HORIZON 2020

Industrial scale PET chemical recycling via an innovative glycolysis process

Reporting

Project Information

ChemPET

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GARBO SRL
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Periodic Reporting for period 3 - ChemPET (Industrial scale PET chemical recycling via an innovative glycolysis process)

Reporting period: 2021-09-01 to 2023-09-30

Summary of the context and overall objectives of the project

Today, massive amounts of plastics are still used for a broad range of consumers and industrial applications.
Among these, PET represents the 7,4% of all plastics and it is mainly used for the manufacturing of

food packaging – including bottles and trays as well as films and fabrics.

The current PET recycling technologies are mainly based on mechanical recycling processes starting from PET rich collected wastes. Mechanical recycling allows to obtain a poor-quality recycled PET – mechanical recycled PET, while the input material must be highly treated and washed. Nevertheless, the obtained mechanically recycled PET is still impure and cannot be newly used for food packaging due to hygienic and safety issues.

The limits of the current PET plastics recycling methods and determine therefore serious burdens which are linked with a still poor domestic recycling capability within the European Union.

Beside the economics, most severe consequences are often related with dramatic environmental consequences like the dispersion of plastic wastes into the environment.

The ChemPET project targets actually the current recycling gap of plastics by offering a high-tech solution for the regeneration of PET polymers and turning PET wastes actually in a valuable feed stock for producing new virgin-like crPET.

This is possible thanks the production of a stable and safe intermediate – BHET, which allows exactly a new polymerization into PET. This crPET – chemically recycled PET, can be considered as a virgin polymer which is suitable even for food grade applications.

The ChemPET project aims therefore at reaching the following objectives:

1) Demonstration of medium-high scale operational condition for a ChemPET-based PET recycling plant until reaching the capability of producing 66 ton per day of BHET intermediate
2) Demonstration of plant economics and adjustment of production parameters for sustaining a large-scale production
3) Demonstration of BHET suitability as intermediate chemical commodity for the manufacturing of different crPET-made goods
4) Improve process economy as well as the capability of recovering by-products obtained from PET rich wastes
5) Establishment of stakeholder network worth for replicating the ChemPET approach at European and Global Level and aimed at showing the benefits offered by ChemPET to industry and consumers.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

As 2021, the ChemPET project faced several contingencies directly and indirectly related with the COVID-19 pandemic crisis and international markets turmoil.

The market fluctuations concerning energy, oil, and access to raw materials, including the PET rich wastes, imposed Garbo to review the previously accomplished engineering for the ChemPET plant. This implied the update of the previous plant engineering in order to reach the target performances in terms of process volumes, sizes, and yields. These are the necessary goals for ensuring an adequate process economy. The review allowed then to update the plant layout configuration, equipment specifications and technical schemes including adjusted designs and process diagrams.

The main review concerned the plant-resizing moving to 66 ton per day as BHET production target. More precisely, the scale of the plant was redefined and engineered in modules of 66 tpd capacity

each.
The license is now composed by 2 modules in order to achieve a daily output of 132 tpd of BHET in total, a size that can match with a fraction of the most common polycondensation technology facility all over the globe.
The under-scale of the first industrial plant to 66 tpd:
i. is more coherent with raw material availability, technical achievements, and expected market demand,
ii. better complies with the risks assessment because a smaller and less-complex plant is easier to build and operate,
iii. gives the opportunity to license the process in a lean way, because the modules are easily standardized and customized.

Since also the initial CAPEX foreseen for Pilot plant construction, commissioning and acceptance, adapted to today's reality, appeared totally underestimated, the erection of large-scale pilot plant at GARBO premises in Cerano could not be completed within ChemPET Project duration.
Instead, the existing pilot plant has been improved representing a remarkable technological achievement for the following reasons:
a) Technology design revised to operate in modules;
b) Technology design from batch to continuous flow;
c) Continuous feedstock waste alimentation to process quickly and lowering waste warehouses;
d) Capacity upgrade to 6 tpd of BHET produced – making the plant ready to market some niche application such as textile and high-tech fibre sector, that require lower quantity but extremely high quality;
e) Development of new proprietary equipment machinery (Glycolisys reactor & final crystallization section) tested on the upgraded pilot plant.

Garbo is pursuing a series of engagement activities aimed at reaching the key stakeholders within the value chain and continuing the contacts with future clients to pursue the future marketing accession plan for BHET sales.
Several leading chemical groups, brand owners and technology & engineering companies are interested in the Technology and its industrial potential.
On 01/03/2023, Ghirba, Garbo, CHEMPET and a "new 3rd investor" signed a binding investment Agreement for the construction of a first industrial plant at Cerano to produce RBHET and cRPET and the development and worldwide commercialization of the Technology.
Already 2 contracts have been signed with leading counterparties for Licensing of the Technology.
Furthermore, to ensure the highest protection of the R&D outcomes, GARBO/CHEMPET detain currently #6 national and international patents concerning the most relevant steps involved in the ChemPET process.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

Garbo is implementing an innovative process technology able to produce chemical recycled PET at very high efficiency - ChemPET.

The advantages brought by ChemPET relates with the possibility of using a heterogeneous mix of PET wastes, including dyed PET, which is otherwise unrecyclable at the state of the art, and limits therefore an effective circularization of the entire plastics value chain.

A major Project advancement consist in the possibility of obtaining a chemical intermediate – BHET, which can be easily polymerized in crPET – Chemical Recycled PET. BHET is completely safe, and it can be easily moved.

The obtained chemically recycled PET has purity and quality features which allow its use for food grade applications. This is currently the only technology capable of producing virgin-like crPET at very high efficiency and starting from both transparent and dyed PET wastes.

Beside the technical advancements, GARBO S.r.l. relies on a highly developed stakeholder network, active at national and European level. This further allows to immediately translate the research results into operational conditions, and to establish since now the cornerstones for a future PET circular value chain vision within the European Union.

The results from the present project are although particularly relevant to demonstrate the suitability of ChemPET approach for the PET circularization and for its following scale-up at European level.

In details, the collaboration with waste collectors is particularly relevant for ensuring the continuity of PET supply thus maintaining appropriate manufacturing volumes regardless feedstock prices volatility.

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