



## PROWASTE Project

Efficient utilization of Plastic Waste through Product Design and Process Innovation

ecodesign

eco-innovation

circular economy

production process

eco-friendly products

environmental  
sustainability

## PROJECT DESCRIPTION

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The PROWASTE project regards the plastic waste recycling sector which has seen a strong increase in recent years. On the other hand, while the recycling of "pure" plastics consisting of only one type of material, is well established, there are still substantial problems for the recycling of mixed plastics which inevitably results in low recycling rates.

At the same time, the use of heterogeneous plastics for films or components is becoming increasingly popular due to the better properties of this type of plastics during their useful life. This leads to the presence of ever greater quantities of mixed plastics in the waste flows.

**Currently most post-consumer mixed plastics are destined for landfills or incineration** despite the waste hierarchy established by the Waste Framework Directive 2008/98/ EC.

Only a small percentage is mechanically recycled to produce profiles (called plastic lumber or profiles with high thickness, at least 20 mm, made 100% with recycled plastic) which are subsequently assembled to create urban and/ or outdoor furniture (benches, tables, chairs, gazebos, fences, flooring etc.). The low level of compatibility between the different polymers present in mixed plastic materials, together with the contamination from non-polymeric materials (especially paper) result in poor mechanical properties, and often lead to oversized profiles to ensure the necessary stiffness. Thus, the products obtained are heavy and not particularly attractive.

Various approaches are currently used to increase the stiffness and creep resistance of plastic lumber, for example by adding talc, calcium carbonate or wood fibers, or inserting iron bars. However, all these systems tend to further increase the weight of the product and adversely affect the processability of the plastic.

**The PROWASTE project tested the industrial application of an innovative process consisting in the introduction of glass fiber reinforcement bars in the plastic matrix during the moulding of heterogeneous plastic profiles.** The parameters of the production process and the equipment necessary for the loading of pultruded rods were defined during the scale up, conducted by the project partners, to enable industrial manufacturing.

The result is a significant improvement in the flexural strength and resistance to creep of the plastic lumbars.

## PROJECT PHASES

Intrusion is the process traditionally used to produce recycled plastic profiles: the extruder melts the polymer mixture and pumps it in a metal mould obtaining bars with poor mechanical properties. The innovative aspect of the new production method is the creation of profiles in reinforced recycled plastic by use of glass fiber pultruded rods. The parameters of the production process and the equipment necessary for the loading of pultruded rods were defined during the scale up, conducted by the project





partners, to enable industrial manufacturing. Pultruded rods are inserted inside the profiles during the extrusion phase and the developed method does not require any substantial modification to the existing plants.

To achieve the expected results of the project, the following phases have been developed:

- characterization of the mixed plastics in order to develop an optimized plastic mixture with physical and mechanical characteristics suitable for the final application;
- automation of the insertion process of reinforcing pultruded rods inside the profiles directly during the extrusion phase; to this purpose a specific equipment was designed and manufactured by MASMEC of Bari;
- redesign of the outdoor furniture elements according to the improved mechanical properties of the plastic lumber reinforced with the PROWASTE system;
- realization of two different types of benches for urban furniture.

## PROJECT RESULTS

In the PROWASTE project, a recycled reinforced heterogeneous plastic profile was created, of better quality and with superior mechanical properties compared to the analogous products already on the market. **The innovative aspect of the new production method is the creation of profiles in recycled reinforced plastic by use of glass fiber pultruded rods. Compared to the same type of profile, the flexural properties are 3 times increased, therefore, in a hypothetical cantilever beam, the maximum deformation would be reduced to a third.**

The continuous extrusion of mixed plastics was also developed within the project, given that this technology allows greater productivity than that of the intrusion. The scale up of the production led to the optimization of the continuous process and the design of a specific supply chain for the production of reinforced profiles.

The most important technical results of the project were: **implementation of a faster system for the loading of pultruded rods into the moulds, elaboration of a plastic mixture that maximizes the resistance of the final products** and design of demonstrative objects capable of highlighting the improved mechanical properties of the profiles (currently, the modified intrusion system is operational in the plant of the Spanish partner Solteco).

The estimated **cost savings** of an urban furniture (such as a bench) made with recycled plastic profiles goes from **18% to 32% compared to a similar one made of wood**. Finally, the results of the life cycle analysis have shown that the PROWASTE profiles have a lower environmental impact than traditional wooden profiles (**80% less CO2 emissions**). A comparison was also made between a PROWASTE bench and two traditional benches of the same weight in wood and metal. The analysis showed that the PROWASTE bench has a significantly lower environmental impact.

Impact categories	PROWASTE bench	Steel bench	Wooden bench
Greenhouse gas emissions	0,00082259	0,02420282	0,08356584
Ozone reduction	2,6768E-05	0,00067136	0,00306314
Soil acidification	0,00139474	0,03733224	0,11802967
Marine eutrophication	0,0004374	0,00608044	0,02153097
Toxicity to humans	0,00943711	0,28970757	0,72323913
Photochemical oxidation	0,00051388	0,01680709	0,04930051
Reduction of fossil material consumption	9,2088E-06	0,00041559	0,00081406



#### Acronym

PROWASTE

#### Number of reference

ECO/09/256120/SI2.565732

#### Reference Programme

[COMPETITIVENESS AND  
INNOVATION FRAMEWORK  
PROGRAMME \(CIP\) ECOINNOVATION](#)

#### Beneficiary Coordinator

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#### EU contribution

783.492,00

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2009

#### Start Year

2010

#### End Year

2013

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#### Region

Puglia