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Recycled plastics with wastewater screenings

"We showed that biogas can be generated by anaerobic digestion and that residues can be used as additive in recycled polymers."

Introduction

Modern wastewater treatment plants (WWTP) employ three treatments. In the primary stage screens are used to separate coarse materials from the influent wastewater. These materials have to be removed to reduce the chance of plugging in subsequent processes. The separated coarse material is called (filter) screenings. The composition of screenings varies dependent on the geographical area and the gap sizes of the screens used. In general screenings are a mix of cellulose, plastics and miscellaneous materials. Screenings are generally not separated, mostly disposed and incinerated. The disposal of screenings costs about 20€ per tonne. Reusing these materials to create a useful product would reduce the amount for incineration as well as costs for storage and transportation.

In the Netherlands there is no debate on the use of sewage sludge as regulatory requirements have almost prevented the use since 1991. Anaerobic digestion (AD) is the most prevalent sludge disposal route as it is not affected by the high water content. AD transforms organic solids of sludge to biogas and an organic residue, which is treated as chemical waste and mostly disposed in incineration plants. The costs for disposal of one tonne is currently 70€.

Approach

In this project, the composition of wastewater screenings was analysed to determine their polymer content. Furthermore strategies for reusing this waste were evaluated.

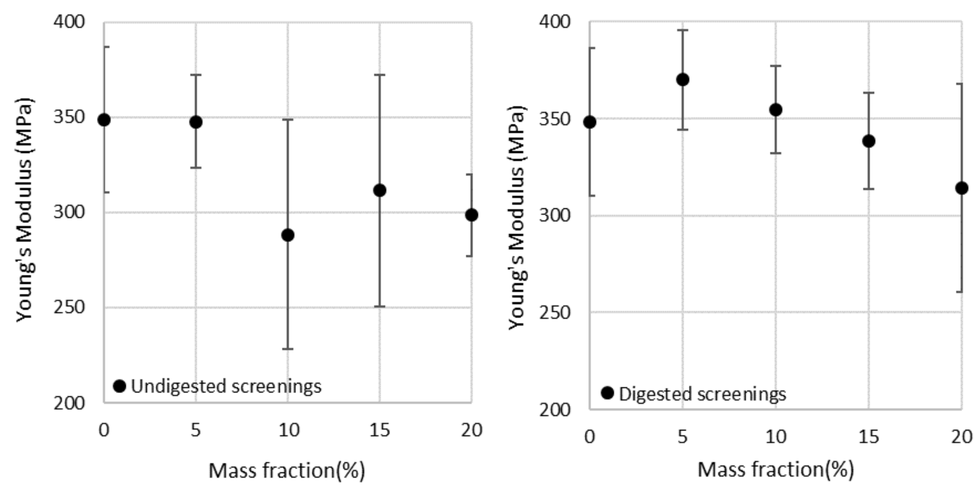
Anaerobic digestion was employed to evaluate the potential of filter screenings for the production of biogas. Due to the high cellulose content of screenings an active sludge from a paper waste treatment plant was selected as it contains mesophilic microorganisms and strong cellulolytic bacteria. The pH value of the mixture in the digester is crucial for the digestion process. A drop in pH can inhibit the methanogenesis and thus reduce the biogas yields. It was constantly monitored by means of sensors and adjusted using sodium hydroxide.

Moreover, screenings and waste from the digestion process were used as filler in a recycled LDPE/PP blend. Tensile tests were carried out to analyse the mechanical performance of compounds with filler mass fractions of 0–20%. Compression moulding and extrusion were employed to produce plastic parts.

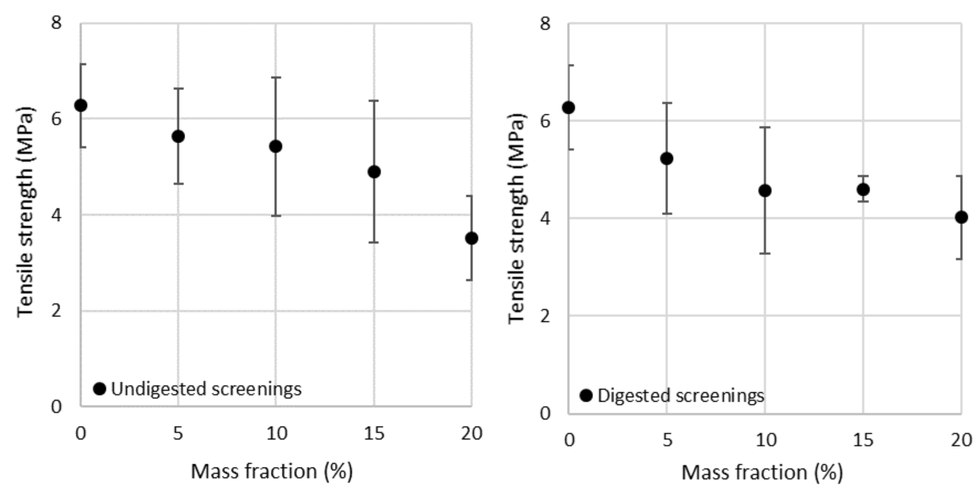
Results

Small quantities of plastics, such as foil, bag clips, rhinestones, cigarette filters, were found. The identified items reflect the origin of wastewater from laundry, cooking, blackwater and surface water.

A biogas yield of 601 l for 20 kg screenings was generated within 6 days, which corresponds to about 30 m^3 per tonne. The dry mass was reduced by about 80%, which indicates a huge digestible organic content in screenings.



Young's modulus of recycled polymer filled with screenings



Tensile strength of recycled polymer filled with screenings

In order to use screenings or digestate as filler, the material has to be dried due to its high water content. Tensile properties of polymers cannot be improved by adding (un-)digested screenings. Particularly the tensile strength de-creases with increasing filler content. The standard deviations indicate big variations in properties. Besides the varying quality of (un-)digested screen-ings, irregular size and shape have an effect on the properties. Manufacturing trials showed that filled plastic parts can be readily produced without major obstacles. A maximum mass fraction of 5% is recommended to maintain stiffness and strength.

Recycling

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Approach

Screenings

Anaerobic digestion

Biogas

Digestate

+

Recyclate

Product

Recycling

www.thermoplasticcomposites.nl
www.saxion.nl/lightweight

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