

C-AGG Heartland Digester Tour Summary

Monday, July 11, 2016
Weld County, CO – USA

C-AGG staff (Debbie Reed and Monica McBride) and a group of 6 stakeholders (Jerry Bingold & Mark Stoermann (Newtrient), Ryan McCarthy (CA ARB), Sean Babington (US Senate Committee on Agriculture, Nutrition and Forestry), Garth Boyd (Prasino Group) and Charles Stanier (U of Iowa)) toured EDF (Electricite de France) Energy's Heartland Digester located in Weld County, Colorado. The tour was hosted by Jim Potter the President of AgEnergy USA, LLC. The \$100M facility is adjacent to the county's largest fracking well, on land (valued at \$40M) formerly owned by Sheldon's Dairy, a feedstock supplier to the digester. The tour was held on July 11, 2016 in advance of C-AGG's Denver meeting held over July 12-13, 2016. The Heartland Digester produces renewable natural gas from a mixture of manure and food waste. The facility receives around 400,000 gallons of material daily including ~160,000 gallons of manure from local dairies and 200,000 -240,000 gallons of food waste substrate from local food processing plants, distribution centers, and city food waste collection programs. Sheldon's Dairy, one of Heartland's major suppliers of manure, is a 3,000 head dairy using a combination of scrape, flush, and free-stall manure management techniques. The dairy recently built a new heifer facility that will house an additional 1,000-2,000 head cows.

Leprino foods, the world's largest producer of mozzarella cheese, has a new \$250M cheese plant located in Weld County that is processing 7 million pounds of milk each day from over 100,000 head of cattle. This plant provides a steady stream of processing waste for the digester. Currently, the plant is receiving materials from a roughly a 50-mile collection radius that stretches to from Denver, Boulder, and Fort Morgan, CO and into Wyoming. This radius includes the Leprino plant, a 5,000 head JBS beef processing plant in Greeley, CO and another similarly sized Cargill plant, 3 dog food plants (which send off-spec dog food), de-watered grease from local restaurants (30,000 – 40,000 gallons a week), and organics from A-1 Organics.

EDF has established a 20-year contract with A-1 Organics to process their organic waste. If the digester is down or at capacity the Rattler Ridge 430-acre compost facility 10 miles away provides back-up capacity. The food waste received by the facility runs through a Ecoverse Tiger HS640 Food Depackager system, which is an initial processing step to remove all packaging and non-organic material (it can handle any packaging except glass). The system can process 20 tons per hour and currently only runs Monday through Friday one shift a day.

The facility relies primarily on the production and sale of natural gas to support the operation (accounts for ~80% of revenue) with the production of 300-340 cubic yards of compost a day as a secondary revenue stream (~20%). The compost is being sold as a peat moss replacement material to Scotts in Fountain, CO to replace their purchase of peat moss from Canada, creating savings for both transportation costs and avoided emissions from mining of peat bogs. The

fiber has a slightly higher pH than naturally occurring peat moss, so the facility can correct the pH using the acidic production water resulting from digestion.

The Heartland Digester is a dry climate digester which means the 400,000 gallons of micronutrient- and nitrogen-rich water produced daily from the digestion and gas production process is an incredibly valuable resource. Heartland built a 6-mile pipeline to carry the water to local farms for reuse. They are not currently charging for water delivery, but intend to in the future. They have 42 M gallons of onsite water storage, 30 M gallons of offsite storage, and another 30 M gallons of storage under construction onsite. The additional storage is needed since the demand for water is very variable and based on crop rotation needs and weather.

At present, the facility is operating at 129-130°C (131°C is optimal), which is considered thermophilic, using \$2 gallon natural gas from the pipeline (Poudre Valley Coop, a member of the Tri-State Coop, provides electricity, and had to build 12 miles of power lines to the project) to power the two 10M BTU boilers, which produce close to \$10 a gallon renewable natural gas that is supplied back to the pipeline to meet their 44 MW gas contract with the Sacramento Municipal Utility District (SMUD).

The facility has faced a few challenges starting up, but one of the biggest challenges and surprises compared to their original design was the quantity of H₂S generated during digestion. The original model and digester design was based on the assumption that the gas would contain 3,000 ppm H₂S, however, this did not account for sulfur additives used in the cattle feed. These additions result in an actual H₂S of 4,200 ppm, which required additional scrubbers to be added to the backend of the system to properly clean the gas. The scrubber system (a Greenlane scrubber and stripping vessel) currently includes 3 scrubber towers that use small plastic balls to increase surface area. The bioscrubbers are heated to 59 degrees, and the biogas is inoculated with bacteria in the passive system, which has a 98% removal efficiency of the H₂S and removes some of the carbon dioxide as well. (Raw gas is 65% methane.) The water resulting from the scrubbing has a pH of 2 and can be used to lower the pH of the compost, if necessary. The facility uses a PSA 400 kw system to dry the gas and a deoxo unit to remove excess oxygen from the gas. Once the gas is cleaned, it is run through one of 3 compressors to generate pipeline quality compressed natural gas at 1000 psi.

The digester uses a precise but changing recipe of food waste slurry and manure to achieve optimal gas production. The facility has two 600,000-gallon substrate tanks to separately store the high fat and low fat food waste materials, which are filled directly from the food depackaging system. These tanks then feed two 20,000 gallon dosing tanks which blends the substrate with the manure in appropriate quantities. The mixture remains in the tanks for 10-12 hours, and pulses out periodically. The final mixture is then pumped into one of six 1.87 M gallon internally heated bioreactor tanks (30'x100'), which use propeller mixers to facilitate the digestion process. Once digestion is complete, the resulting solids from the bioreactors are run through a non-stop Centrysis centrifuge unit to produce the final peat moss replacement material, which is used as a high quality soil amendment. They currently have 80% excess centrifuge capacity to handle the solids.

The facility is classified as a class A solid waste facility, which means they need to meet certain minimum contamination prevention standards to operate. To minimize potential contamination from the bioreactors, the 6 reactors were built on top of a three-layer fused lining consisting of one 60 mil high-density polyethylene (HDPE) layer, a geo-netting (a latticed plastic netting that provides structure to the liner), and a second layer of 60 mil HDPE.

The facility has a 28M gallon lagoon, which is now used as a dredging pond for solid accumulation; and a smaller (8.5M gallon) covered lagoon, which was first used to produce gas for the SMUD contract.

The facility has 23 full time employees, and had 120-140 during peak construction. and uses a host of external consultants to monitor the temperature and pH probes in the bioreactors and to test daily samples for proper chemical and biological make-up, so the bioreactors can be adjusted accordingly.

The project is still in its first phase of development. When Phase I is fully operational, the plant will produce 4,800 standard cubic feet of renewable natural gas per minute (or 4,700 decatherms); at present, they are producing ~3,700 decatherms. Phase II of the project will aim to bring capacity to 7,000 decatherms.

The plant is EDF's first biogas digester in the US. They invest about \$2 B / year in the US, mostly in wind and solar development projects. Last year EDF installed 7700MW of wind production.