

THE REBIRTH OF BOTTLES

Polymers between myth and reality: recycling of plastic bottles



ABSTRACT - CIRCULAR ECONOMY

The circular economy is an economic philosophy that deals with the impact that all actors of the system, companies, consumers and governments, have on the environment with the objective of reducing the consumption of raw materials and energy; this can be achieved through an improvement and responsible consumption of objects. Nowadays, the circular economy imposes itself as an immediate necessity due to the increase in demand for raw materials to satisfy a constantly growing world population and due to the very decrease in primary resources, also due to their location in the world. The circular economy is a system in which the value of products and materials is maintained for as long as possible: waste is minimized and resources maintained in the economy in order to reuse them several times and create further value. It is therefore an economy in which growth is decoupled from the use of exhaustible resources. It is a system designed to regenerate itself: materials of biological origin must re-enter the biosphere, while materials of technical origin are designed to circulate within the flow, without losing quality. Of course, this innovative economic system applies to all spheres of our life and we will describe how the recycling of PET bottles fits perfectly into the model. In fact, the transition from a linear economy to a circular economy also involves recycling plastic and, specifically, PET. In the following we describe the complete system of PET bottle recycling, starting from the arrival of waste at the recycling centre to the end product partially recycled.

1) Durable supply: It's about the propensity to use recycled raw materials and renewable resources in order to respect the environment. So, plastic bottles manufacturers, should use recycled PET in their production rather than virgin PET, obtained from fossil fuels.

2) Industrial & territorial ecology: It means to develop a network of industries on the territory in order to reduce the movement of products after their realization and to deepen the exchanges between the recycling companies and the ones that will market the final product.

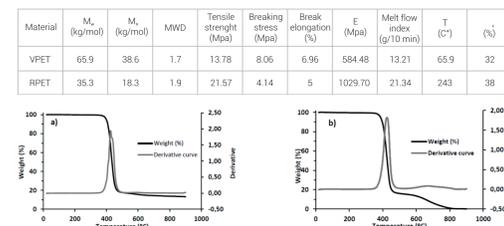
3) Responsible consumption: It should lead the buyer (economic actors, consumers) to make his own choice by taking into account the environmental impact in the whole product life. So it is preferable to buy recycled PET bottles to reduce their carbon footprint.

4) Recycling: The purpose is to use raw materials from waste to create the same or different products. At the end of the process, the aim is to optimize the quantity of recycled PET, keeping the total cost of the operation as competitive as the one made of virgin PET.

PET VERGIN & RECYCLED - General properties

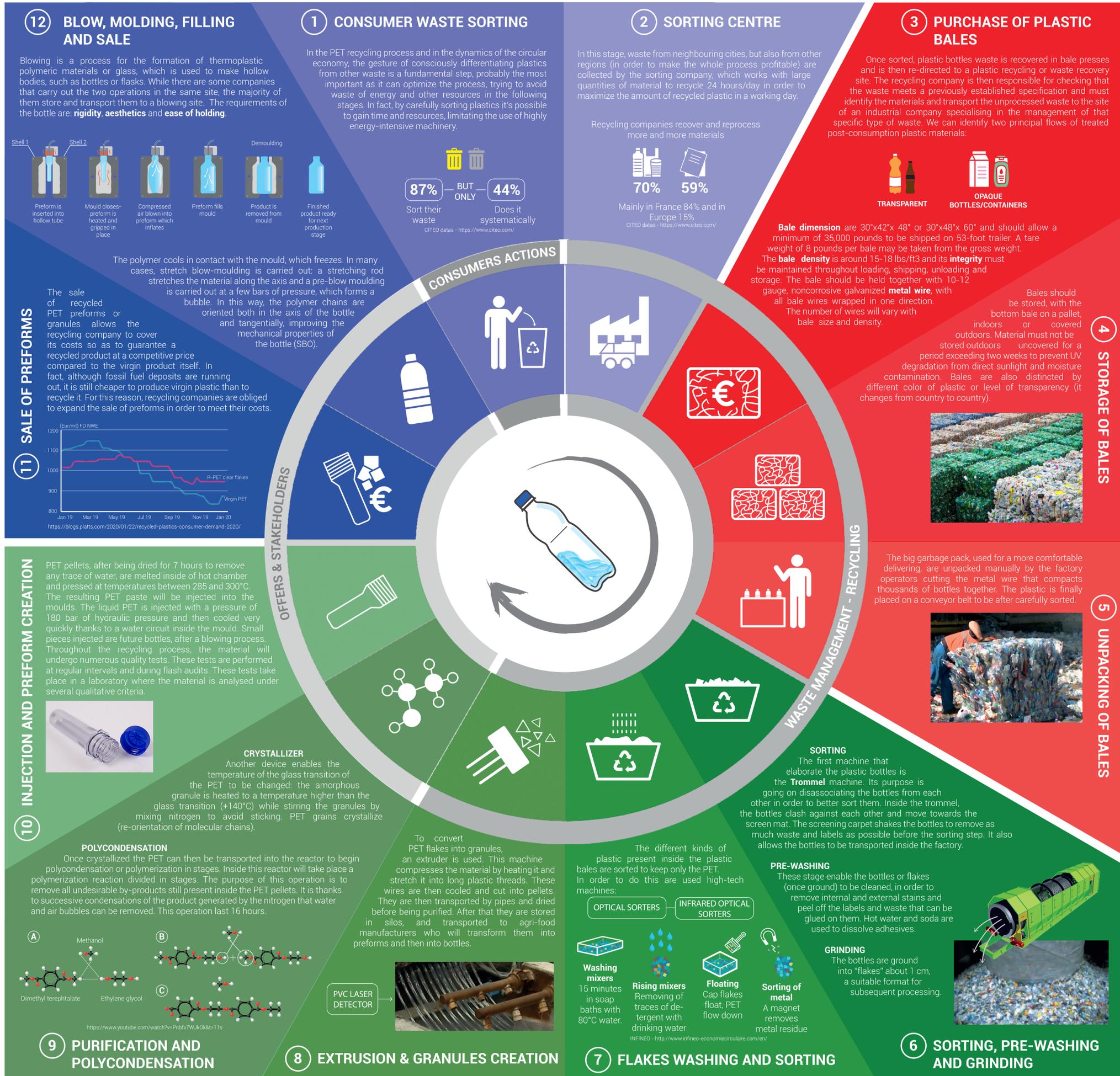
PET is a cheap thermoplastic material and it has the mayor recycled percentage between all polymers (~ 22%). The break stress and the Young's modulus are different between the two materials, because the average molecular weights were calculated using the intrinsic viscosity approach. The presence of smaller polymer chains, due to the polymer degradation can cause a decrement of the crystallinity, which has a significant influence on the mechanical properties. Therefore, the fibers with lower average molecular weight may show lower break elongation, higher Young's modulus and a lower breaking stress. The difference in flow index is caused by the hydrolytic degradation that the extrusion process produced on the recycled PET; therefore, an increase in the melt flow is an indicator of the extent of the thermo-mechanical degradation. The surface morphology of the virgin fibers consists of smooth cylindrical fibers. The viscosity of PET polymer has a significant impact on the fiber diameter than any other process variable.

Furthermore, while virgin fibers show a lower diameter, it is possible to obtain a bigger diameter in recycled PET. This is due to the lower flow mass of the virgin PET at the process temperature, is caused principally by the lower flow index of the raw material in comparison to the recycled material. Additionally, the surface of virgin fibers has lower defects and higher shining than those obtained for the recycled ones. In the thermograms reported in the upper figure, it is shown a degradation of R-PET(b), that happens at lower temperature than V-PET(a) due to the thermal history of the material and possible residual impurities in the samples. The mass loss of PET is attributed to the polymer degradation process involving a random scission of ester links in the main chain resulting in the formation of different oligomers. The curve shows 85 wt.% loss in the case of V-PET and 88 wt.% loss in the case of R-PET at their respective end set temperatures.



Polyester Fiber Production Using Virgin and Recycled PET- DOI: 10.1007/s12221-014-0547-7

Physical and Mechanical Properties of Recycled PET Composites- DOI: 10.14311/CEJ.2019.04.0045



CONCLUSION

Given the importance, for the environment and for our future, of reducing plastic production worldwide, the aim of our poster has been to overturn a widely diffused idea among the public: the PET recycling process is extremely complex and expensive. Therefore, we started from the circular economy, and then we went deeper into the different phases of PET recycling, trying to be at the same time exhaustive and understandable in the explanation. Furthermore, the objective must be to minimize the manufacture of new products and reuse existing ones as much as possible in order to minimize our impact on the planet. From this point of view, our work shows that the PET recycling process is not an unattainable myth, but rather a reality to be spread worldwide, thus reducing the production of virgin plastic.

FUTHER DEVELOPS

With the aim of improving the process as a whole and dispelling the myth that plastics are not recyclable, we propose three possible guidelines to ameliorate this key process for our society: firstly, increase the percentage of recycled PET in each bottle and make the whole process more efficient in terms of total costs and energy resources consumed. Secondly, raise public awareness both of the quality of recycled bottles and of the importance of conscious recycling. Thirdly, propose fiscal incentives to recycling companies in order to reduce process costs and offer a more competitive product on the market.

