PLAST2bCLEANED

NONTOX 16th November 2021
Introduction by Annemieke van de Runstraat

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 821087

Overview of the project

The overall aim of PLAST2bCLEANED is to develop a human and environmentally safe recycling process for Waste Electrical and Electronic Equipment (WEEE) plastics in a technically feasible and economically viable manner.

Key technologies developed within the project are:

- Improved sorting of HIPS and ABS
- Dissolution of Waste Electrical and Electronic Equipment (WEEE) plastics in superheated solvents;
- Separation of additives to concentrate BFR and ATO fractions for recycling;
- Energy efficient recovery of solvent and of polymer.

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Consortium

PLAST2bCLEANED

Industry/SME

Recycling Company — Coolrec

Engineering company — JUCHHEIM

Polymer

Plastics producer — ELIX POLYMERS

End user — Electrolux

Bromine fraction

Bromine recovery — ICL

Chemical industry

Antimony fraction

Antimony recovery — Campine

Chemical industry

Research Institutes

Coordinator — TNO

Fraunhofer ICT

Gaiker — MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Dissemination and exploitation — Sustainable INNOVATIONS

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Team

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Objectives

The overall aim of PLAST2bCLEANED is to develop a human and environmentally safe recycling process for Waste Electrical and Electronic Equipment (WEEE) plastics in a technically feasible and economically viable manner.

1. **Development of a mechanical presorting technology**
2. **Closing 3 loops using dissolution under superheated conditions by separation of :**
   - **(1) the polymer**
   - **(2) the bromine**
   - **(3) the antimony trioxide**
3. **Process integration and scale-up**
4. **Performance testing of process and products**
5. **System optimizing for sustainability and economic viability**

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Main results obtained

1. Pre-processing and sorting: RAMAN equipment set-up and spectral library. Measuring conditions with Raman spectroscopy defined for WEEE streams.

2. Dissolution under superheated conditions: A process flow is set-up based on >300 experiments. Removal of ATO on specs, removal of Br almost on spec. ATO and BFR recovered to be further processing.

3. Impact assessment: better environmental performance and reduced costs by using 50% rABS and rHIPS compared to virgin material in first analysis

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WP1 PRE-PROCESS: SENSING AND SORTING

Goal:

DESIGN A PRE-TREATMENT AND SORTING PROCESS to provide separate and clean polymers (ABS & HIPS) from WEEE streams

- To identify all coloured polymers (including blacks)
- To sort ABS & HIPS for upgrading in other WPs

Considering:

- ✓ Legal limitations and requirements on the use of recycled plastics (P2BC target: Br (HBCD) < 38 ppm, Br (total) < 380 ppm): D1.1. Limitations, barriers, standards for using recycled polymers (Public report)
- ✓ WEEE plastics compositions and implications for recycling

KEY TECHNOLOGIES

Coolrec Part of Renewi

Gaiker MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Industrial sorting technologies
+
Advanced identification sensors (Raman Spectroscopy)

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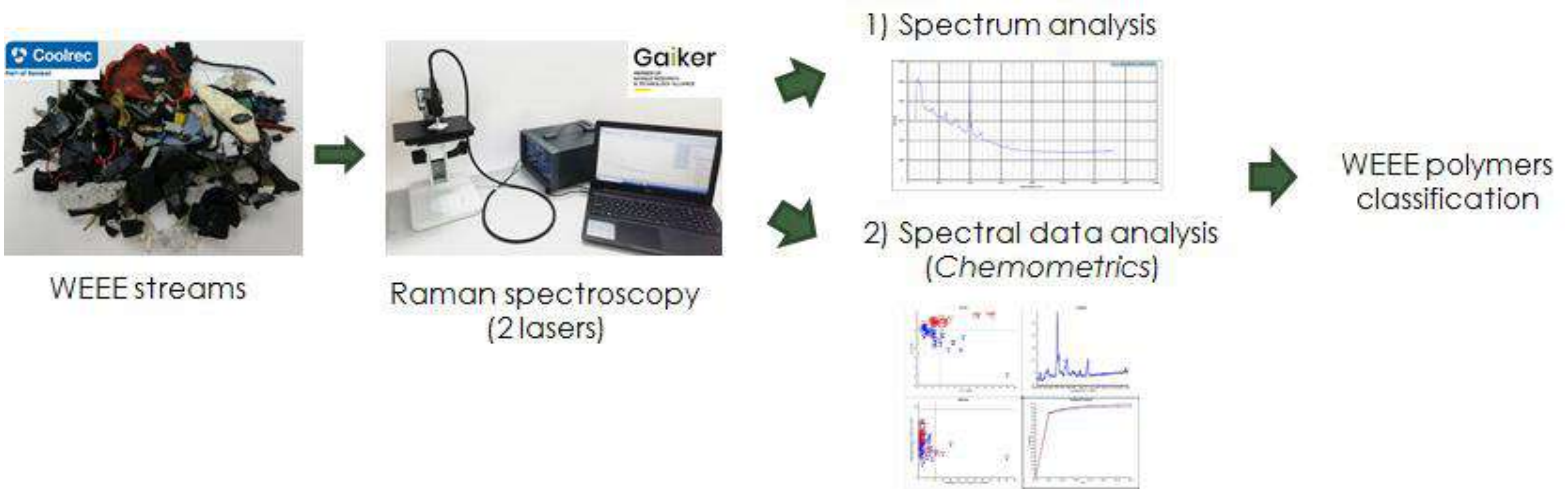
WP1 PRE-PROCESS: SENSING AND SORTING



Main results

- Raman spectral library for WEEE polymers and additives (ATO, BFR)
- Sorted HIPS and ABS for further processing at lab-scale
- Multivariate analysis of spectral data of WEEE samples (>500 spectrum). Classification model for HIPS & ABS under development.

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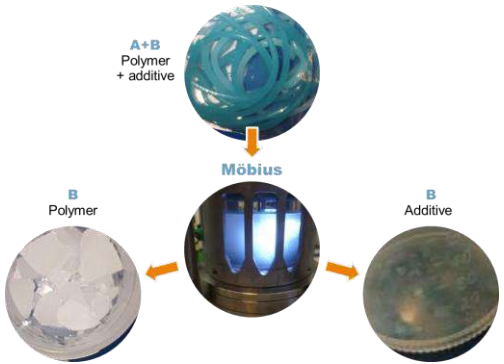
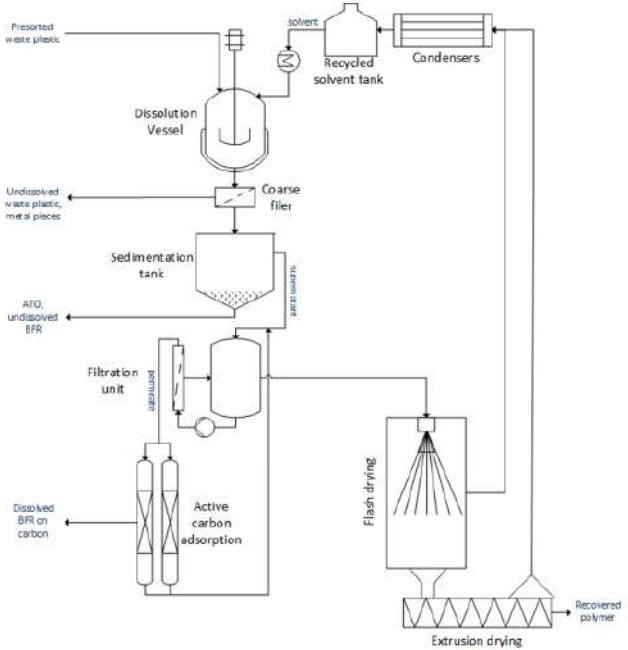
WP2: PROCESS DEVELOPMENT

Goals:

- Dissolution of HIPS respectively ABS
- Separation of the bromine (Brominated Flame Retardants, BFRs) and antimony trioxide (ATO) additives
  - With high yield
  - Recovery of ATO with low levels of organic contaminants
  - Recovery of BFRs with low levels of inorganic contaminants
- Recovery of solvent and polymer samples
- Lab scale development as preparation for scaled-up demo TRL 5/6
- TNO Möbius concept





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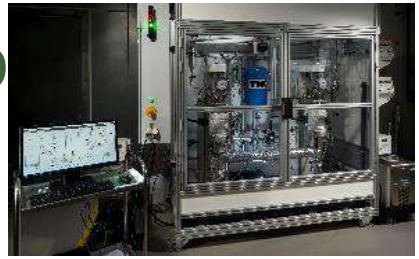
WP2: PROCESS DEVELOPMENT IN CLOSE COOPERATION BETWEEN TNO AND FHG

From basic testing in pressurized test tubes to a 100 g/day semi-batch process

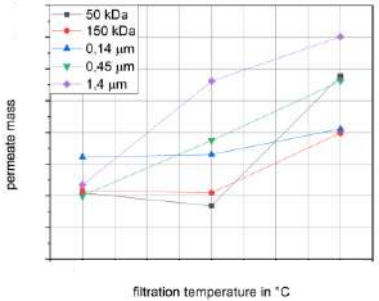
TNO



FHG

Main results

- Process developed
- Dissolution, filtration and sedimentation steps
- Removal of BFR and ATO from polymer on spec
- ATO and BFR recovered to be further processed at partners



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WP3: DEMONSTRATOR AT FHG

Goal:
Scale-up the process developed in WP2 to TRL5

Main results

- Decision to choose one polymer for scale-up
- The other one is still developed at lower scale
  - And will be scale-up in a follow-up project

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WP4: PERFORMANCE TESTING OF PROCESS AND PRODUCTS

Goal: to assess the effectiveness of the process, and the quality of its output fractions

- Removal efficiency assessment
- Purified polymer quality assessment
- Formulation for end-user application
- Output Bromine and Antimony containing fractions testing

Main results

- Continued close collaboration between WP2/3 and WP4 to meet the necessary analytics.
- Main flame retardants identified in ABS by FTIR analysis at ICL

Webinar PRE-1000-1 method by Patrick de Kort, Regulatory Affairs Manager for Plastics Recyclers Europe

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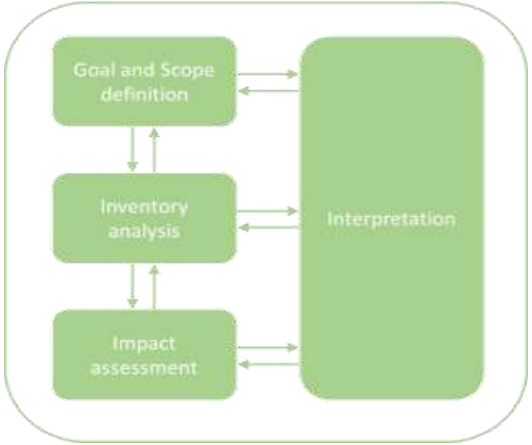
WP5: ECONOMIC AND ENVIRONMENTAL ASSESSMENT

Goal: Develop a recycling process that is environmentally sound and economically viable.

- Environmentally sound: LCA - Address the environmental impact of a full product system along the entire life cycle (ISO 14040).
- Economically viable: LCC - Address the economic viability by mapping all costs and profits along the life cycle (ISO 14045).



Waste perspective: to compare the P2bC recycling method to other recycling methods

"The End-of-Life treatment of 1 tonne of WEEE plastics in a defined average composition and particle size, coming from a WEEE treatment plant".

Product perspectives (ABS and HIPS): to compare the benefits of using recycled plastics (and flame retardant) instead of virgin materials

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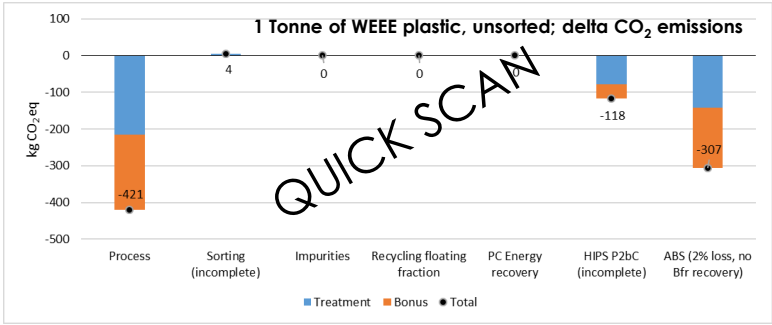
WP5: FUNCTIONAL UNIT

*1 external door frame (made out of 0.495 kg **ABS**) of a washing machine with overall running time of 220 washing cycles per year and an expected lifespan of 10 years (7,000 running hours)".*

*1 inner liner (made out of 5.7 kg **HIPS**) of a household refrigerator's cabinet with overall running hours of 78,840 hours and an expected lifespan of 9 years"*

Main results quick scan

- P2bC reaches a lower CO_2 impact compared to the reference.
- ABS is contributing more to the total impact savings compared to HIPS.
- Life Cycle Costing showed that the use of 50% rABS & 50% rHIPS allow to reduce the costs significantly compared to virgin ABS and HIPS



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PLAST2BCLEANED CORPORATE VIDEO (PUBLIC)

https://www.youtube.com/watch?v=nlNFrMGhaj4&feature=emb_imp_woyt

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Summary

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We are half way of the project

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Thank you!

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Reserve

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