

Ecology and reliability of textiles for baby clothing produced in Turkey

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Materials come into contact with skin, such as clothing, should be produced in accordance with certain standards. In the fabrics used in baby clothes like all garment product are undergoing various chemical processes during the production phase. Chemical substances and heavy metals used in the production phase of baby clothes; allergic, toxic and carcinogenic, these substances cannot be completely removed from clothes by washing. In this study, fabrics used in the production of the clothes planned to be sold in various stores were provided. These fabrics produced in Turkey, which will be used in the baby clothes production, have been examined with various tests and checked whether they contain any residue which may be harmful to health.

Keywords: baby clothing, reliable and sustainable textiles, harmless to health, Oeko-Tex Standard 100

1. Introduction

The ever-evolving technology leads consumers to expect more from their clothes. People are not just looking at the outward appearance of clothes they buy now, but also evaluating products in terms of health. When it comes to baby clothes, people must be more careful and attentive, and their approach is more inquisitive towards products. All these awareness and searches seem to diversify and increase the demands on baby products [1].

It should not be forgotten that the quality standards applied for baby clothes are of great importance in terms of health and environment. Because the quality of clothing is important not only in terms of clothing and usage, but also in terms of health.

Features that make the dress comfortable fabric, accessories and mold details should not give the baby any feeling of discomfort, and should not lead to danger or health problem. Everything from fabric to button, used in the production of baby clothes, must be suitable for health conditions. Chemical substances that threaten health should never be used in the production of these materials, ie they must not be on the end product [3]. In this context, it has become an important issue not to damage the environment and human health in all stages of production from the production of fibers to the production of clothes [4].

Good quality garments should be professionally produced, must fit the body, must be durable, and harmful

chemicals should not be used in the production of these clothes. It is important to identify if the chemical dyes and prints used in the production process do not contain harmful compounds, or if these harmful compounds are acceptable, then their values must be checked by tests. For this reason, product standardization plays an important role in terms of consumer satisfaction and safety that cannot be ignored [2]. In addition, some of the products produced by poor quality producers in recent years caused allergies on the baby's skin, and the media made it possible for consumers to become aware of this issue [1].

When literature review is done, it is seen that there are various studies on ecological textile. McCarthy and Bur-

dett reviewed the ecological labels of the Nordic Swan Label, The Swedish Nature Conservation Society, Gut and Oeko-Tex, and provided information on the characteristics of these labels [4]. Cebeci University students participated in survey about ecological textile product awareness. Although 42% of the students who participated in the survey knew the concept of "Ecological Textile", 65% did not know it [5]. In the study of Gümüşer, the natural fibers used in baby clothes have been evaluated from an ecological point of view. It is emphasized that many big baby brands nowadays prefer natural fiber usage³. In the study done by Türkdemir, the characteristics required for 0-2 year old baby clothes were examined, the increase of education level of 0-2 year old babies' mothers, showed positive impact on their knowledge in terms of anti-bacterial formation of baby clothes, organic formation, formation of harmful chemicals and prints concepts [1]. Kariuki and colleagues conducted ecological tests on baby clothes they obtained from Kenya and China countries and compared the results [2].

The scope of this study ten different fabric samples in ready-to-produce condition to be used in various baby clothes to research on the subject products were supplied randomly from the manufacturers and a number of ecological tests were applied to the fabrics and the test results were evaluated.

2. Ecological textiles

The act of environment that has become increasingly widespread throughout the world has also affected the textile industry, and as a result, the concept of "textile ecology" has emerged. This concept, human ecology and waste ecology, and is used for products that can be produced, used and disposed in a short time without damaging the human and environmental health [3, 6]. In order for any textile product to be regarded as an environmentally

friendly, ecological product, it must contain three important features. The first one is production should be done ecologically. Beginning with the fibers, precautions should be taken such as not harming the people and the environment, making the process steps environmentally friendly, treating and eliminating air and water wastes, and avoiding noise. The second one is toxic effects on humans should be considered: toxic effects of textile products on the human body; should not contain any harmful effects by contact with the skin, by inhalation, or, in particular, by salivation or digestion for children.

The last one is waste should be disposed in such a way that it does not harm the environment. Waste recovery or destruction must be done without harming the environment. Destruction by burning, decaying or storing should be done in such a way as not to harm nature and people [1]. Due to the fact that infants have a more sensitive skin than adults, there are various prohibitions and restrictions on the use of chemicals that can be found in baby products. There are a variety of environmental textile standards in Europe and many world countries bringing these restrictions. The most popular among these is "Oeko-Tex Standard 100" [6, 7].

The ecological product label is an indication of the environment-related quality of the product during its production [8]. The fact that products have ecological ethics plays a very important role in terms of their demands and trade. For example, the countries that will export to European countries should definitely meet the Oeko-Tex standards and meet the requirements of these standards. This label is a guarantee that the health of consumers using their own products is not at risk for this reason [9].

It was suggested that these items would increase sales volumes and would be produced with higher cost. It has been observed that extra costs have been incurred during the production unharmed to environment.

This cost increase is caused by reasons such as the use of more expensive raw materials, the use of harmless dyes, and the possession of environmentalist production staff to comply with environmental standards. In addition, the difficulties that may arise in investment; High investment cost, insufficient knowledge, errors in estimations due to fluctuations in prices and demands [8].

3. Oeko-Tex Standard 100

The quality control of textile products and the certification reliability vary according to the quality standard of measurement [10]. Therefore, new standards are being developed and existing standards are being renewed according to requirements. While these changes are being made, other international standards are being evaluated and new standards are being developed [2].

As a result of the ecological tendency that started in the world and studies on this, special environment labels were created. The most common use of the "Oeko-Tex 100" standard was established in 1994 by the Austrian Textile Research Institute [ETRI] and the Hohenstein Research Institute [FIH] as a result of the "International Association for Research and Testing in the Field of Textile Ecology". Oeko-Tex 100 is an international standard for the analysis of chemicals that can be used in textile products and limits to limit values that will not harm human health. In this standard, additions and changes of contents which are understood to be dangerous over time have been made. Products with this ethics are products that do not harm human health and environment. This label is only concerned with textile products and does not address the environmental aspects of the textile production process. The Oeko-Tex 100 standard specifies the general conditions for granting the authority to use the Oeko-Tex mark in textiles [11, 12].

Oeko-Tex 100 covers the regulations for general and all textile products,

the establishment of quality control, the definition of test methods, and the rules of implementation [3]. The aim of the Oeko tex association is to ensure that harmful chemical substances are not used in textile products and to raise awareness of the ecological risks and hazards that may arise in non-certified products. The diversity of standards includes not only human health but also environmental dimension.

The product classes within the scope of this standard are based on the intended use of the products. Different product groups generally differ in terms of the requirements that the products must meet and the test methods applied. There are 4 classes in Oeko-Tex 100 [4,13]:

- Product Class 1: Includes toys with textiles and textiles which are used for the production of items for babies and children younger than 36 months.
- Product Class 2: These are products that come into direct contact with the skin.
- Product Class 3: Products that do not come into direct contact with the skin.
- Product Class 4: Upholstery materials.

4. Ecology Effecting Factor in Textile

The fact that babies are more vulnerable to certain chemicals has led to the introduction of relatively restrictive (but still insufficient) regulations on harmful chemicals that some products contain. The use of harmful chemicals in children's clothing also causes these chemicals to be released into the environment during production or directly through products [14]. Researches in German skin clinics suggest that 2% of allergic reactions are textile-borne³. The definitions of the harms of some important content that are harmful to human health and that are subject to standard prohibition or restriction are as follows:

Dyes: 70% of the currently used dyes belong to the azo dyes class. It has

been determined that 130 of the 3,200 azo dyes found on the market are carcinogenic compounds under certain conditions. Reactive dyestuffs in high purity and bright colors can react with proteins and cause allergies [15].

Formaldehyde: Formaldehyde-releasing compounds are consist of shrinkage and crease resistance, finishing process, chemicals used for preservation and fixation of paint and print [16]. Depending on the formaldehyde concentration, the effects of formaldehyde on human health are determined according to Japan Law 112, accepted by the Oeko-Tex 100 standard [17]:

- 300 ppm for textile surface which is away from the skin,
- 75 ppm for clothes which are in contact with skin, and
- 20 ppm for children clothing and infant beds.

Heavy metals: Metals can also penetrate into textile products through painting and finishing operations. Heavy metal ions such as nickel, cobalt, copper, zinc and chromium can pass through the textile products to the human body through sweat. Heavy metals tend to accumulate in internal organs such as the liver and kidney. Also; Anemia, pulmonary diseases, allergies can also occur as a result of interaction with metal ions [15, 18].

pH value of textile product: Textile products are processed with various alkaline and acidic substances during finishing process [19]. Fabrics with high pH values can easily damage the skin and cause allergic reactions. The pH value of the finished product, which can be controlled in the washing and neutralization steps, is influenced by each chemical used in the production steps [18].

Phthalates: Phthalates have important concerns about hormone-disrupting effects as well as toxic effects on human life [14]. Not only in infants, but also in the mother during pregnancy, endocrine disruptors are able to change the threshold values for the functioning of the endocrine glands, the birth weight, and birth height [20].

Flame retardants: Prolonged contact with flame retardants at high doses can lead to weakening of the immune system and memory loss [18]. For this reason, the use of these substances for baby clothing is not allowed.

5. Materials and methods

5.1. Materials

The information about the properties of the tested and supplied fabric is given in Tab.1. It was paid attention to use the most preferred content and knitting type in baby products in material selection. For this reason, research has been done especially with fabrics containing cotton and their blends. Chosen 10 samples present the quality proof of turkish industry.

5.2. Methods

In scope of this application 7 tests were applied in all samples as,

- Color fastness to washing was made at 40°C according to TS EN ISO 105 C06.
- Color fastness to water was made according to TS EN ISO 105 E 01.
- Color fastness to sweat was made according to TS EN ISO 105-E04.
- Color fastness to friction was carried out according to TS EN ISO 105-X12-April 2006.
- Color fastness to saliva was carried out according to DIN 53160.
- pH analysis was carried out according to TS EN ISO 3071.
- Formaldehyde was determined according to ISO 14184-1.

The most important criteria in selecting these 7 tests are the basic requirements and university test opportunities to ensure reliability. The test results were evaluated according to the Oeko-Tex 100 standard and the reliability of the products was determined [21].

6. Results and discussions

The results of the tests performed are summarized in Tab.2 Also more detailed results are shown in the Tab. 3-5. According to this measured values of evaluated fabrics for color

Tab.1 Properties of fabrics evaluated (Viscose: VC, Cotton: CO, Polyester: PES, Elastane: EL)

Sample Code	Fiber Content	Yarn Count	Fabric		
			Knitting Type	Colour	Print colour (if it exist)
F1	VC/EL	30/1	Ribana	Lilac	None
F2	CO/PES/EL	30/1	Velvet	Beige	None
F3	CO	10/1	Supreme	Green	None
F4	CO	30/1	Futter	Navy	None
F5	CO/EL	20/1	Ribana	Red	None
F6	CO	30/1	Supreme	White	None
F7	CO	30/1	Supreme	White	Blue
F8	CO	30/1	Supreme	Light green	None
F9	CO	30/1	Supreme	Dark green	Black
F10	CO	40/1	Supreme	Black	Yellow

Tab.2 Overall test results of the fabrics evaluated

Sample Code	Color fastness to washing	Color fastness to water	Color fastness to sweat	Color fastness to friction	Color fastness to saliva	pH	Formaldehyde amount (ppm)
F1	5	5	5	4-5	Durable	6.5	2.5
F2	5	5	5	5	Durable	6.2	2.2
F3	5	5	5	4-5	Durable	6.7	3.2
F4	4-5	4.5	5	4	Durable	6.8	3.6
F5	5	5	5	4	Durable	5.9	2.8
F6	5	5	5	5	Durable	6.1	4.2
F7	5	5	5	4-5	Durable	6.4	3.9
F8	5	5	5	5	Durable	6.2	2.9
F9	5	5	5	4-5	Durable	5.8	3.6
F10	5	5	5	4-5	Durable	5.9	3.5

Tab.3 Measured values of evaluated fabrics for color fastness to washing

Sample Code	Color Change	Color Migration					
		Acetate	Cotton	Nylon	Polyester	Polyacrylonitrile	Wool
F1	5	5	5	5	5	5	5
F2	5	5	5	5	5	5	5
F3	5	5	4	5	5	5	5
F4	4-5	5	1-2	4-5	5	4-5	4-5
F5	5	5	4	4-5	5	5	5
F6	5	5	5	5	5	5	5
F7	5	5	5	5	5	5	5
F8	5	5	5	5	5	5	5
F9	5	5	4-5	5	5	5	5
F10	5	5	4-5	5	5	5	5

fastness to washing shown as Tab.3, measured values of evaluated fabrics for color fastness to water shown as Tab.4 and measured values of evaluated fabrics for color fastness to sweat shown as Tab.5.

In this study, research was conducted to ensure ecology and reliability within the scope of baby clothing. For this purpose 10 samples were chosen which present the quality proof of turkish industry. After that 7

tests were then applied to these fabrics. These tests are the basic requirements and university test opportunities to ensure reliability

Under the Oeko-Tex 100 standard, the acceptable lower limit value of color fastness to dry friction is given as 4 It can be seen that the fastness values of sample 10 are above this lower limit value, so that the measured values are found to be within the standard range.

According to the Oeko-Tex 100 standard, pH value should be between 4 and 7., and it is seen that each sample conforms to the Oeko-Tex standard. The Oeko-Tex 100 standard accepts the limit values of Japanese law 112 for formaldehyde. According to this law, the upper limit value of the amount of formaldehyde is 20 ppm in infant products [20, 17]. Looking results of investigationat it appears that the amounts of formaldehyde

Tab.4 Measured values of evaluated fabrics for color fastness to water

Sample Code	Color Change	Color Migration					
		Acetate	Cotton	Nylon	Polyester	Polyacrylonitrile	Wool
F1	5	5	5	5	5	5	5
F2	5	5	5	5	5	5	5
F3	5	5	4-5	5	5	5	5
F4	4-5	5	4-5	4-5	5	4-5	4-5
F5	5	5	4-5	4-5	5	5	5
F6	5	5	5	5	5	5	5
F7	5	5	5	5	5	5	5
F8	5	5	5	5	5	5	5
F9	5	5	4-5	5	5	5	5
F10	5	5	4-5	5	5	5	5

Tab.5 Measured values of evaluated fabrics for color fastness to sweat

Sample Code	Color Change	Color Migration [Acidic and Alkaline]					
		Acetate	Cotton	Nylon	Polyester	Polyacrylonitrile	Wool
F1	5	5	5	5	5	5	5
F2	5	5	5	5	5	5	5
F3	5	5	4	5	5	5	5
F4	5	5	4-5	5	5	5	5
F5	5	5	4	4	5	5	5
F6	5	5	5	5	5	5	5
F7	5	5	5	5	5	5	5
F8	5	5	5	5	5	5	5
F9	5	5	4	5	5	5	5
F10	5	5	4-5	5	5	5	5

present in the samples are well below the acceptable upper limit. For this reason, it has been found that fabrics are also safe in terms of the formaldehyde amount.

Accordingly to results of color fastness to saliva determined that each sample is resistant to saliva and conforms to the Oeko-Tex 100 standard.

By testing the color fastness to washing, all samples, except sample F4, were rated with the highest grade 5, tab.3. Sample F4 has a rating of dye resistance to washing 4-5, due to the transition (migration) of dyes in the washing on a cotton fabric, which is very low, value 1-2. Therefore, for sample F4 (navy blue color), washing should be done with clothes of similar color shades, ie should avoid using opposite colors.

The acceptable limit value of the color fastness to water of the Oeko-Tex 100 standard is 3 [20]. The fastness values of Sample 10 were mea-

sured above as 3, so that the color fastness of each of them was found to be acceptable, tab.4.

Additionally, by examining the color fastness to sweat, a overall value of 5 was obtained for all samples, although by segments of dcolor migration to the byside fabrics, some of the samples received grades 4 and 4-5, respectively, tab.5. Since according to the Oeko Tex 100 standard the limit value for color fastness to sweat 3 is acceptable, all samples of textile materials meet this quality assessment criterion [21].

When the findings obtained from the tests conducted were evaluated, it was determined that the results did not exceed the standard limits given. This shows that the manufacturers in Turkey are acting in the frame of certain rules. Turkey has gone a long way in the field of textiles and garments and has got the quality of producers required. Many of the companies in Turkey that produce the do-

mestic market are also exporting. Therefore, there is a requirement to meet the quality standard of the customer expectancy. Otherwise, there is no chance to market the products manufactured. Firms that buy in the domestic market are very careful about the fact that the products do not carry any risk that can create health problems. For this reason, textile fabricators who produce garment fabrics have acquired various certificates regarding the chemicals they use and have to comply with the production conditions determined by these certificates in their production. Every business has marketing opportunities. Firms that do not comply with these production conditions today are closed due to their inability to continue their activities. This situation has also increased the quality of production in our country with regard to health. The values in this study should be remembered no matter how good it is. It is necessary to

avoid the use of materials which have harmful effects on human ecology and environment. Otherwise, it can be seen that unlimited applications can lead to very serious problems both in terms of human health and environment. For textile products that are in constant contact with human skin, the essential tests must be made in areas where there is a standard limit thus the emergence of the clothes can be provided to the market safely [22].

7. Conclusion

In this study, research was conducted to ensure and proof ecology and reliability within the scope of baby clothing. For this purpose 10 samples were chosen which present the quality proof of textile materials for baby clothes produced in Turkey.

The applied tests, are the basic requirements and universal test for ensure reliability of baby clothes - color fastness to washing, water, friction, sweat and saliva, determination of pH value and amount of formaldehyde.

The findings obtained from the all applied tests shows good results in accordance with Oeko-Tex 100 standard.

The results did not exceed given standard limits. This shows that the manufacturers in Turkey acting in the frame of certain rules in the field of textiles and garments and has got the quality and reliability.

It is necessary to avoid the use of materials which have harmful effects on human health and environment. For textile products that are in constant contact with human skin, especially baby clothes, the essential tests must be made to provided reliable products and market safely.

Compliance with Ethical Standards
The authors declare that they have no conflict of interest.

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