ENVIRONMENTAL IMPACT OF DYEING AND FINISHING CONVENTIONAL AND ORGANIC EGYPTIAN COTTON

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ABSTRACT

The textile environmental issues associated with impact represent both cotton agriculture and dyeing processes . Cotton farms emit hazard chemical compounds as Piperonyl butoxide , Cypermethrin, Lambds- cyhalothrin, Chlorpyrifos, Profenofos, Malathion, Lufenuron and Carbendazim. These compounds were detected by multiresidue method analysis for convention cotton in addition to wet processes and dyeing operations ; high BOD,COD,TS, alkaline wastewater and wasted residual unfixed dyes. So this investigation focuses on monitoring of environmental contaminants and eco-production environmental friendly clothes as model which are more healthy for humans and safe on the ecosystem. On using organic cotton instead of conventional cotton, where organic agriculture farms there are no synthetic chemical pesticides, no synthetic fertilizers .The ring spun yarns of 30/1 Ne combed organic and conventional cotton were produced with similar parameters like beating point and settings. Rib knitted fabrics were produced with similar loop length and weight using organic and conventional cotton yarn. The fabrics were processed in eco textile processing by using Levafix Red CA Gran(vinyl sulphone and difluoropyrimidine) reactive dyes by soft flow machine in single dye bath. The fabrics were tested for colour fastness to washing, water, rubbing, perspiration, light and ecological emission measurements.

Keywords: Organic Egyptian cotton , Reactive dye behavior, Residual pesticides in cotton, Ecofreindly apparel.

1. INTRODUCTION

In the textile industry, ecology is the most important aspect in the present worldwide scenario. 25% of the world's chemical pesticides are sprayed on pure cotton. Pesticides pollute our land, air, as well as, water. The toxic chemicals present in pure cotton could well be assimilated through our skin.

In the conventional cotton industry, pesticides are sprayed over the cotton crops, causing serious health problems to cotton workers and soil degradation (Ferrigno, 2005). Organic production systems replenish and maintain soil fertility, reduce the use of toxic and persistent pesticides and fertilizers, and build biologically diverse agriculture. Third-party certification organizations verify that organic producers use only methods and materials allowed in organic production (Punj, 2000).Organic cotton is a crop that is grown without the use of synthetic chemicals such as pesticides, herbicides and fertilizers using methods and materials that have

a low impact on the environment. Cotton was always cultivated organically, like all crops, until the early 20th century, but the demand for cosmetically perfect production and higher yields gave rise to increase the use of synthetic pesticides and fertilizers, and subsequently to genetically modified cotton (Rieple A and Singh R; 2010). Consequently, this led to the accreditation and certification of organic production (P Ton 2002).

Organic cotton will have a smaller impact on Mother Nature from sustainable agriculture policies, as well as, processing without the utilization of insecticides and chemicals.

Also, up to 200,000 tons of dyes are lost to effluents every year during the dyeing and finishing operations, due to the inefficiency of the dyeing processes. Unfortunately, most of these dyes need conventional wastewater treatment processes and persist in the environment as a result of their high stability to light, temperature, water, detergents, chemicals, soap and other parameters such as bleach and perspiration (Couto SR ;2009). The wastewater composition is depending on the different organic-based compounds, inorganic chemicals and dyes used in the industrial dry and wet-processing steps. Textile effluents from the dyeing and rinsing steps represent the most coloured fraction of textile wastewaters, and are characterized by extreme fluctuations in many quality indicators such as COD, BOD, pH, colour, salinity and temperature.

Design approaches for the environment have evolved in scope and depth, beginning with environmental awareness and leading to a complex understanding of how society and the environment interact with and affect each other. Environmental design approaches started with green design, a term originally borrowed from the environmental “buzzword” of 1980’s politics (Madge, 1997).

The present study aims to produce ecofreindly clothes with low environmental impacts starting from sourcing to readymade garments including safe textile chemistry science and dyeing technology by using organic cotton as cleaner product instead of conventional cotton. Also, hazardless chemical substances and nontoxic materials; are atilized to preserve the environment surrounding.

2. MATERIALS AND METHODS

2.1. Fiber Measurements: Measurements of length parameters, tenacity properties and micronaire value for two samples from conventional and organic Egyptian cotton fibers; both of them are Giza 86.which related to HVI system according to ASTM D- 4603-86-1776-1998.(ASTM, 1998) are performed.

Table 1. Micronaire measurements

Conventional cotton			**Organic cotton**		
MIC	MV	LD(mtex)	MIC	MV	LD (mtex)
3.87	0.80	176.00	4.16	0.87	179.00

All fibers were measured under atmospheric conditions at 65% ± 2% Rh and 21 ^{O}C ± 2 ^{O}C according to ASTM D1776- 2004. (ASTM, 2004).

2.2. Yarn samples: Conventional cotton yarn samples of 30/1 and organic cotton 30/1 were spun in super spinning mill, Coimbatore with the following machines and process parameters.

2.3. Fabric samples: Rib conventional cotton fabric produced from conventional cotton yarn samples 30/1 Ne and also Rib organic cotton produced from Organic cotton yarn samples 30/1 Ne by Circular Knitting Machine

Table 2 . Yarn and Fabric Process parameters.

Structure of fabric	Conventional cotton	Organic cotton
Yarn Count	30/1Ne	30/1 Ne
α –Twisting Test	3.5 per inch	3.5 per inch
Strength of yarn	Force :0.78 kg Elong. :11.5mm	Force : 0.815 kg Elong.:13.2mm
Number of columns	11	11
Weight /squ.meter	175 g/m2	175 g/m2
weight after dyeing	200 g/m2	200 g/m2
Width of raw fabric	105 cm	105 cm
Width after finish	93 cm	93 cm
Gauge	18”	18”
Diameter	30”	30”
Circular Knitting M.	Orizio gauge 18	Orizio gauge 18

2.4. Scouring and dyeing: Scouring applies in overflow sample machine for conventional and organic fabrics then dyeing process was carried out with Levafix Red CA Gran (vinyl sulphone and difluoropyrimidine) reactive dyes, using exhaustion method **(Figure. 1)**.

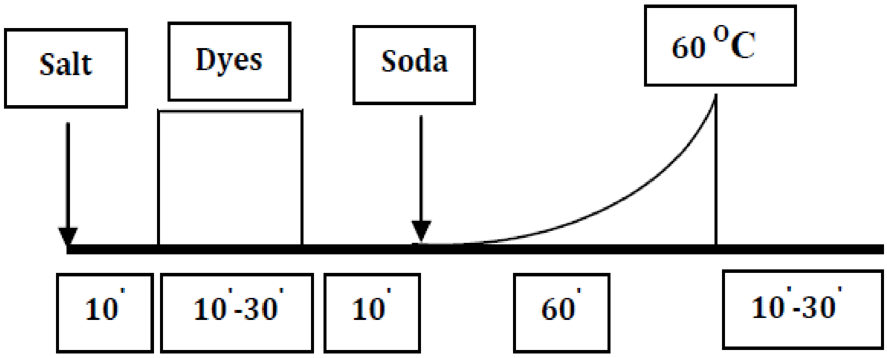


Figure 1 . Dyeing Isothermal process. (Exhaustion method).

Table 3. Scouring and dyeing processes parameters.

Scouring parameters	
Fabric weight	2kg conventional cotton & 2kg organic cotton
Alkali (NaOH)	4 gm per liter.
Soda ash	7 gm per liter PH 10.5
Wetting agent	1 gm per liter.
Sequestering agent	1 gm per liter
Temperature	100 to 125 □ c.
Time	1 hour (open vessel overflow)
M : L	1 : 10
Dyeing parameters	
Machine capacity	1kg to 5 kg
Levafix Red CA Gran	1.5 %
Sodium chloride	25g/l
Sodium carbonate	6g/l
Liquor ratio	1:10
Dyeing temperature	60 □ C

3. RESULTS AND DISCUSSION

The residual analysis of pesticides in cotton by Agricultural Research Center, Central Laboratory of Residue analysis of pesticides.

Method name: Multiresidue method in cotton.

Method Description: Gas chromatographic multiresidue quantitative determination of organohalogen ,organonitrogen,organophosphorus and some pyrithroids pesticide residues **(Figure 2).**

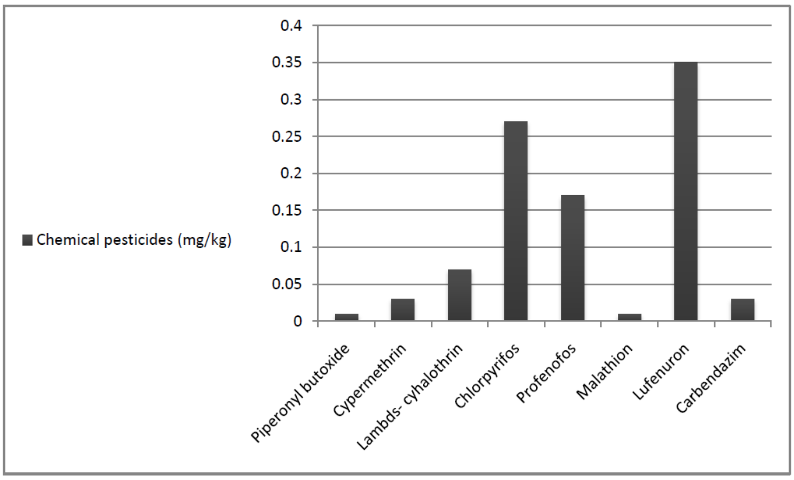


Figure 2. Residual analysis of pesticides in conventional cotton

Table 4. Residue analysis of pesticides in conventional cotton

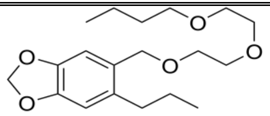
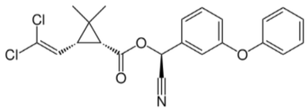
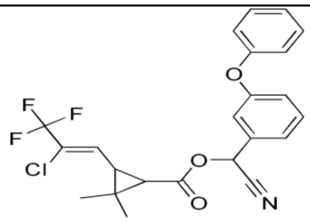
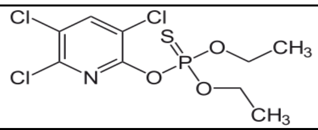
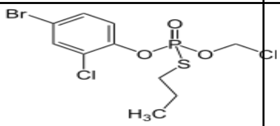
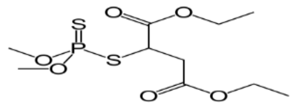
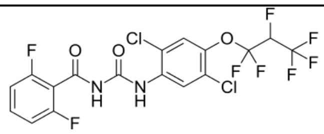
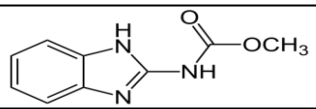
Compound	Structure	Resultmg/kg
Piperonyl butoxide 5-[2-(2 butoxyethoxy)ethoxymethyl]-6-propyl-1,3-benzodioxole		0.01
Cypermethrin [Cyano-(3-phenoxyphenyl)methyl]3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropane-1-carboxylate		0.03
Lambds- cyhalothrin 3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethyl-cyano(3-phenoxyphenyl)methyl cyclopropanecarboxylate		0.07
Chlorpyrifos O,O-Diethyl O-3,5,6-trichloropyridin-2-yl phosphorothioate		0.27
Profenofos 4-bromo-2-chloro-1-[ethoxy(propylsulfanyl)phosphoryl]oxybenzene		0.17
Malathion Diethyl 2-[(dimethoxyphosphorothioyl)sulfanyl] butanedioate		0.01
Lufenuron 1-[2,5-Dichloro-4-(1,1,2,3,3,3-hexafluoropropoxy)phenyl]-3-(2,6-difluorobenzoyl) urea		0.35
Carbendazim Methyl 1H-benzimidazol-2-yl carbamate		0.03

Table 5 . residue analysis of pesticides in organic cotton

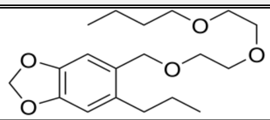
Compound	Structure	Result mg/kg
Piperonyl butoxide 5-[2-(2-butoxyethoxy)ethoxymethyl]-6-propyl-1,3-benzodioxole		0.01

Table 6. Analytical results of textile wastewater.

Process	Type	COD (g O2/L)	BOD (g O2/L)	TS (g/L)	TDS (g/L)	pH
Dyeing	C. C	3.8	1.6	14.8	0.9	10
	O. C	3.2	1.6	14.8	0.7	10

4. CONCLUSION

The Conventional cotton has multiresidual chemical pesticides compounds ; Piperonyl butoxide , Cypermethrin, Lambds- cyhalothrin, Chlorpyrifos, Profenofos, Malathion, Lufenuron and Carbendazim. But organic cotton hasn't residual pesticides except Piperonyl butoxide . Analytical results of textile wastewater after wet processes and dyeing operations gave high BOD, COD, TS, alkaline wastewater and wasted residual unfixed dyes. But in case of conventional cotton is higher than organic cotton. There are no difference in colour fastness between conventional and organic cotton. Also there is no major difference in wet process and dyeing behavior of organic cotton when compared to conventional cotton except scouring loss, whiteness index, less heavy metal .So organic cotton can be considered as Green processing of eco-friendly textiles with very low environmental impact and more healthy to human.

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الأثر البيئي لصباغة وتجهيزالقطن المصري التقليدي والعضوي

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المستخلص

تكون المشكلة البيئية لصناعة المنسوجات مصحوبة بأثر زراعة الأقطان حيث حقول زراعة القطن تستهلك مركبات كيميائية ضارة مثل:" ببيرونيل باتوكسايد– سايبرمثرين– سيهالوثرين – لامبداس سيهالوثرين– كلوربيريفوس– بروفينوفوس– ملاثيون– ليوفينيورون– كاربيندازيم." هذه المركبات وجدت عند اجراء تحليل لمتبقيات المبيدات لعينة قطن تقليدي بالإضافة إلى عمليات الرطبة والصباغة حيث ارتفاع معدل الأكسجين المستهلك حيويا وكيميائيا وزيادة كمية المواد الصلبة و قلوية مياه الصرف واهدر الأصباغ غير المثبتة المتبقية . لذلك هذا البحث يقوم برصد الملوثات البيئية وانتاج ملابس كنموذج صديق للبيئة وأكثر صحية لإنسان وأمنا على النظام البيئي بواسطة استخدام قطن عضوي بدلا من القطن التقليدي حيث حقول الزراعية العضوية ليس بها مبيدات كيميائية وأسمدة مصنعة .

تم اجراء عملية الغزل الحلقي لإنتاج خيط قطن عضوي ذات نمرة ١/٣٠ ممشط وبالمثل خيط قطن تقليدي ذات نمرة١/٣٠ممشط أيضا .ومن نفس الخيط العضوي تم انتاج أقمشة تريكو ريب وأيضا من الخيط التقليدي تم انتاج أقمشة تريكو ريب بنفس الوزن والطول. وإجراء عمليات الصباغة الصديقة للبيئة للأقمشة العضوية والتقليدية باستخدام صبغة ليفافكس أحمر (فينيل سلفون وداي فلوروبيريميداين) بواسطة ماكينة الونش في حوض صباغة مستقل. ثم اجراء الإختبارات للأقمشة (ثبات اللون للغسيل والماءوالإحتكاك والعرق والضوء وقياسات الإنبعاثات البيئية) ودل ذلك على انتاج ملابس صديقة للبيئة وأمنة على صحة الإنسان.