Journal of Interdisciplinary Science Topics

How many fleeces could be made from the plastic bottles wasted in the United Kingdom?

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23/04/2018

Abstract
This paper explains and evaluates the process of upcycling PET plastic bottles into fleeces. The ability to do so in the UK would reduce the pressure on landfills and environmental pollution. It was estimated that if the 5.59×10^9 wasted plastic bottles were upcycled, the UK would be able to produce approximately 2.2×10^8 fleeces each year. This is enough to give every member of the population 3 fleeces. The paper however recognises that the fleeces themselves are not completely sustainable and could have an impact on the environment once made and worn.

Introduction
The understanding and concern with regards to the amount of waste the country produces has only begun to develop over the last decade. More effort and money is being put into finding potential solutions to reduce the annual household waste, from reducing plastic packaging to greater advertisement raising awareness. The public perception on their carbon footprints and influence on the environment has improved, however there is still an enormous amount of waste pilling into the landfill sites and seas.

With greater pressure than ever to reduce the impact humanity is having on the environment and the waste left behind, new methods and uses of our waste are being developed.

The ability to produce clothing from plastic bottles is an interesting prospect. This paper will evaluate how many plastic bottles are thrown away each year and the number of fleeces which could potentially be made. As homelessness is also an urgent issue within the UK, this paper determines whether the process is sustainable in clothing the rising numbers.

Theory and application
A common polyester fleece is made up of the polyester polyethylene terephthalate formed from two petroleum products; terephthalic acid and ethylene glycol [1]. The chemical structure of polyethylene terephthalate (PET) is shown in figure 1.

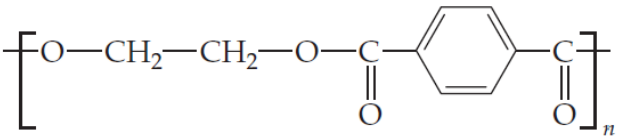

Figure 1 – Showing the structure of PET used in plastic bottles [2].

The process of turning a plastic bottle into a fleece can follow two paths; chemical decomposition or mechanical. Chemical decomposition consists of reforming the original monomers of the PET. It has better energy consumption but only cost effective if there is an annual capacity of 50,000 tonnes, which is not produced by the UK currently and so inefficient [1].

For the mechanical method, the bottles are collected and sorted so to separate the clear bottles from the green ones. Any caps, non-PET items or foreign objects are removed from the system. The selected bottles are then cleaned and sterilised, removing any contamination. They are then crushed into fine pieces and washed again.

The flakes of plastic are then heated whilst forced down through spinnerets. This allows the plastic to form hardened strands when cooled and so can be

collected [3]. These are described to be 'five times finer than human hair' [1]. A spinning machine is then used and the strands are threaded through which twists and winds them around spools.

These threads are then pulled through heated rollers, allowing them to become up to four times their original length. Once longer, they are drawn through a crimping machine which introduces the required strength and texture. The tread is then dried and spun into yarn. The product now resembles the yarn of normal fleece.

The yarns are then immersed in chemical dyes, usually a darker colour, and dried again. Using a knitting machine, for efficiency, the yarn forms rolls of cloth. This is then fed through a machine which can produce the unique texture of the fleece, commonly known as a napper. It is now suitable to be cut and made into the fleece or garment [3].

In the UK there is approximately 13 billion plastic bottles used each year. With 57 % of these being recycled, there is 5.59×10^9 bottles wasted [4].

It takes approximately 25 recycled plastic bottles to make a fleece, therefore the UK would be capable of making 2.2×10^8 fleeces. This is an extraordinary number of fleeces. There are currently 66.5 million people living in the UK [5]. That would mean each person would receive 3.4 fleeces.

According to the government, in Autumn 2017 the total number of rough sleepers was estimated to be 4751 [6]. If the same number of wasted plastic bottles were upcycled to fleeces and given to the homeless, they would each receive 4.7×10^4 fleeces. If, say, each homeless person was to receive two fleeces each, only 2.4×10^5 bottles would have to be collected and processed.

This is highly a prospective initiative. If all wasted plastic bottle were utilised in the UK and reformed into clothing, this would allow for local manufacturing, production and growth within the country. It would also reduce the dependence on additional petroleum extraction and the use of landfills. It is estimated that 1 barrel of oil is normally used to make 150 fleeces. Therefore, if this scheme was followed, 1.5×10^6 barrels of oil would be spared [1]. However, this is not a perfect solution.

The fleeces are made from petrochemicals and so this makes them difficult to recycle the fabric itself once worn. Due to the chemical nature this also means the fleeces are flammable and would generate a lot of static when worn. Microplastics would also shed when the fleeces are washed, these pose a large risk to the oceans as they damage sea life and pollute the natural environments [1]. It should also be mentioned that the process of upcycling into the fleeces requires a workforce and energy, therefore it will require fuel and money to allow this process to occur.

Conclusion

To conclude, it was estimated that if the unrecycled plastic bottles were upcycled into fleeces, the UK would be capable to make $2\times10^8$of them. This would provide every member of the UK population with approximately 3 fleeces each, or provide enough clothing for every homeless person (4.7×10^4 each). Although the upcycling of bottles reduces the issues with landfills and waste, this issue still arises when considering the disposal of the fleeces themselves and the possibility of introducing microplastics into the oceans.

References

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