



ENSURING KNITTED PRODUCTS QUALITY BY IMPROVING THEIR ECOLOGICAL FUNCTION

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Abstract: *Worldwide, recent years are characterized by an increasingly acute manifestation of the ecological phenomenon, seeking solutions for obtaining products that are based on natural components, as well as the safe use of products. In this respect, in the textile industry, the concept of eco – fashion has developed: manufacturers and designers increasingly using eco – friendly materials and technologies.*

Any approach to designing, evaluating or improving the quality of a product is based on establishing the technical dimensions of product functions and adopting the representative quality features that can best meet the demands of the beneficiaries.

Achieving and continuously improving the ecological function of clothing products is presently a major requirement, being addressed in both research and production. This function is in a relationship of interdependence with the comfort functions (thermophysiological and sensorial), the ergonomic function, the safety in use and the availability function.

The paper presents some key aspects of the ecological function of clothing products, its components, ways and solutions for implementation and product quality assurance, as well as the advantages offered by the creation and use of ecological products.179

Key words: *ecology, products, knitted, functions, quality.*

1. INTRODUCTION

In the textile industry, the last years have been marked by the eco-fashion concept, manufacturers and designers increasingly using organic materials and technologies.

Ecofashion aims at:

- ✓ protecting users health;
- ✓ maintaining and securing the integrity of the environment;
- ✓ improving working conditions for service staff in the textile industry.

Eco-friendly products have the following characteristics:

- are manufactured from organic and eco-friendly textiles (a wide variety of natural and recycled fibers) obtained in controlled systems without pesticides, herbicides or synthetic fertilizers;
- have a low impact regarding carbon content, water and energy consumption for production and processing;
- create less waste during production;
- are less polluting to the environment, compared to the standard methods of production for knitted materials and clothing;



- are hypoallergenic, antimycotic, antibacterial;
- are more durable and resistant to UV radiation;
- can be worn by all wearer groups (including babies);
- are certified by an international governing body. For example: Control Union, IMO-Institute for Marketecology or One-Cert.

2. THE IMPORTANCE OF THE ECOLOGICAL FUNCTION IN EVALUATING THE QUALITY OF KNITTED PRODUCTS

2.1 Requirements – functions – characteristics correspondence

The interface between user requirements and quality characteristics is the set of functions that products have to meet. The share of functions (their degree of importance in quality assurance) differs from one type of product to another, being determined by the requirements imposed in use.

The ecological function expresses the ability of a product to not affect the health and life of the user and to protect the environment by [1]:

- ✓ the products capacity to withstand the action of contamination factors;
- ✓ products resistance to ignition;
- ✓ products resistance to the action of biological factors;
- ✓ products ability to degrade in the natural environment.

The main quality features through which textile product manufacturers can potentiate the ecological function and its divisions are presented in Table 1.

Table 1: Quality characteristics in correspondence with the ecological function

No.	Ecological function subdivision	Quality characteristics
1.	Products capacity to withstand the action of contamination factors	- noxious substances contained by the products - product resistance to radioactive contamination
2.	Products resistance to ignition	- non-flammable
3.	Products resistance to the action of biological factors	- breaking resistance under the action of biological factors
4.	Products ability to degrade in the natural environment	- biodegradable

2.2 Components of the ecological function of knitted products

Achieving and continuously improving the ecological function of clothing products is a major requirement, being addressed in both research and production.

The ecological function is in a relationship of interdependence with the comfort functions (thermophysiological and sensorial), the ergonomic function, the safety in use and the availability function. Depending on the nature of the raw materials used, application of special processing and finishing treatments, the ecological function can be divided into four components, corresponding to its production, product, its maintenance and the possibility of recycling or degradation of the product into the environment. These components, accompanied by a series of observations, are presented in Table 2.



Table 2 Ecological function components

No.	Ecological function components	Observations
1.	Ecological function of production	It refers to the effects that manufacturing technologies have on human health as well as on the environment. This component involves work safety, levels of water and energy consumption, waste water treatment, personnel exposure to noise and dust, etc.
2.	Ecological function of the product perceived by the user	Is expressed by the fibrous composition and the content of materials and chemical substances associated with the product, which could influence both the sensory and thermophysiological comfort status and the health of the user.
3.	Ecological function manifested during product maintenance	Refers to the effects that household maintenance (washing, chemical cleaning, ironing etc.) have on the user and the environment.
4.	Ecological function for waste administration following products fabrication and use	It consists in the ability of products to be recycled, degrade in the biological environment and be eliminated from the environment.

Considering the desires of product and life quality assurance, the adoption and implementation of solutions for the realization and use of ecological products is of paramount importance. For the four components of the ecological function, table 3 presents some of the quality assurance modalities and solutions, namely non-quality conditions (non-fulfillment of the ecological function).

Table 3 Quality assurance conditions, respectively non-quality conditions for the ecological function

Nr. crt.	Ecological function component	Quality assurance conditions	Non-quality conditions
1.	Ecological function of production	<ul style="list-style-type: none"> - implementing protection measures for people and products against harmful factors (toxic substances, extreme temperatures, excessive humidity); - reducing the degree of phonic pollution); - reducing air pollution with dust and fly waste; - equipping production and storage spaces with ventilation and air purification installations; - permanent control of the microclimate parameters (temperature, humidity). 	<ul style="list-style-type: none"> -lack of protection measures against harmful factors; - high degree of phonic pollution; - high degree of air pollution; - lack of ventilation and air purifying installations; - absence of apparatus for measuring and controlling the microclimate parameters.
2.	Ecological function of the products perceived by the user	<ul style="list-style-type: none"> - reduced content of nocive substances; - pleasant touch (soft, smooth); - elasticity and flat appearance of the seams; -low flammability (reduced capacity to ignite or spread the flame). 	<ul style="list-style-type: none"> - high content of nocive substances; - unpleasant touch (rough, coarse); - rigid and uneven seams; - high flammability (ignites and easily spreads the flame);



Nr. crt.	Ecological function component	Quality assurance conditions	Non-quality conditions
3.	Ecological function of products manifested during maintenance	- lowered soiling capacity; - efficient maintenance (short time, low consumption of cleaning or washing solutions); - cleaning with biodegradable substances.	- high soiling capacity; - lower cleaning capacity (long time, increased consumption of cleaning or washing solutions); - cleaning with non-biodegradable substances.
4.	Ecological function for waste administration	- product manufacturing from biodegradable materials and components; - recycling possibility for the product or its components	- product or components non-degradable partially or totally in the biological environment; - inability to partially or totally recycle.

3. IMPLEMENTING THE SOLUTIONS FOR THE ECOLOGICAL FUNCTION IMPROVEMENT AND QUALITY ASSURANCE OF KNITTED PRODUCTS

3.1 Directions for the implementation of technical solutions in product quality assurance

In order to answer the explosive rise in demand and taking into consideration the ecological problems, research has progressed more and more. The most dynamic sectors are interdisciplinary, combining the research in medicine, textile industry, metrology, transport etc. New generation of ecological clothing has become more solicited. Their market already covers 30% of textiles sold in Europe and 40% in the United States and Japan, and could well exceed 50% in the future [2, 4, 5].

Research regarding the improvement of protective functions and ecology of clothing product had as objectives:

- **using of natural fibre** (cotton, flax, silk, wool, etc.) **organically cultivated**, with the capacity to absorb and remove moisture, air penetrable, thermal regulation capacity (cooling sensation, respectively warming according to extern temperature), protection against bacteria and UV protection, contributing to the increase in environment and life quality [2];
- **using ecologic, biodegradable or recyclable fibres**, with antibacterial effects, auto-sterilizing and auto-cleaning, with high UV radiation protection;
- using a mix of natural, ecologic and synthetic fibres that will offer superior quality characteristic tu products and high UV radiation protection;
- **using yarn realized through performant technologies** to insure protection against insects, bacteria, fungi and acariens and UV protection;
- **using intelligent fibers/yarns/materials** that can influence health by adapting the temperature of the textile material according to ambient temperature fluctuations, as well as modifying the intensity of the color thus increasing the degree of UV protection;
- **using performant processing and manufacturing techonologies** for all categories of knitted products;
- **washing the materials with special detergents** or treating them with chemical substances with UV screen role, but at the same time reducing the waste of chemical treatments.

Some examples that illustrate the results of the research and improvement to ecological and protective functions are presented below.



1. **Naturally colored cotton** (different shades of brown and green) Fox Fiber and Top Cot with superior tensile strength and flame resistance.

2. **Biowool** - ecological wool fibers (Biotex company), with superior characteristics (count, volume, strength), hypoallergenic characteristics and body temperature control capacity [3].

3. **Bamboo fibres** are fabricated out of 100% **bamboo** pulp. Being completely biodegradable and sustainable, the bamboo is the most ecological material of the 21st century. Materials made out of bamboo fibres have antibacterial, anti-allergic, antiperspirant and absorptive proprieties. Articles realized from these material are light, nice to touch, natural sheen, don't cause allergic reaction, but protect the skin from UV rays perfectly (reflecting 98% of damaging rays). They have antibacterial proprieties and prevent the development of pathogenic organisms, fungi and acariens (on a bamboo fibre, 70% of bacteria is killed), and keep these proprieties even after a hundred washings.

4. **Fibres realized from Cocona (derived from coconut husks), Pineapple** [2] – combines the principles of UV protection improvement and the following characteristics:

- Fabricated from Cocona and PES with Polartech Power Dry technology – a material that is part of the Next To Skin category, with absorptive capacity and humidity removal, air permissive and thermal regulation capacity;
- Anti-odorizing natural treatment, without involving any chemical antibacterial treatment;
- Offers resistance and good protection to UV rays;
- Knitted structure type mesh, and the tailoring of the product is adjusted, with a high coverae degree of the body.

5. **Biodegradable vegetable fibers type PLA** (contain poly-lactic acid, polymer extracted from corn) offering a very good protection by blocking the UV rays.

6. **Alginate fibers** - made from brown algae (which are naturally renewed) biodegradable ecological polymers are obtained by treating them according to the content of gluconic and manuronic acids, the basic components of the alginated copolymers. Alginate fibers are mainly used in manufacturing dressings in the medical sector because they have the advantage of creating a healing field with high absorption power (20 times their mass) and healing in a wet environment [3].

7. **Chitin and dibutyrylchitin bioactive fibers - DBCH** (Chitin is a natural polysaccharide with bioactive properties, insoluble in common solvents) [3].

8. **Wear – internationally brevetted anti-radiation weave** [2] for articles of clothing for adults and children (is certified Oeko-Tex – Baby class), linens, covers, sleeping bags, etc. Characteristics: - is realized from cotton and copper/silver (copper wire wrapped in silver has 0,02 mm thickness being integrated almost invisible in the weave of cotton fibres); is bio - compatible because of the protective polyurethane cover, hypo-allergic and antiseptic recommended especially to chemicals sensible persons; very good screening power, that remains unchanged even after 30 washings; has high density;

9. **Meryl products** (Rhône Poulenc France - [2]) – are made out of polyamide PA 6 and PA 6, 6 type fibres. The sheen of Meryl products can be: shiny, semi-matter and ultra - matte. From Meryl type yarn can be realized materials wind and waterproof, with goo thermal isolation, good behaviour in humidity and OV radiation protection. It is used mixed (with wool, rayon, or other types of fibre) with varied systems or yarn under the trademark Nylstar® that has loose and comfort qualities. There have been realized varied fibres Meryl®: Meryl anti UV, offers protection to UVQ and UVB; Meryl Satine, creates a light reflective effect, Meryl Tango, for weaves with a natural silk aspect etc.

10. **MERINO Perform™ products** (23% merinos wool and % polyester) – combine the principles of UV protection improvement with the capacity of thermal regulation.

3.2 Advantages offered by using ecological products

Increasing the ecological functions in the textile industry has the following advantages:



- **scientific and technical impact** through:
 - implementing competitive technologies for sustainable textile engineering;
 - setting up waste analysis and monitoring networks;
- **economic impact** through:
 - increasing the competitiveness of economic agents;
 - ensuring sustainable economic development;
 - supporting the process of integration into the EU's economic and social area;
 - preserving the environment and natural resources;
 - expanding / strengthening multiple cooperation relations;
 - capitalizing on research potential in the field of textile and leather waste;
 - achieving international quality and environmental standards;
- **social impact:**
 - creating better conditions in work, health and life;
 - opportunities for teaching, improving and raising the level of education;
 - population awareness in the spirit of environmental protection;
- **impact on the environment:**
 - complying with the conditions regarding the quality of the working environment;
 - increasing the level of biosecurity;
 - decreasing the level of soil and air pollution.

4. CONCLUSIONS

Building on the desires of product and life quality assurance, the achievement and continuous improvement of the ecological function of clothing is a timely requirement, being addressed in both research and production.

The ecological function is in a interdependent relationship with comfort functions, ergonomic function, safety in use and availability functions. As such, the research, design, development and use of eco-friendly textile products in line with current requirements for the preservation and protection of users' health and environmental integrity are the new vital goals.

The paper presents systematically the characteristics of the eco-friendly textile products, the components of the ecological function, the quality assurance methods, as well as the main solutions implemented in the technological practice, which allowed taking the best decisions, fully informed and obtaining the most advantageous benefits.

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