



PlastiCity

Resourcing plastics from the city

WP 4 – Output 7.1 A mobile unit for plastic characterization, pre-treatment, demonstration and sensitization

Mobile Unit – Characterization, testing and demonstration

Date of finalisation of deliverable	30/04/2020 – <i>delayed until 12/2020</i>
Partner responsible for finalising deliverable	PP2
Partners that contributed to the deliverable	PP2



General description



Figure 1: Mobile unit photo

During the course of the project, a mobile plastic recycling lab, short mobile unit, was developed and is depicted on Figure 1. The mobile unit will be used to characterize, and processes collected plastic waste material during the project PlastiCity. The mobile unit consists of 2 parts the physical lab in two 40ft shipping containers (O7.1) that resulted out of Investment 1 (mobile unit – Characterisation, testing and demonstration) and the second part (O7.2) resulting out of investment 2 (Mobile unit – Advanced logistics) that will be reported on in a separate document.

This Output 7.1 report will explain the planning processes as well as the final state of the mobile unit. As planned travels of the mobile unit could not take place due to the global pandemic of the coronavirus, it is planned to provide a virtual tour of the mobile unit, directed by a professional film team. So far, the development of the pandemic rules made it not possible to film this virtual tour yet, but some amateur video material is shot and accompanying this document to give a first impression of the mobile unit in operation.

Planning

During the planning phase several option of the building a mobile recycling lab were discussed. First plans of 4 smaller shipping containers were adapted to use 2 bigger sized (40ft) containers to ensure easy transportation. This final plan can be found in Figure 2.

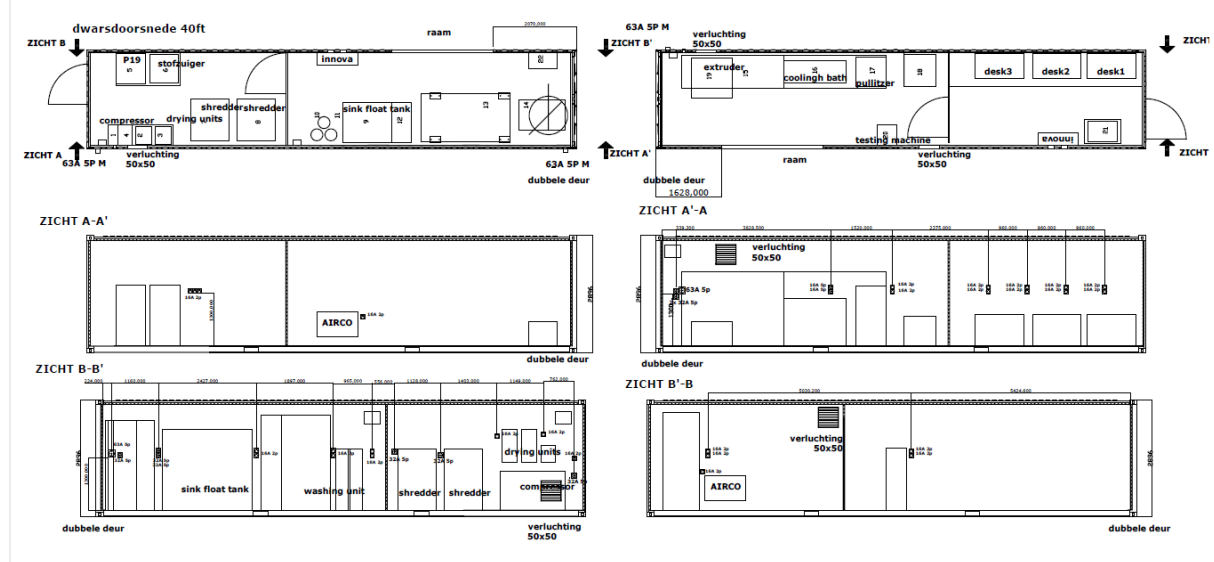


Figure 2: Final drawings of mobile unit planning phase

Nonetheless, the mobile unit is divided into 4 zones, that can be seen on the final drawing in Figure 2. Container 1 could be referred to as the “pre-treatment” container. A schematic drawing in Figure 3 gives an overview of the equipment stored in container 1.

The first zone of the container 1 comprises of a shredding and drying compartment. The size reduction of the collected plastic waste is a crucial step for further characterization, pre-treatment and processing steps. This is done with a shredder which is suitable for shredding both rigid plastics and flexible film fractions. The dryer will be used after washing steps or to dry extruded material to ensure proper storage for further testing following ISO norms.

The second zone of container 1 is contains all equipment that need water connection. Pre-treatment procedures are important in the purification of plastic waste. The main pre-treatment step is the washing of the waste plastics. Under the influence of friction, organic residues, adhesives and other contaminants are removed. Fibres such as paper are also removed during this washing procedure. For this purpose, the container 1 contains an industrial sized washing machine. Wastewater is collected in IBC containers.

The mixing of plastics during reprocessing usually leads to reduced mechanical properties of these polymer blends. Polymeric contaminants are removed using separation techniques. A simple sink-float separation step can divide the light polyolefins (L(L)DPE, HDPE and PP) from the heavier (and often more polar) plastics PET, PA, PS, PVC, ... This settling can be accelerated by using a centrifugal decanter. Here, the separation is performed under the influence of high g-forces. The centrifugal decanter is currently undergoing a maintenance step that is heavily delayed due to the corona-rules in place and is therefore currently not placed in the mobile unit but on the campus Kortrijk, where the maintenance is taking place.



Finally, the purified plastics must be dried before these can be processed and can for this purpose easily be transferred into the available dryers in the container 1.

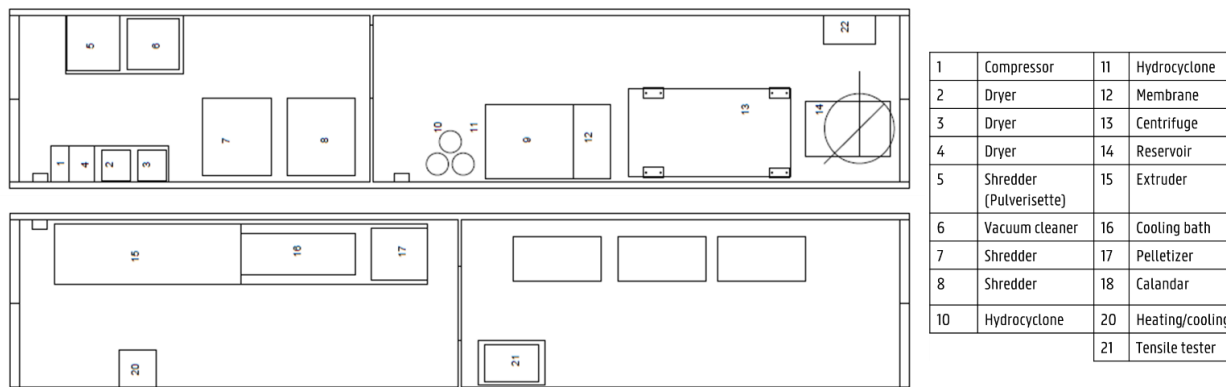


Figure 3: Schematic overview of equipment in the mobile unit

Container 2 is divided in the extrusion area and the lab/desk compartment. In the extrusion area collected waste plastics can be reprocessed after leaving the pre-treatment container. Re-melting can be realised by means of different processing techniques: injection moulding, extrusion, heat pressing, ... Extrusion is the most commonly used and again converts the plastic into uniform granules, therefore it was decided to include a state-of-the-art extruder (Labtech LE25-30/CV) with an accompanying cooling bath, calander and pelletizer in the mobile unit. During extrusion, the quality of the regranulate can be increased by degassing. The use of a melt filter can remove the last remains of higher melting polymers or non-melting contaminants such as wood and rubbers. Both techniques can be used in the mobile unit.

The desk/lab compartment was planned to house the delicate analytical equipment for characterization of plastic waste and polymeric properties. As the mobile unit will not travel at the moment due to the regulations of the global corona pandemic, most of the analytic equipment (e.g., Balances, FTIR, DSC, TGA, Tensile tester Tinus Olsen, Pulverisette, MFI) are placed for safety reasons in the laboratories of UGent. The moment that it will be possible again for the mobile unit to travel the equipment will of course travel with the mobile unit and be placed at the planned spots in the desk/lab compartment.

Location needs and transportation

Even though the mobile unit cannot travel, planning for location needs and possible transportation options have been researched as part of the work package 4 and discussed with the project partners that would have received the mobile unit in their project area. For a collection and testing cascade a concrete surface of 200 m² and space to store samples (e.g., 20ft containers) are needed. The site has also to be able to be accessed by a 40' side loader truck, see Figure 4. Furthermore, possible needed permits for e.g., water discharge or storage of waste needed to be assessed before receiving the unit. Fresh water connection and discharge of wastewater needs to be possible for operating the mobile unit. Further electrical connections of 380V/64A need to be provided. Restroom access for working



staff in the mobile unit must be provided as well.

If the mobile unit is used for demonstration purposed only, it possibly can be used on smaller locations as less storage space for different waste fractions are needed.



Figure 4: Generic image of a side loader truck that was planned to be used for transportation of the mobile unit

Stickering

As the mobile unit offers a great space for advertising the project, we partnered up with a design office to develop stickers that will be placed on the outside of the container, as to be seen in the Figure 5. Next to the logos of the project, project partners and further funding institutions these stickers are placed that explain the overall purpose of the project as well as the recycling process taking place in the containers.



Figure 5: Planned stickering of the mobile unit

Adaptions to COVID crisis

Due to travel regulations for the working staff members and further regulations in place due to the world-wide coronavirus crisis, travelling of the mobile unit to the other project regions are not possible. As current solution the mobile unit is placed on the grounds of PP2 UGent property and it is planned that collected plastic waste in the project regions will be send there to be processed in the mobile unit. The planning is frequently re-evaluated according to the changing rules.

Secondly, the use of the mobile unit to demonstrate the project's activities to a broader audience and to facilitate the collaboration between partners (e.g., research institutes and industrial partners) can at the moment not take place as planned. To overcome the lack of open days this it in planning that a professional virtual tour will be directed with the help of a professional filming team. This virtual tour can be shared via social media channels or used in further project activities that currently have to take place online (e.g., online workshops). Story boards of the planned virtual tour can be found in Figure 6.

Figure 6: Story board for planned virtual tour in the mobile unit with expert explanations.



Appendix

List of most important infrastructure and equipment bought for mobile unit.

Equipment/ Infrastructure	use
Electricity cables 5G 16 mm ²	Equipment
Submersible pump	Equipment
Vacuum cleaner	Equipment
Hoses + piping	Equipment
Tools for maintenance	Equipment
Boxes	Equipment
Compressed air system	Equipment
Cooling bath	Equipment
Electric parts for container	Infrastructure
Containers itself	Infrastructure
IBS containers	Infrastructure
Balance table	Infrastructure
Complete vented extruder LE25-30	Plastics reprocessing
Pelletizer LZ-120	Plastics reprocessing
Chill roll unit (2-roll haul off) (calander)	Plastics reprocessing
TGA with FTIR coupling	Polymer characterisation
DSC	Polymer characterisation
FT-IR	Polymer characterisation
PCs for analytical equipment	Polymer characterisation
Tensile tester	Polymer characterisation
Balances	Polymer characterisation
Thermal desorption unit	Polymer characterisation
Industrial washing machine IY 280	Pre-treatment of waste plastics
Decanter	Pre-treatment of waste plastics
Hydrocyclone	Pre-treatment of waste plastics
Universal Cutting Mill PULVERISETTE	Pre-treatment of waste plastics
Compressed air dryers	Pre-treatment of waste plastics
Central granulator	Size reduction of waste plastics
Storage cupboards	Storage
Further equipment and infrastructure	