



ECONWARD TECH

vegware™ 

TRIALLING COMPOSTABLE PACKAGING IN FOOD WASTE Optimising Anaerobic Digestion with Thermal Hydrolysis

Depackaging – a missed (biogas) potential

Anaerobic digestion professionals often see compostable packaging as an operational challenge. Collecting food waste in conventional plastic risks polluting any resulting fertiliser, but many compostable materials are not optimised for inclusion in wet AD. Depackaging means that AD operators miss out on the biogas potential represented by the material they are forced to dispose of at great cost.

Packaging materials in Biomak® Thermal Hydrolysis

Engineering firm ECONWARD has created an AD pre-treatment technology called Biomak®. This patented thermal hydrolysis process breaks down biodegradable materials to make them more accessible for the AD process.

Biomak® equipment uses semi-continuous pressure and temperature in 20-minute cycles to change the physical and chemical properties of the waste. This homogenises, hygienises and degrades the organic material, delivering an efficient energy and material recycling to produce both a high-quality biogas, and a compost resulting from the digestate (meeting compost quality class B, the second highest class according to Spain's fertilizer products Royal Decree 999/2017).

- **Physical degradation** reduces particle size, providing an optimal separation of non-organic materials.
- **Chemical degradation** transforms the organic waste into a new material with multiple potential uses, especially biogas production.

Testing compostable material

Econward have a Biomak® industrial scale plant in Madrid, capable of treating 8 tonnes of waste per hour. In 2023, compostable packaging company Vegware provided foodservice disposables for testing through this system.

Vegware sent a wide variety of products representing a range of compostable plant-based materials:

- Compostable polymer items: clear PLA water cups and deli containers, CPLA coffee cup lids, clear PLA film windows in sandwich boxes
- Fibre items: moulded sugarcane fibre plates and takeaway boxes, PLA-lined paper cups and soup containers



Trial summary

- Biomak® thermal hydrolysis degraded and blended all the Vegware compostable packaging mixed in with food waste, creating a homogenous and degraded substrate ideal for AD.
- The substrate became a homogenous pumpable material which included the blended-in compostable packaging. Therefore the packaging would not later be separated and rejected at a depackaging or separation stage.
- The substrate has a higher energy yield due to the additional compostable material and its high biomethane potential that is unlocked through the thermal hydrolysis pre-treatment.



Trial data

- Feedstock: source segregated food waste (92.5% food waste, 3% compostable bags, 4.5% compostable packaging) – on a weight basis. Total Solids / dry matter = 27%
- This feedstock was divided into three samples, to test at distinct pressures and temperatures:
 - o Sample W1: 70kg raw untreated
 - o Sample W2: 70kg, processed with TH at 150°C 4 barg for 30mins
 - o Sample W3: 70kg processed with TH at 130°C 2.5 barg for 30mins
- All 3 samples were further diluted to a 10% TS to be fed into a semi-continuous low solids reactor. Dilution for W1 was done with water; W2 and W3 used the liquid condensates produced by the TH process.
- 5-litre reactors were fed with the three different substrates (W1, W2, W3) to measure AD process stability and biogas/biomethane production during 50 days.

Results

Physical and chemical degradation:

- High homogenization of the waste stream. Full integration of the compostable bags and packaging with the food waste fraction. No bags or packaging can be distinguished amongst the substrate. Food waste fraction also highly degraded into a homogenous slurry.
- Reducing generation of waste rejects; improved separation efficiency of screening equipment.
- Improved pumpability of the substrate. This enhances AD operation and reduces mechanical wear of equipment.

Increased energy yield from Thermal Hydrolysis

- Average biomethane production results from samples W2 and W3 demonstrate increased biomethane compared to sample W1 which did not undergo thermal hydrolysis:

Sample	Test conditions	Biomethane (L CH ₄ /kg COD)	Biomethane (L CH ₄ / kg VS)
W1	No thermal hydrolysis (TH)	230	266
W2	TH at 150°C; 4 barg; 30mins	454	392
W3	TH at 130°C; 2.5 barg; 30mins	532	444
W0	Control sample: food waste only, no thermal hydrolysis	227	250

Digestate

- No particles of packaging or compostable materials physically detectable in the digestate resulting from the semicontinuous operation. The output would be PAS110 compliant.

Conclusions

Based on Econward's trials, we conclude that Biomak® thermal hydrolysis pre-treatment offers the following benefits for food waste AD operators:

- Ability to safely accept liners and packaging made from compostable polymer and fibre-based materials, mixed in with the food waste. This does not alter the process stability or operation of the plant, but it will enhance its performance.
- Increase energy production, as well as benefitting from the biogas created by the compostable packaging materials now able to enter the AD process.
- Reduce reject material disposal costs from screening and depackaging stages.

At a time when food waste feedstock is scarce and compostable materials are ever more present as a substitute for fossil fuel plastics, AD operators can unlock a new source of energy for AD through innovative pre-treatment technology like Biomak®.



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