Fachgebiet Kunststofftechnik

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Investigation of the Fiber Length of Recycled Continuous Fiber-reinforced Thermoplastic Waste

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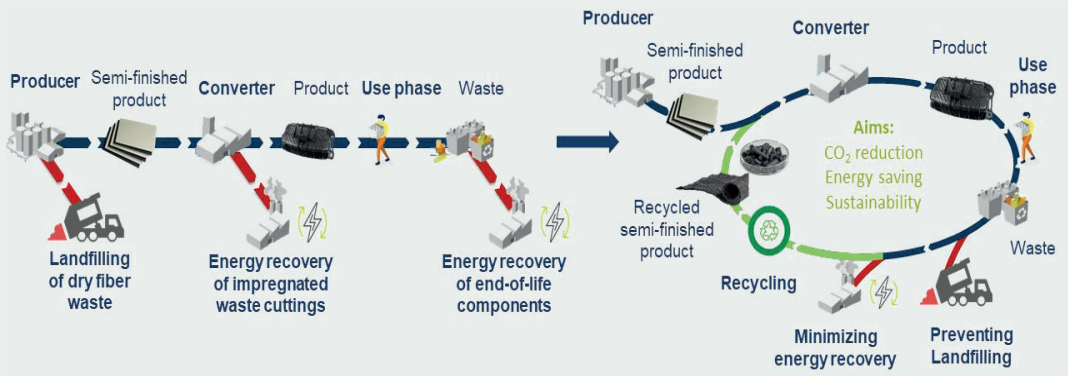
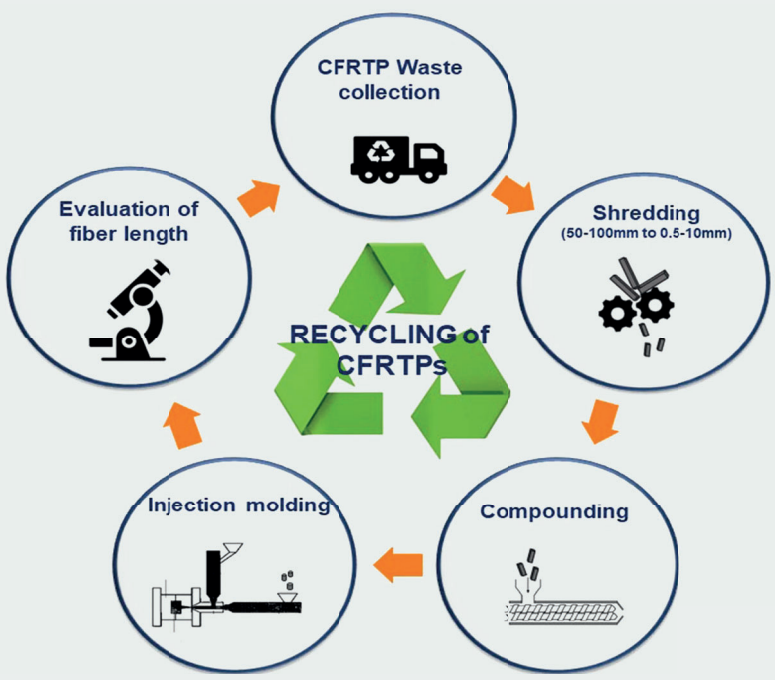
Continuous fiber-reinforced thermoplastics (CFRTP) combine exceptional mechanical properties with low density and therefore are predestined for lightweight applications. The increased use of CRFRTP products comes with emerging production- and end-of-life-waste material. Aim of the presented study is to evaluate potential recycling strategies and to develop a process chain to gently process CFRTP waste into recycled fiber reinforced pellets for injection molding in order to obtain maximum fiber lengths.

Motivation

- Increasing use of CFRTP results in increasing CFRTP waste
- CFRTP waste is currently primarily thermally utilized
- Mechanical recycling is associated with downgrading and unknown properties
- Recycling chains are still insufficiently investigated and not established mostly due to economic reasons
- Investigation of CFRTP waste recycling by compounding and injection molding



Process Steps



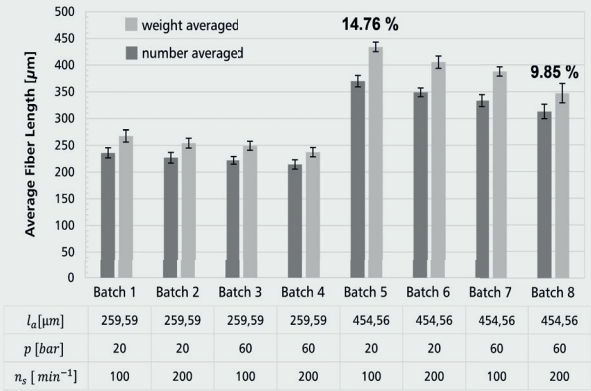
Mechanical size reduction
CFRTP waste was reduced in size by shredding, pre-crushing using saws, cutting mills and sieves. The final particle sizes ranged from 0.5-10.0 mm.

Compounding
Short fiber-reinforced thermoplastics were produced, varying the fiber volume content, the processing temperature and the screw speed. The CFRTP waste material was mixed with virgin material to obtain compounds processable by injection molding.

Injection molding of parts and test specimen
Short fiber-reinforced parts were produced by injection molding varying the initial fiber length in the recycling material, the back pressure, and the screw speed.

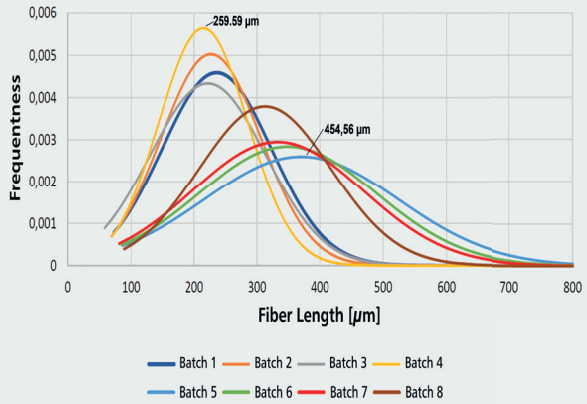
Evaluation of the fiber length
The resulting fiber length in the injection molded samples was investigated by optical microscopy.

Results

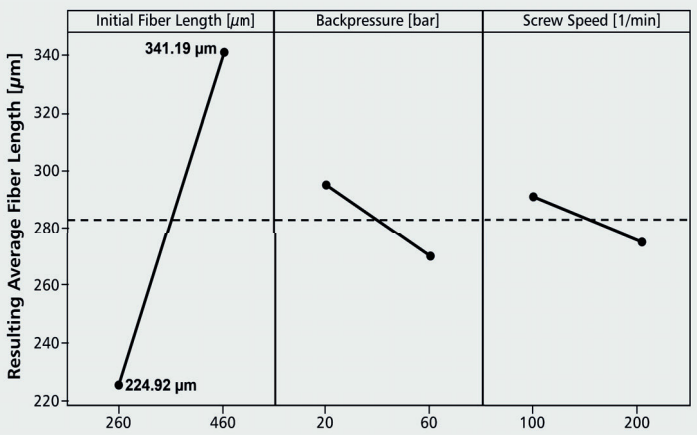


	Batch 1	Batch 2	Batch 3	Batch 4	Batch 5	Batch 6	Batch 7	Batch 8
$l_a[\mu m]$	259,59	259,59	259,59	259,59	454,56	454,56	454,56	454,56
$p\ [bar]$	20	20	60	60	20	20	60	60
$n_s\ [min^{-1}]$	100	200	100	200	100	200	100	200

- Higher weight-average fiber length than number-average fiber length for all batches.
- The lowest and largest deviation percentage of fiber shortening is recorded for batch 8 and 5 respectively.



- The greater the mean value of a batch, the broader the fiber length distribution, which results in a flatter curve.



- The initial fiber length has a direct influence on resulting average fiber length.
- The back pressure and screw speed have inverse influence on the resulting average fiber length.

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