LIFE PlasPLUS

RESULTS

MEETING THE CHALLENGE OF
SEPARATING COMPLEX PLASTICS

www.lifeplasplus.eu - LIFE18 ENV/BE/000368

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PROJECT - RESULTS

STEP 1 PRODUCTION OF HIGH PURITY THERMOPLASTIC

High purity thermoplastics production & upcycling in end products

This step being the first one in the project value chain, it has been the one first implemented and is now fully achieved and fulfills project objectives with the demonstration at industrial scale of the production of purified thermoplastics : **8,687 tons of purified secondary plastics (FPP & ABS at 98% purity, PS 95% purity) have been produced and sold to Comet Traitements' compounder customers.**

RoHS compliant

It was demonstrated that desired quantities and qualities of recycled thermoplastics can be obtained with the tribo-electric unit commissioned by Comet and now in operation.
In particular the products were shown to be **fully compliant with RoHS regulations**

The last project period, from start 2022 to May 2023 was devoted to the production and validation of LIFE PlasPLUS tailored **intermediate and final products in the automotive and EEE sectors.**

The methodology was to :

1

Start from the design new compounds incorporating recycled plastics from shredder residues.

It was based on the **material specifications sheets for the automotive and EEE sector**. Two PP compounds for semi-structural parts interior and/or exterior were selected and two for ABS regrinds.

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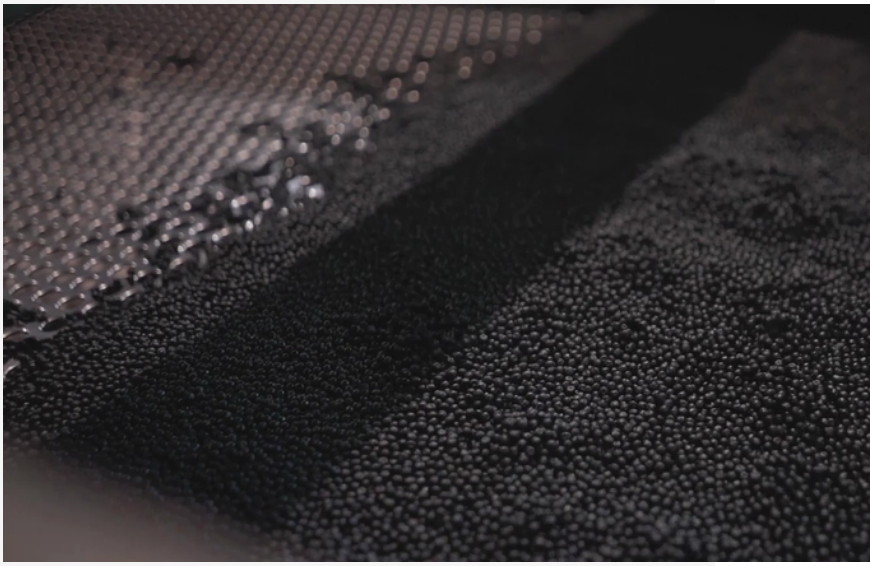
2 **Perform the compounding in order to fulfill the compliance with spec sheets requirements.**

Comet Traitements supplied large scale samples to the consortium's compounder : Seriplast.
Two tons of FPP Regrind and 2 tons of ABS Regrind were shipped to Seriplast

Seriplast adjusted the main parameters of their extrusion process equipment (feeding system, temperature gradient, throughput, others) to produce new compounds.
It was possible for Seriplast to produce a compound made of 100% recycled FPP with the main mechanical properties being attained.
This greatly surpasses the **project's objective of 40% reduction** in the use of virgin plastic for the manufacture of new products.



PROJECT - RESULTS

STEP 1

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For ABS, it was decided to target a compound made of a mix of ABS and PC (Polycarbonate) to obtain similar properties as a commercial compound used for car interior parts. Different composition were tested, with various mix of virgin vs recycled ABS.

Use of recycled ABS from Comet in combination with both virgin ABS and glass fibers was positively demonstrated.

3 **Validation of the compound compliance with spec sheet**

Seriplast carried out several analytical tests in the lab to assess the compounds' mechanical characteristics (e.g. MFI, VICAT, IZOD, Flexural Modulus, Traction Test ...). It ended up with **a full validation of the compounds compliance.**

Finally compound batches of 200 kg, were produced and shipped to CRF.

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4 **Injection molding of interior part and validation of mechanical properties**

CRF selected and produced **2 different car interior parts** :

- A **glove box** – FIAT 500 - based on FPP compounds made of Comet 100% recycled FPP regrinds
- **Speaker adaptors** based on ABS – PC – Glass fibers coumpound.

Injected part

The injection moulding process was optimized to guarantee aesthetical, functional and dimensional properties. Achieved surface quality showed to be acceptable.

Quality validated ✓

The parts were validated under **thermos-mechanical Stellantis standard procedures.** Deformations appeared to be inside the standard limits.

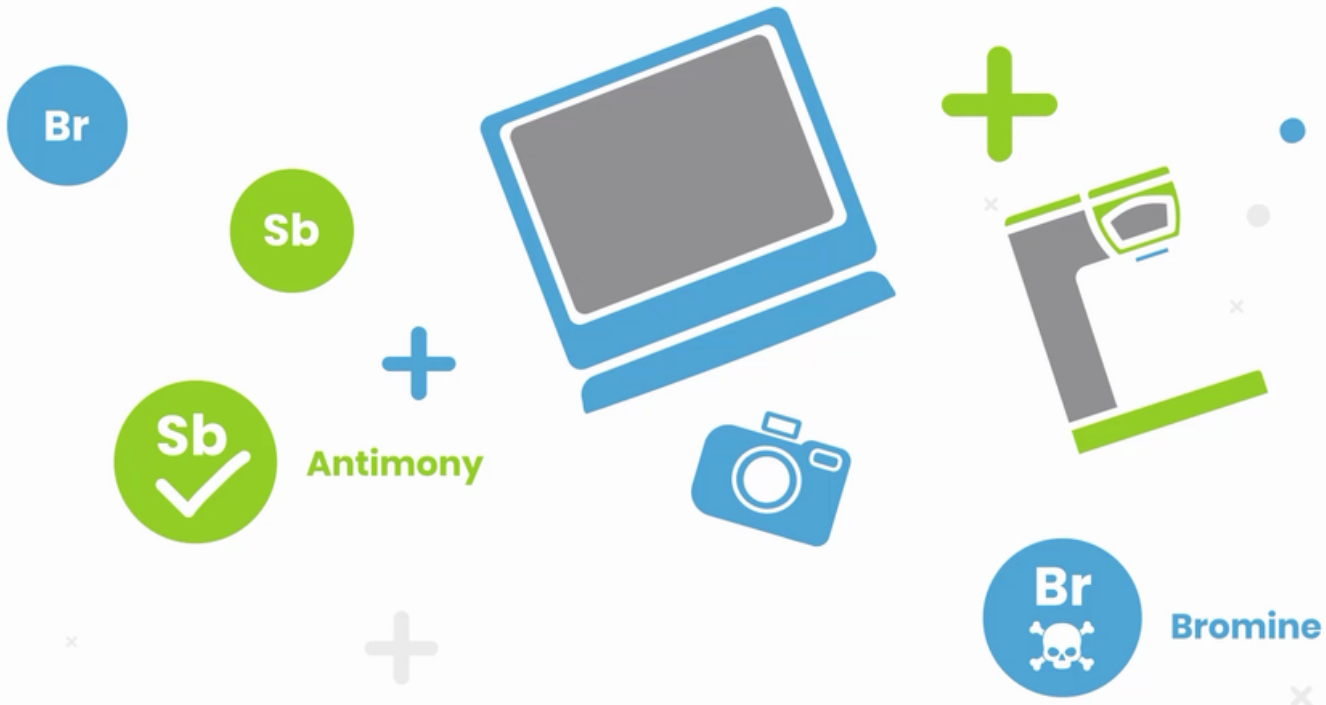
PROJECT - RESULTS

STEP 2 SENSOR BASED SORTING AND SEPARATION OF FLAME RETARDANT PLASTIC (FRP)

Extraction of Flame Retardant Plastics

In the framework of the LPP project, Université de Liège adapted the PICKIT technology, a robotic sorting line with real-time multi-sensors acquisition, to identify and extract Flame Retardant Plastics (“FRP”) containing elements such as Br and Sb by modifying its LIBS-based detection system.

Extraction of FRP was targeted on Comet’s heavy plastic fraction ‘Drainaplus’ which is the commercial name for the Comet’s non-recyclable plastics with a density over 1.08 g/cm. This plastic fraction enriched in FRP is obtained by density separation in Comet’s plastic plant.

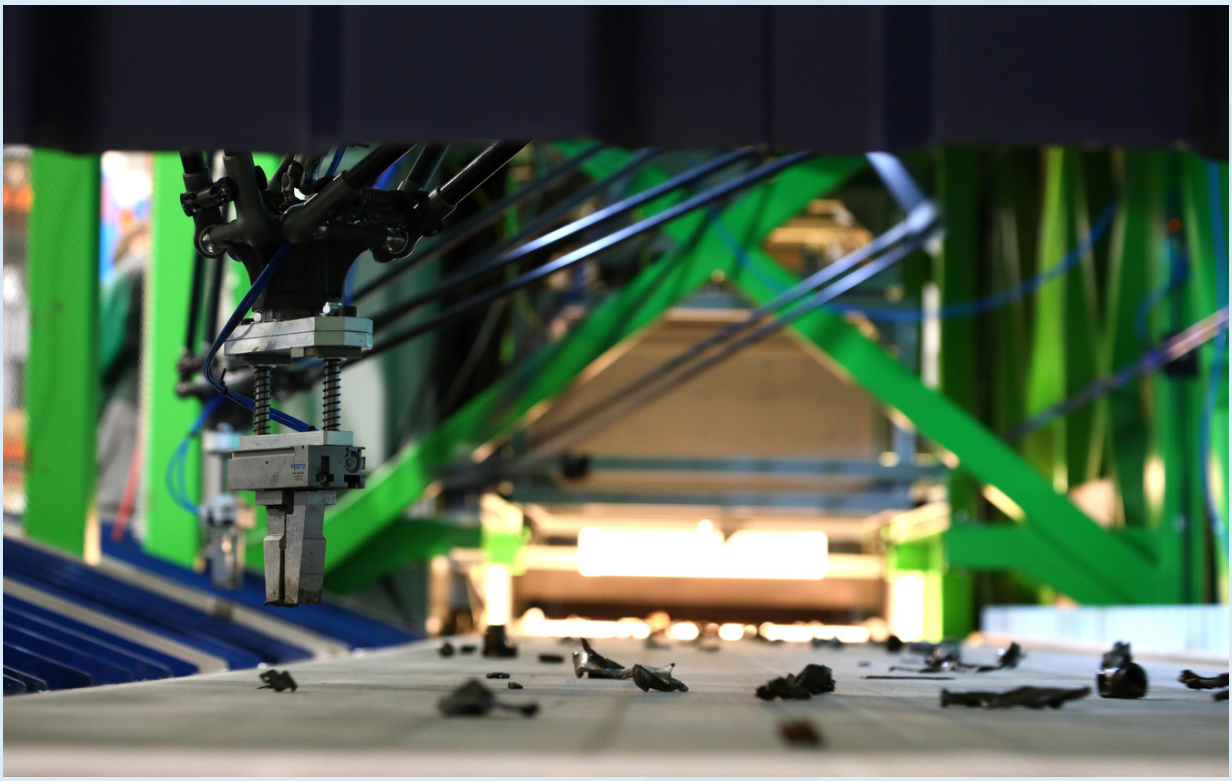


PROJECT - RESULTS

STEP 2 SENSOR BASED SORTING AND SEPARATION OF FLAME RETARDANT PLASTIC (FRP)

Extraction of Flame Retardant Plastics

The adaptation of the PICK-IT technology to plastic turned out to be much more complicated than anticipated to identify and isolate flame-retardant plastics (FRP), due to surface contamination by magnetic particles.



Industrial progress independent of LIFE PlasPLUS, resulted in the emergence of an XRF technology to separate FRP from WEEE and ELV waste plastic streams. To align itself on these new developments, the LPP partners relied on the REDWAVE XRF sorting technology. Two XRF sorting campaigns were successfully conducted in February 2021 and April 2022 to produce 1.2 tons of high-grade bearing Sb plastic.

Research activities however progressed on PICKIT, led to several findings, with potential exploitation. PICKIT system is able to differentiate and sort Printed Circuit Board (PCB) cards out of the FRP streams. PCB contains a significant amount of copper and precious metals that could be valorised.

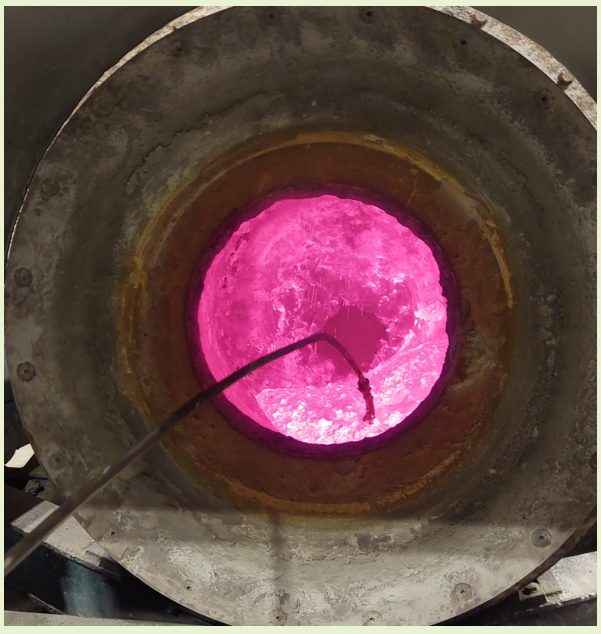
PROJECT - RESULTS

STEP 3 RECYCLING OF BY-PRODUCT ANTIMONY (SB) THROUGH CATALYTIC CONVERSION AND HYDROMETALLURGY

COM characterized and performed the catalytic conversion of FRP generated with the XRF technology through 5 lab-scale and 3 semi-industrial scale campaigns which treated a total of 1,229 kg of FRP and delivered a total of 402 kg of Sb-Char at a grade of 5% Sb.

Sb-Char produced by catalytic conversion were then processed to obtain ATO or other Sb based products for industrial applications. Two routes were developed: hydrometallurgical route (ULI) and pyrometallurgical smelting route (CAM). The last one were experimented at pilot-scale, giving 1,8 kg Sb2O3 available for the production of a flame retardant masterbatch in compliance with the expected project results.

The recovered antimony trioxide is not 100% pure as was wanted and expected. The process still needs some optimisation activities, to be planned after project end. However, the proposed pyrometallurgical route succeeded at industrial level in purifying antimony trioxide, only present in 5% - 7% in the char.



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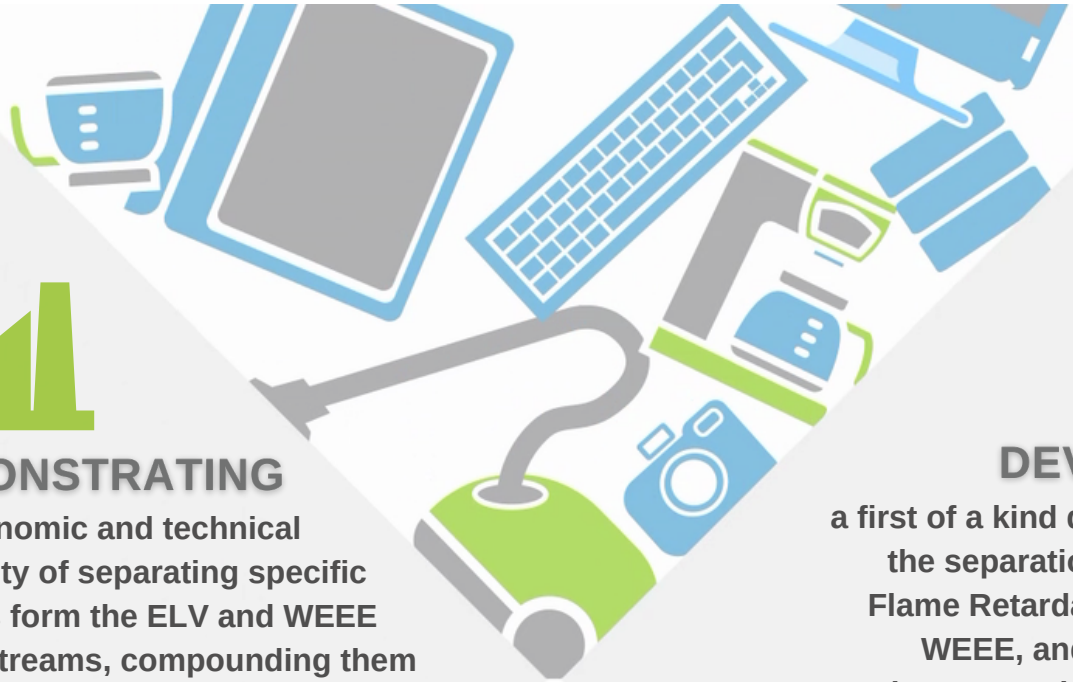
IMPACTS - INDUSTRIAL

PLASPLUS CONTRIBUTES TO THE TRANSITION TOWARDS A CIRCULAR ECONOMY, BY SUCCESSFULLY :



DEMONSTRATING

the economic and technical feasibility of separating specific plastics form the ELV and WEEE waste streams, compounding them and reinserting them into the production process instead of virgin plastics

DEVELOPPING

a first of a kind demonstration of the separation of brominated Flame Retardant Plastics from WEEE, and the recovery of antimony, a critical raw material

At the end of the project , the plastic purification unit is already in operation. With a future capacity of 50,000 tons per year of mixed plastic waste input from ELV & WEE, it will enable the production of 16,000 t/y purified thermoplastics (ABS, FPP, PS, PE/PP mix) ready to re-enter the automotive and EEE markets.

Upcyling has been demonstrated with high impact on European circular value chains

Car interior part with FPP recycled content up to 100% have been showcased : the manufactured part fulfils end user automotive requirements for the same part made of virgin resins.

It open the door to the development of circular, closed loop recycling in the automotive and EEE sector from complex plastic mixes obtained by shredding ELV and WEEE in the same recycling plant.

Demonstrated closed loop recycling fully contributes to European policies on recycling ELV. In particular to the revision of European ELV Directive, Commission proposal of July 2023, that sets objectives in recycled plastic content target of 25% in new cars. It fully fits with Life PlasPLUS strategy to upcycle thermoplastics in the automotive sector.

Replication potential is high :

The plastics which are separated at significantly higher purity rates, have a higher value in the market and 8,687 tons of purified ABS, FPP and PS have been sold to customers during project completion demonstrating its market potential. Given the very positive technical results obtained by the separation and purification unit, some existing customers have now been asking to treat their mixed thermoplastics at Comet's facilities given their inability to treat their mixed thermoplastics on their current industrial sites.

Detailled business plan of the plastic plant indicates a payback time of 4 years. The plastic purification plant is fully profitable.

As the EOL vehicle and WEEE waste streams throughout Europe propose similar characteristics, **the replicability of LPP's technology is assured.**

Upscaling the plant and replicate it in Europe is part of the after LIFE plan.

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IMPACTS

A full Life Cycle Analysis (LCA) conducted during the project enabled to quantify the PLasPLUS processes' environmental benefits. The LIFE PlasPLUS technologies contributes to :

Reduced water consumption

In comparison with virgin resin production of the same amount of thermoplastics

Reduced energy consumption

Reduced greenhouse gases emissions

90%

90 % CO2 eq. emissions reduction for the production purified secondary plastics (FPP & ABS at 98% purity, PS 95% purity) in comparison to the production of equivalent virgin resins

28,000 tons

28,000 tons CO2 emissions saved per year when the plastic production unit will run at full capacity, in 2024

5,310 tons

5,310 tons CO2 eq. emissions saved during last year operation of the plastic purification unit.

51
Sb
Antimony
121.760

Resource Depletion of minerals & metals impact

The antimony recovery routes were shown to be a very relevant development of the project, with normalised results indicating a very important potential benefit on the Resource Depletion of minerals & metals impact category

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IMPACTS

Waste management impacts

When the plastic production will run at full capacity, in 2023, 16,750 tons of recycled thermoplastics will be diverted from landfilling per year

16,750 TONS DIVERTED FROM LANDFILLING PER YEAR

Social benefits

The project has positive impact on health, as it has prevent plastic waste to be landfilled or incinerated and thereby contributing to the circularity of the EU economy.

Policy implications

LPP will contribute to the development of approaches for circular economy by waste recovery and valorisation. Plastics are an important part of European waste streams and are still largely landfilled and incinerated. As plastics can be separated more precisely and re-used with higher purity, the project will have a big impact on the following policies:

- **ELV Directive** (2000/53/EC) and its revision (2023)
- **Landfill Directive** (EU 2018/850): The project aims at diverting a wider proportion of ELV and WEEE plastics from landfill.
- **European Strategy for Plastics in a Circular Economy** (COM/2018/028 final)
- **The WEEE Directive** ((EU) 2012/19): The project tackles the problem of FRPs in the WEEE recycling stream, by enabling these components to be identified in an automated and rigorous manner.
- **EU Raw Materials Initiative** (COM/2008/0699 final): The project demonstrates a recycling route for Sb, a Critical Raw Material with a very high supply risk