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Reusing and Reprocessing Textiles Effects on the Atmosphere

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Abstract

This paper provides a summary of the current knowledge and highlights areas for additional research by reviewing studies on the environmental impact of textile recycling and reuse. A total of 41 studies were examined, with recycling being the focus of 85% and reuse being the focus of 41%. The most researched recycling method is fiber recycling, followed by polymer/oligomer recycling monomer recycling and fabric recycling. Polyester (63%) and cotton (76%) are the most researched materials. Claims that textile reuse and recycling have a lower impact on the environment than incineration and landfilling, as well as that reuse is more beneficial than recycling, are supported by the reviewed publications. The investigations do, nonetheless, uncover situations under which reuse and reusing are not valuable for specific ecological effects. Benefits, for instance, may not be realized in situations with low replacement rates or if the avoided production processes are relatively clean because benefits primarily result from the avoidance of new product production. Additionally, if the use phase is not sufficiently extended, induced customer transport may have an impact on the environment that is greater than the benefits of avoiding production for reuse. When it comes to critical methodological assumptions, authors typically make the assumption that textile that are sent to recycling are wastes that do not pose a threat to the environment and that products made from recycled materials and products that have been reused can take the place of products made from virgin fibers. Other examples of content mapped in the review include: patterns of distributions over the long run, normal points and topographical extensions, ordinarily included and discarded influence classifications, accessible wellsprings of essential stock information, information holes and future exploration needs. The latter include the requirement to investigate cascade systems in order to investigate the possibility of combining various recycling and reuse methods.

Keywords: Fiber recycling • Reuse methods • Water depletion

Introduction

The global demand for textile products is steadily increasing (a trend likely to continue due population growth and economic development. Meanwhile, the textile industry is facing tremendous environmental and resource challenges. Sixty-three percent of textile fibres are derived from petrochemicals whose production and fate give rise to considerable carbon dioxide (CO_2) emissions . The remaining 37% is dominated by cotton (24%), a thirsty plant associated with water depletion – the desiccation of the Aral Sea being the most infamous example and toxic pollution, due to intensive use of pesticides . For most categories of environmental impacts, later stages in the textile production process give rise to even larger impacts. Wet treatment processes (dyeing, finishing, printing, etc.) are major sources of toxic emissions and spinning of yarns and weaving/knitting of fabrics most often rely on fossil energy use, causing emissions such as CO_2 and particulates . greenhouse emissions, water use, toxic chemicals and waste are the main environmental issues facing the textile industry. estimate that, for several environmental impact categories, the impact per garment use in a western country (in this case, Sweden) must be reduced by 30–100% b if the industry is to be considered sustainable with regard to the planetary boundaries outlined. Show that such a grand transition requires a combination of different measures for impact reduction, most likely including more reuse and recycling [1].

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Discussion

Because of the aforementioned challenges, there is regulatory interest in increasing textile reuse and recycling, which would move the treatment of textile waste further up in the waste hierarchy, consistent with the EU directive on waste (European Commission (EC), 2008). Increased textile reuse and recycling could potentially reduce the production of virgin textile fibres and, in the case of reuse, also avoid engineering processes further downstream in the textile product life cycle, and thus reduce environmental impact. The potential environmental benefits of various systems of textile reuse and recycling have been assessed in the literature, using methods like life cycle assessment (LCA). To date, no review of such studies has been published in the academic literature or elsewhere, which means that there is no available comprehensive source of information on, for example, (i) what has been studied and what has not been studied (e.g. in terms of product systems and environmental issues); (ii) what the results of such studies tell us about the environmental potential of textile reuse and recycling; (iii) what methods and methodological assumptions are usually employed in such studies; (iv) whether there are general methodological challenges to resolve; and (v) what inventory data pertaining to textile reuse and recycling is available in the literature. Therefore, the aim of this paper is to review studies of the environmental impact of textile reuse and recycling, to provide a summary of the current knowledge and point out areas for further research. The intended audiences of the review are decision makers and stakeholders in the textile industry as well as practitioners and researchers involved in assessing the environmental impact of textile reuse and recycling [2]. Textile reuse refers to various means for prolonging the practical service life of textile products by transferring them to new owners, with or without prior modification This can for example be done through renting, trading, swapping, borrowing and inheriting, facilitated by, for example, second hand shops, flea markets, garage sales, online marketplaces, charities and clothing libraries. In the academic literature, various forms of reuse have been conceptualised in terms such as collaborative consumption, product-service systems, commercial sharing systems and access-based consumption. Textile recycling, on the other hand, most often refers to the reprocessing of pre- or post-consumer textile waste for use in new textile or non-textile products. In this paper, we adopt a more generous notion of textile recycling, also including the recycling of non-textile materials and products (such as polyethylene terephthalate (PET) bottles) into textile products.

Conclusion

Textile recycling routes are typically classified as being either mechanical, chemical or, less frequently, thermal. This is in many cases a simplification of reality, as recycling routes often consist of a mix of mechanical, chemical and thermal processes. For example, chemical recycling most often refers to a recycling route in which the polymers are depolymerised (in the case of synthetic polymer fibres derived from petrochemicals, such as polyester) or dissolved (in the case of natural or synthetic cellulosic fibres, such as cotton and viscose). Having thus been dissembled to molecular levels, monomers or oligomers are repolymerised, and polymers respun into new fibres. However, prior to the depolymerisation or dissolution, the recycled material is most often mechanically pretreated. Moreover, thermal recycling often refers to the conversion of PET flakes, pellets or chips into fibres by melt extrusion – but the flakes, pellets and chips have been produced from PET waste by mechanical means, which is why this recycling route is sometimes referred to as mechanical recycling . Furthermore, the term thermal recycling is easily confused with thermal recovery, which is when textile waste is incinerated to generate heat and/or electricity). To complicate things further, incineration with energy recovery is occasionally labelled as recycling, although the term recycling most often refers solely to material recycling (as is the case in the present paper). So the systematisation of recycling routes into mechanical, chemical and thermal ones is ambiguous and questionable. In the present paper, instead of systematising recycling routes based on the nature of one of the processes involved, we systematise based on the level of disassembly of the recovered material. If the fabric of a product is recovered and reused in new products, we refer to this as fabric recycling (sometimes this is referred to as material reuse. If the fabric is dissembled, but the original fibres are preserved, this is fibre recycling. If the fibres are dissembled, but the polymers or oligomers are preserved, this is polymer/oligomer recycling. And if the polymers/oligomers are dissembled, but the monomers are preserved, this is monomer recycling. Then there are various means of achieving these types of recycling routes, often by combining various mechanical, chemical and thermal processes. The above systematisation of recycling routes resembles a systemisation recently presented by the Ellen MacArthur Foundation [3-5].

Acknowledgement

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Conflict of Interest

None.

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