

NOWON SYSTEM AND BIOMAK® SUPPLY

ECONWARD provides technology that transforms solid waste into a variety of value-added products, such as with verified environmental, economic, and social benefits.

The NOWON System pivots around Econward's patented continuous autoclave technology designed for the treatment of solid waste. After the organic waste is collected or received at the facility receiving pit, the organic fraction is captured from the waste stream to produce biogas, that can be either upgraded to biomethane or combusted for electricity production.

NOWON SYSTEM

MATERIAL INPUT AND PRE-SEPARATION PROCESS

The NOWON System process begins once Municipal Solid Waste (MSW), or highly contaminated Source Separated Organics is delivered to the receiving hall.

The acceptable incoming waste material is first transferred via crane or wheel loader to a screen to ensure the particle size is less than 5,12 inches. The waste is then conveyed under a magnet to extract the metal elements, and then sent to an infeed storage bunker. This pretreatment process of screening and metal removal is provided to optimize the transformation process, but the procedures can be modified (or not included) as necessary depending on the composition of the incoming waste stream and scope of project.

After this pre-separation process, the pre-processed material is conveyed to the infeed hopper at the top of the BIOMAK®.

BIOMAK®

The BIOMAK® processing system is made up of 4 autoclaves connected in series by hydraulic valves, inside which, by means of mechanized movements and under certain conditions of pressure, temperature and residence time, the residue is subjected to thermal hydrolysis reaching a treatment capacity of 8 tons / hour. This process is semi-continuous and fully automated, in which saturated steam is used to adjust and maintain the operating conditions of the treatment.

This system is composed of:

- 1 Inlet Chamber
- 1 Reactor

- 1 Transit Chamber
- 1 Outlet chamber

Through the infeed hopper, the waste enters the Inlet Chamber and is adjusted to the established treatment parameters. Once the optimal conditions are reached, the material is transported to the Reactor and the Transit Chamber where the thermal hydrolysis process takes place. After this process, the material continues towards the Outlet Chamber, where the depressurization process occurs. The steam used is condensed in a vacuum system, where it is partially recovered to preheat the boiler water and is finally condensed using water from the cooling tower. The wastewater generated can be reused to optimize the substrate. Both the vacuum system and the cooling tower are additional equipment that are included in this offer.

The raw biomass leaves the discharge chamber completely homogenized thanks to the quality of the thermal hydrolysis process; so, if a post-treatment is required, the separation operations are much more efficient.

The total duration of the process is 20 minutes. After that, a hygienic, homogeneous, and chemically degraded biomass is obtained, whose excellent characteristics allow it to be used as a substrate in Anaerobic Digestion processes with high added value.

ECONWARD has designed the hydrolysis process to operate as a dual-line system (two modular autoclave units). The core treatment process consists of the following equipment:

- Two (2) Hydrolysis Systems with a capacity of 8 metric tons per hour each
- Support Boiler and Heat Exchanger for process heat and steam generation
- Vacuum System for steam condensation
- Cooling System to maintain process water temperature and circulation.

During the thermal hydrolysis process, waste is transformed into a hydrolyzed biomass that optimizes the input conditions to other treatment processes, due to the following distinctive characteristics:

- Sanitized, free of pathogens because of the process temperature conditions.
- Homogeneous, due to the movement of the material inside the chambers.
- Thermally and biologically stabilized, odor free.
- Physically and chemically degraded as a result of thermal hydrolysis under pressure.

The **NOWON SYSTEM®** process works as a capture of the organic fraction of solid waste to Anaerobic Digestion systems and generates multiple benefits:

- **Enable biogas production** from highly contaminated source separated organics or municipal solid waste.
- **High quality biogas** with a high methane content (between 65 and 70%). Regarding impurities or contaminants, no chemical or reagent additives are required to maintain the pH or to reduce hydrogen sulphide, which gives the process robustness and stability.
- **Process stability** and robustness eliminating pathogens, biocides and antibiotics which might produce acidification or inhibitions in the system providing greater stability.
- **High biodegradability**, between 75 and 90% of the total solids that are sent to the digesters.
- **Low residence time** in the digester between 15 and 20 days, whereas, in the standard anaerobic digestion, the times are between 25 and 30 days.
- **Substrate with high organic content.** The residue undergoes a disintegration process during thermal hydrolysis that affects its physical properties. This contributes to the more efficient separation of improper particles, minimizing the loss of organic matter. This, added to the previous benefits, means that the net biogas production of a biomethanation plant is considerably increased.
- **Better quality of the digestate.** A substrate with a lower content of ammonia nitrogen and free of pathogens is obtained, without using additional equipment (pasteurizer).
- **Energy self-consumption**, for an installation that valorizes biogas in cogeneration engines, the electricity demand of BIOMAK® represents less than 1% of the plant's electricity production. For its part, thermal demand accounts for 89% of the heat recovered at high temperatures from the combustion gases.
- **Odor reduction** produced in a conventional plant during storage.
- **Carbon footprint reduction.** When comparing the biomethanation process of the organic waste hydrolyzed by BIOMAK® and the recovery of biogas, with the shipment to landfill and the production of electricity with natural gas, the generation of 12,000 tons of CO₂ / year, equivalent to the safeguarding 3,400 ha of forest for every 60,000 tons treated.

POSTTREATMENT ORGANIC SEPARATION PROCESS

The sanitized material exiting the final chamber of the autoclave system has a high organic matter content that is contingent on the composition of the incoming waste. Depending on the project criteria, this treated material can be further refined to increase the purity level of the organic content. ECONWARD has an organic separation process to remove large particles and contaminates. The additional material screening and separation procedures ensure a final homogenized biomass product with a high-organic matter content of 98%.

The two-phase process is designed to efficiently separate and recover the organic matter, free of impurities, and with the least associated cost, both in energy and maintenance. The first phase process will separate the organic fraction from textile, plastic, and other light weight contaminants. The second wet phase process will separate metal, glass, and other inert contaminants.

The post-treatment organic separation system is provided to remove the percentage of impurities remaining in the treated biomass product. The organic separation system is designed to provide a final biomass product with an organic matter content of approximately 98%. This high-organic content biomass will ensure optimal operating conditions within anaerobic digestion systems and maximize biogas generation.

AUXILIARY SYSTEMS AND PROCESS AUTOMATION

As indicated above the core hydrolysis process includes the following auxiliary equipment, boiler, heat exchanger, vacuum, cooling, and wastewater treatment system. ECONWARD has designed the entire system and auxiliary equipment to be linked by a supervisory control and data acquisition system for complete process automation. The system can monitor and control all the process parameters by customized software which provides real-time information from each progressive step of the process. It can be easily integrated into any processing facility to link the hydrolysis process with existing operations. The control system allows for continuous monitoring of the material treatment process to optimize energy consumption, water recovery, waste reduction, and ensure safe and efficient operations.

INTEGRATION OF TREATMENT SYSTEM WITH BALANCE OF PLANT AND OPERATIONS

An integrated treatment and anaerobic digestion facility can be designed with a variety of system processing components. As identified below, the following operational components have been included in the conceptual layout.

Anaerobic Digestion Operations:

- Posttreatment Organic Separation Systems to increase organic matter content
- Anaerobic Digestion System to process organic matter and generate biogas
- Biogas Recovery System for production of electrical and thermal energy
- Solid Product Recovery System residue and solid digestate



BIOMAK[®] INTEGRATION INTO AN EXISTING OPERATION

BIOMAK[®] MANUFACTURING TRANSPORTATION, ASSEMBLY, TESTING AND COMMISSIONING

BIOMAK[®] MANUFACTURING

The manufacturing period includes the time range between Day 1 (LC opening notification) and the moment when the equipment is ready to be sent to The Client. Throughout this period, The Client may schedule site visits with ECONWARD to be informed about the manufacturing status. For this purpose, ECONWARD will appoint a project manager who will maintain a constant and regular communication with The Client to inform about the whole process. This will be extended throughout the whole period of assembly and commissioning.

Furthermore, ECONWARD will collaborate with the engineering company designated by The Client for the correct integration of the BIOMAK[®] in its facilities, if needed. The estimated time of the manufacturing phase from Day1 to the beginning of the assembly phase (arrival of the equipment at the plant) is thirty-eight (38) weeks approximately.

DELIVERY TIME

At the end of each milestone, an approval record will be sent where The Client agrees or disagrees by observations.

The milestone will be considered fulfilled once ECONWARD and The Client have signed the approval act to proceed with the payment of the corresponding milestone.

The deadlines may be modified in the event of unforeseen circumstances or force majeure as detailed in the contract to be concluded.

TRANSPORT AND LOGISTICS

ECONWARD includes in its proposal the BIOMAK[®] loading and unloading at The Client premises. **ECONWARD** will perform the agreed services, but without incurring penalties for delays during customs clearance services at the destination port.

Unloading will take place during the opening hours of the plant, by prior agreement with The Client.

ASSEMBLY

ECONWARD will carry out the assembly of the BIOMAK[®] and will ensure correct compliance with the assembly specifications to guarantee its proper functioning. For this purpose, **ECONWARD** will send the necessary team for such work, and will bear the necessary expenses for this purpose.

The Client shall be responsible for the supply of electricity, water, compressed air and other necessary supplies on site for its execution, and they must be available before starting the assembly works.

The Client provides **ECONWARD** with the site and the required civil works, including authorizations and permits for such assembly.

TESTING AND COMMISSIONING

Technical assistance will be provided by the appropriate technical personnel for this purpose, once the assembly of the equipment has been completed, with a maximum delay period of two (2) weeks.

The consumables necessary for the commissioning, such as natural gas, electricity, or any other necessary, will be at the expense of The Client.

The estimated commissioning time is eight (8) weeks. During this period, tests will be performed at 50%, 75% and 100% of nominal speed.

BIOMAK® OPERATION, TECHNICAL TRAINING AND MAINTENANCE

BIOMAK® OPERATION

The operation of the BIOMAK® will be carried out by ECONWARD during the first fourteen (14) weeks from the end of the commissioning and will be carried out by specialized personnel.

TECHNICAL TRAINING FOR STAFF MEMBERS

From the moment the BIOMAK® is commissioned by ECONWARD, the specialized personnel will offer a complete technical training to The Client's plant personnel for the subsequent handover of the installation. At the end of this period, The Client's personnel will have received the training that will enable them to operate the BIOMAK®. Even so, ECONWARD will support The Client with a specialized operations manager during the following forty (40) weeks.

COMPREHENSIVE MAINTENANCE AND MONITORING PLAN

ECONWARD will carry out the integral maintenance of the BIOMAK® during the first year of operation free of charge.

For this purpose, the following periodic inspections will be carried out: Inspections without plant shutdown: every week.

Inspections prior to BIOMAK® shutdowns: every six (6) months.

Inspections with BIOMAK® shutdowns: every six (6) months, and can be done during plant shutdown periods so as not to affect production.

AFTER SALES SERVICE

After the expiration of the period of free maintenance at ECONWARD's expense, The Client may contract with ECONWARD an additional maintenance service throughout the useful life of the equipment.