

Textile Wastes: State of the Art

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Abstract

This document resumes the state of the art in waste subjects in Europe and specifically those generated from textile industries, where there are two lines of bigger priority in order to diminish residue, productive efficiency and increase value, reinstating waste in its productive cycle or elaborating new products in other industrial fields external to textile.

Keywords: Textile; Wastes; Recycling; Reducing

Introduction

Problematic of waste in the past decades, world population has exponentially risen reaching the current 7530 million inhabitants [1] with a population growth of 61 million per year [1]. Such circumstance added to the planet production rate has risen 35% in the last years [2] urges the need to adopt an ecological vision which prioritizes the resources reutilization. Its believed that up to 50% earth surface has transformed because of human action in the last three decades [3].

Besides, such circumstance agravates, if considers that 54.7% of world population is urban, against 1960 33.8% [1]. In fact, a total of 2.494 million tons of generated waste was registered by EU-28 in 2014, being the highest amount between 2008 and 2014 with a 2.8% growth compared with 2008 [4]. About the EU-28 average inhabitants number, the mean is 4.9 tons per inhabitant for 2014 [4]. Together with modernization and constant research for a better life quality, humanity has generated a higher wasted amount in the past years, among some reasons are found: demographic growth, fast expiration well materials, non-return package, higher amount of industrialized process, etc. This action sequence strongly affects the habitat we live and therefore ourselves, creating environmental problems because of bad management of produced waste instead of promoting reutilization [5].

Among industries sector that concentrates waste production are construction and demolition (34.7%) followed by mineral extraction (28.2%) and manufacturer industry (10.2%) [4].

European politics in waste reduction

Awarded of the global waste problematic, EU has adopted various management and promotion politics of circular economy.

First politics and targets in waste matters came with the Waste Framework Board, which imposed an harmonic regulation in waste issues, for prevention and reduction of the result from waste generation and handling [6].

The current Board 2008/98/CE has modified its legislation in three general steps: at first it aborded waste as problematic and in has to manage its handling, later it was understood that also has to generate minimum as possible, and finally it adds recycling, reuse and reactivation of useful and economic cycle [6,7]. This Board comprehends also the definition of waste as "any substance or object from which its owner detaches or has the intention or obligation to detach".

Therefore two goals were established, which the member States have to reach before 2020: increase as minimum 50% of its weight, reuse and recycling of domestic waste; paper, metal, glass, plastic. And increase as minimum 70% of its weight, reuse, recycling and material

valorisation, in refill and non-dangerous operations in construction and demolition [8].

Member states must guarantee that their waste politics, as legislation compliance are transparent processes, registered, informed (every three years) and which indicates clearly the participation of every involved actor due to politics, programs, normative, etc., of every state, but also respecting the principles and general framework set by EU [8].

As a long term goal, the VII Environment Action Program projects an ideal vision of the European Community for 2050 and describes it as a conscious society which respects earth's ecological boundaries, applying an innovative and waste-free circular economy, managing resources in a sustainable way and protecting biodiversity [9].

Compared to Latin America and Caribe the per capita indicators involve a 295.000 ton of domestic solid waste daily generation and 436.000 ton urban solid waste, in other words 0.63 kg/inh/day and 0.93 kg/inh/day respectively [10]. Few are the advance and interventions on waste operation in Latin America and Caribe, still prevailing these days outdoor storage, direct responsibilities on local government, which don't have enough resources and have technical failures to aboard the problematic. About legislation the problem lays on regulatory framework; non-specifically legislation, limited collecting services, inadequate storages, null minimization and limited recycling, among others. Another failure that slowed down answer projection is the lack of concrete figures since some municipal landfill doesn't have weights to have a proper record [11].

Definition, percentages and types of textile waste in Europe

From the gathered waste in EU, textile waste represent 0.2% [4], identified as those considered so because of reaching the "end" of its useful life as product, as those coming from industrial proceses that, by default or commercial reasons, doesn't make it to the next production line. In both cases, raw material can be from natural origin (animal, vegetal or mineral) or chemical (artificial or synthetic). These waste are

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specified in the published list from EU decision from May the 3rd 2000 in which appear classified as “textile leather and skin industries waste”, in code 04 [12].

European discard 5.8 million tons each year assigning 75% to landfills or incineration and recycling only 25% [13] From this figures, even 50% of thrown away textile are adequate for its reuse, even 25% are useful as multi-use cloth and 30% as raw material for other industries [13].

Also, 350.000 tons of used clothes coming from all over Europe, ends every year in a United Kingdom landfill where they are classified individually and redestinated according their used clothes condition for re-sale, cloth selection, waste, etc. [13].

Types of reuse in engineering

Main processes inside a textile recycling facility are: cut and preparation, transportation, storage and load, shredding and packaging. Processes, which transform residue into fibers that can have a new use [14]. Later, there are four lines of textile recycling, according to applied technology:

- a) Primary: Recycle a product to its original shape;
- b) Secondary: Transform into a product with lower requests regarding physical, mechanical and chemical properties;
- c) Tertiary: Transform plastic residue into basic chemical fuel.
- d) Quaternary: Burn the solid and solid fibrous residues and use generated heat.

Finally, use of textile waste ends in the following order: use clothes markets, converting to new products, use as clothes, energy and diamonds obtainment [15]. However, in the last times textile enterprise innovated in management, production processes reduction and multifaceted materials, e.g., laser cut, nanotechnology, 3d printing, textile printing, etc. Saving resources, cost and time, which means lesser waste amount [16].

Research and actual products tend toward construction, geotextiles and chemical engineering, areas which found in textile waste utility thanks to its properties: weight, resistance, durability, flexibility, isolation and absorption, fire and heat resistance [17].

For example geotextiles, are used in various fields of engineering mainly in landfills to extend its useful life and reduce environmental impact. They can be defined as a textile material, flat, permeable and polymeric from synthetic origin given its durability compared to natural ones, it can be confectionated with short fibers from 2 to 15 centimeters and joined mechanically, thermal or chemically, its composition allows to recycle residues and waste from other textile processes [18]. Taiwanese Enterprise MINIWIZ Co. Jackie Chan Group created TrashPresso, a mobile recycling plant which transforms residues (plastic bottles and textile) into tiles used for inner and outdoor floor finish. The machine needs 40 work minutes to make 10 square meter tile surface [19].

On the other hand in Cuba, researchers from the Jose Antonio Echeverría Polytechnical Superior Institute proved the chance to obtain ethanol from textile residues, which used as fuel contributes significantly to reduce environmental pollution [20].

In Europe, INPAT project developed a textile residue confectionated material, which presents acoustic and thermal insulation properties for

buildings, and estimates will revalue up to 4 million kg/year reaching a 44 dB noise reduction with only 15 mm thickness [21].

Additionally, there are diverse studies developed to put in value textile residue, even the obtained products have not yet been commercialized, two of them elaborated by researchers from the Madrid Polytechnical University, which consists of panel creation meant to construction with thermal-acoustic properties, one of them stick together the textile with hydraulic lime properties [22] and the other a metallic or polymeric cover material [23].

On the other hand researchers from the Vicosa Federal University in Brazil made studies about briquette confection from biological mud with textile industry solid residues, using different cotton and mud percentage until achieving ideal consistency. It was concluded that residue mix for briquette production can optimize its physical-chemical and mechanical properties depending on relation of mix used [24].

So too researchers from Monastir University in Tunes used textile residue grout in building insulation confection proving that recycled textile materials have competitive thermal properties compared to market insulation materials. Alike to this study is the one from Politehnica University of Bucharest in Romania, which improves sound absorption properties from polyurethane foam when added with textile fiber residue.

Besides, Boras University in Sweden studies biogas production from textile waste and Chalmers Technology University also in Sweden studies ethanol production from cotton-based textiles, among others.

Conclusion

Waste reduction is one of the main acting lines at a political level originated from resource consumption and exponential population growth over the past years. Among areas that generate bigger resource consumption is construction with 34.7% of produced waste globally. Along with this, textile residues have increased the most over the last decades driven by current consume politics, as to price reduction and increase of population's standard of life [4].

The main difficulty in textile recycling subjects, is the diversity of creating process resulting waste, in a textile remnant and clothing focused approach, where selection and classification is meticulously done by staff, which leads to costs that current society still doesn't economically compensates.

In conclusion, there are two bigger priority leads in ways to reduce waste, productive efficacy and revaluation, both implies investment in research and innovation, a process which assures a circular economic politics, however often textile research lacks of continuity, strategically direction, personnel, specific knowledge and funding.

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