APPLICATION OF THE NATURALLY COLORED COTTON IN THE WOVEN FABRICS

Małgorzata Matusiak
Teresa Rymarz, Krzysztof Sikorski
Textile Research Institute, Lodz Poland

Urania Kechagia, Elleni Tsaliki
National Agricultural Research Foundation NAGREF,
Cotton and Industrial Plants Institute, Thessaloniki Greece

Iwona Frydrych
Clothing Department, Technical University of Lodz, Poland

INTRODUCTION

Research was done in the frame of the Eureka project:

EUREKA! 3151 NAGREFIAT

Using Naturally Colored Cotton for Good Quality,
Attractive and Ecological Textile Products

INTRODUCTION

Start of the project:
January 2004

Partner countries:
- **POLAND**
- **GREECE**
- **TURKEY**

INTRODUCTION

Meetings:
- Bremen, Germany - March 2004
- Thessaloniki, Greece - September 2004,
- Krakow, Poland – September 2005,
- Izmir, Turkey – February 2006,
- Bremen, Germany – March 2006,
- Alexandroupolis, Greece - September 2006.

INTRODUCTION

Meeting in Thessaloniki (September 2004)

INTRODUCTION

Meeting in Izmir (February 2006)

INTRODUCTION

Meeting in Cracow (September 2006)

INTRODUCTION

Meeting in Alexandroupolis (September 2006)

INTRODUCTION

Areas of investigation:

- fibers,
- yarns,
- fabrics,
- clothing.

INTRODUCTION

Presented results concern the project activity
realized by the Polish and Greek partners of
the project.

THE AIM OF WORK

The aim of work was:

- to investigate an application of the naturally colored cotton of Greek origin in yarns and fabrics,
- to analyze the influence the share of brown Greek cotton on the properties of yarns and fabrics made of this cotton.

EXPERIMENTAL

In the frame of the presented work the following investigation were carried out:

- laboratory measurement of the naturally colored cotton of Greek origin,
- manufacturing the rotor yarns from the naturally colored cotton of Greek origin,
- laboratory assessment of cotton yarns made of naturally colored cotton,

EXPERIMENTAL

- designing the woven fabric structures and patterns with the application of the naturally colored cotton,
- production of the woven fabrics with the application of colored cotton,
- measurement of the structural, mechanical and biophysical properties of woven fabrics made of the naturally colored cotton.

EXPERIMENTAL

- analysis of the influence of share of naturally colored cotton in fabrics on their properties:
  - mechanical,
  - thermal,
  - barrier against UV radiation,
  - color fastness.

RAW MATERIAL

- Naturally colored cotton of Greek origin was used for experimental production of yarns.
- Lay down was composed of 4 bales of brown cotton.

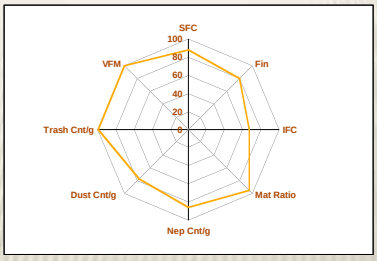
FIBER PROPERTIES

	L(w)	L(w)CV	UQL(w)	Bale
-	mm	%	mm	%
I	22.7	34.2	27.6	10.8
II	21.4	35.7	25.9	12.3
III	21.8	37.3	27.1	13.9
IV	21.7	34.6	26.2	11.0
Av.	**21.9**	**35.4**	**26.7**	**12.0**

FIBER PROPERTIES

Bale	Fine	IFC	Mat	Nep	Dust	Trash	VFM
-	mtex	%	-	g^{-1}	g^{-1}	g^{-1}	%
I	166	7.0	0.87	366	850	149	2.87
II	160	7.7	0.83	504	1286	278	5.13
III	160	7.7	0.83	476	664	141	2.65
IV	160	7.4	0.84	437	976	248	3.86
Av.	**162**	**7.4**	**0.84**	**448**	**944**	**204**	**3.63**

FIBER PROPERTIES



Fiber quality according to Uster Statistics

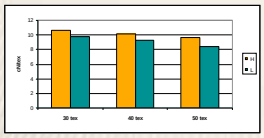
YARN PROPERTIES

No	Parameter	Unit	Value of the parameter					
			30 tex		40 tex		50 tex	
			H	L	H	L	L	H
1.	Linear density	Ttex	29.7	30.4	39.1	40.0	48.7	50.6
2.	Mass variation coefficient	%	3.78	2.17	0.66	2.21	1.56	1.42
3.	Tenacity	cNtex^{-1}	10.60	9.75	10.20	9.24	9.68	8.44
4.	Breaking force variation coefficient	%	12.0	12.0	10.7	11.6	12.3	11.3
5.	Breaking elongation	%	9.72	8.40	8.90	8.40	8.42	7.54
6.	Elongation variation coefficient	%	6.62	8.05	7.83	7.22	7.61	9.16
7.	Twist	obr. m^{-1}	939.0	821.4	763.2	658	653.0	550.4
8.	Twist coefficient	-	161.8	143.2	150.9	131.6	144.2	123.7
9.	Twist variation coefficient	%	2.31	3.24	1.61	2.72	1.91	2.12

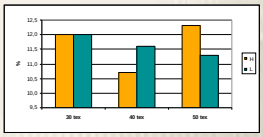
YARN PROPERTIES

No	Parameter	Unit	Value of the parameter					
			30 tex		40 tex		50 tex	
			H	L	H	L	L	H
1.	CV	%	14.2	15.3	14.4	16.78	15.8	15.4
2.	Thin places/1000 m	-	8.0	4.8	0.0	15.2	10.4	8.0
3.	Thick places/1000 m	-	54.4	72	56.0	56.0	48.0	40.0
4.	Neps/1000 m	-	72.0	69.6	59.2	27.2	36.8	12.0

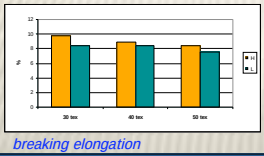
YARN PROPERTIES



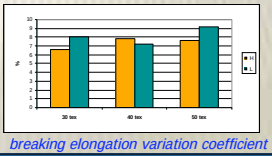
strength



breaking force variation coefficient

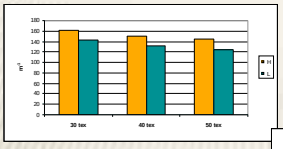


breaking elongation

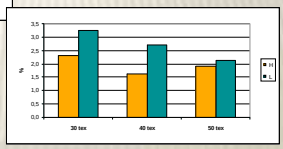


breaking elongation variation coefficient

YARN PROPERTIES

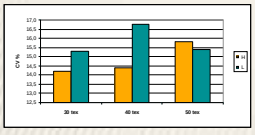


twist

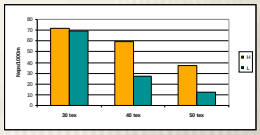


twist variation coefficient

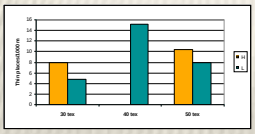
YARN PROPERTIES



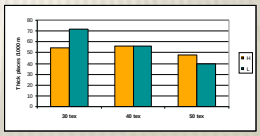
CV



neps /1000 m



thin places / 1000 m



thick places / 1000 m

YARN PROPERTIES

No	Linear density	Variant	CV %	Thin places	Thick places	Neps
1.	30 tex	H	29	19	36	81
2.		L	62	5	52	80
3.	40 tex	H	54	< 5	56	83
4.		L	> 95	79	56	70
5.	50 tex	H	95	82	60	79
6.		L	90	76	53	55

Quality level acc. to Uster® Statistics	*Description*
< 5 %	*Very good*
5 % ÷ 25 %	*Good*
25 % ÷ 50 %	*Average*
50 % ÷ 75 %	*Satisfactory*
75 % ÷ 95 %	*Unsatisfactory*
> 95 %	*Bad*

Fabric manufacturing

In the frame of the project different kinds of fabrics were elaborated:

- woven fabrics,
- knitted fabrics.

FABRIC MANUFACTURING

Woven fabrics:

- fabrics for clothing on the basis of plain weave,
- goffer fabrics,
- terry towels,
- flannel.

WOVEN FABRICS

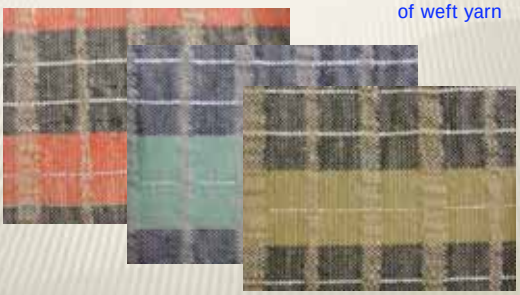
goffer fabrics

Different colors of weft yarn

WOVEN FABRICS

goffer fabrics

Different colors of weft yarn



WOVEN FABRICS

goffer fabrics

Fabrics with fancy yarns in weft

WOVEN FABRICS

terry towels

Color yarn in fringe

WOVEN FABRICS

terry towels

Color yarn
in weft

WOVEN FABRICS

terry towels

Color yarn
in warp and weft

TEXTILES

TEXTILES

FABRIC PROPERTIES

Fabrics investigated:

- the plain woven fabrics made of white and brown cotton,
- OE yarns:
  - warp yarn of linear density 30 tex,
  - the weft yarn of linear density 40 tex.
- the nominal warp density – 230/dm
- the nominal weft density – 180/dm.

FABRIC MANUFACTURING

The set of fabric variants

Symbol of variant	Color of yarn	
	warp	weft
WW	white	white
WB	white	brown
BB	brown	brown

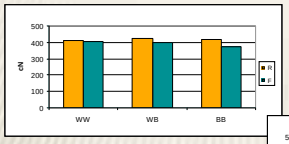
FABRIC PROPETRTIES

Mechanical properties

Parameter	Unit	Raw fabrics			Finished fabrics		
		WW	WB	BB	WW	WB	BB
Width	m	1.74	1.74	1.73	1.63	1.63	1.62
Mass per square meter	gm^{-2}	159.8	152.8	157.5	179.1	177.5	176.0
Mass per meter	g	277.7	265.2	273.2	291.4	289.8	285.6
Warp density	dm^{-1}	230	231	232	244	245	248
Weft density	dm^{-1}	179	176	180	196	197	204
Tenacity in warp direction	cN	411	425	417	403	399	372
Tenacity in weft direction	cN	406	331	408	432	372	415
Elongation in warp direction	%	17.3	17.0	12.5	32.1	31.7	26.9
Elongation in weft direction	%	12.5	12.0	11.7	21.0	19.8	18.3
Shrinkage in warp direction	%	16.8	17.1	18.4	5.9	6.3	5.2
Shrinkage in weft direction	%	13.0	11.6	11.6	4.2	5.0	4.7

FABRIC PROPETRTIES

Fabric tenacity:

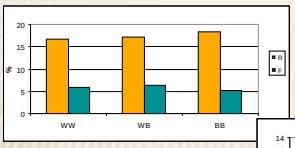


a) in warp direction

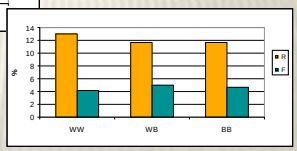
b) in weft direction

FABRIC PROPETRTIES

Fabric shrinkage:



a) in warp direction



b) in weft direction

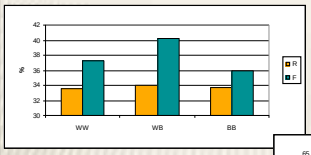
FABRIC PROPETRTIES

Thermal insulation properties

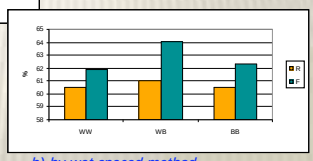
Parameter	Unit	Raw fabrics			Finished fabrics		
		WW	WB	BB	WW	WB	BB
Air permeability	mms^{-1}	810.3	828	-	598.4	574.8	-
Water absorbability	%	123.0	123.2	121,4	167.3	159.9	161.1
Warm/cool feeling	Wm^{-2}	0.102	0.100	0.129	0.110	0.118	0.104
Thermal conductivity	$Wm^{-1}K^{-1}$	0.040	0.037	0.041	0.045	0.044	0.047
Heat keeping property	%	33.6	34.05	33.7	37.3	40.2	35.9
Heat keeping property	%	60.5	61.0	60.5	61.9	64.0	62.3
Water vapour resistance	m^2PaW^{-1}	12.30	13.39	10.27	10.12	14.22	11.73

FABRIC PROPETRTIES

Heat keeping property acc. to Thermo Labo II:

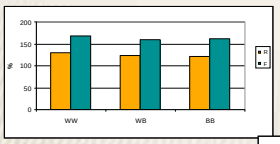


a) by wet contact method,

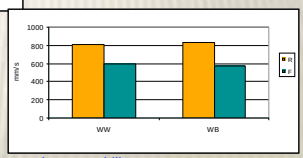


b) by wet spaced method

FABRIC PROPETRTIES



water absorbability



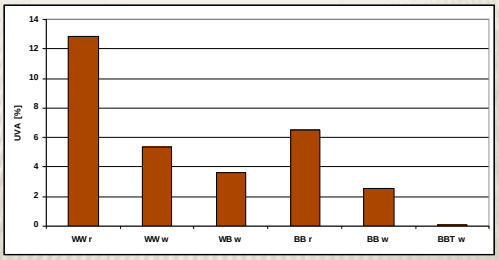
air permeability

FABRIC PROPETRTIES

Barrier properties against UV radiation

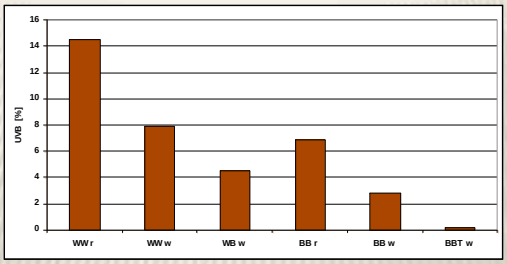
Sample	UVA	UVB	UPF
WW - raw	12.92	14.60	5
WW - washed	5.37	7.98	10
WB - washed	3.65	4.58	20
BB - raw	6.57	6.90	10
BB - washed	2.59	2.83	30
BBT* - washed	0.13	0.19	+50

FABRIC PROPETRTIES



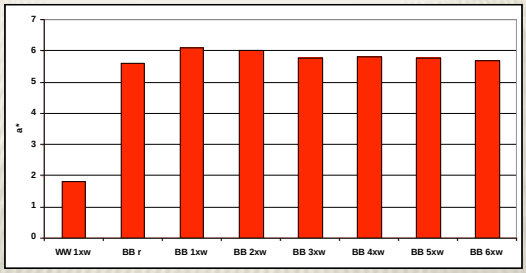
Transmission of UVA radiation

FABRIC PROPETRTIES



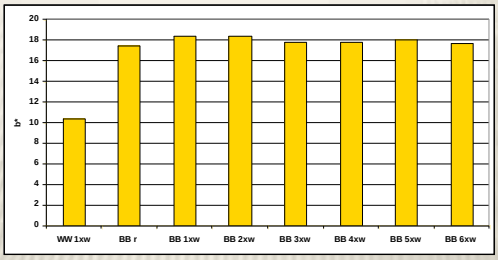
Transmission of UVB radiation

FABRIC PROPETRTIES



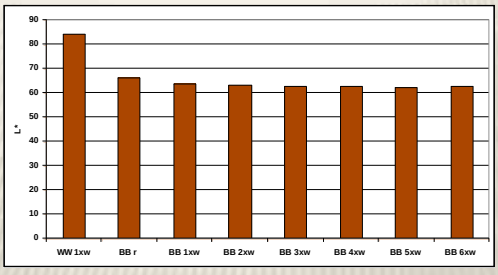
Color coordinate a (green/red)

FABRIC PROPETRTIES



Color coordinate b (blue/yellow)

FABRIC PROPETRTIES



Color coordinate L (lightness)

CONCLUSIONS

On the basis of the carried out research it can be concluded that:

- although the brown cotton of Greek origin is characterized by low maturity, great amount of total neps, SCN neps, trash and dust particles, its application in OE yarn manufacturing did not cause any disruptions in the technological process of yarn manufacturing,
- the quality parameters of OE yarns made of naturally colored cotton depend on the yarn twist,
- the quality of OE yarns made under industrial conditions is on the satisfactory level according to the Uster® Statistics except for yarn neppiness,

CONCLUSIONS

- the brown Greek cotton can be processed in rotor mill into OE yarns of linear densities similar to that of yarns made of middle staple white cotton: from 30 tex to 50 tex,
- application of the brown cotton in warp preparation and weaving did not disturb the industrial processes and the fabric manufacturing,
- the low strength of brown cotton fibers in the warp yarn caused a decrease in the tenacity of washed fabrics in the warp direction,

CONCLUSIONS

- brown cotton has not influence on fabric shrinkage,
- the thermal properties of fabrics made of colored cotton and colored cotton blends were similar to that made of white cotton while fabrics made of the brown cotton were warmer to the touch than that of white cotton.
- an application of brown cotton in woven fabrics improves their barrier properties against UV radiation,
- fabrics made of brown cotton are characterized by the excellent color fastness.

Thank you very much for your kind attention!