

REINFORCED RECYCLATES

Top-performance of recycled plastics in composites

“We showed that TPC’s can be manufactured cheaper, more sustainable and with excellent properties using recycled polymers.”



Introduction

There are many obstacles that restrict the recycling of polymers. It is still very difficult to obtain PP and PE in a nearly pure composition, particularly from post-consumer waste. It cannot be avoided that these polymers remain mixed up to a certain extent after extracting them from waste polymer streams. Besides, many sub-grades do exist within these polymer families. Mechanical properties of post-consumer recyclates thus do not meet virgin material properties.

In a continuous fibre reinforced material, fibres are responsible for the required extreme stiffness and strength: any effect on these mechanical properties due to non-virgin matrix properties are expected to be marginal.

Furthermore, aesthetical requirements like smoothness and colour are often not relevant for the type of (semi-) finished products that are being made of these thermoplastic composites (TPC). Finally recycled polymers are available at lower cost than their virgin counterparts. This makes TPC excellent candidates for use of recycled polymers.

Approach

In this project, the producibility and the mechanical properties of continuous fibre reinforced composites from recycled PE and PP were investigated, in collaboration with CompTape and Addcomp.



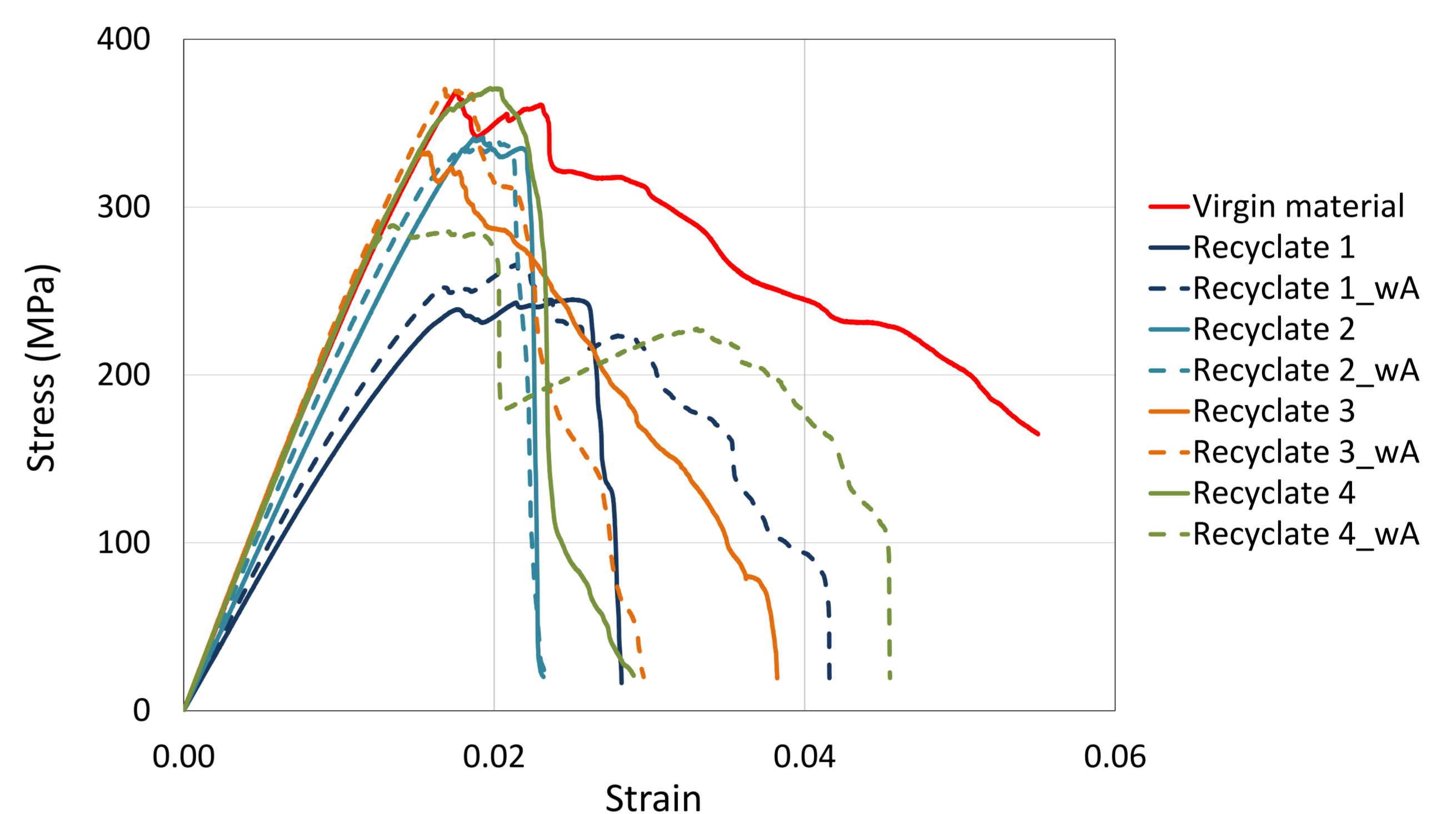
Recyclates were sourced from several different suppliers and used for tape production, with special emphasis on the relationship between MFI, purity and processability.

In order to verify the effect on processability and properties, tapes were produced with additives from Addcomp, aimed at increased bonding, thermal- and UV-stability. Consecutively, TPC test plates were wound and moulded from the tapes. To analyse the mechanical behaviour, in comparison to virgin material, four point bending tests and inter-laminar shear strength (ILS) tests were conducted.

Calcination tests were carried out to determine the fibre volume fraction (V_f) of the manufactured plates. Additionally, elastic moduli were analytically calculated with the Rule of Mixtures using the determined V_f .

Results

The results from this project show that glass fibre reinforced thermoplastic tapes made of post-consumer and post-industrial recyclates can be readily produced. The only obstacle observed was that the size of recycled granules has to be adjusted to guarantee granular flow during tape production.



Representative flexural stress vs. flexural strain curves

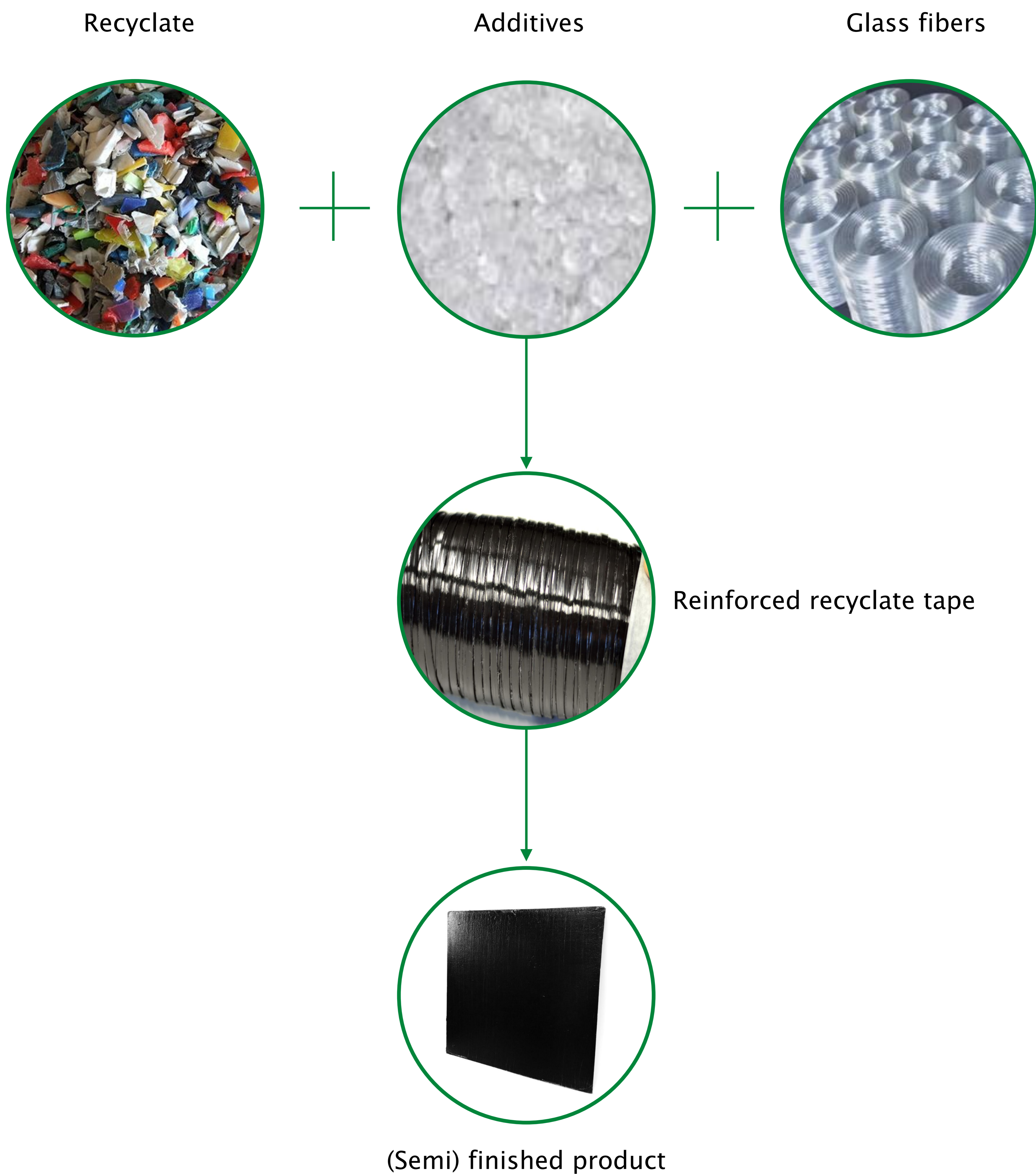
Flexural properties and ILS of TPC made of recyclates are at the same order of magnitude as the virgin polymer. The experimental values for the virgin material agree well with the theoretical predictions, whereas the measured moduli of the post-consumer recyclate composites are lower than the analytically predicted values. Assuming that processing parameters, fibre content and orientation are similar for all TPC, differences can be attributed to lower moduli of the recycled polymers. The obtained ILS of all post-consumer recyclates is similar or even higher than the ILS of the benchmark material. Values obtained for some polymers containing additive are further increased. Overall, the current study proves the feasibility of manufacturing thermoplastic composite tapes using recycled polymers. The results indicate the potential of using recycled polymers for cost-efficient and sustainable tape manufacturing without loss of properties.

This research is co-financed by Regieorgaan SIA, part of The Netherlands Organisation for Scientific Research (NWO).

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Composition



www.compositetape.com

www.addcomp.nl

www.thermoplasticcomposites.nl

www.saxion.nl/lightweight

Recycling