

# Functionalization of Natural Fibres Textiles by Improvement of Nanoparticles Fixation on Their Surface

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## Abstract

Lignin is a natural polymer characterized by its ability to absorb ultraviolet rays and antibacterial properties. Thanks to nano size, nanolignin deposited on the fabric surface does not cause colour change, even though the lignin is originally dark. As a functional polymer it can be used as a natural UV barrier and antibacterial agent in finishing process of protective textiles.

The paper describes the study on the improvement of nanoparticle fixation on the lignocellulosic fabric surface by the introduction of a binding agent in the finishing technology. Several binding agents with nanolignin solution were applied to the linen fabric and non-woven by padding method. Effectiveness of textile covering by functional nanoparticles was evaluated by UPF tests after ten washing cycles and abrasion tests. The best nanolignin coating on the linen fabric surface durability was obtained for application of acrylic dispersion as a binding agent. The FTIR (Fourier Transform Infrared) spectroscopy was applied for additional evaluation of linen fabrics covered by lignin nanoparticles.

*Keywords:* Nanoparticles; Linen; Functional Textiles

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## 1 Introduction

Development of high functional textiles is forced by strong market competition and continuous increase of customers' requirements, who more often favor clothing with additional properties, like dirt repellence, UV protection, antistatic behaviour, antibacterial, wearing comfort, low degree of shrinkage and others. The functionality of textiles is a key element of protective and sport clothing, where barrier and comfort properties must be combined to improve wearer performance. Manmade fibres with applied special modification or finishing are the raw materials for the functional textile manufacture. Polymers like polyester, polyamide, para-aramid, polyethylene and polyurethane are usually used as the high performance fibres, because it is possible to apply different processes and treatments to create and alter fibre shape, composition, and thickness etc. which are responsible for different textile properties [1]. Barrier properties can be given to the clothing by the application of special textile construction, for instance multi-layered fabric or

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phase-change material as well as by development of different finishing processes. However, most of work in this area is focused on manmade fibres.

Development of functional textiles based only on natural raw materials is related to many more difficulties because natural fibres have their own unchangeable inherent characteristic features, like shape, linear density, and surface structure. But application of natural fibres for advanced functional clothing allows to obtain green, safe and healthy products, environmentally and human friendly, that is products oriented towards specific consumer needs and requirements, such as UV protection, comfort, health, well-being and safety.

Zimniewska, Krucińska [2] proved, that clothing made of natural cellulosic fibres positively influences the human body, ensures well-being and is not a reason of desynchronization of muscle motor units and thus, will not cause the increase of tendency to tiredness of users. Tokura, Hattori et al. [3] showed that wearing of natural fibre clothes positively influences the activity of sebaceous glands that improve resistance to skin diseases. Zimniewska, Witmanowski and Kozłowski [4], proved that clothes made of natural cellulosic fibres does not cause the increase of reactive oxygen species and oxidative stress as opposed to garment made of synthetic fibres. Conducted research prove that apparels made of natural fibres influence favourably some of the physiological factors of the human body and show specific synergy with human skin [5].

One of the groups of customers focused on functional textiles based on natural fibres is seniors. Usually, everyday products and services are designed in a way that ignores the needs of older people, patients or other, e.g. wheelchair users. The clothing is the closest environment of human organism and has to be prepared with special attention for the increasing market of consumers with specific needs. The Eurostat data – European Statistical Data Support – revealed that within the European community, the population is projected to become older. Ageing of population is indicated by a rise in average age of 40.4 years in 2008 to 47.9 years in 2060. The proportion of people aged 65 years or older in the total population is projected to increase from 17.1% to 30.0% and the number is going to rise from 84.6 million in 2008 to 151.5 million in 2060. Similarly, the number of people aged 80 or over is predicted to almost triple from 21.8 million in 2008 to 61.4 million in 2060. The population aged 65 or older is projected to increase by almost 67 million people. In view of the above, it is obvious, that the market for textiles such functional natural fibres clothing dedicated to seniors acquires growing importance. For this reason, there is necessity of focusing on the seniors' needs by development of healthy, safe, functional and comfortable clothing.

## Nanotechnology

New possibilities to obtain functional natural fibre clothings aimed to satisfy specific requirements arose with the development of nanotechnology.

Nowadays, nanoparticles coating of materials has become applied more often to give effective functional properties to textiles. Numerous advantages result from the use of nanoparticles instead of traditional finish agents in textile processes:

- New possibilities appeared to apply active solid materials, e.g. silver in the form of nanoparticles for textile,
- Active surface increases by the use of nanoparticle,