INFLUENCE OF FINISHING PROCESS ON THE THERMOPHYSIOLOGYCAL PROPERTIES OF KNITTED FABRIC MADE OF UNCONVENTIONAL CELLULOSE YARNS

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ABSTRACT

The knitted fabric thermophysiological comfort is influenced by raw material and fabric structure, including yarn spinning and finishing process. The research on raw and finished cotton, viscose and Tencel® double jersey knitted fabrics knitted from ring, rotor and air-jet spun yarns counts of 20 tex were carried out. The knitted fabric made by different yarn structures and raw material as well knitting fabric finishing process has an impact on the knitted fabric structural parameters, thus on thermal and water vapour resistance. Obtained results can serve as guidelines for further research on the knitting and finishing process in order to produce quality garments made of non-conventional yarns spun from cellulose fibres.

RESULTS AND CONCLUSIONS

The results of the basic knitted fabric parameters as well as thermal and water vapour resistance are given in Table 1. A change in all parameters of the knitted fabric structure after the finishing process is visible through fabric mass per unit area. The mass per unit area of almost all knitted samples has increased after finishing, except for samples knitted with ring spun yarn made from viscose and Tencel® fibres due to the fabric widening that occurred after the finishing process. The sample made from ring spun yarn from viscose fibres expanded by 6% and sample from Tencel® fibres expanded by 10%, with other samples shrinking from 6% to 9% after finishing process, not due to the relaxation. The thickness of all finished samples decreased from 4.6% for the cotton yarn to 30% for the ring spun yarn from Tencel® fibres.

Table 1. Basic knitted fabric properties, thermal and water vapour resistance

Fibre type	Yarn type	M, $g\ m^{-2}$	T, mm	Dh, cm^{-1}	Dv, cm^{-1}	Nl, l/cm^{-2}	S, %	Rct, $m^2C\ W^{-1}$	SD $m^2C\ W^{-1}$	CV %	Ret, $m^2Pa\ W^{-1}$	SD $m^2Pa\ W^{-1}$	CV %
COTTON	R-Ring	157	0.64	11.1	11.4	253	39	0.030	$3.0x10^{-4}$	11.3	4.71	0.32	6.8
	F-Ring	162	0.61	10.5	12.3	258	32	0.026	$4x10^{-4}$	1.5	3.78	0.43	11.4
VISCOSE	R-Ring	165	0.63	10.9	11.8	257	39	0.022	$1.8x10^{-4}$	8.3	4.03	0.19	4.6
	F-Ring	141	0.36	10.1	11.7	236	33	0.021	$6x10^{-4}$	2.7	3.18	0.17	5.5
	R-Rotor	131	0.59	8.6	12.0	206	22	0.013	$1.4x10^{-4}$	11.3	3.03	0.05	1.6
	F-Rotor	160	0.47	9.5	12.4	236	28	0.015	$3x10^{-4}$	2.1	3.27	0.38	11.9
	R-AJet	127	0.58	9.0	12.0	216	25	0.017	$8x10^{-4}$	4.8	3.06	0.04	1.2
	F-AJet	147	0.47	8.8	13.5	238	23	0.017	$8x10^{-4}$	4.6	2.88	0.11	3.8
TENCEL	R-Ring	152	0.63	10.8	11.8	255	36	0.023	$2.8x10^{-4}$	12.2	3.70	0.50	13.5
	F-Ring	139	0.44	9.4	11.7	220	26	0.019	$3x10^{-4}$	1.5	2.94	0.22	7.5
	R-Rotor	128	0.61	9.2	12.1	223	25	0.015	$1.2x10^{-4}$	7.9	3.28	0.16	4.9
	F-Rotor	161	0.51	10.3	13.0	268	36	0.014	$1.1x10^{-4}$	7.4	2.82	0.16	5.7
	R-AJet	132	0.62	9.0	12.3	221	25	0.017	$1.3x10^{-4}$	7.5	3.28	0.33	10.1
	F-AJet	156	0.49	9.3	12.8	238	33	0.017	$2x10^{-4}$	1.4	3.01	0.28	9.4

Where: R is raw knitted fabric, F is finished knitted fabric, Ring is knitted fabric made of ring yarn, Rotor is knitted fabric made of rotor yarn, AJet is knitted fabric made of air jet yarn, M is knitted fabric mass per unit area in g m-2, T is knitted fabric thickness in mm, Dh is number of loops in courses cm-1, Dv is number of loops in wales cm-1, Nl is knitted fabric number of loops per unit area in l/cm-2, S is knitted fabric shrinkage in %, Rct is knitted fabric thermal resistance in m2C W-1, Ret is knitted fabric water vapour resistance in m2Pa W-1.

Although mass per unit area and thickness of almost all fabric after finishing process increased, except knitted fabric made of viscose and Tencel® ring spun yarns, thermal and water vapour resistance of all finished knitted fabric decrease. Considering that, thermal resistance describes the thermal barrier of heat passage from the human body to the environment it can be concluded that after finishing the fabric will provide greater heat loss, i.e. worse thermal barrier property.

On the other hand, a decrease of the knitted fabric water vapour resistance indicates easier transmission of water vapour (sweat) through fabric, thus better physiological properties. It can be concluded that besides different yarn raw material and yarn structure, finishing process additionally influences on thermo-physiologycal properties.

CONCLUSION

Based on conducted research it can be concluded that raw material, yarn structure and the finishing process itself cause significant differences of basic knitted fabric parameters after the finishing process, thus thermophysiological properties. For the commercial application of the knitted fabrics, the recommendation is a careful selection of knitting parameters in order to obtain a satisfactory knitting structure. Furthermore, special attention should be paid to the process of knitted fabric finishing which must be adopted to a precisely defined structure. Guidelines for processing procedures should be found in the extreme values of the obtained results when comparing raw and finished knits properties. This is a basic precondition for the quality garments production from non-conventional yarns spun from regenerated cellulose fibres.

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