SEPARATE
WASTE SYSTEMS

QUALITY PRODUCTS FROM WASTE THROUGH EFFICIENT WASTE SEPARATION

Co-funded by the Eco-innovation
Initiative of the European Union

THE CHALLENGE:
A HIGHER BIO-WASTE RECYCLING RATE

Bio-waste can be valorised twice: through the capture and use of the biogas emanating from anaerobic digestion (AD) and through the preparation of the organic matter into high-quality compost and fertiliser. However, despite the great potential, the recycling rates of bio-waste lag behind the steadily growing rates of material recycling. Currently, the majority of the 88 million tonnes of bio-waste that Europe produces each year is still lost through landfilling (40%) and incineration (20%).

On the practical side, the main obstacle for bio-waste recycling appears to be the difficulty of effectively separating bio-waste from other waste fractions, as well as the impurity of the organic matter which causes problems for AD.

Municipal Solid Waste
Germany

Separately collected
bio-waste UK

Separately collected
bio-waste Italy

Separately collected
bio-waste Germany

Today, there are two available options for the separation of bio-waste:

Source separation of bio-waste at household level, for which an increasing amount of schemes have been introduced, particularly in Northern Europe. While these schemes are quite successful, only a part of the bio-waste generated in Europe is currently captured, and the majority remains in the rest waste disposed by households. Moreover, in many cases the source-separated bio-waste contains impurities such as packaging, plastic bags and metals that are harmful for AD.

Centralised separation at waste treatment plants: At MBT plants, separation through shredding and sieving is the most widespread method, but its efficiency is suboptimal and the high remainder of organics in the non-organic fraction and/or non-organics in the organic fraction causes problems for both streams. AD plants operating on bio-waste mostly use pre-treatment solutions that have originally been developed for agricultural feedstocks, where the main aim of pre-treatment was to break the cell structure and increase the surface area of the feedstock by cutting and crushing in order to increase the accessibility of the sugars. Yet, cutting and crushing heterogeneous feedstocks such as mixed household waste into small pieces makes clean separation rather difficult and hinders AD. Therefore, new technologies such as the SEPARATE Waste System have been developed that can do both: enabling clean separation and ensuring access to the sugars in the organic matter.

To tap into the vast potential for reducing greenhouse gas emissions, and to drastically increase the recycling rates of bio-waste, source separation and mechanical separation schemes have to work in a complementary manner. The challenge now is to introduce eco-innovative technologies into the market that are tuned to separate bio-waste stemming from heterogeneous, mixed waste and to make it available for AD and fertiliser production.

"'bio-waste' means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants."

Directive 2008/98/EC on waste and repealing certain directives (2008)

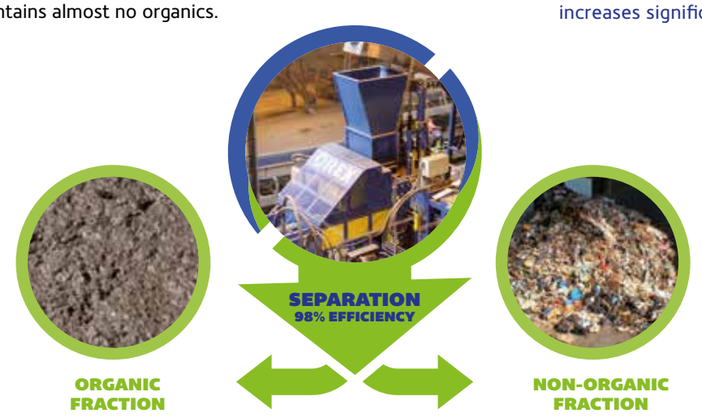
THE SOLUTION:
EFFICIENT SEPARATION OF BIO-WASTE

The SEPARATE Waste System enables the efficient separation of Municipal Solid Waste (MSW), separately collected bio-waste (SSO) and mono-streams into a very clean organic fraction and a non-organic dry rest fraction.

At the heart of the SEPARATE waste system is the innovative hydraulic OREX press that achieves an extremely high separation efficiency. The incoming waste is loaded into the press. Under the high pressure of the press, the cell structure of the soluble organic matter is broken up, the organic matter then behaves like a liquid and gets separated from the dry fraction in the form of a homogenised wet paste. This first step alone eliminates up to 98% of all inorganic impurities, depending on the feedstock. Where required, the organic fraction can then be further cleaned in a dynamic cyclone to limit any remaining impurities such as plastics and inert materials to less than 0.5% of the total organic matter. This represents an almost revolutionary 30% efficiency improvement in terms of separation and purification compared to conventional shredding and sieving solutions and results in a homogenous paste that is perfectly suitable for anaerobic digestion. The remaining fraction is dry and contains almost no organics.

KEY ADVANTAGES

Effective and clean extraction of organic matter from incoming waste streams ensures smooth operation and low maintenance costs for the digesters. Breaking up the cell structure during the pressing step results in a high biogas yield with shorter retention times. Short retention times are of economic importance as they reduce the necessary size, and hence the investment costs, for the digesters. The non-organic rest waste fraction undergoes a weight and volume reduction whereas its calorific value increases significantly.



QUALITY PRODUCTS FROM WASTE

BIOGAS
(ANAEROBIC DIGESTION)

The organic fraction undergoes anaerobic digestion to produce biogas that can be transformed into electricity and heat. Biogas can also be purified and upgraded to natural gas quality to be fed into the gas grid, be bottled as liquid gas, or used as transport fuel or process gas in power plants.

COMPOST

The digestate from the anaerobic digestion is stabilised and prepared into high-quality compost according to European Compost Network standards.

RECYCLABLES

Sorting processes before and after the separation of the organic and non-organic fraction allow optimal recycling of paper and cardboard, plastics, glass and metals.

HIGH-QUALITY RDF

The dry fraction from the SEPARATE Waste System can be easily prepared into high-quality RFD due to its minimal content of organics. It is suitable for use in RDF plants and high-temperature industries.

THE RESULTS:
ANALYSIS OF WASTE STREAMS TREATED WITH THE OREX PRESS

The SEPARATE project has analysed the quality and characteristics of the waste streams separated with the new hydraulic press with regard to the quality of the organic feedstock, methane yields and biogas potential. The results of the analysis have been certified by laboratories in the test countries. Trials have been carried out in Germany, Spain and the United Kingdom. By using 'local waste' in the trials, the results show the potential of the OREX press under real and specific local conditions.

Separately collected bio-waste

In Germany, long-term trials with separately collected bio-waste from an urban environment (City of Dortmund) and from a rural area (County of Borken) have been carried out at the location of project partner EGW in Gescher. The waste streams have been analysed by a qualified external waste analysis laboratory, certified in Germany.

• **Urban bio-waste**
After separation, the organic fraction of the bio-waste collected in Dortmund generated biogas yields ranging between 326-430 L/kg VS. The ratio of Volatile Solids/Total Solids was consistently high, with values between 57-60, and the methane content of the organic fraction varied between 52.3-55.5%.

• **Rural bio-waste**
The bio-waste originating from the separate kerb-side collection in Borken was of a different nature and contained more garden waste than that collected in the urban environment. During the long-term tests, the biogas yields of the rural organic fraction ranged between 315-502 L/kg VS and also showed a high Volatile Solids/Total Solids ratio with values between 53-58. After separation, the rural bio-waste had a methane content between 52-57%.

• **Methane evolution**
The trials indicate that the majority of readily degradable material from the urban bio-waste was converted to methane within 12-13 days, while the conversion of the material from the rural area took slightly longer, within 14-15 days.

Municipal Solid Waste

Trials with Municipal Solid Waste (MSW) were carried out with operators of waste treatment plants in Manchester and Liverpool, accompanied by a qualified external waste analysis laboratory that is certified in the UK.

In both Manchester and Liverpool, the rest waste, or so-called black bag waste, was separated into 55% non-organic dry fraction and 45% organic wet fraction by the mobile OREX test press.

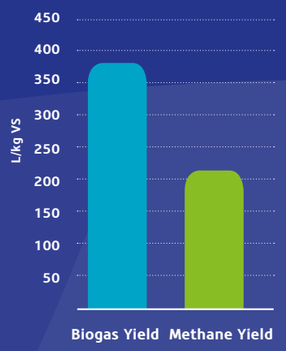
In the **non-organic fraction**, the moisture content was reduced to 37% and 41% respectively whilst the Total Solids increased to 63% and 59% respectively. The gross calorific value of the dry fractions was very high, with 16,600 kJ/kg in Manchester and 14,200 kJ/kg in Liverpool.

In the **organic wet fraction**, the Total Solids were reduced to 28.6% and 25.5% respectively. Both organic fractions were very clean, with 4.3% impurities in Manchester and 2.6% in Liverpool, and thus very suitable for anaerobic digestion.

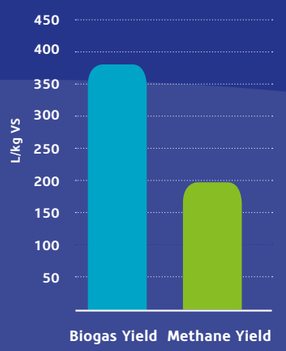
With regard to the digestibility of the organic fractions, excellent results were achieved, with very high methane yields (616 and 576 L CH4/kg VS) and biogas values, 257 m3/ton in Manchester and 231 m3/ton in Liverpool.

• **Methane evolution**
The methane evolution also shows positive effects following separation with the OREX extrusion press. For the organic fractions from both Manchester and Liverpool, the majority of readily degradable material was converted to methane on days 1-6, thus allowing a very short retention time in the digesters.

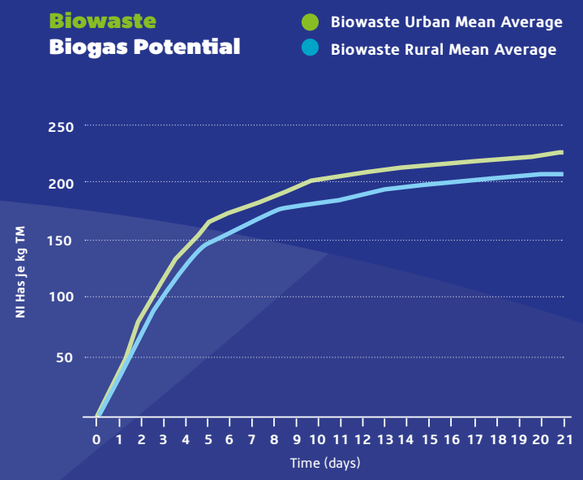
Biowaste Urban
Mean Average Biogas and Methane Yields



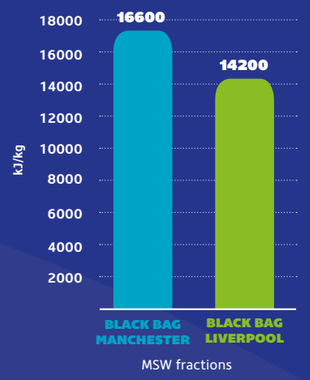
Biowaste Rural
Mean Average Biogas and Methane Yields



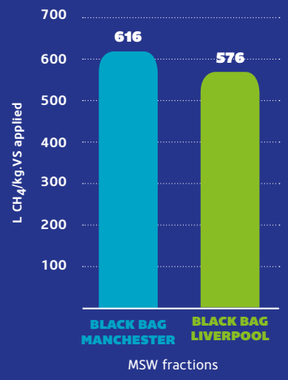
Biowaste
Biogas Potential



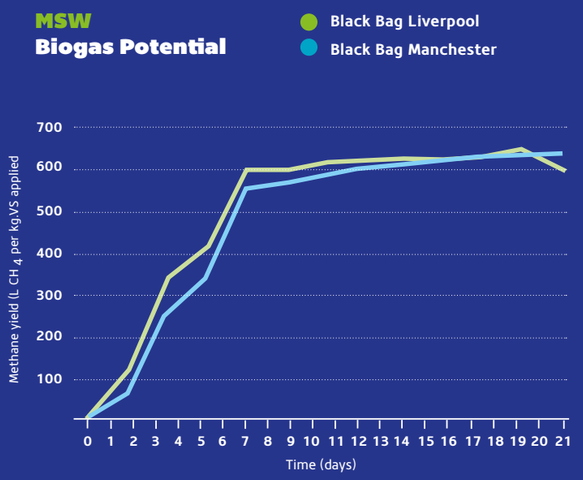
MSW Gross Calorific Value Dry fraction



MSW Methane Yield
Wet Fraction



MSW
Biogas Potential



MARKETS

The markets for efficient systems to separate and clean the organic fraction of any waste stream from non-organic materials ahead of anaerobic digestion are multiple and indeed global. They are intimately linked to the diverse markets for biogas.

A high-performing bio-waste cleaning solution can play a role in the context of different local waste management realities, and potential clients for the OREX product family come from different backgrounds and have different reasons to be interested.

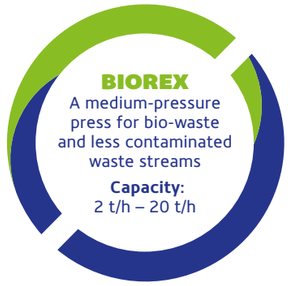
- **MBT and biogas production from mixed (rest) was**te: Operators get a high-performing organic separation technology that allows them to generate extra income from AD.
- **AD from kerbside-collected bio-waste:** Operators get a pre-treatment solution that is particularly adapted to deal with non-organic contaminants, unlike most conventional pre-treatment solutions that originate from agricultural bio-waste. Operators upgrading composting plants to AD can benefit from the OREX machines in a similar way.
- **Treatment of special waste streams, such as packaged perished food, used nappies, or mixed green and kitchen waste**: In each of the cases, separating the soluble organics from the non-organics, or the non-soluble organics in the case of green waste, has the advantage of preparing the organics for AD while drying the remaining fraction for easier onward use.
- **Diversion of the organic fraction in rest waste from incineration:** To divert bio-waste from incineration without losing the associated gate fee, operators of incinerators can look into onsite separation of organics from their incoming waste, producing biogas for their own energy use or sale to the grid and increasing the calorific value of their rest waste.
- **Electricity production for grid stabilisation in developing countries:** Waste as a feedstock for electricity production from biogas is typically available in urban concentrations where electricity demand is high. Urban-waste-to-biogas is a natural fit for the double-challenge of waste management and local grid stabilisation.

Potential of bio-waste as a feedstock for anaerobic digestion

Future market trends will be largely guided by policy. The untapped potential from bio-waste is massive. Of the 80Mt of bio-waste produced in the EU each year (150kg per person), only about 30% is separately collected and biologically treated. In lower income countries, where organic waste tends to make up a larger share of the waste mix (often more than 60%), the potential is even higher. Accordingly, the worldwide number of bio-waste anaerobic digestion plants is expected to double by 2023.

An OREX for each demand

The OREX product family comprises two different types of presses and a range of sizes. The treatment capacity depends on the size of the machines and on the density of the incoming material.



EUROPEAN IMPACT

The SEPARATE Project has made large strides toward overcoming the key barriers that prevent the market replication of bio-waste separation and cleaning systems specifically developed to deal with heterogeneous mixed waste such as MSW and separately collected bio-waste. In particular, it has raised awareness about the SEPARATE Waste System among waste experts and illustrated the added value it provides to the efficient operation of waste treatment and AD plants and the production of high quality products from waste.

Moreover, it has helped establish customer confidence by demonstrating the results of separating and cleaning local waste streams with the SEPARATE Waste System and having the results analysed by locally certified laboratories.

Significant environmental impacts result from capturing the methane gas emanating from organic waste and transforming it into precious renewable biogas which in turn can replace more polluting energy carriers. Diverting organic waste from landfilling and incineration also keeps valuable organic matter in the biogenic cycle, in line with circular concepts.

PROJECT OUTCOME

- Trials with municipal solid waste and separately collected bio-waste in Germany, the United Kingdom and Spain
- Analysis of the quality and biogas potential of the organic fraction stemming from different waste streams
- Presentation of the trial results at 2 workshops in the United Kingdom and a conference in Germany
- 30 country profiles to gain a better understanding of country specificities with regard to waste composition, waste treatment and legal frameworks Strategies to focus activities in the most suitable European markets for the SEPARATE Waste System
- Export strategy for markets beyond Europe
- 15 one-on-one meetings with waste operators and project developers
- 20 visits to the site where the long-term trials with the SEPARATE Waste System took place
- 6 exhibitions and presentations at major waste conferences in Germany, France, the United Kingdom and the Netherlands
- Establishment of own analytical capabilities
- A SEPARATE unit to carry out trials with local waste at the premises of potential clients
- A short video illustrating the functioning of the SEPARATE Waste System.

Partners:

www.separate-wastesystems.eu

SEPARATE stands for "Enabling market uptake of innovative separation and cleaning solutions for material recycling of all product groups contained in bio-wastes and MSW". The European eco-innovation project aimed to support the market entry of an innovative separation and cleaning technology that separates organics from non-organic waste with an efficiency of more than 98%. The SEPARATE project carried out on-the-spot trials of different waste streams and analysed the quality and characteristics of the waste streams that have been separated with the new technology. The results of the analysis were produced by certified laboratories in the trial countries.

CONTACT

Astrid Severin (astrid.severin@greenovate.eu)
Karl Dirkes (k.dirkes@dbtechnologiesbv.nl)

Co-funded by the Eco-innovation Initiative of the European Union