Biowaste Management in Bavaria – the 2023 study tour

In October 2023, Cré and the REA held a study tour of wet and dry-AD plants in Germany. Delegates from the UK and Ireland assembled at Munich airport where we were picked up by our tour guide Josef Barth. We were in good hands as Josef is an international expert in the field of organic waste treatment, quality management, compost quality and marketing. He was Executive Director of the European Compost Network for over ten years. Now working as a consultant, his clients include governments and industry all over the world.

Day One

After a late dinner and overnight stop in Landsberg, we made our way to the first plant of the tour - the Oko Power anaerobic digestion plant in Altenstadt. The plant operates a wet-AD, processing 50,000 tonnes per annum (tpa) of biowaste and organic residues from food production. They upgrade the biomethane to inject to the gas grid. Feedstocks are predominantly commercial food waste from an area approximately 250km radius from the plant. The main difference from UK plants was obvious when we arrived, as the main digestion tanks were underground - it did not look like a typical AD plant! This is also unusual in Germany, but when the plant was built over 20 years ago, it was considered to be state-of-the-art. According to the site manager, the main advantage is that they the underground digestion tanks are reasonably easy to clean out with an excavator.

Photo 1 - Standing on top of the digesters looking at the gas upgrading plant

Food waste is received into a bunker, and they have a separate line with a hammer mill to remove any packaging. The feedstock is pasteurised and then goes into one of three digesters for the initial phase. They operate a two-phase digestion process with six tanks in total and a residence time of approximately thirty days. Digestate is then screened with a 0.7mm screen to remove any remaining contamination and is regularly tested to ensure it meets the German quality label. The final digestate is collected by local farmers to be spread on farmland. All contaminants removed from the process are sent to energy from waste facilities.

Biogas is captured and used for the combined heat and power (CHP) engine. The rest is cleaned up for injection into the gas grid. They also have a filling station for biomethane vehicles. The plant is not currently capturing the carbon dioxide but are about to undergo development of a new gas upgrade where CO_2 will be recovered. The CHP powers the plant and surplus energy used for an adjacent facility treating wastewater. The gas injected into the grid from the plant is enough to power a town with 13K inhabitants using gas for heating and cooking. Adjacent to the AD site is a sewage sludge incineration facility.

Photo 2- Biowaste in reception bunker

Photo 3 - Walk along the river in Bad Tölz for lunch

En-route to the next site we stopped for lunch in Bad Tölz. A nice walk along the riverbank took us into a pretty town centre where we enjoyed lunch outside in the sunshine. The next site was the VIVO Municipal Enterprise's dry AD site in Warngau. They operate a dry AD process followed by In-vessel composting. The site treats 15,000tpa of biowaste (co-mingled food and garden waste). Alongside the AD and composting plant there is a household recycling centre and a well-stocked 'fleamarket' (a.k.a reuse shop) with a wide range of items for sale.

Incoming waste is received into the site, screened and the larger fraction goes over a sorting line for contamination removal and then is processed through a hammermill. Material is loaded into one of four fermenter tunnels which are filled three-quarters full and undergo a short aerobic phase to heat up. Then, water is added at the top to start the anaerobic digestion process. The percolate is collected at the bottom of the tunnels in below ground storage tanks and is recirculated. The gas generated is captured.

Photo 4 - Pretreated biowaste awaiting digestion

Photo 5 - Empty digestion tunnel

After 21-28 days in the AD tunnels, material is transferred to one of six composting tunnels alongside some fresh garden waste. In the aerated composting tunnels, the material undergoes a hygienisation phase for a minimum of six days at 60°C before being transferred to another tunnel for three more weeks. Following composting, the material is screened to 12mm. The resultant compost is tested and used by local landscapers and gardeners. The biogas is used in a CHP to supply on-site demand and is fed into the grid.

The evening concluded with a lovely dinner in the hotel in Straubing where plenty schnitzel, sausages and schnapps were consumed!

We had a presentation from Horst Müller about the 3A Biogas process, and their two reference plants in Austria. They have a dry fermentation process with three phases. First, a short aerobic phase to heat material up, then an anaerobic phase for 21-35 days before returning to a final aerobic phase for hygienisation and stabilisation to produce compost.

Photo 6 - Delegates at dinner

Day Two

The first plant of the day was the ZAW-SR dry AD plant Aiterhofen in the Straubing district. The site is owned by the municipality and services approximately 150,000 households over an area of 1270km^2. The company is responsible for all collections and household waste recycling centres. The site was built in 1992 and has capacity for approximately 18,000tpa of garden waste, biowaste (food & garden waste) and some organic commercial waste. After reception, material is loaded into one of seven digestion tunnels. There is a short aerobic phase to heat the material to 38-41^{o}C.Then aeration is stopped, and the biowaste is sprinkled with the percolate water to begin the anaerobic phase. The biogas is used through a CHP to provide heat to the process and export power to the grid.

Photo 8 - Post digestion composting

Photo 7 - Delegates at the Aiterhofen site

After about two weeks the gas production decreases, the fermenters are aerated and the digestate goes for composting. It is mixed 1:1 with shredded garden waste and composted in windrows for six to eight weeks. There is a different interpretation of the animal by-products regulations.

The site has a good market for their outputs. Following screening they sell bagged and loose compost. Of all the compost they sell, 80% goes to agriculture for €6 per tonne, 10% as woody biomass, 4% to landscapers at €38/t and 6% to soil production at €3.5/t. The site works hard to remove contamination throughout the process, and contamination received is typically around two percent. They have staff going out on collections to lift lids on bins with a yellow and red card warning system and widespread education programmes for householders.

We made the most of the good weather and had another lovely lunch outside in the sunshine before visiting the final plant. AWG Donau-Wald operate a dry thermophilic plug flow system in Passau. With a capacity for 47,000tpa, the site mostly takes food and garden waste from households. They also operate a second 22,00tpa composting plant for garden waste only. The site serves approximately 500K inhabitants across an 4500m^2 area.

Contamination in household biowaste typically received is between seven and twelve percent. The site removes approximately three percent at the front end with the remainder being removed at the end of the process. They have recently expanded collections into a new area and have put a lot of effort into communications and education for householders. They are now seeing contamination levels around 0.5%, and as a result, strongly advocate the benefits of education and communication. The company is also considering a new system with optical scanning of bins when they are tipped to detect and record contamination.

Photo 9 - Reception of biowaste

Photo 10 - Input to plug flow digesters

Incoming material is screened to 80mm, contamination removed via a picking line and then undergoes size reduction to less than 50mm. The site has three parallel digesters and material is fed in at one end and moves slowly through the digester. The material is discharged at the other end. It is a thermophilic process and operates at 58^{o}C with a residence time of approximately two weeks. The biogas is used for on-site heating with excess heat going to a district heating system and the electricity exported to the grid. There is no gas connection locally but there is a nearby business with a high energy demand, so they are planning to supply gas to them.

Digestate is removed and dewatered. Some of the liquid fraction is recirculated in the process and the rest is used as liquid fertiliser. The solid fraction goes for composting for four weeks with aeration prior to screening. They have a strong focus on marketing and produce thirty different compost types for growing media and a range of special blends. Alongside the AD and compost plant, the company operate a household waste recycling centre collecting thirty-eight different types of materials – an impressive array of different and well labelled skips.

Photo 11 - Aerated composting

The tour concluded with a farewell meal at the airport. It was a great trip to be part of, and it was interesting to see how biowaste is managed in Bavaria. Thanks to Percy Forster of Cré and Josef Barth for organising the study tour and looking after us all. Massive thanks also to all the hosts who were very welcoming, open in sharing information about their process and willing to answer our many questions.

Photo 12 - Delegates on study tour at Passau