

ECOPARC 2 / MONTCADA - VALORGA
ANAEROBIC DIGESTION FACILITY (SPAIN)

Friday, October 15

Facility Name: Ecoparc 2 / Montcada - Valorga Anaerobic Digestion facility

Location: Barcelona, Spain The Ecoparc 2 (Ecoparc Montcada) is located in Montcada y Reixac, north of Barcelona, in a commercial/light industrial estate. The facility site is 24 acres and was designed to minimize visual impact. The Ecoparc is solid waste processing facility that includes process units such as: sorting, and screening units that recover recyclable materials, compost unit, and power generation unit.

Startup date: The facility has been operating since 2003, but the Valorga anaerobic digestion facility started operations on March 2004, which produces methane.

Conversion Technology: Biological Anaerobic Digestion Facility

Conversion Technology Supplier: Valorga International S.A.S.

Definition: Anaerobic Digestion Facility - Biological and chemical conversion technologies are focused on the conversion of organics in MSW. MSW consists of dry matter and moisture. The dry matter further consists of organics (i.e. whose molecules are carbon-based), and minerals (also referred to as the ash fraction). The organics can be further subdivided into biodegradables or refractory organics (for example food waste) and non-biodegradables (for example plastics). Biological technologies can only convert biodegradables, while chemical processes can potentially convert any organics.

Process Description: In anaerobic digestion (AD), biodegradable material is converted by a series of bacteria groups into methane and carbon dioxide (CO₂). A first group breaks down large organic molecules into small units like sugar; this step is referred to as hydrolysis. Another group of bacteria converts the resulting smaller molecules into volatile fatty acids, mainly acetate, but also hydrogen (H₂) and CO₂; this process is called acidification. The last group of bacteria, the methane producers or methanogens, produce biogas (methane and CO₂) from the acetate and hydrogen and CO₂. This biogas is a medium-Btu gas containing 50 to 70% methane. Anaerobic digestion has been used for over a century to process sewage biosolids. If the MSW feed is processed in the solid phase, AD is often referred to as *anaerobic composting*. The biogas produced can be used on site to generate electricity and heat using a generator (reciprocating engine, microturbine, conventional turbine, etc.). If a nearby industrial user exists, the biogas can be conveyed over short distances for such uses as boiler fuel. The biogas can also be purified extensively (dehydrating, H₂S removal) to pipeline quality and pressurized, for example to be used as compressed natural gas (CNG), a safe and clean vehicular fuel. Biogas can also be converted into methanol and/or used in fuel cells.



Technical Meeting and Facility Tour with: Marc Vinot, facility designer and start-up engineer, Valorga S.A.S.

Owner/Operator: City/EBESA (Urbaser, Fomento, TIRSSA, TERSA). The City of Barcelona owns the Ecoparc, including the Valorga facility. The City selected a builder-operator who hired constructors and set up an operating company for the Ecoparc (EBESA). Valorga generally limits itself to design, construction, and startup operations.

Feedstock: Mixed MSW (presumably after collection of recyclables) and source-separated biowaste from Barcelona; the city has 2 million residents; the metropolitan area has approximately 3.5 million residents, generating over 1.6 million tons of MSW per year.

Throughput: The facility full capacity is of 265,000 tpy (approximately 1000 tpd, 25 percent of the MSW generated in the City of Los Angeles, 1.0 million tons/yr), of which only 24,000 tpy is source-separated biowaste. The Valorga section processes approximately 130,000 tpy.

Technology Description (Ecoparc): The MSW is thoroughly pre-processed for the removal of all recyclable materials before processing the organic residual in the anaerobic digestion using the Valorga process. The pre-processing includes:

- Various typical screening and sorting devices, such as magnetic separators, air suction devices to remove film plastics in a falling material stream, etc.
- Several manual picking lines operating in parallel, for the mixed waste;
- A trommel with 6-inch openings, followed by a 2.4-inch mesh trommel. The trommels contain cutting blades to rip open plastic bags.

Knowing the composition of the incoming waste is of great importance to the Ecoparc operators, so the Ecoparc performs a detailed waste characterization twice a week, picking apart a significant composite sample of waste. Mr. Vinot mentioned that he

encounters materials handling problems when the glass content reaches 40% and large panes of glass make it into the digesters, because they tend to accumulate in the digesters.

Approximately 45% of the incoming solid waste is rejected, including unopened bags amounting to 4.5 % of the total input. Various recyclables are recovered, amounting to an additional 5% of total input. The remaining 50% of total input goes to the digesters, to be biogasified. The dewatered effluent of the digesters is further screened, yielding additional rejects amounting to 8% of plant input. The remaining 42% are either biogasified or converted to compost, which is marketed in its entirety. So, for 100 tons entering the Ecoparc,

- 45 tons are rejected in pre-processing;
- 5 tons are recycled;
- 8 tons are rejected in post-processing; and
- 42 tons are converted to biogas and compost.



Wrapped reject bales ready for the landfill; unwrapped bales to the right

The rejects are baled and the bales wrapped before going to the landfill. This allows for a space-saving balefill.

Technology Description (Valorga): The Valorga digesters are cylindrical; they have a partition running from one wall across the center towards the opposite wall, extending over approximately 2/3 of the diameter. MSW feed is introduced on one side of the partition and is removed from a port on the other side, to ensure a minimum residence time in the digester. During their transit, the contents are mixed via pulsed injections of pressurized biogas.

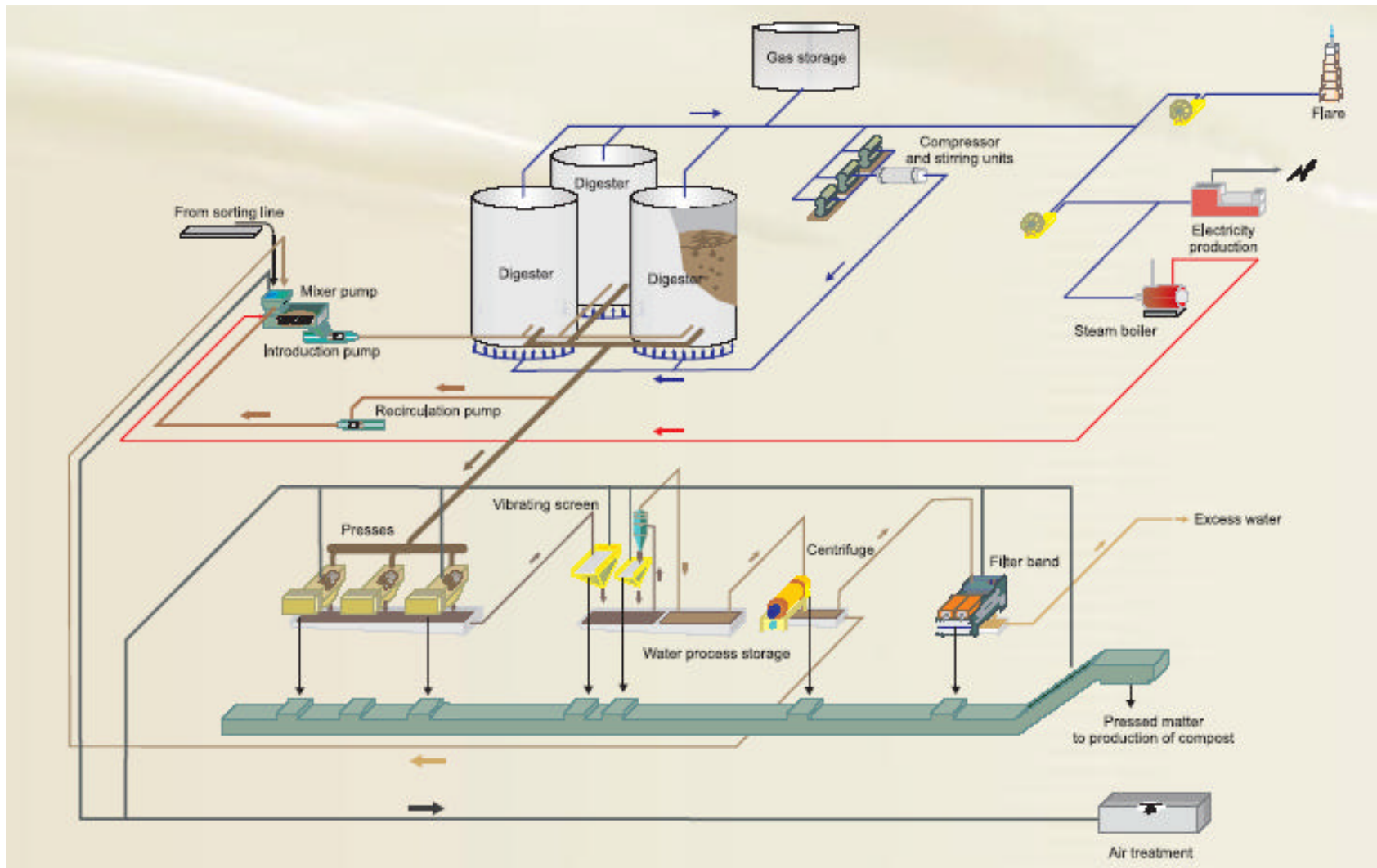


All three Anaerobic Digesters (Valorga Unique Technology)

Ecoparc Montcada control room

In Barcelona the digester temperature is 100 °F (mesophilic range); the digesters could operate in the thermophilic range (130⁺°F) without significant modifications. There are 3 digesters, each approximately 54 ft in diameter and 75 ft high. They are fed once a day; this takes a few hours; the retention time is approximately 30 days. A side stream of biogas is compressed to 5 atmospheres and injected in brief pulses from the bottom of the digester to mix the contents. The bottom of each digester has approximately 200 gas injection points.

In anaerobic digestion of solids, moisture management is very important. In this case, the effluent from the digester is dewatered in a set of parallel screw presses; the filtrate from the screw presses is further treated in two centrifuges in series, with polymer injection between the two stages. The combined liquid recovered from the screw presses and the centrifuges is used partially for feed dilution, and the remainder is discharged as wastewater. The wastewater undergoes chemical/physical treatment followed by nitrification/denitrification.



Valorga Barcelona process flow overview



Filtrate centrifuges; screw presses are in the background

All recovered solids (press cake and centrifuge solids) go to aerobic composting, which is conducted in 17 enclosed tunnel composters; the compost is maintained at 104 °F for a residence time of 2 weeks. Mr. Vinot explained that this aerobic post-treatment step is necessary to guarantee overall organic stabilization, since the digester allows some short-circuiting (some digester feed spends only a short time in the digester, so it is only partially treated). After the 2-week aerobic treatment, the compost is post-processed, including screening and separation steps, and the finished compost is marketed.



Finished compost

The finished compost has an attractive appearance, without extraneous or colorful objects or particles. Upon close observation, one can find many gray film plastic particles in the ¼-inch range. These should not interfere with agricultural application.



Finished compost, close-up

The digester feed has approximately 55 to 58 % dry matter. It is diluted with recycled filtrate to 40% dry matter. Steam is also injected into the feed to heat it to digester temperature.

Biogas production amounts to 5600 scf per ton of feed. The gas contains 65% methane and 35% CO₂; it also contains 2000 to 3000 ppm of hydrogen sulfide, which is unusually high for MSW-derived biogas. The biogas is biologically desulfurized to 200 ppm H₂S. The treated gas is conveyed to a process steam boiler and to diesel generators via blowers. A side stream is recirculated and compressed for pulse injection. Biogas that isn't used in the boiler is converted to electricity; the plant typically produces 4 MW. The entire electrical output is sold to the grid, none is used in-plant, and all plant power is purchased from the grid. This is more profitable than using the power they generate, because of the high rates at which they can sell the power, due to green energy incentives.



Diesel generators fueled with biogas

Other than the digesters themselves, the entire facility is enclosed and kept at negative pressure. The air handling system is conservatively oversized and has a design capacity of 18 million cu ft per hour. The extracted air is treated by a succession of acid scrubbing, alkaline scrubbing, and biofiltration in a peat biofilter.

Products (Valorga facility): Medium-Btu gas (510 million scf/year or approximately 700 MMBtu/day), used for electricity production.

Byproducts: Compost and recycled materials.