The Eco-legalization and Quality Requirements for Textiles, State of the Art and Current Developments

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Abstract

Generally, legalization is the process of making something legal. The environmental legalization actually helps in solving environmental problems, especially in the developed countries. The Eco-legalization for textile materials refer to ecological legalization, confirming all textile processes, including the application of the various extreme criteria given in Oeko-Tex standards. The system of bilateral quota restraints on textiles and clothing measures mainly achieved by fulfilling the ecological legalization stated in the different Oeko-Tex standards which involved: Oeko-Tex standard [100, 200, 1000 and 100 –plus] for testing, certificating and labeling of the textile products. Thus ensuring remarkable advantages as replacing harmful chemicals without damaging to materials, having good quality of the products with low cost, less energy and water consumption. The goal of the recent trends in textile industry is to direct the researches work to be eco-friendlier by fulfilling the Eco- legalization applying Oeko-Tex standards. The use of Oeko-Tex and labels seem to be a way for consumer to make a concrete choice when they buy environmentally friendly products and differentiate those products from the conventional ones. Applying for a certification for an eco-label is a step forward in the process for companies to decrease environmental impact in their products.

Keywords: Eco- legalization, Oeko-Tex standards- EPA- bilateral quota- Oeko labeling.

1.Introduction

The term Eco-Tex referred to ecological textiles are mainly described to those materials or products that do the minimum possible damages to the environment [1,2] and producing qualified products without harmful effects on the consumer health. These Eco-Tex could be expressed by different words such as "environmentally safe," "non -polluting," "recyclable," "biodegradable," "ozone friendly," "earth friendly," "green," etc. This term covers also, the selection of raw materials, the different trends in textile finishing, the use of energy and water consumption, giving the experience in dyeing and finishing, define Oeko- labels and harmful substances used in final products [3].

The United State Environmental Protection Agency [4]-EPA-defines an Eco-friendly material as that which has a renewable source, i.e., biodegradable, reuse of waste product, reuse/recycle, aids in saving energy, local availability, no land or water pollution, durability and life span. The abbreviation Oeko-Tex or (Öko) standards is the same according to the

language of the standard itself and here one abbreviation which is Oeko-Tex will be defined through this article.

The textile industry describes a plan of different stages from the starting raw material to the final textile product which is the universal system applied around the world under the umbrella of different environmental legalization [5]. Thus, applying common and international ecological standards is the only way to unify this fragmented structure. However, Eco-Tex legalizations are obeyed by fulfilling the criteria and acceptable testing parameters with their ranges that specified in ecological standards which is a principle way to get an Oeko label for a product. This label seems to be the way for consumer to make a consistent and specified, choice when they buy environmentally friendly products and differentiate those products from the conventional ones [6]. The use of these friendly products confirming that the garment or textile has the least environmental impact in the complete supply chain. The certification for an Oeko label is a step forward in the process for companies to decrease environmental impact in their products. Where the textile industry is characterized by a form of cooperation in which each production stage from raw material to finished textile product is often located in a different place in the world.

This article is dealing with the Eco-Legalizations for textile materials and their related topic to keep safe and unpolluted environment. The article discusses the different types of Oeko-Tex standards with their application and usage according to Eco-legalizations with a spot on recent advances in eco-friendly processes in textile industry.

2. Facts and Data

2.1. Significance of Oeko-Tex Standards and their Advantages

Oeko-Tex standards refer to the different standards applied for testing, certification and labelling of a textile product. They differ in their use and the purpose of their application for textile materials. In all of Oeko-Tex standards the preparation of samples is performed according to standard test method ISO-139. The application of Oeko-Tex standards results in production of safe products that compatible with the Eco-legalizations [6]. Also obeying Oeko-Tex standards defines accurate steps in the delivering of different raw materials or textiles which are not harmful to the health for both manufactures and consumers respectively by fulfilling such Eco-legalizations.

All Participants including manufactures and suppliers all over the world that involved in the textile and garments production process such as yarn, fabric and knitwear producers, dye-houses and accessories manufactures should work according to certified rules [7] to fulfill the Eco –legalization. All of these processes can be carried out in different related metrological institutes through their intensive work on testing and research. These processes led to the progress in development of the Oeko-Tex network system.

Here, we are dealing with the advantages and benefits [8] of the Oeko-Tex for both industry and the consumers with their application as follows:

I) For Industry:

The usage of Oeko-Tex standards providing the textile industry by many advantages [9] such as: a) the application of Oeko-Tex standards leads to more compatible products with rapid flow of accurate and clear information. b) These standards ensuring the safety of all textiles materials involved in the textile processes and forbidden the harmful substances c) Obtaining an Oeko certification will help producers in extending their purchasing markets and selling opportunities. E) The fulfilling requirements of Oeko-Tex standards will lead to lowering the production costs, by using all materials that have an Oeko-Tex label.

II) For Consumers:

The application of Oeko-Tex standards permits many benefits to the consumers as follows: 1- The use of Oeko-Tex label helps the consumer in making purchasing decisions by dealing with the well tested and examined products. 2- Applying Eco-legalization should guarantee to consumers on getting textiles materials that are not harmful to their health with ensuring of high-quality, modern and functional textiles [10].

3-By fulfilling Eco-legalization the textile products are tested by independent members of the Oeko-Tex associations [8] who are well known testing institutes that provide higher degree of confidence for consumers. The list of these members is clarified below in Oeko-Tex 100.

2.2-Classification of the Oeko-Tex Standards

The Oeko-Tex standards are divided into many kinds depending mainly on their use and the purpose of their application for textile materials. Here is a brief discussion for each of these standards.

2.2-1-Oeko-Tex Standard 100:

Oeko-Tex Standard 100 is a normative document, published by the international association for research and testing in the field of textile ecology [11]. This standard specifies the general and special conditions for guaranteeing authorization to mark textiles with Oeko-Tex Standard 100 mark. This standard provides the consumer with the name of the two certification agencies for Oeko-Tex which is:

-German Certification Body Öko-Tex -Frankfurter Str. 10-14, D-65760 Eschborn Germany.

-ASQUAL, Association for the Promotion of Quality Assurance in the Textile-Clothing Sector 14 rue de Reculettes, F-75013 Paris- France.

Oeko-Tex standard 100 defines harmful substances as a substance which may be present in textile products or accessories and exceed a maximum limit or which evolve during normal use and may have some kind of effect on people specially babies. The tests for harmful substances according to Oeko-Tex standard 100 are always based on the intended use of the textile. Thus, the following principle must be applied:

“The more intensively a textile comes into contact with the skin (and the more sensitive the skin), the higher the human ecological requirements to be met”. Accordingly, successful tested textile products are assigned to four different classes [11]:

1-Products for babies which are termed Product Class(I) and represent 36% of textile for babies and toddlers up to 3 years (clothing, toys, bed linen, terry cloth items, etc.).

2-Products with direct contact to skin which are termed Product Class II and represent 57% of textiles articles such as underwear, shirts and blouses.

3-Products without direct contact to skin which are termed Product Class III represents 2% of textiles articles, which are worn with only a little part of their surface in direct contact with the skin (e.g. stuffing, jackets, coats etc.).

4-Products of furnishing fabrics which are termed Product Class IV represent 5% of textile decoration such as table cloths, wall coverings, furnishing fabrics, curtains, upholstery fabrics, floor coverings and mattresses. The Oeko-Tex standard 100 services in the following items:
a) All of the institutes that involved in the International Association for Research and Testing in the field of Oeko-Tex are nearly about 34 institutes along the world.
b) Oeko-Tex standard 100 mark which may be single language marking or multiple languages marking as shown in figure (1).

Single language Marking Multi-language Marking

Fig.1 :Oeko- Tex 100 Marks[11].

c) The packing instructions are clarified in Oeko-Tex standard 100 for test material, where the packing of test samples should satisfy specific requirements in order to protect the samples and guarantee exactness and reproducibility of the test results. Individual samples must be packed in polyethylene foil or polyethylene bags of high tensile strength to avoid contamination during the transport of the goods [11].

d)- Oeko-Tex standard 100 gives the limit values and fastness of the all testing criteria as shown in [Table (1)].

Table (1) : Eco parameters Limit Values and Fastness Grades

Product Class	**Class I baby**	**Class II direct contact with skin**	**Class III with no direct contact with skin**	**Class IV decoration material**
PH – Value				
	4.0 - 7.5	4.0 - 7.5	4.0 - 9.0	4.0 - 9.0
Formaldehyde (JAP Law 112)				
Extracted heavy – metals (mg / Kg)				
Sb (Antimony)	30.0	30.0	30.0	
As (Aresenic)	0.2	1.0	1.0	1.0
Pb (Lead)	0.2	1.0	1.0	0.1
Cd (Cadmium)	0.1	0.1	0.1	2.0
Cr (Chromium)	1.0	2.0	2.0	
Cr (VI)	Under detection limit			
Co (Cobalt)	1.0	4.0	4.0	4.0
Cu (Cupper)	25.0	50.0	50.0	50.0
Ni (Nickel)	1.0	4.0	4.0	4.0
Hg (Mercury)	0.02	0.02	0.02	0.02
Heavy Metals in digested sample (mg/Kg)				
Pb (Lead)	90.0	90.0	90.0	90.0
Cd (Cadmium)	50.0	100.0	100.0	100.0

Product Class	**Class I baby**	**Class II direct contact with skin**	**Class III with no direct contact with skin**	**Class IV decoration material**
Pesticides				
Include PCP	0.5	1.0	1.0	1.0
Chlorinated phenols (mg/Kg)				
Pentachlrophenol (PCP)	0.05	0.5	0.5	0.5
TeraChlorPhenol (TECP) Sum	0.05	0.5	0.5	0.5
Phthalate (W %)				
Di-iso-nonylphthalate (DNP) Di-n-octylphthalate (DNOP) Di-(2-ethylhexyl)-phthalate (DEHP) Di-isodecylphthalate (DIDP) Butylbenzyphthalate (BBP) Dibutylphthalate (DIBP) Di-iso-butylphthalate (DIHP) Di-C6-8-branched alkyphthalates (DHNUP) Di-C7-branched alkyphthalates (DBAP) Di-n-hexylphthalate (DHP) Di-(2-methoxyethyl)-phthalate (DMEP)	0.1			
DEHP , BBP , DBP , DIBP , DIHP , DHNUP , DHP , DMEP Sum		0.1	0.1	0.1
Product Class	**Class I baby**	**Class II direct contact with skin**	**Class III with no direct contact with skin**	**Class IV decoration material**
Organic tin compounds (mg/Kg)				
Tributyltin (TBT)	0.5	1.0	1.0	1.0
Triphenyltin (TPHT)	0.5	1.0	1.0	1.0
Dibutyltin (DBT)	1.0	2.0	2.0	2.0
Dioctyltin (DOT)	1.0	2.0	2.0	2.0
Other chemicals residues				
Orthopheny phenol (OPP)(mg/Kg)	50.0	100.0	100.0	100.0
Arylamine (mg/Kg)	None			
PFOS (mg/Kg)	1.0	1.0	1.0	1.0
PFOA (mg/Kg)	0.1	0.25	0.25	1.0
Short chained chlorinated paraffin (SCCP)(W%)	1.0	1.0	1.0	1.0
Tris-(2-Chloriethyl)Phosphate (TCEP)(W%)	1.0	1.0	1.0	1.0
Colorants	Not used			
Cleavable arylamines	Not used			
Cracinogens	Not used			
Allergens	Not used			
Others	Not used			

Chlorinated benzenes and toluenes (mg/Kg)				
Sum	1.0	1.0	1.0	1.0
Polycyclic aromatic hydrocarbons (PAH)(mg/Kg)				
Benzo / Pyrene	1.0	1.0	1.0	1.0
Sum	10.0	10.0	10.0	10.0
Biological active products				
	None			
Flame retardant products				
General	None			
Polybrominated biphenyles (PBB) Tri-(2,3-dibromopropyl)-phosphate (TRIS DBPP) Tris-(aziridinyl)-phosphinoxide (TRIS) Pentabromodiphenylether (pentaBDE) Octabromodiphenylether (octaBDE) Decabromodiphenylether (decaBDE) Hexabromodiphenylether (HBCDD) Short chained chlorinated paraffin (C 1O – C 13) (SCCP) Tris(2-chloroethyl)phosphate (TCEP)	Not Used			
Product Class	**Class I baby**	**Class II direct contact with skin**	**Class III with no direct contact with skin**	**Class IV decoration material**
Solvent residues(W%)				
1-Methyl-2-pyrrolidone (NMP)	0.1	0.1	0.1	0.1
N,N-Dimethylactamide (DMAC)	0.1	0.1	0.1	0.1
Surfactant ,Wetting agent residues				
Octylphenol (OP)	0.01	0.01	0.01	0.01
Nonylphenol (NP)	0.01	0.01	0.01	0.01
Octylephenoethoxylates (OP (EO))	0.1	0.1	0.1	0.1
Nonylphenolethoxylates (NP (EO))	0.1	0.1	0.1	0.1
Color Fastness (Staining)				
Water	3	3	3	3
Acidic perspiration	3-4	3-4	3-4	3-4
Alkaline perspiration	3-4	3-4	3-4	3-4
Rubbing , Dry	4	4	4	4
Saliva and perspiration	Fast			
Emission of volatiles				
Formaldehyde (50-00-0)	0.1	0.1	0.1	0.1
Toluene (108-88-3)	0.1	0.1	0.1	0.1
Styrene (100-42-5)	0.005	0.005	0.005	0.005
Vinylcyclohexene (100-40-3)	0.002	0.002	0.002	0.002
4-Phenylcyclohexene (4994-16-5)	0.03	0.03	0.03	0.03
Butadiene (106-99-0)	0.002	0.002	0.002	0.002
Vinylchloride (75-01-4)	0.002	0.002	0.002	0.002
Aromatic Hydrocarbons	0.3	0.3	0.3	0.3
Organic volatiles	0.5	0.5	0.5	0.5
Determination of odors				
General	No abnormal odor			
SNV 195 651 Modified	3	3	3	3
Banned fibres				
Asbestos	Not used			

2.2-2- Oeko -Tex Standard 200

Oeko -Tex standard 200 gives the procedures for the different testing criteria [12] that had been stated with their valid limits in Oeko -Tex standard 100 such as:

- Formaldehyde
- Heavy metals
- Skin-neutral pH-value
- Organochloride compounds
- Pesticides
- Polycyclic Aromatic Hydrocarbons (PAH)
- Fastness to Perspiration
- Fastness to Rubbing
- Fastness to Water
- Fastness to Saliva
- Banned azo dyes (carcinogenic aromatic amines)
- Carcinogenic and allergenic dyes

2.2.3-Oeko-Tex Standard 1000

Oeko-Tex standard 1000 that had been established in 1995 provides a certification system for the environmental processes for the textile and production sites [13]. Oeko-Tex standard 1000 extends the human ecological testing in conformity with the Oeko-Tex standard 100 by the inspection of the production ecology.

This standard involves two parts (A&B), Part (A) contains the requirements for certification of production sites: part (B) covers the requirement for labelling of textile products. The label of Oeko-Tex standard 1000 is shown in figure (2) below.

Fig.2: Oeko-Tex Standard 1000 Mark[13]

One member from the 34 member institutes which are stated in Oeko-Tex standard 100 is the independent responsible auditor for the verifications of any textile participants intended to be eco-labelled by Oeko-Tex standard 1000. This authorized member provides a certificate which is valid for three years, this certificate should be renewed regularly.

The test criteria [13] of Oeko-Tex standard 1000 include the following:

1. Exclusion the environmental harmful chemicals and auxiliary materials (e.g. ban of chlorine bleach)
2. Compliance with guide values for waste water and exhaust air treatment

3. Economical usage of energy resources
4. Avoidance of noise and dust pollution

2.2.4-Oeko-Tex Standard 100 plus

This standard identifies textiles which were tested for possible harmful substances and produced exclusively [14]. The application of standard 100 plus is the proof that the entire production chain- i.e. all companies involved in the production of a certain end product – meets the requirements of the other Oeko-Tex certification without exceptions. Which means that, this end product was certified as environmentally friendly according to Oeko-Tex standard 100 and 1000. The label for a product certified according to 100 plus is shown in figure (3). Conformity with Oeko-Tex standard 100plus's standard is verified by an independent organization (third party). Where a third party is an agency that will be independent and responsible to evaluate any company intend to get Oeko-Tex 100 plus label.

Fig.3:Oeko-Tex Standard 100-Plus Mark[14]

2.3-ECO-Tex Testing Parameters and Their Limits for Legalization of Textile Materials

Many authorized agencies modify the testing criteria and limit values of the used harmful substances [15]. The maximum value of some Oeko-Tex parameter may be differed according to the requirements of the product group concerned [11,12]. The assessment covers the following parameters:

Clothing: baby clothing, children's clothing, underwear, sleepwear, shirts, blouses, stockings, and sportswear, outwear and work clothing.

Home textiles: bed linen, bathroom textiles, household textiles, curtains and decorative fabrics.

Accessories: involve items that are added to supplement textile goods for required functional or for fashionable reasons that must be tested such as: linings, prints, buttons, zip fasteners, rivets etc.

The most important parameters and their valid limits to fulfill the Eco- legalizations [6, 11,12] are shown as follows:

2.3.1-Skin-neutral pH-value

Human skin is slightly acidic which inhibits the development of many diseases. Fabrics with extreme pH values can easily damage skin and may cause allergic reactions. This parameter is determined in accordance with ISO 3071, It must be within the range as shown in table (1). Where, for product class I and II (pH is: 4-7.5) because this range is corresponding to the normal conditions of undamaged human skin [11]. While for product class III and IV (pH

is: 4-9). Safe pH values of the used fabrics can be achieved through final acidification of modified fabrics or by adequate washing.

2.3.2- Formaldehyde

Generally, textile fabrics are treated with urea formaldehyde resins to give them easy care finishing properties such as antistatic, anti-wrinkle, anti-shrink, water proofing, mildew resistant and color fastness. The American Federation of Governmental Employers blamed formaldehyde usage as it may cause skin irritation, red eyes, bloody noses and cracked lips [16, 17]. Thus it is restricted in consumer products such as cosmetics and textiles fabrics that worn tightly against the body. Testing for free formaldehyde is performed according to standard method [ISO: 14184 - part 1], while for release formaldehyde testing is [ISO: 14184 - part 2]. According to this method the content of free and partially releasable formaldehyde is determined in aqueous extract using the acetyl-acetone method by means of a spectrophotometer. The limits [11] of formaldhyde in the four product classes are as shown in table (1). These results show that the lowest formaldehyde content is lower than 20ppm for babies clothes, while for textile products with no direct contact or textile furniture, the limit is lower than 300ppm. Generally, a consumer is advised to wash any new textile product prior to first usage for safety requirements and to ensure better skin compatibility [18].

2.3.3-Pesticides

Pesticides are biological active compounds which control the growth of organisms such as bacteria, fungus, algae, or insects [19]. Although they control the growth of organisms, their use must be under restricted conditions especially in cellulosic materials plantations which represent 18% of the world's usage of pesticides. The specified limits[11] of pesticides are shown in table (1). The most important chemical groups present in pesticides are for example, organochlorine, organophosphorous, carbamate, etc. For pesticides determination the tests are performed with cleaned-up extracts by gas chromatography with selective detection using Mass Spectrometer Detector (MSD) or Electron Capture Detector (ECD). For organochlorine pesticides such as DDT and Toxaphene the specified limit is less than (1.0) mg/kg. These values are primarily applicable to natural fibers [19]. Table (2) shows the list of banned pesticides according to Oeko-Tex 100.

Table (2): List of some banned pesticides according to Oeko-Tex standard 100[11].

Pesticide Name	CAS Number
2,4,5-T	93-76-5
2,4-D	94-75-7
Azinophosmethyl	86-50-0
Azinophosethyl	2642-71-9
Aldrin	309-00-2
Bromophos-ethyl	4824-78-6
Captafol	2425-06-1
Carbaryl	63-25-2
Chlordane	57-74-9
Chlordimeform	1970-95-9
Chlorfenvinphos	470-90-6
Coumaphos	56-72-4
Cyfluthrin	68359-37-5
Cyhalothrin	91465-08-6

Pesticide Name	CAS Number
Cypermethrin DEF	52315-07-8
Deltamethrin	52918-63-5
Dichlorodiphenyldichloroethane (DDD)	53-19-0 , 72-54-8
Dichlorodiphenyldichloroethylene (DDE)	3424-82-6 , 72-55-9
Dichlorodiphenyltrichloroethane (DDT)	50-29-3 , 789-02-6
Diazinon	333-41-5
Dichlorprop	120-36-2
Dicrotophoshos	141-66-2
Dieldrin	60-57-1
Dimethoat	60-51-5
Dinosep and salts	88-85-7
A- Endosulfan	115-29-7
B- Endosulfan	B-33213-65-9
Endrin	72-20-8
Pesticide Name	CAS Number
Esfenvalerate	66230-04-4
Fenvalerate	51630-58-1
Heptachlor	76-44-8
Heptachloroepoxide	1024-57-3
Hexachlorobenzene	118-74-1
A- Hexachlorcyclohexane	a.319-84-6
B. Hexachlorcyclohexane	B.319-85-7
S. Hexachlorcyclohexane	S.319-86-8
Lindane	85-89-9
Malathion	121-75-5
MCPA	94-74-6
MCPB	94-81-5
Mecoprop	93-65-2
Metamidophos	10265-92-6
Methoxychlor	72-43-5
Mirex	2385-85-5
Monocrotophos	6923-22-4
Parathion	56-38-2
Parathion-Methyl	298-00-0
Phosdrin / Mevinphos	786-34-7
Propethamphos	1218-83-4
Profenophos	1198-08-7
Quinalphos	3593-03-8
Toxaphene	001-35-2
Trifluralin	582-09-8

2.3.4-Heavy Metals

The using of metal salts as pre-requisite for application of natural dyes for obtaining desired shades with higher fastness properties, may cause contamination of the dyed textiles with objectionable heavy metals such as Copper (Cu), Nickel (Ni) and Chromium (Cr). Higher concentration of these heavy metals may cause their accumulation in body tissues and binding to enzymes thus disrupting the correct functioning of the cells, with tumors and mutations development resulting carcinogenic effect. Thus their limits should be ensured [20] and they must be used in trace amount. The quantitative determination of the extracted heavy metal is performed by atomic absorption spectrometry (AAS), ICP, or spectrophotometry. The limits of the different heavy metals are listed in table (1). where according to this list, Copper must not excesses [50.0] ppm for classes (IV, III, and II) and [25.0] ppm for class (I), Nickel, must

not exceeds [4.0] ppm for classes (IV,III, and II) and [1.0] ppm for class I, Chromium must not excesses [2.0] ppm for classes (IV,III, and II) and [1.0] ppm for class (I). Other metals like, Cadmium, mercury and lead on textiles are highly un-desirable and if present in textiles goods should be within trace content [16].

2.3.5-Chlorinated phenols

Chlorinated phenols such as pentachlorophenol (PCP) are used as anti-mildew agents for the preservation and impregnation of textiles [16]. The content of pentachlorophenol (PCP) and its derivatives is determined using gas chromatography with mass spectrometric (MSD) or electron capture detection (ECD). The specified limits of PCP were shown in table (1), these limits should be ensured [11] to not exceeds [1.0] ppm for classes (IV, III, and II) and [0.5] ppm for class (I).

2.3.6-Azo Dyes

Textile companies in Germany refer to the German MAK list (Threshold Limited Value) which list some aromatic amines that are known to be carcinogenic to humane (MAK III Al). Those which are detected to be carcinogenic in animal tests under conditions comparable to the work place (MAK III A2) and those which are suspected to be carcinogenic (MAK III B)[6,16] . The reasons for the restrictions on those dyes is due to the potential of azo dyes to split into banned arylamines from which they have been synthesized by chemical reduction. The list of forbidden arylamines is shown in table (3) according to Oeko-Tex standard 100 and the list of the corresponding azo dyes based on these amines is shown in table (4), these dye stuffs are classified to be allergenous [11].

Table (3): List of arylamines that are not allowed to be spilt off from colorants under reductive conditions [according tex standard 100]

Name	CAS – NUMBER
MAK III , Category 1	
4-Aminobiphenyl	92-67-1
Benzidine	92-87-5
4-Chloro-o-toluidine	95-69-2
2-Naphthylamine	91-59-8
MAK III , Category 2	
o-Aminoazotoluene	97-56-3
2-Amino-4-nitrotoluene	99-55-8
p-Chloroaniline	106-47-8
2,4-Diaminoanisole	615-05-4
4,4-Diaminobiphenylme thane	101-77-9
3,3-Dichlorobenzidine	91-94-1
3,3-Dimethoxybenzidine	119-90-4
3,3-Dimethylbenzidine	119-93-7
3,3-Dimethyl-4,4-diaminobiphenylmethan	838-88-0
p-Cresidine	120-71-8
4,4-Methylene-bis-(2-chloroaniline)	101-14-4
4,4-Oxydianiline	101-80-4
4,4-Thiodianiline	139-65-1
o-Toluidine	95-53-4
2,4-Toluylendiamine	95-80-7
2,4,5-Trimethylaniline	137-17-7
o-Anisidine (2-Methoxyan)	90-04-0
2,4-Xylidine	95-68-1
2,6-Xylidine	87-62-7
4-Aminoazobenzene	60-09-3

Table (4) : Dyestuffs classified to be allergenous [According to Oko-Tex standard 100] and their color index (C.I.) (Generic name and structure number) or CAS registry number .

C.I. Generic name	C.I. Structure number	CAS-Number
C.I. Disperse blue 1	C.I. 64 500	2475-45-8
C.I. Disperse blue 3	C.I. 61 505	2475-46-9
C.I. Disperse blue 7	C.I. 62 500	3179-90-6
C.I. Disperse blue 26	C.I. 63 305	
C.I. Disperse blue 35		12222-75-2
C.I. Disperse blue 102		12222-97-8
C.I. Disperse blue 106		12223-01-7
C.I. Disperse blue 124		61951-51-7
C.I. Disperse brown 1		23355-64-8
C.I. Disperse orange 1	C.I. 11 080	2581-69-3
C.I. Disperse orange 3	C.I. 11 005	730-40-5
C.I. Disperse orange 37	C.I. 11 132	
C.I. Disperse orange 76	C.I. 11 132	
C.I. Disperse red 1	C.I. 11 110	2872-52-8
C.I. Disperse red 11	C.I. 62 015	2872-48-2
C.I. Disperse red 17	C.I. 11 210	3179-89-3
C.I. Disperse yellow 1	C.I. 10 345	119-15-3
C.I. Disperse yellow 3	C.I. 11 855	2832-40-8
C.I. Disperse yellow 9	C.I. 10 375	6373-73-5
C.I. Disperse yellow 39		
C.I. Disperse yellow 49		

Other dye stuffs are listed in Oeko-Tex standard 100 as carcinogenic and their list is shown in table (5).

Table (5): Dyestuffs classified to be carcinogenic

C.I. Generic name	C.I. Structure number	CAS-Number
C.I. Acid red 26	C.I. 16 150	3761-53-3
C.I. Basic red 9	C.I. 42 500	569-61-9
C.I. Basic violet 14	C.I. 42 510	632-99-5
C.I. Direct black 38	C.I. 30 235	1937-37-7
C.I. Direct blue 6	C.I. 22 610	2602-46-2
C.I. Direct red 28	C.I. 22 120	573-58-0
C.I. Disperse blue 1	C.I. 64 500	2475-45-8
C.I. Disperse orange 11	C.I. 60 700	82-28-0
C.I. Disperse yellow 3	C.I. 11 855	2832-40-80

2.3.7-Flame Retardants Products

The term flame retardant describes chemicals which added to textile materials to inhibit or delay spreading of fire within it. Some of them are toxic and may cause serious health issues [6]. The list of some forbidden flame retardant substances according to Oeko-Tex standard 100 is shown in table (6) [11].

Table (6): Chlorinated benzenes and toluenes [According to OKo-Tex standard 100]

Dichlorobenzenes
Trichlorobenzenes
Terachlorobenzenes
Pentachlorobenzenes
Hexachlorobenzene
Chlorotoluenes
Dichchlorotoluenes
Trichlorotoluenes

2.3.8-Color Fastness

The testing criteria of harmfulness of textile goods do not contain colorfastness as a criterion but it is not allowable or admissible that dyed products with an eco-label should be of very bad color fastness to different types of influences, e.g., water, rubbing, washing and, perspiration etc. For -product Class I(baby clothing) fastness to saliva should also be tested [11].

Where, in all the color fastness tests given below only the fastness grades with respect to staining of the adjacent fabrics are determined using Gray or Blue Scale for assessment. Some of the standard methods for each test are given below:

-Color fastness to washing is performed according to ISO 105- C06.

-To water is performed according to ISO 105-E01.

-To saliva is performed according to ISO 105- A01

-To acidic and alkaline perspiration according to ISO 105-E04.

-To rubbing is performed according to ISO 105-X12.

For judgment the tested textile product should marked with statements e.g., Fast to saliva and perspiration or− Not fast to saliva and perspiration [16].

2.3.9-Sensory Odours

Textile floor coverings which belong to product class IV may emit a more or less perceptible odour after being fitted. Due to the large number of compounds, which may produce an odor, sensory odour testing may be a valuable complementally analysis [6]. The textile specimen is tested for the development of odour in a closed system, with monitoring of time, temperature and humidity after both delivering and storage. For judgment the grades are: 1 = odourless, 2 = weak odour, 3 = tolerable odour, 4 = annoying odour, 5 = intolerable odour. Odour test on other articles must be performed before the start of other tests and immediately after delivery of the sample but - if necessary – after storage at increased temperature in a closed system [11].

Odour may be: mould, high boiling fraction of petrol (color printing), fish (permanent finish), or aromatic hydrocarbons (carrier, etc.).

2.3.10-Banned Fibers

Asbestos is banned [8,11] as one of the most forbidden fibers and should be rejected from any textile industry and for usage as a whole.

2.4-Eco-Friendly Steps in Processing and Production of Textiles According to Eco-Legalization

For Eco-textile production the following steps [21] should be considered:

1-Fiber Origin: The producer must select fiber constituents of low contamination for good quality products. The new market today is subjected to use organic fibers rather than synthetic ones. These organic fibers are derived from natural bio-fibers such as: chitin, corn, wheat, rice, sugar cane, pineapple, banana and coconut or from regenerated ones. Some of these natural and regenerated fibers are: hemp, organic cotton, indigo-corn fiber, wool, soy silk, bambo, chitosan fiber, chitin silk, lyocell fiber (regenerated cellulose fiber), …etc.

2-Fabrics and Yarns Production: The production method which results in the least possible contamination and easily removal sizes should be selected.

3-Textile Processing: Different types of pretreatment including: physical, chemical and biological, might be used for better applicability of textiles [22]. Also selection of suitable auxiliaries and processes with minimal chemical contamination. Besides, the contaminants can be removed by commercial washing or bio-enzymatic removal method.

4-Clothing Production: The final textile product of ecological responsible and technically desired properties should be obtained with the choice of the material according to ecological quality and not only the cost.

5-Textile Marketing: Marketing is an important issue should be done with correct choice of articles, correct consultation, and correct clarification

6-Final Consumer: Regulations must be taken into consideration concerning for final consumer such as: the selection not only according to fashion but must concentrated on ecological acceptability and care treatments.

2.5- Application of Oeko-Tex Standards in Egyptian Textile Sector

The Egyptian Organization for Standardization and Quality (EOSQ) has issued standard specifications for textile raw materials and their products with the safety requirements, in accordance with Oeko-Tex standards in a collective standard of number: ES -7266. This Egyptian collective standard contains five issued parts[23-27]. As a common view in these parts, each part stated the criteria and acceptable limits and ranges from Oeko-Tex 100 and the procedure for testing from Oeko-Tex 200, but the difference between five parts is the nature of tested textile material. The common items involved in all are: a list of toxic and harmful azo dyes, forbidden aryl amines, harmful auxiliaries used in dyeing process and their acceptable limits such as formaldehyde, and heavy metals and their acceptable limits, with Oeko and care -labelling criteria.

2.6-Recent Trends in Textile Fabric Modification to be Eco-friendly and Fulfill Eco-Legalization

There are different types of textile modifications may be used for obtaining eco-friendly fabrics with desired properties including [28-35] physical, chemical, biological and nanotechnology treatments.

2.6.1. Physical modification: generally, physical modification of textiles is a safe, environmental unpolluted treatment, imparting many desired properties to the treated surfaces as antimicrobial activity, shrinkage, wrinkle resistance, decreased skin irritation, increase dye exhaustion. Examples of these modifications are: ultraviolet UV/ ozone treatments [36-37] and plasma modifications [38-40].

2.6.2. Chemical modifications using natural materials such as: cellulose, chitosan [41], starch, alginates and their derivatives. This type of modification characterized by its biocompatibility, biodegradability, nontoxicity and antimicrobial activity.

2.6.3-Chemical functionalization using new techniques like microencapsulation as an effective method to protect the natural functional agents from reactions with moisture, light, and oxygen. Such modifications accept the treated fabrics high durability of more functional properties [42].

2.6.4-Nanotechnology with the usage of nanomaterial in a safe concentration range with controlled legalization, the treated fabrics will accept desired functions such: hydrophobic

finish, self-cleaning effect, uv-protection, antimicrobial, odour flights finish and flame retardant properties [43-46].

2.6.5- Biological treatment of textiles includes enzymes usage [47] as in bio-washing, bio-scouring and bio-polishing.

2.6.6-Recently [48], sights are focused on replacing some of the used harmful chemicals by alternative safe, eco-friendly and environmentally un-pollutant ones. Thus several different chemical suppliers to the textile industry have been developed what so called "Positive lists" or "White lists" in order to meet their client's requirements for safer chemicals. Some of these substitutions [49] are shown in table (7) below:

Table (7) : Forbidden flame retardant substances toluenes [According to OKo-Tex standard 100].

Name	CAS-Number
Polybrominated biphenyles	59536-65-1 PBB
Tri-(2,3-dibromopropyl)-phosphate	126-72-7 TRIS
Tris-(aziridinyl)-phosphinoxide	5455-55-1 TEPA
Pentabromodiphenylether	32534-81-9 penta BDE
Octabromodiphenylether	32536-52-0 octa BDE

2.6.7- Beside to the aforementioned Oeko-Tex standards, the International Working Group has released, the Global Organic Textile Standard (GOTS) which is the worldwide leading textile processing standard [50] for organic fibers, including ecological and social criteria. Where a textile product carrying the GOTS label grade 'organic' must contain a minimum of 95% certified organic fibers whereas a product with the label grade 'made with organic' must contain a minimum of 70% certified organic fibers, figure (4) represents such label.

Fig.4. Global Organic Textile Standard (GOTS) Certified Fabric [50]

According to Eco-legalization in (GOTS) standard the textile production cycle from raw material to final product must [50] permits and fulfils the followings:

1-At all stages through the processing organic fibre products must be separated from conventional fibre products and must clearly identified.

2-All chemical inputs (e.g. dyes, auxiliaries and process chemicals) must be evaluated and meeting basic requirements on toxicity and biodegradability/eliminability according to Oeko-Tex legalization.

3-Prohibition of critical inputs such as toxic heavy metals, formaldehyde, aromatic solvents, functional nano particles, genetically modified organisms (GMO) and their enzymes.

4-The use of synthetic sizing agents is restricted; knitting and weaving oils must not contain heavy metals.

5-Bleaches must be based on oxygen (no chlorine bleaching).

6-Azo dyes that release carcinogenic amine compounds are prohibited.

7-Restrictions for accessories (e.g. no poly vinyl chloride (PVC), nickel or chrome permitted)

8-All operators must have an environmental policy including targets to obtain procedures with minimized waste and discharges.

9-Packaging material must not contain poly vinyl chloride (PVC) paper that used in packaging material, hang tags, swing tags etc. must be recycled or certified according to standard test methods.

2.7- Oeko Labelling Requirements According to Eco-legalization

Eco labelling induces valuable and very important information for producer where they are designed to inform consumers that the labelled product is more environmentally friendly than most in its product category [51]. Financial savings for those producers can be achieved through process optimization and reduced consumption of raw materials, reduce processing time, improve environmental performance and improved conditions. Besides Oeko label includes valuable information for consumer in usage and wearing of different textile products and specify also the mode for caring of this label [14]. There is a wide range of Oeko -Labelling Schemes covering a variety of textile product groups. Each has developed criteria that vary in approach from full life cycle analysis to schemes that address only the quality of the final product [51]. The organizations involved in the Oeko -labelling schemes may be: Private Organizations including four types that are: Non-Governmental Organizations (NGOs), Institution Related Organizations (IRO), Producers Association Organizations (PAO) and Company Related Organizations (CRO).

Or Government Organizations, these may be: national such as Oeko -Mark in India or in Korea and Green Mark in China or multinational such as EU-label through Europe and Nordic Oeko -label through Nordic countries such as Sweden and Denemark.

2.7.a- Oeko Labelling for Producer

Generally, the label should be, easily legible, visible, accessible, and durable enough to remain attached to the product until sold and delivered to ultimate consumer. There are five basic elements [14,51] must be included in each Oeko –Tex label

1-The respective product logo - e.g. MADE IN GREEN as shown in figure (5) below.

2-The test number / product-ID, and the name of the responsible Oeko –tex institute

3-The explanatory label text - e.g. "Tested for harmful substances and produced sustainably in accordance with Oeko –Tex guidelines"

4-The respective internet address - e.g. "www.madeingreen.com"

5-The frame around all other label contents.

Without these basic elements all the oeko –tex labels are not legally valid.

Fig.5: Basic elements included in each oeko –tex label [51]

The minimum width of all Oeko-Tex label is 27 mm to ensure an adequate legibility, but its height may varies depending on language of the label text,
Examples of environmental labels are shown in figure (6).

Certifies products made with 100% organic fiber

Healthy Child Healthy World

Global Organic Textile Standard

NATUR TEXTIL

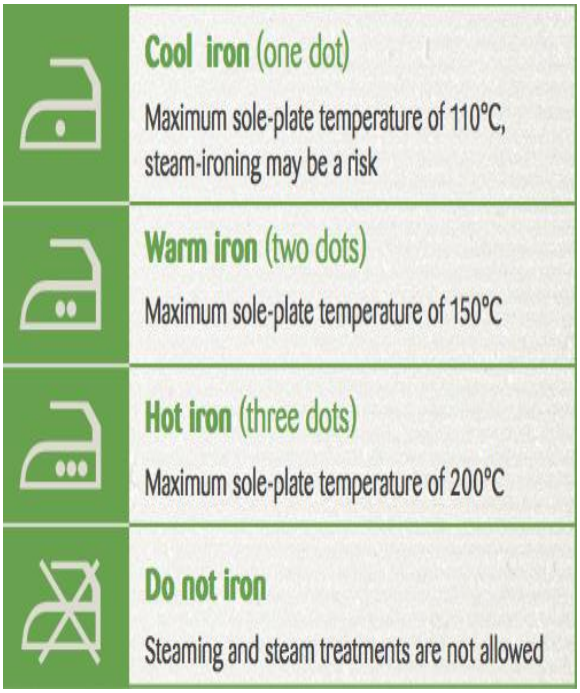
Fig.6: Examples of environmental labels [51].

2.7.b- Oeko labelling for Consumer-Care Labelling:

1-Suppliers must ensure that care instructions are adequate and appropriate for the article[51]. For example, providing overly cautious instructions such as ‘dry-clean only’ or ‘hand wash in cold water only’ on a garment that a user can safely wash.

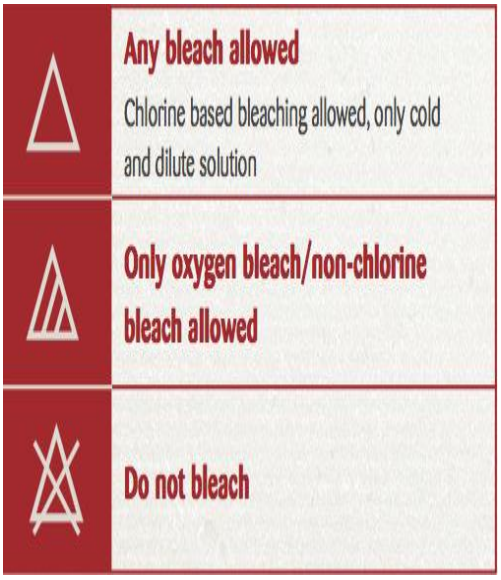
2-Specific instructions provide advice on what a user should do with the article. Examples include: dry flat, cool iron, dry-clean only.

3-Prohibited instructions provide advice on what a user should not do with the article. Examples include: do not iron, do not tumble dry. Figure (7) showed some of valuable care labels.

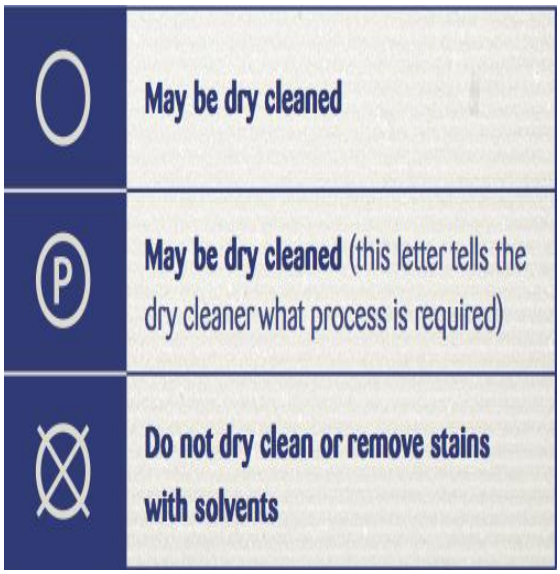


Washing Care Label

Ironing Care Label



Bleaching Care Label



Dry- Clean Care Label

Fig.7: Some of Valuable Care Labels [51].

2.8-ECO-Labelling Implementation in The Egyptian Textile Sectors

Eco-labelling requirements for textiles was implemented as an example in two Egyptian textile factories which is a part of the Support for Environmental Assessment and Management (SEAM) Programme [52] to fulfill the Eco-legalization. These two Egyptian textile factories are: Misr for Spinning and Weaving Company, Mehalla El-Kobra and Giza for Spinning, Weaving, Dyeing and Garments Company, Kafr El-Hakeim, Giza.

2.9- MADE IN GREEN by OEKO-TEX [53]

Made in green is a traceable product label for all kinds of textiles (e.g. garments, home textiles) and non-textile components (e.g. accessories). The MADE IN GREEN label verifies that an article has been tested for harmful substances. This is carried out through certification in accordance with STANDARD 100 by OEKO-TEX. It also guarantees that the textile product has been manufactured using sustainable processes under environmentally friendly and socially responsible working conditions. This is carried out through certification in accordance with step by OEKO-TEX [53]. You can use a unique product ID on the label to trace the countries and production facilities in which the labelled article was produced.

Label Check. Each item labelled with MADE IN GREEN can be traced using a unique product ID or QR code. The label gives access to information regarding production facilities in which the textile was produced, the stage of production to which the fabrics belong and the countries in which manufacture took place.

The MADE IN GREEN label gives you the certainty of knowing that the textile product is made [53]:

- with materials that have been tested for harmful substances
- In environmentally friendly facilities
- In safe and socially responsible workplaces.
- Sustainable and socially responsible conditions

Fig.8: MADE IN GREEN by OEKO-TEX[53]

2.10-Requirements to obtain a MADE IN GREEN Label

The requirements and criteria for end products that consumers can purchase from retailers [54] can be summarized as follows:

1-The product shall be certified according to STANDARD 100 by OEKO-TEX.

2-Single components that equal or exceed 5% of the total weight of the product as well as at least 85% of the total weight of the product shall be supplied by step by OEKO-TEX. This concerns only facilities with wet/ chemical processes (excluding wet spinning processes). Metallic and plastic components are not considered.

3-The participating companies in this supply chain must register for the step by OEKO-TEX database / MADE IN GREEN Dashboard and actively use it.

4-For semi-finished products (B2B) which are sold to companies within the supply chain, the following additional criterion must also be met that are :

- Validity of green label.
- The made in green label is valid for 1 year [55-59].

Authors should summarize their prospective in points.

3.Conclusions and Future Outlook

3.1-The application of Eco-legalization in textile industries including processing and production ensuring remarkable advantages such as: replacing harmful chemicals, lowering cost, energy and water consumption without damage materials, and confirming the quality of all products. Thus great efforts must be focused on undergoing scientific researches concerning each of the aforementioned advantages.

3.2-Environmental labels operate as informative and voluntary market tools.

3.3-Eco-labelling can accomplish several goals:

-Improving sales or image of a labelled product.

-Directing manufactures for the environmental impact of their product and encouraging the sustainable management of resources.

3.4- Consumer awareness in the matters of environmental and health problems has a direct bearing on textiles and clothing.

3.5- Buyers are more informed about the pollutants in close-to-skin textiles like bed sheets and under garments.

3.6-New information concerning allergy and cancer causing chemicals in materials force the consumers and manufacturers to react.

3.7-Many global laboratories dealing with textile environmental requirements have applied a new application that is Textile Exchange (TE) Standards that work to support the integrity of product claims by providing verification from an independent third-party.

3.8- As a Final recommendation, for developing the position of the Egyptian textile industry in the international textile market, the Egyptian Government and industry together must take a serious note of the situation and developed Eco-strategy with stress on:

3.8.A) Establishing a quality assurance system which is an essential part of maintaining an Oeko-label, this system is based on controlled environmental policies such as: using certified reference or working standard materials, undergoing calibration for all testing devices and undergoing sufficient proficiency testing programs or inter-laboratory comparisons.

3.8.B) Ensuring sufficient marketing communication tools to increase knowledge for the customers of textile producers in public environment and planning for more pounced environmental messages

3.8.C) Eco-mark scheme through different life cycle auditing programs.

3.8.D) Development of necessary eco-related testing facilities.

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