Waste Management

Energy From Waste

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Incineration or ‘Energy from Waste’ provides an effective way of diverting large amounts of waste from landfill, while recovering useful energy.

This incinerator plant generates ‘Electricity’, by burning Ninety-thousand tonnes a year of non-recyclable municipal waste collected from within the county. It was commissioned in 2003 and is one of a number of incinerators that collectively play a key role in achieving the county’s challenging ‘recycling-and-recovery’ targets.

It’s a comparatively small plant, that meets the operating and pollution control standards set by the national regulator under IPPC and it complies fully with the Incineration Directive of 2000.

The site is a couple of miles outside the town centre and was the location of an incinerator that was closed in the 1990s when the first incineration-directive was implemented.

There are two main buildings;
One for the waste delivery-and-storage and for the furnace itself.
The other houses the flue-gas cleaning-equipment.
A third, smaller building, houses a steam turbine and the associated power-generating equipment.

The incinerator is fed with household waste and all vehicles entering and leaving the site are weighed.

The vehicles discharge their load into a bunker which holds about four days supply.

A grab crane distributes the waste throughout the bunker and mixes the incoming loads to give a consistent ‘feed quality’. Mixing’s important, because too much of one type of waste affects the ‘burn-rate’ and consequently the heat produced.

The crane also lifts the waste into a hopper at the top of the furnace ‘feed-chute’.

The rubbish falls down the chute under its own weight. And it’s then pushed into the furnace by means of a ram.

Combustion occurs as a modern version of the conventional ‘Reciprocating-Grate’ furnace. Primary combustion air is supplied through the grate and a proportion of the cleaned flue-gas is re-injected into the furnace. This reduces the formation of ‘Oxides of Nitrogen’.

The need for secondary-air injection is removed as the re-injected exhaust gases create the turbulence in the furnace that’s necessary to ensure complete combustion.
A further reduction in oxides of nitrogen is achieved by injecting ‘Urea’ into the furnace.

On leaving the furnace, the gases are cleaned in a ‘Semi-dry Scrubber’. Lime slurry and ‘Activated Carbon’ are sprayed into the large reactor through which the gas flows. The heat from the gas evaporates the water from the slurry, leaving fine lime particles that neutralise the Hydrogen-Chloride and Sulphur-dioxide. The carbon adsorbs ‘Mercury-Vapour’, ‘Dioxins’ and other trace ‘Organic Compounds’.

The gas then flows into the Bag-filters where the solids, known as ‘Air Pollution Control Ash’, are removed. The ‘APC Ash’ is conveyed pneumatically to a storage silo and later taken by tanker for disposal at a “Hazardous-Waste” landfill.

Meanwhile, the cleaned flue gases are discharged through a 65metre-high chimney. Systems continually monitor the concentration of key pollutants in the flue-gas. If concentration levels rise, the plant operators are informed so that they can take action. The emission measurements are published on the company’s website and if discharge limits are exceeded the national regulator is informed.

A second, and different, type of ash is the ‘Residual Ash’ from the furnace. It’s often called ‘Bottom Ash’ and it drops off the end of the grate into a water quench bath, to cool it and to reduce dust levels. It then passes under a magnetic separator.

Any recovered ferrous-metal can then be recycled.

Most of the ‘bottom-ash’ is sent to an industrial-waste landfill, but increasingly, it’ll be processed with the ash from the County’s other incinerators and used as an aggregate-substitute for road-building projects.

Treated feed-water is converted to steam in boiler-tubes that line the furnace walls. The steam is then superheated by passing it through a second set of boiler tubes, located at the top of the furnace chamber.

An ‘Economiser’ is used to pre-heat the boiler feed-water. This increases the efficiency of the heat-recovery system and reduces the gas temperature, thereby raising the efficiency of the gas cleaning system.

On leaving the turbine, the steam is condensed back to water in the condensers.

The facility may be run as a combined ‘heat and power’ plant, which would increase the efficiency of the energy recovery process. However, at present there is no local demand from industry or from housing developments for steam.

And finally, of the 8-mega-watts produced, about 1-mega-watt is used to run the plant. The remainder is supplied to the National Grid.

The cleaning of ‘Incinerator Flue Gas’ creates ash, known as Air Pollution Control or “APC residue”.

The ash contains a lot of un-reacted lime so it’s highly alkaline and an irritant. It also contains high levels of chlorides, sulphates, heavy metals and dioxins.

For these reasons, APC residue is classed as “Hazardous waste” and must be disposed of at a dedicated landfill. This site’s ‘Waste Management Licence’ allows it to accept up to seventy-five-thousand-tonnes a year.

It’s located in the southwest of England and takes APC residues from several municipal waste incinerators. It also takes similar materials from furnaces burning crop residues and the waste by-products from paper recycling.

The tankers discharge the fine-powder APC residue into one of four silos.

The silo facility serves a number of purposes:
The tankers don’t have to enter the ‘landfill area’ of the site, thereby minimising the amount of dust they pick up. Residues can be delivered to the site 24 hours a day. They’re often still hot when they arrive, so they have the chance to cool in the silo before processing.

Residues from different sources have differing pH levels. They can be stored in a particular silo and then blended to provide a consistent material for landfill. Blending occurs in the central hopper.

Wastewater can be added to the residue in order to keep dust levels to a minimum.
Finally, the ash and water mixture is discharged from the silos. Typically, the moisture content of the material will be around 40% at this point.

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Once they're filled, the dumper-truck takes the ash to the working cell of the landfill.

The ash is tipped onto the top surface of the cell. It then begins to harden slightly due to its cement-like properties and, after a few days, it's compacted by a bulldozer.

The cells need careful construction. They're excavated from the local clay beds to a depth of about 15 metres below ground level. Some of the clay that's removed is used on site and the remainder is sold to the construction industry.

This particular clay has a very low permeability, around ten-to-the-minus-eleven metres per second and the 'seam' is about 200-meters deep. These two facts taken together mean that this area is ideally suited as a landfill.

To comply with the landfill directive, the bottom of the cell's lined with a minimum of one metre thick mechanically-compacted clay, and the sides are a minimum of three-metres thick. This ensures protection from both the loss of leachate and the entry of 'ground-water'.

The cell area is determined through water balance calculations. The APC residue has a very high absorptive capacity (around twenty-five percent water by weight) but the cells are designed so that they will be capped long before the rainfall allows this value to be approached.

Once a cell is complete it's capped with engineered clay to a minimum thickness of one metre. Throughout capping, independent engineers carry out tests to ensure the cap is 'up to spec'.
Subsoil and topsoil are placed on top of the cap and then planted with grass seed. These capped cells can then be put to good use for animal grazing.

Even the best-capped cell will allow some water to get in, so the bottom of the cell is contoured with sumps at the low points. Pipes are sunk into the sumps to allow any leachate to be pumped out. However, it will be many years before any pumping is required.

The operators go to great lengths to protect the local environment and the health of the public and site staff.
All vehicles leaving the site have to pass through a wheel washer and the site roads are constantly being cleaned.The site has four monitoring stations that continuously monitor and record atmospheric dust levels. These allow the operators to ensure that dust is kept well below the objective levels set out in the 'Air Quality Regulations'.

Additional spot-checks are made regularly for health & safety purposes.

There's never been a problem with dust levels being higher than those permitted. But during dry spells, dust levels do rise. So to minimise the affect to the neighbouring area, water can be sprayed into the air from the perimeter fence.

Once the Waste Acceptance Criteria regulations are introduced untreated residues will not be permitted to be landfilled due to the high chloride content of any leachate.

Finally, responsible management of landfill sites ensures a safe future for all concerned.