warp-knitted stitches.

At present, the warp-knitted interlock stitches are not manufactured, as no knitting machines exist which could realise such structures. However, a concept of the construction of a double needle-bar warp-knitting machine which can perform the technology described above has recently been developed, a patent application registered, and a patent applied for [1, 2]. Furthermore, an analysis of the existing technological possibilities connected with already existing warp-knitting machines was carried out, and allowed us to state that, at the experimental stage, an attempt to manufacture a knitted fabric with the new stitches can be successful. Tests were carried out with the use of the K2 MPS warp-knitting machine from Karl Mayer, equipped with spring-bearded needles and a tuck pressure of tuck repeat 1×1. The stitches were designed in order to prevent the formation (in the knitting) of tuck loops, which are characteristic of knitted fabrics manufactured with the use of warp-knitting machines equipped with a tuck pressure. The pressure is displaced by one needle pitch in alternating directions along the needle bar. The change of the pressure's direction of movement succeeded after formation of the following loop course of the stitch. This means that the loops were formed on every second needle.

The structural properties of the interlock stitches were compared with the properties of traditional stitches [3]. With the goal of achieving an objective result, the knitted fabric variants with traditional stitches were designed and manufactured in a similar way to the interlock knitting variants.

Comparative analysis of structural properties of knitted fabrics manufactured by means of warp-knitted interlock and traditional stitches

Figure 1 and 2 present examples of interlock and traditional stitches manufactured with the use of two needle bars performing laps characteristic of the tricot stitch with closed loops.

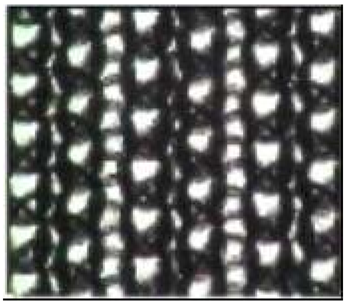

Figure 1. Photograph of an interlock stitch

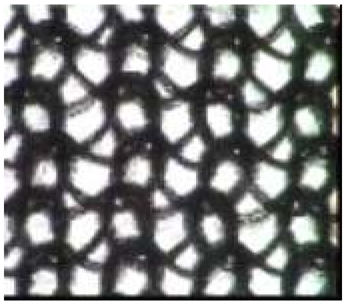

Figure 2. Photograph of a traditional stitch

Twenty variants of both interlock and traditional stitches were tested within the scope of our investigation. All knitted fabric variants were manufactured by two-needle-bar stitches within four stitch groups (Table 1).

Table 1. Stitch systems of the knitted fabrics devoted for the comparative analysis' tests

new stitch variants			traditional stitch variants		
stitch designation	1st needle bar (upper warp)	2nd needle bar (lower warp)	stitch designation	1st needle bar (upper warp)	2nd needle bar (lower warp)
Wn aa	velvet	velvet	**Wt ss**	cloth	cloth
Wn tt	tricot	tricot	**Wt tt**	tricot	tricot
Wn ta	tricot	velvet	**Wt ts**	tricot	cloth
Wn at	velvet	tricot	**Wt st**	cloth	tricot

Diagrams of the new traditional stitches related to them which we analysed are presented in Figure 1, in which the above-mentioned equivalents are arranged in pairs located at the same level.

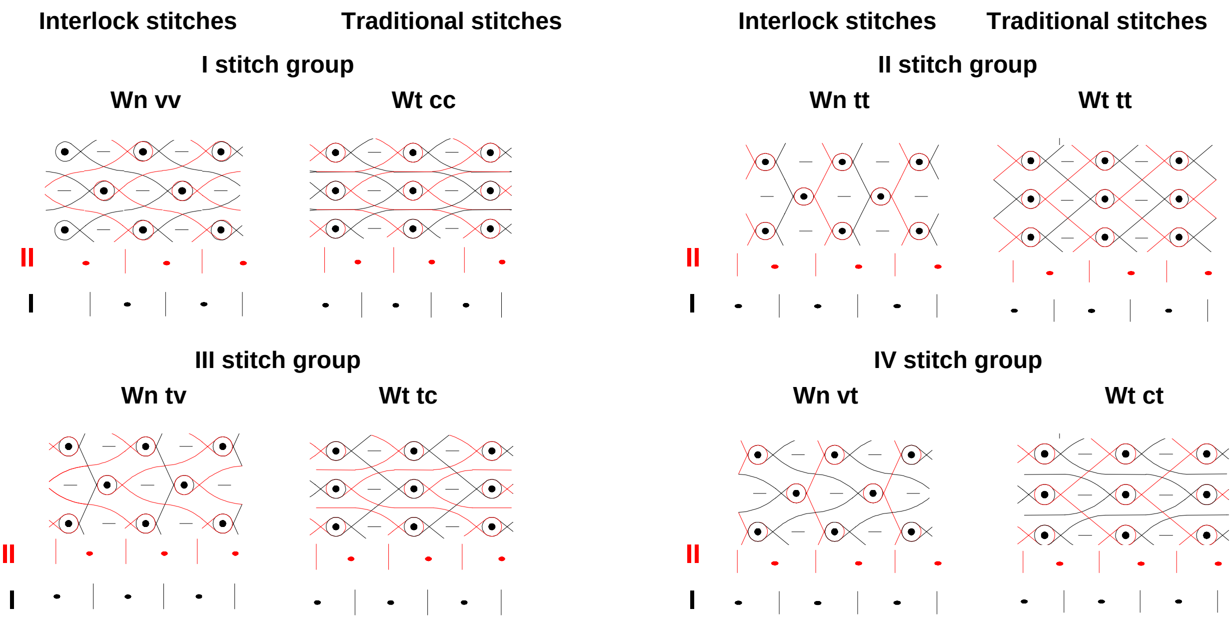

Figure 1. Stitch variants of knitted fabrics' test samples provided for comparative analysis

Descriptions:

- **I** – the first guide bar (upper warp),
- **II** – the second guide bar (bottom warp),
- **Wn** – variant of the new interlock stitches,
- **Wt** – variant of the traditional stitches,
- **v** – velvet, **t** – tricot, **c** – cloth.

The first letter in the stitch designations concerns the stitch obtained by the first guide bar, and the second letter concerns that obtained by the second guide bar.

The stitch variants were additionally differentiated by the length of the warp yarn taken up in the loop. At the same time, efforts were made to maintain the length of the warp take-up on a similar level for the given warp, within the range of the compared variants for both stitches (Table 2). The aim of this treatment was to demonstrate the influence of the kind of partial stitches and the length of the warp take-up on the properties of the warp knitted interlock stitches, and to compare the properties of knitted fabrics manufactured by means of traditional stitches.

Table 2. Warp take-up variants of the individual stitch systems

number of warp take-up variant of the new stitch	number of warp take-up variant of the traditional stitch	***warp take-up level***	
		1st needle bar	***2nd needle bar***
1	**1’**	mean	mean
2	**2’**	maximum	maximum
3	**3’**	minimum	minimum
4	**4’**	maximum	minimum
5	**5’**	minimum	maximum

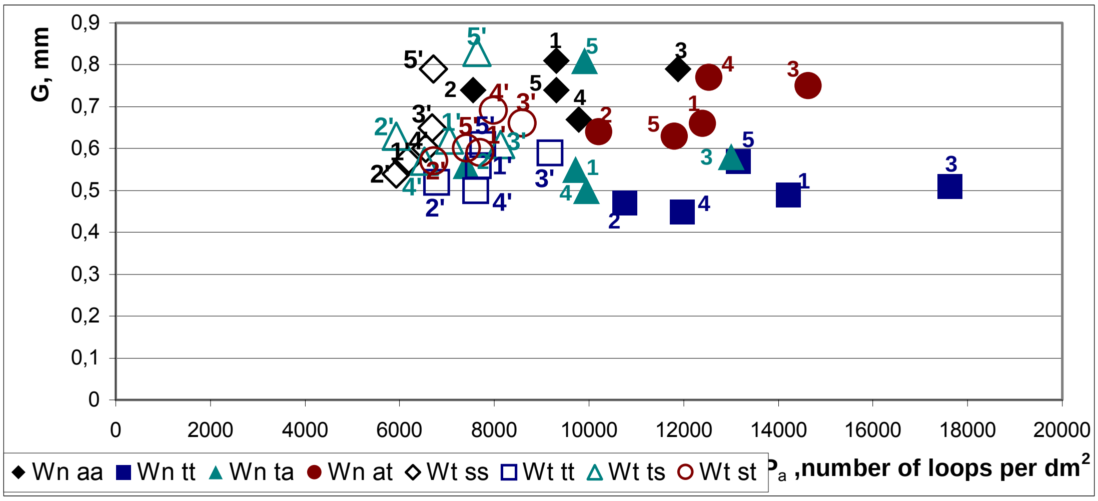

Figure 2. Knitted fabric’s thickness G in dependence on the area density P_a for raw knitted fabrics

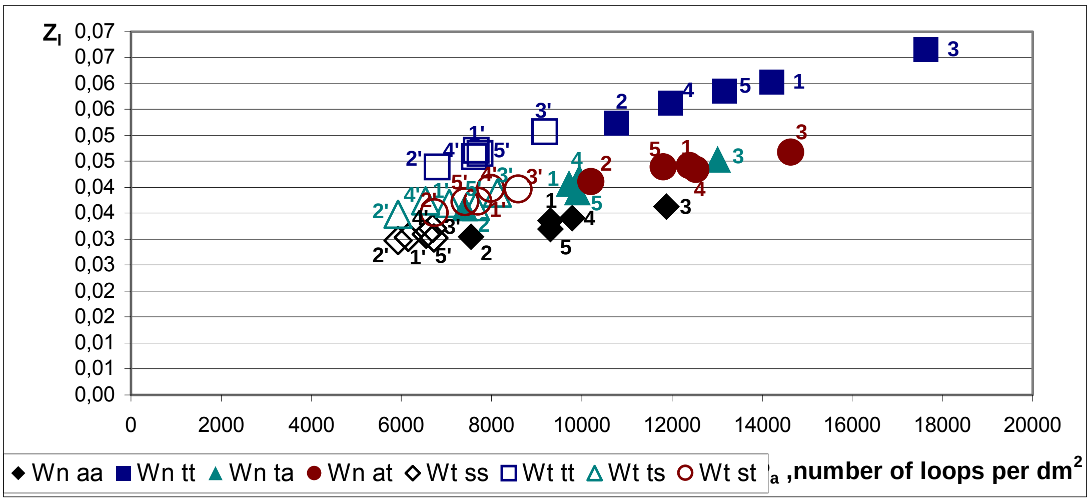

Figure 3. Linear cover factor Z_l in dependence on the area density P_a for raw knitted fabrics

The comparative analysis of the knitting structures manufactured by the new and traditional stitch types was carried out on the basis of the characteristics of the knitted fabrics' structural parameters (presented for the variants tested) within the range of the particular stitch groups. The following parameters were analysed: course density P_c, wale density P_w, area density P_a, and knitted fabric thickness G. The knitted fabric filling with yarn was determined by assessment of the following cover factor values; the linear Z_l, the area Z_a and the volumetric cover factor Z_v, using relations which are in opposition to those generally accepted by literature publications. The aim of this procedure was to achieve relations characterised by an increase in the factors' values with the increase in the filling with yarn of the knitted fabric. The values of the above-mentioned structural parameters of the knitted fabrics tested were analysed in dependence of the area density of the fabric (Figures 2, 3, 4 and 5).

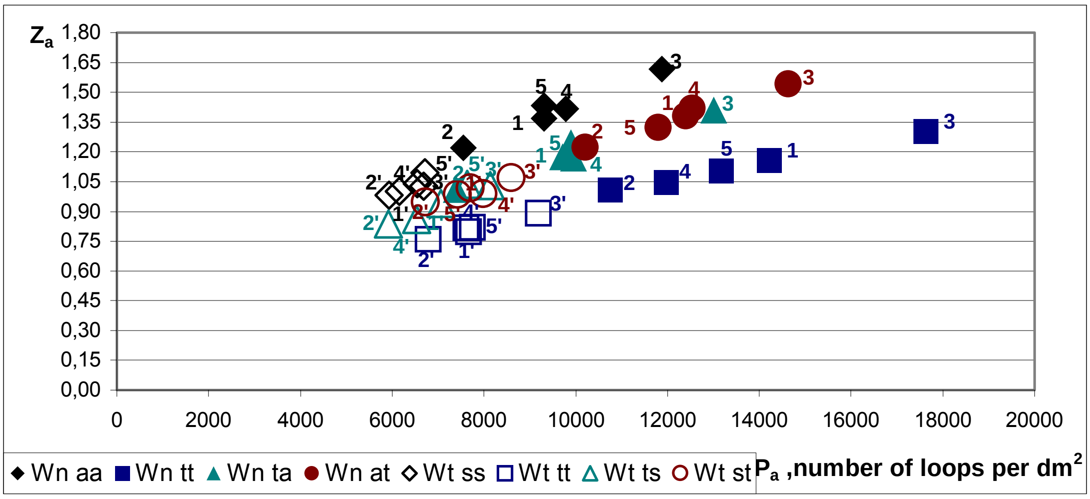

Figure 4. Area cover factor Z_a in dependence on the area density P_a for raw knitted fabrics

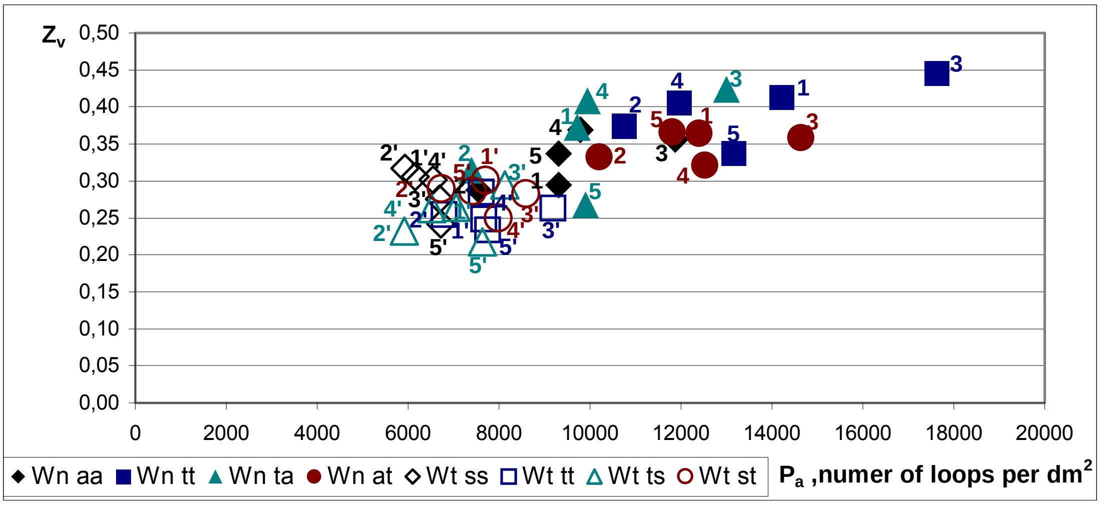

Figure 5. Volume factor Z_v in dependence on the area density P_a for raw knitted fabrics

Conclusions

On the basis of the comparative analysis carried out for structural parameters of knitted fabrics diversified by loop location in the stitches, we have concluded that the knitted fabrics manufactured by means of interlock stitches differ from the knitted fabrics with traditional stitches in the following ways:

- higher values of wale density P_w,
- generally higher values of course density P_c,
- higher values of area density P_a,

- higher values of linear cover factors Z_l and area cover factors Z_a, at higher values of area density P_a,
- generally higher values of volumetric cover factors Z_v, at higher area densities P_a,
- greater or smaller thickness G, at higher area densities P_a, depending on the systems of partial stitches applied, and
- similar direction of the changes of analogical parameters depending on the partial stitches applied and the warp's working-in; it should be emphasised that the value changes of the parameters discussed mostly take place in a greater range for interlock stitches.

Acknowledgement

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References

1. *Kopias K., 'Warp-knitted stitch and double needle bar warp-knitting machine for manufacturing knitted fabrics of plain warp knitted stitch' (in Polish), Patent Application P-329223, 14.10.1998; patent applied for 08.12.2003.*
2. *Kopias K., Pinar A., 'Warp-Knitted Interlock Stitches. A New Group of Stitches. Conception of Formation and Structure', Fibres & Textiles in Eastern Europe, vol. 12, No 1, 2004.*
3. *Kopias K., Pinar A., 'Comparative Analysis of Structural Parameters of Warp-Knitted Fabrics with Interlock and Traditional Stitches', Fibres & Textiles in Eastern Europe, vol. 12, No 2, 2004 (prepared for print).*

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