STUDY REGARDING THE DEVELOPMENT OF THE FUNCTIONAL TEXTILES WITH ANTIMICROBIAL PROPERTIES

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The antimicrobial fibres, with encapsulated antimicrobial agents, prevent the bacteria developing and maintain the body under hygienic conditions a longer time, refreshing and facilitating the skin respiration, eliminating the possibility of giving out the unpleasant odour. The capsules continuously migrate towards the fibre surface, until exhaustion, achieving a protection zone on the surface. The clothing products and socks made of antimicrobial fibres preserve their antimicrobial effect after numerous washings, unlike the textiles covered with polymers that contain antimicrobial agents that retain their antimicrobial effect only several washings. The main objective of the research was the development of advanced technologies and functional textiles with ecological impact on the environment and human body, the promotion of raw materials using superior hygienic-functional characteristics as well as antibacterial and anti-allergic properties. Finally, both the performances of the hygienic and functional characteristics of the developed textile products and the positive impact over the environment were accomplished due to the antimicrobial fibres and by using the ecological finishing technologies and treatment with plant extracts with antimicrobial and anti-allergic properties. Microencapsulation can prolong the shelf life of various volatile and non-volatile cosmetic ingredients by delaying oxidation and evaporation. The suitability of microcapsules for cosmetic textiles applications depend on the range of diameter, mechanical robustness and content release profile of microcapsule to offer appropriate potential for specific functionality.

Keywords: antimicrobial fibres, bioactive textiles, extracts from plants.

INTRODUCTION

With the development of the textile and technology industry, the demand for value-added functional materials is growing. The trend in the worldwide is focused on: the use of a material for various applications - multifunctional textiles, and on the other hand on their functionalization that falls within the group of cosmetic textiles, only for a certain purpose in a narrow field.

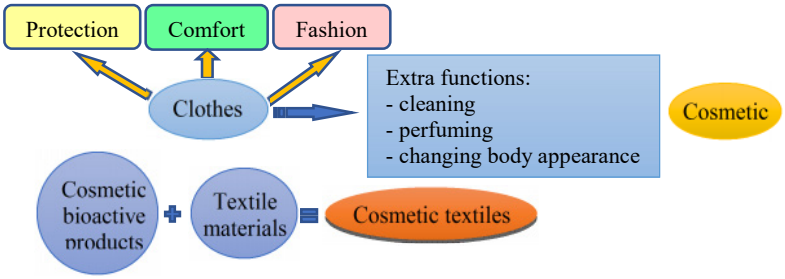

Figure 1. Functions of cosmetic textiles

The European Cosmetic directive has define cosmetic product as “any textile article containing a substance or preparation that is released over time on different superficial

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parts of the human body, notably on human skin, and containing special functionalities such as cleansing, perfuming changing appearance, protection, keeping in good condition or the correction of the body odours is called a cosmetic textiles" (Almeida, 2005). Figure 1 shows functions of cosmetic textiles. Cosmetic textiles induce a state of well-being in the human body, causing a healthy balance between the human body and the mind. The properties of functional textiles have to correspond to high quality standards, respecting the increased efficiency conditions with minimal impact on the environment.

METHODS OF ACCOMPLISHING

The "cosmetic textiles" functional textiles are created by micro-encapsulation, grafting, nanotechnology and coating techniques by incorporating various body care and health products that are gradually transferred to the skin through movement, pressure, or the effect of natural skin heat (Figure 2).

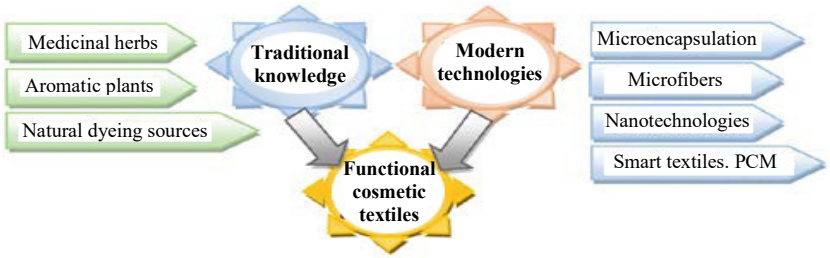

Figure 2. Accomplishing ways for cosmetic functional textiles

APPLICATION IN TEXTILES AND ISSUES RELATED TO THEM

Application in textiles and issues related to them microcapsules can be applied to textiles by padding, coating, spraying, immersion or exhaustion. A binder is required for all these methods. The binder may be acrylic, polyurethane, silicone, starch, etc. Its role is to fix the capsules onto the fabric and to hold them in place during wear and washing. Microcapsules can be applied to various fibres both natural and synthetic (Ocepek and Forte-Tavčer, 2008). Release mechanisms of the core for cosmetic textiles are friction, pressure, biodegradation and for aromatherapy and fragrance textiles these methods are friction and diffusion through polymer wall (Nelson, 2002).

The smaller the microcapsules, the greater the covering of the product and the longer the fragrance will last, as it takes longer for the capsules to be ruptured by physical pressure (Roshan, 2015). In practice the aim is to produce textiles with microcapsules which would last for as many wash cycles as possible. A method of fixing fabric aromatic microcapsules has been developed. The fabric is first treated with a nitrogenous cationic compound and the microcapsule wall is manufactured to adhere to this layer. The produced capsules are 0.1 to 100 μm in size and are made using interfacial or in situ polymerization methods. Typical encapsulated compounds include perfumes (Nelson, 2002). Scientists investigated that using this resin with an initiator allows the fragrant to remain on the fabric for more than 50 wash cycles (Li, 2005).

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Researchers have reported that there are also some issues related to the durability of microcapsules during washing, drying, maintenance and resistance to the functionalized textiles in many washing cycles. Increasing durability implies the correct choice of the textile support, the method of preparation of the microcapsules and their application on the support.

TECHNOLOGICAL FLOW OF COSMETIC TEXTILES

- Selection of the extraction systems for natural and essential products to be applied to textile materials;
- Testing them;
- Selection of essential oils and microcapsules taking into account the desired functionalities, treatment methods and the type of textile material;
- Preliminary preparation of the textile support in order to increase the affinity → changing the surface of the textile materials by different chemical methods → treatment of the textile material with the dispersions/emulsions of the microcapsules with essential oils → condensation of the impregnated textile material → drying;
- Investigation the influence of functionalization processes on the technical and qualitative characteristics of textile materials by physical-mechanical, physical-chemical, biological and toxicological analyses.

Generally, major cosmetic ingredients from inorganic and synthetic chemicals, and plant derivatives are original. Various scientific and medical researchers have proved that plant derivatives are safer than chemicals and animal derivatives as cosmetics. The efficacy of cosmetic textiles should be tested using the same testing tool & testing conditions as for cosmetics. The ISO/DIS 11930 test may be successful in testing the efficacy of cosmetic textiles, although this test is designed for cosmetics. Figure 3 shows functional effects of cosmetic textiles:

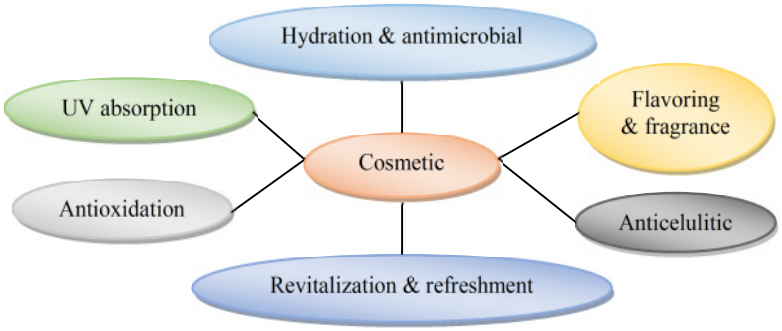

Figure 3. Functional effects of cosmetic textiles

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FUNCTIONAL EFFECTS OF COSMETIC TEXTILES

The moisturizing effect of cosmetic textiles on the skin consists in wrinkle reduction, maintaining a soft and supple appearance of the skin.

Nanotechnology can lead to the development of hydrophilic textile surfaces. The integration of TiO_2 increases the possibility of moisture absorbance on textile surfaces through the photocatalytic process (Mahltig *et al*., 2005). This approach can be used to develop quick-dry textiles for sports or outdoor clothing.

The antimicrobial effect prevents the growth of bacteria and maintains the body in hygienic conditions with essential oils (lavender, fennel, Aloe Vera, rosemary) (Mathis and Mehling, 2010). The fabric has features, such as: calming, antioxidation and anti-aging. The use of antimicrobial fibres that have encapsulated antimicrobial agents prevents the development of bacteria and keeps the body in hygienic conditions for a long time, eliminating the possibility of creating unpleasant odors, refreshing and facilitating the breathing of the skin (Drambei and Pricop, 2011). Antibacterial microcapsules migrate continuously to the outside of the fibres, until exhausted, creating a surface protection area. The clothing products made of this type of yarns maintain their antimicrobial effect after many washings (50-200).

The fragrance effect consists in eliminating the possibility of creating unpleasant odours, refreshing a special fragrance with essential oils (rose, lavender, basil, rosemary, etc.) and facilitating skin breathing. The incorporation of deodorant into a textile substrate is conducted during polymerisation at the finishing stage.

The refreshing and relaxing effect is achieved either by using phase change materials in the form of microcapsules (menthol encapsulation, Aloe Vera together with emulsifiers and very durable synthetic cooling), or by increasing the area of contact between the surfaces with high transmission of moisture and human body. Scientific researches on Aloe Vera have proved that textiles treated with it are very pleasant to wear, having a significant effect on energy levels, which offers a feeling of well-being. Aloe Vera is used to obtain antibacterial, antiviral, antimycotic effects (Eshun and He, 2004).

A textile structure that is able to release **revitalising** aromas synthesised by plants and fruit based ingredients like ginger, menthol, orange or rosemary at a slow rate comes under the category of vitalising textiles. These ingredients are added to textiles using the microencapsulation technique. The durability of this function remains even after a number of washings. Cosmetic textiles vitamins are suitable for bathrobes and other similar purposes (Welch, 2013).

The UV protection effect is conferred by the type of fabric, the number of wash cycles of the material, the UV protection factor that can be improved, and the use of Zn nanoparticles, iron oxide, zinc oxide, titanium oxide, oxalic bi-reactive and various other chemicals. To improve the UV protection factor of textiles, are used Zn nanoparticles, iron oxide, zinc oxide, titanium oxide, bi-reactive oxalic acid and various other chemicals (Singh, 2005).

The textile structures that work to offer a **slimming effect** by means of yarn properties, fabric structure and finishes are called cosmetic textiles for slimming. The use of compressional garments has offered a third option for slimming, as well as a reduction in muscle damage and a maintaining muscle function. Functional muscles give a better appearance and a good-looking effect by accelerating blood flow in veins. Cosmetic textiles for slimming provide rehabilitation to the wearers. Anti-cellulite fabric contains a combination of agents, such as caffeine, retinol, vitamin E which may

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reduce the outer appearance of cellulite. In addition, it was claimed that slimming effect persists, even after the garment has been washed several times.

EFFICACY OF COSMETOTEXTILES

The efficacy of cosmetic textiles should be tested using the same testing tool & testing conditions as for cosmetics. The Group WG-25 agreed to set some guidelines to solve the complexity of this problem. The ISO/DIS 11930 test may be successful in testing the efficacy of cosmetic textiles, although this test is designed for cosmetic.

Perfume Performance Analysis

This analysis is required to test the performance of various perfumed textiles. Headspace gas chromatography/mass spectrometry (Headspace GC/MS) is a specific technique used to analyze volatile compounds. A specimen is placed in an airtight closed sampling vessel and then subjected to a temperature with a known temperature profile. The vapors in the vessels are sampled to analyze the odor issues, for identification of polymer additives and for residual solvent analysis according to various ASTM standards like ASTM - D3362, D3452, D4128 (Salaün *et al*., 2009).

Durability

The Group WG25 formed a separate subgroup to emphasize the durability aspect of cosmetic textiles. For wash fastness, a lot of testing methodologies are recommended by this subgroup. The efficiency of a binder to bind microcapsules on a textile surface depends on the compatibility of the different interfaces of the products involved in the finishing process. The choice of binder adapted to fix the microcapsules can be finalized by making a comparison of the surface energy components induced by various components in terms of the contact angle. Generally, the adhesion of microcapsules is closely dependent on the chemical nature and structure of the textile substrates (Zhu and Chai, 2005).

CONCLUSION

The complex documentary study presented in this article for this new field of cosmetic textiles regarding how to make functional textiles, the effects of textiles on their various technologies for accomplishing them, will be used in research projects. The correlation of the bioactive extracts properties with the raw material type, textile fabrics and application technologies will contribute to the accomplishing of a large variety of functionalised textiles.

Antimicrobial fibres and yarns that have encapsulated antimicrobial agents that prevent bacterial growth and keep the body in hygienic conditions for longer time, eliminating the possibility of creating unpleasant odours, refreshing and facilitating breathing (Drambei and Pricop, 2011). Antibacterial microcapsules migrate continuously to the outside of the fibres until exhausted, creating a surface protection area. The clothing products made of this type of yarns maintain its antimicrobial effect after numerous washings (50-200).

The optimization of the quantity of cosmetic ingredients and enhancing the durability of cosmetic effect are the two real challenges in this field. Cosmetic textiles

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have to be designed so as the blend of the fabric, cosmetic finishes technologies and fashion to work together, in order to obtain an optimum cosmetic effect.

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