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An Overview on the Fate of Fast Fashion and Nanoparticle Treated Textiles

Liu Yu

School of Textiles & Fashion Management, Milano Fashion Institute, 20158 Bovisa, Milan, Italy

***Corresponding Author:** Liu Yu, School of Textiles & Fashion Management, Milano Fashion Institute, 20158 Bovisa, Milan, Italy. liuyu90@zoho.com.*

ABSTRACT

This paper reviews studies of nanoparticles treated textiles in term of its disposal fate, to provide an overview of current knowledge and potential points for further research. The reviewed literature provide strong evidence that nanoparticles are essential for their promising uses in textiles, and information is available for the manufacturing of nanoparticles and their incorporation to textiles. Major concern is the missing knowledge to fill in the gaps for the primary inventory data and their potential future research needs.

Keywords: *Textiles; Fashion; Waste Management; Recycling; Nanoparticles*

INTRODUCTION

Fashion is perceived as a glamor of the world, with numerous fashion shows and photographic services in glossy magazines. Behind, however, there is an evolving industry that is constantly confronted with new problems: from the ecological impact of production and manufacturing chains (1), to the speeding marketing by social media. The textile and fashion industry is the second most polluting sector in the world(2,3). The production of raw materials, including natural and synthetic textile materials, causes deforestation and endangers the safety of farmers and workers in developing countries(2). This industry is also responsible for 20% of water pollution globally (2,4).

According to recycling a non-profit organization in Italy (Textile Exchange),in less than twenty years the volume of textile and fashion products waste has been doubled from 7 to 14 million tons, among those 47% is of the total cotton consumption of the 97 companies it represents is organic and the use of alternative materials is increasing. For instance, recycled polyester Lyocel and feather (5). Table 1 shows major textile suppliers to European Union-28 countries, the major supplier are in Asian countries like; China, Turkey, India, Pakistan and USA.

There utilization is molded according to the customers end. Moreover, with recent growth in innovative materials and technologies showed interesting applications in the textile and clothing sector, such as: conductive fabrics for heating and wearable electronics, hi-tech surface treatments for the textile industry, decorative fabrics for composite, and most importantly, nanoparticles enabled textiles (6). Generally, in the textile sector the materials guarantee a certain flexibility to encourage the better conformability to the specific product and, in particular in the case of clothing to allow adequate comfort to the wearer. With increasing demand of modern technologies in public sector, the utilization of nanoparticles became inevitable, and are being used in daily life products, for instance, nanoparticle treated socks (cotton) to prevent germs, sportswear (polyester) and in medical centers for bacterial inhabitation (cotton and polyester).

Table1. *Textile suppliers of EU-28, five major suppliers represent80% of the total imported clothes (7)*

Fabric Suppliers (country)	Year 2012 (EU millions)	Year 2013 (EU millions)
China	7.864	8.009
Turkey	3.805	4.172
India	2.318	2.367
Pakistan	1.585	1.748
USA	1.229	1.231
Rest of EU-28	2.4497	2.5300

MATERIALS AND METHODS

Manufacturing Nanoparticle Treated Textiles

Three dimensions particles of nanoparticles are in nanometers, they are 3-dimensional particulates

and are called “iso-dimensional” (8). The content of nanoparticles is different in each textile significantly. But there is a lack of information on the nanoparticles used for the purpose of antibacterial properties in textiles. The mining and refining of nanoparticles also have greatest impact on the nanoparticle treated textile manufacturing.

The synthesis of nanoparticles has shifted from synthetic (chemicals) to eco-friendly (plant extracts) production techniques, for instance synthesis process of nanoparticles from plants extracts using leaves of bamboo (9) osmanthus (6), nageianagi (10) and Chinese Holly plant (11), and different chemical and physical methods are used ranging from chemical reduction to vapor deposition can be found in literature. Such biosynthesized nanoparticles are later used in treatment or deposition on textile products to attain required function. Moreover, acknowledging nanotechnologies and new deposition techniques it is possible today to use printing technique that involves photonic sintering low-temperature nano-inks on substrates.

In this way conductive inks are deposited containing silver or gold nanoparticles and, morerecently, copper nanoparticle inks uplow-cost substrates such as paper, polyester and film inpolyethylene.

Moreover, thanks to nanotechnologies, it isa nano-coating can be deposited on the fabrics metallic: the deposition of this film decreases the contact angle between liquid and fabric and increases hydrophilic, or the fabric can absorb water more easily. Though, these methods and implementation of nano particles in various textile and fashion products is promising, but their disposal has raised various concerns overtime.

General Discussion

Disposal of Nanoparticle Treated Textiles

The major sources of bringing nanoparticles from textiles into environment are generally textile finishing procedures in the manufacturing stage, washing, and finally disposal. Figure 1 shows common pathways of nanoparticles to enter nature. In the procedures referenced first, the nanoparticles can enter wastewater treatment plants through industrial and urban wastewater. The degree, to which they are expelled from the water cycle with the sludge treatment plants, is rather limited. Currently, no substantial proclamations are made on can on the subject of final treatment of nanoparticle in wastewater treatments. The nanoparticles are stably embedded in textiles to maintain their quality and functionality, so does their persistent in disposals. One way to lower the release of nanoparticles from textiles is to fix or embed strongly to them, to prevent the release of nanoparticles with potential hazards to the environment and human health, eventually. Following parameters are responsible for the release of nanoparticles to the environment from textiles; the incorporation site into the textile (e.g. coating, finishing or core of the fiber, bonding type and strength of nanoparticles and textile fibers (e.g. a covalent bond), abrasion resistance property of textiles and losing its finish. Quantification of nanoparticles release is not obvious also; most textiles lose major weight of nanoparticles in their use phase. For instance from the launderings, mechanical abrasions and sunlight exposures.

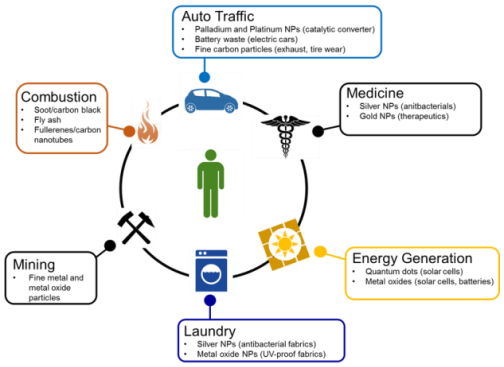

Fig1. *Common pathways of nanoparticles to enter into the environment (12)*

As aforementioned, textile products covers extensive part in global ecological impacts, as they take different procedures to create a single piece of fabric, since the manufacturing chain of textile products is long and complex(4,13). Considering the fate of such textiles, ecological impacts ought to occur in every disposal procedure chosen that is land filling or waste to energy. Moreover, sorting nanoparticle treated textiles from non-treated ones is rather difficult.

Even though all textiles goes through a similar list of procedures, for example, spinning, weaving, sewing, and further to the utilization becomes different from each other, for example antibacterial textiles, waterproofing textiles, fire retardant textiles, and their disposal also gets segregated. Fast fashion textiles are created to have short lives, because they are ought to degrade, for example, low cost ease or disposable clothing. Most of these fashion textiles are low cost clothing are cellulose based

materials either cotton, linen or recovered /regenerated fabrics, like acetic acid derivation and rayon etc. (14). The interesting point of these biodegradable cellulose based materials that when land filled, decay or decompose generally quicker and show less ecological harmful (15). However, the issue standout when the chemical treated textile materials are equivalent to non-technical textile materials are considered same and portrait less environmentally harmful (16). In this context, nanoparticle treated textile materials have picked up an impressive prevalence in recent years and are being utilized in textile materials extensively (6,9). However, the textiles with nanoparticles pose threat when land filled, as the materials decompose earlier than the chemical present on it. Some studies, suggested to degrade the chemicals present on textiles before land filling, like flame retardants textiles, as decomposition predominantly relies upon the raw materials being used (3,17,18). With the degradation of long lasting chemicals on textiles can assist in lowering the impacts of landfills.

It's important to understand also that, once nanoparticles are disposed of from the drainage or garbage, their excursion to the environment has just started. These nanoparticles will eventually escape to the wastewater treatment plants, after flowing with water down the drain. Various processes for nanoparticle tainted water are proposed and are implemented, such as chemical disinfection, settling treatments and mechanical filtering and digestion with microbes. However, none of mentioned treatment processes are considered ultimate to remove nanoparticles from the waste stream.

Conclusions

Nanoparticles treated textiles are resource and energy intensive in terms of brining functionality in textiles. From this overview, it is visible that there are various research literatures available for the manufacturing phase of nanoparticles, including synthesis of nanoparticles and their incorporation to textiles.

On the other hand, fate of nanoparticles treated textiles waste or disposal is found to be missing.

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