BRECHT II DRANCO –

ANAEROBIC DIGESTION FACILITY (Belgium)

Monday, October 18

Facility: Brecht II DRANCO (Dry Anaerobic Composting) Plant.

Location/Site:. The OWS Brecht II DRANCO plant is located North of Antwerp in outside the City of Brecht, Belgium, which is surrounded by farmland within a one-mile radius. The plant started operating in 2000 and it is part of a site that includes a landfill and a windrow composting operation. Brecht I was its smaller predecessor. It is presently closed but the owner intends to reopen it for service soon.

Feedstock: Biowaste (source-separated biodegradable waste, not municipal solids waste, MSW), waste paper, industrial waste.

Throughput: 55,000 tpy.

Conversion Technology: Biological – Anaerobic Digestion.

Conversion Technology Supplier: OWS (Organic Waste Systems), NV.

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 ($CO_{2)}$. 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 (H_2) and CO_2; this process is called acidification. The last group of bacteria, the methane producers or methanogens, produce biogas (methane and CO_2) from the acetate and hydrogen and CO_2. 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, H_2S removal) to pipeline quality and pressurized, for example to be used as compressed natural gas (CNG), a safe and clean vehicular fuel.


Brecht II in foreground, Brecht I in background

Technical Meeting and Facility Tour with : Luc De Baere, Managing Director and founder of OWS.

Owner/Operator: IGEAN, a regional agency set up by several municipalities.

Technology Description (general): We first met at OWS' headquarters in Ghent, where Mr. Luc De Baere presented a seminar on the status of MSW AD in Europe. OWS performs process design, construction, and operation if possible. The company has two branches: 1) a lab and consulting division which specializes in measuring biodegradability (they wrote the ASTM biopolymer biodegradation method), and 2) the DRANCO (DRy ANaerobic COmposting) division, which designs AD facilities.

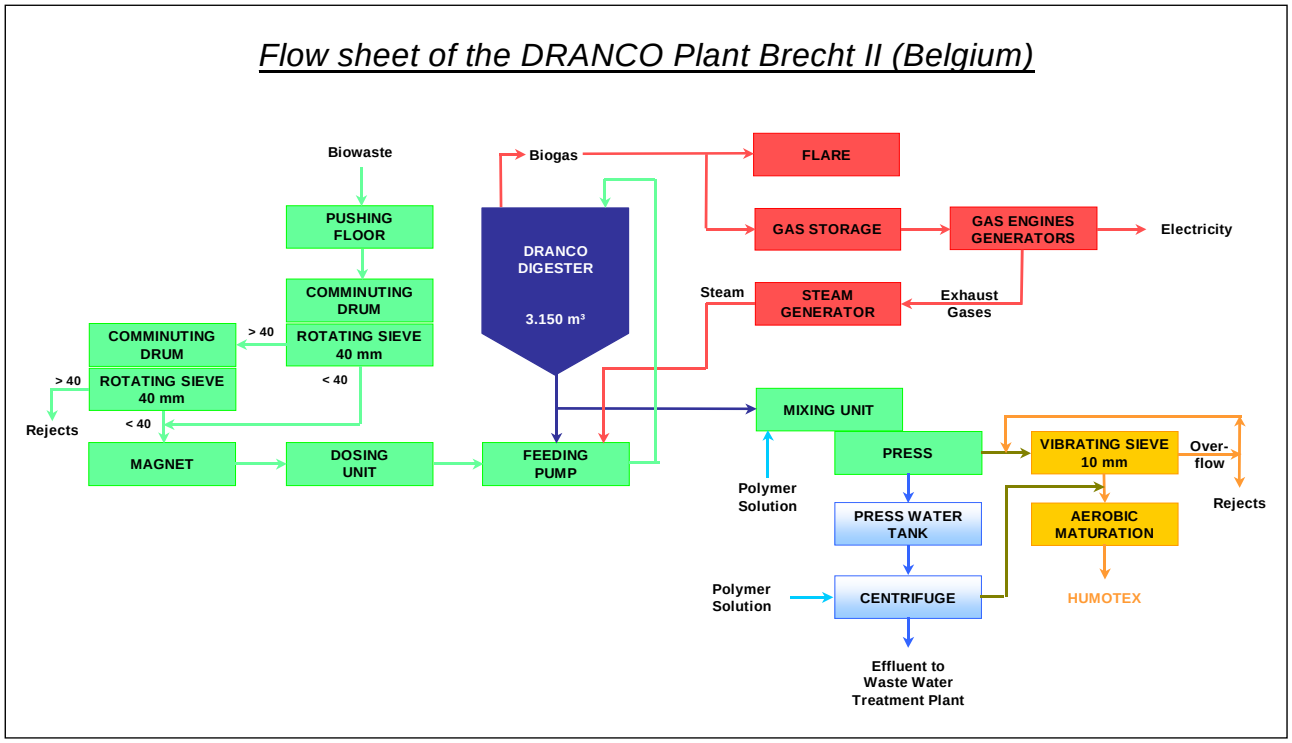
Mr. De Baere stated that typical European tipping fees are $100/ton at landfills and $100-150/ton at waste to energy facilities. There are currently 87 MSW AD plants in Europe, processing approximately 2.75 million tons per year; most of them use a single-phase process and operate in the mesophilic temperature range (95°F). In Europe, a driving force behind the development of waste conversion technologies is the European Directive that mandates that the amount of organics landfilled must decline to 25% of the 1996 level by 2012. More and more of the AD facilities (approximately half of the new facilities) are designed to process mixed MSW, as opposed to source-separated biowaste. OWS has such mixed MSW facilities, in particular the one in Bassum, near Bremen, Germany. OWS has developed a mixed MSW process called Sordisep that combines dry sorting, high solids AD, and wet separation to maximize waste conversion. He presented the highlights of a paper he had presented at the International AD conference in Montreal in August. In this paper he examined the different ways of implementing MSW AD, e.g. whether to do most of the mechanical processing before or after AD. He presented mass balances indicating that state-of–the-art process design and use of AD can lead to 76% landfill diversion, versus 53% if aerobic composting is used. De Baere also stated that the obvious advantages of AD over aerobic composting are that AD produces valuable fuel

gas and fully controls process odors. He discussed compost quality standards. US compost heavy metals standards are approximately one order of magnitude higher than in Europe because of a different regulatory philosophy. The European philosophy is that background heavy metal concentrations should not be significantly increased, whereas the US approach is based on controlling risk.

Technology Description (Dranco): The main challenge in digesting solid substrates like MSW is phase separation. If the reactor contents are to any extent liquid, there is a strong tendency for the contents to separate into a bottom sediment layer, a top floating layer, and an aqueous layer in between. This greatly complicates materials handling. The Dranco process addresses that by a) operating at high solids concentrations (the digester effluent varies between 20 and 45% dry matter), and b) letting the digesting material move vertically from top to bottom. Feed material is mixed with recirculated effluent, pumped up the sides of the digester, and dumped into the top of the digester. Due to the high solids concentration in the digester, the Dranco process typically achieves high volumetric biogas production rates, on the order of 10 volumes of biogas per volume of reactor space per day.

Brecht II, entrance; emergency flare in foreground, preprocessing building behind it, digester in background

Technology Description (Brecht II): The facility takes source-separated biodegradable waste (biowaste) and waste paper (not recyclable) from the surrounding community; it also accepts biodegradable industrial waste, such as sausage casings.



These materials are screened and processed. At the heart of the processing are large (approximately 10 ft in diameter) comminuting drums. These drums rotate vigorously (probably more than 30 rpm), and the feed stays in them for several hours. By the time it leaves the drums, its particle size has been substantially reduced. The material leaving the drums is screened to < 40 mm (1½ inches). This feed is mixed with digester effluent at a rate of 6 tons effluent to 1 ton fresh feed and heated with steam injection. The resulting mix is dumped in a hopper from where a cement pump pushes it to the top of the cylindrical digester and dumps it in. As material is added at the top and withdrawn from the bottom, it moves down vertically through the digester.

So, in effect the movement of material through the digester flows a plug flow mode, but the intense recirculation results in a completely mixed reactor overall. It takes the material only about 3 days to travel down the reactor once, but it repeats this trip on average 6 or 7 times, resulting in an overall retention time of 20 days. At the time of our visit, the reactor temperature was 127°F. The biogas yield averages 4300 scf per ton of Brecht II feed.

Raw feed being pushed by slow ram feeder

Comminuting drum in background, drum feed conveyor belt in foreground

Dranco digester with feeding pipes along the sides; the bottom third contains the conical bottom of the digester

Conical digester bottom; the blue valves control the effluent rate; the pipe in background conveys effluent to the recirculation and mixing area

Digester effluent arrives in the recirculation and mixing area via the inclined pipe

Digester effluent is mixed with fresh feed, heated, and pushed back up by the cement pump at the bottom of the picture

The facility has a footprint of approximately 2.5 ac. From 55,000 tpy input, it exports about 2500 tpy of rejects, 22,000 tpy of compost; and 1.3 MW of electricity. The biogas is used to produce steam and electricity; 30% of the produced electricity is used internally, the remaining 70% (1.3 MW) is sold at a renewable energy rate of 12.5 cents/KWh.

Wastewater treatment plant for landfill leachate and excess liquid from digestion

The digester effluent goes through a 2-week aerobic curing step. The buildings are operated at negative pressure and all the extracted air is pumped through the aerobic compost piles. The air extracted from the compost piles is treated in a biofilter, using finished compost as its media. The compost is fine-grained and looks very attractive; no extraneous objects or plastics are visible. A broker purchases all the compost.

Finished compost, close-up

Front side of biofilter

Back side of biofilter (Air cleaning system)

Air handling system, air from compost bays is injected into biofilter

Products: Medium-Btu gas (220 million scf/year or approximately 300 MMBtu/day), used for heat and electricity production (net export of 1.3 MW).

Byproducts: High-grade compost.