Method for the production of Polyhydroxyalkanoates (PHA) from organic waste at high solids content.

KEYWORDS

- ❑ BIOPOLYMERS
- ❑ POLYHYDROXY-ALKANOATES
- ❑ ORGANIC WASTE
- ❑ ACIDOGENIC FERMENTATION

AREA

- ❑ CHEMISTRY & BIOTECHNOLOGY

CONTACTS

➢ PHONE NUMBERS
+39.06.49910888
+39.06.49910855

➢ EMAIL
u_brevetti@uniroma1.it

Priority Number
n. 102018000003322 _ 07.03.2018.

Patent Type
Patent for invention.

Co-Ownership
Sapienza University of Rome 44%, "Ca Foscari" University of Venice 28%, University of Verona 28%.

Inventors
Mauro Majone, Francesco Valentino, Paolo Pavan, David Bolzonella, Federico Micolucci, Marco Gottardo.

Industrial & Commercial Reference
Waste management (also urban bio-waste) and thermoplastic biodegradable polymer production for packaging.

Time to Market
The technology is currently at pilot scale level and it could be marketable in 5-7 years, provided a further scale up is performed at a demo-scale.

Availability
Cession, Research, Develop-ment, Experimentation, Start-up and Spin-off.

Fig. 1 Representative diagram of the closed production cycle: from FORSU to biopolymers and biogas.

Fig. 2 Pilot platform at the Treviso water purification plant.

Fig. 3 Pre-treated Feedstock (on entry to the acidogenic fermenter).

Abstract
The proposed method consists of a process for the microbial synthesis of biodegradable polymers (polyhydroxyal-kanoates, PHA) from fermentable organic waste at high solids content, including the organic fraction of domestic solid waste.
The method uses mixed microbial cultures (MMC) and it is based on the combination of a biological process in three phases: a) anaerobic fermentation; b) aerobic cultivation of the mixed culture; c) aerobic production of PHA in batch.
The process involves a composite system for filtering the fermented flow, to reduce the concentration of suspended solid particles and nutrients before its use in the two following aerobic phases.

Publications

- ❖ Valentino F., Gottardo M., Micolucci F., Pavan P., Bolzonella D., Rossetti S., Majone, M., 2018. Organic fraction of municipal solid waste recovery by conversion into added-value polyhydroxyalkanoates and biogas. ACS Sustain. Chem. Eng. In press. https://doi.org/10.1021/acssuschemeng.8b03454.
- ❖ Majone M., Pavan P., Bolzonella D., Fatone F., Cecchi F., EUBCE2017 proceedings, Bioplastics and Biofuels from Urban Organic Waste. 3) Innovative bioprocesses for the organic waste valorization, Monograph BRIC-INAIL, 2017.

Method for the production of Polyhydroxyalkanoates (PHA) from organic waste at high solids content.

Technical Description

Microbial synthesis biodegradable polymers (polyhydroxyalkanoates, PHA) from organic waste at high solids content through a three-stage process: (1) acid fermentation of waste and synthesis of volatile fatty acids (VFA); (2) selection of PHA-producers mixed consortium (MMC) in sequencing aerobic reactor (SBR); (3) aerobic production of PHA in batch.

After fermentation, the process involves the separation of solid fraction from liquid fraction usable in the aerobic stages.

A first filtration reduces the solids content of the fermented stream, without interfering with the concentrations of VFA, phosphorus and nitrogen, necessary for the growth of PHA-producers consortium.

A second membrane filter is installed to completely eliminate solid particulate and to reduce the concentration of phosphorus and nitrogen, in favour of PHA synthesis.

Technologies & Advantages

The three main benefits of the mixed culture (MMC) technology are: a) contained energy demand related to the process with respect to the current PHA production process based on pure culture; b) use of low or no-cost renewable feedstock (e.g. large set of organic wastes with no competition with food chain); c) tunable polymer composition based on the requested applications (basically they have similar mechanical properties if compared to thermoplastic materials).

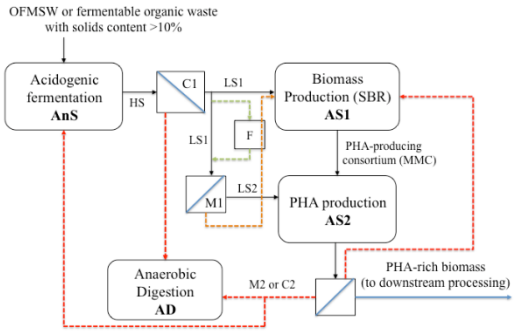

Fig. 4 Scheme of the FORSU valorisation process developed on a pilot scale.

Fig. 5 Fermented feedstock with high solids content.

Fig. 6 Feedstock fermented after the second filtration step, used in the PHA production phase.

Based on these aspects, the cost of PHA produced by MMC should be lower compared to the current PHA cost (5-6 €/kg) produced by pure culture.

This can facilitate its competitiveness in the bio-plastic market scenario. Moreover, with the particular case of the organic fraction of municipal solid waste, this technology substantially improves the economy in urban waste matter, because it prevents the costs associated to waste disposal allowing a recovery of a final value added product. Indeed, this technology sustains the concept of circular economy, since bio-wastes are recovered and converted in bio-products to be located in new market scenarios.

Applications

The patent can be applied in the frame of organic waste valorisation and new technologies that facilitate its disposal; in particular the waste management in urban areas, where the produced waste, if controlled by an efficient separate collection, has the suitable characteristics for the patent applicability: high fermentable organic content and high solids content, which are typical features of the organic fraction of municipal solid waste and municipal sewage sludge.

In the field of polymers, the areas of interest could be many depending on the physical and mechanical properties of the final product: rigid and flexible packaging, thermoplastic and durable materials, groundwater remediation sector.

CONTACTS

- PHONE NUMBERS
+39.06.49910888
+39.06.49910855

- EMAIL
u_brevetti@uniroma1.it

SAPIENZA UNIVERSITÀ DI ROMA

ASuRTT _ UFFICIO VALORIZZAZIONE E TRASFERIMENTO TECNOLOGICO
SETTORE BREVETTI E TRASFERIMENTO TECNOLOGICO
- http://uniroma1.it/ricerca/brevetti