CROWCON
Detecting Gas Saving Lives

Waste to Energy

An Introduction

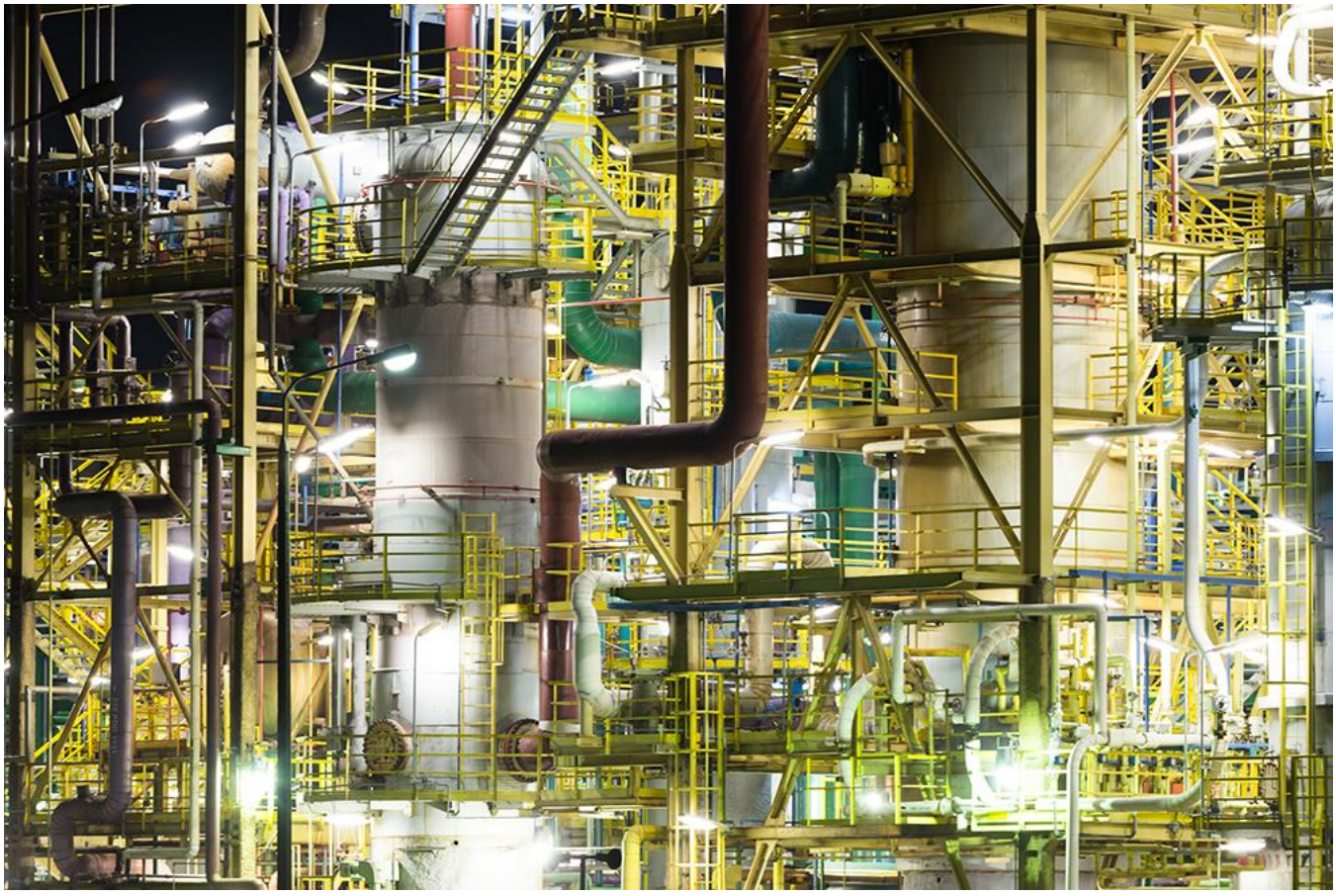
August 2020

1. Introduction

Waste comprises materials that are no longer needed, and thus are discarded. Waste can be classified as solid or liquid according to its form, and further categorised as hazardous and non-hazardous waste. Liquid waste includes municipal wastewater, storm water run-off and industrial wastewater discharge. Solid waste includes household rubbish, which is also called municipal solid waste (MSW), industrial waste – for example, from agriculture – medical and electronics waste.

The treatment of solid waste is challenging because it may contain one of more contaminants (which may include heavy metals, explosive and flammable materials) and these must be dealt with before the waste can be treated.

In this document, we explore the means by which waste can be treated and converted into energy, along with the associated gas monitoring needs.



2. The treatment of solid waste for conversion into energy

Waste can be treated and turned into a source of energy – this process is generally referred to as waste to energy (WtE). Biological conversion uses waste materials that have a substantial water content (for example, agricultural waste and products of wastewater treatment) and processes them through a series of anaerobic digestors to generate biogas. Thermal conversion produces electricity or heat energy directly through combustion, usually in an incinerator. Thus, the energy generated by the processing of waste can be electricity, heat or fuel.

Generation of biogas

Biogas is produced when organic materials such as agricultural and food waste are broken down by bacteria in an oxygen-deficient environment. This is a process called anaerobic digestion. When the biogas has been captured, it can be used to produce heat and electricity for engines, microturbines and fuel cells. Alternatively, biogas can be upgraded into biomethane, also called renewable natural gas (RNG), and used as town gas or vehicle fuel.

The composition of biogas (typical values):

Methane CH_4	50–75% vol
Carbon dioxide CO_2	25–45% vol
Hydrogen sulphide H_2S	3,000–10,000ppm
Ammonia NH_3	up to 100ppm

Monitoring gas hazards in a biogas plant

Clearly, biogas has high methane content as well as substantial H_2S, and this generates multiple serious gas hazards. In particular, there is elevated risk of:

- **Fire and explosion**
- **Confined space hazards**
- **Asphyxiation**
- **Gas poisoning (H_2S, NH_3)**
- **Oxygen depletion**

Operators in a biogas plants must have personal gas detectors that detect and monitor flammable gas, oxygen and toxic gases like H_2S and CO.

Users of Crowcon portables can use Crowcon Connect to provide visibility and insights on detector use and readings; this eases compliance, optimizes efficiency and provides higher levels of safety. For more details on Crowcon Connect **please click here**.

Gas monitoring equipment for use in biogas generation/WtE environments

Crowcon provides a wide range of portable gas monitoring equipment to cover the hazards of WtE environments. These are summarised below:

Portable monitors

T4

- Easy to use one button functionality
- TWA Resume function
- MED certification
- Easy servicing and quick turnaround
- Bump test station available

Gas-Pro

- Integrated pump (up to 30 m sampling)
- One button operation
- IR sensor for wide range of hydrocarbons
- MED certified
- Confined space entry (CSE) kit available
- Bump test station available

Gasman

- One button operation
- Suited for CO_2 and NH_3

Leakage of biogas within a manufacturing site implies that not all biogas is being converted successfully, and harmful emissions will make the plant hazardous. Biogas itself is highly flammable, wet and corrosive. To protect staff and property from gas leaks from biogas digesters, Crowcon offers sampling systems that prolong sensor life while keeping the plant safe. Crowcon control systems, with analog and digital outputs and web access, allow remote monitoring. Examples are given below.

Fixed monitors

Xgard

- Easy to use one button functionality
- TWA Resume function
- MED certification
- Easy servicing and quick turnaround
- Bump test station available

Xgard Bright

- Rugged reliable detector
- Available for various gases and material
- mA or mV output

Vortex

- Up to 12 configurable channels
- MODBUS compatibility
- SIL 1 (IEC 61508) validated

GM controller

- Up to 128 channel inputs
- Modular configuration
- Screen display

Crowcon's GM64 control system, which has a modular design and selectable output card, channel module, relay module and power module, is a very scalable controller. The GM64 can also record events, such as alarm, fault, calibration, warnings, e.g. of high ambient temperature, power-on and power-off. It can be linked to various off-site control equipment, improving system integration and allowing the user to read gas data remotely.

3. Solid waste incineration power plant

Incineration of waste is another WtE technique that also generates multiple gas hazards.

Refuse collection

Refuse collection vehicles are weighed at the plant's weighbridges before discharge into the bunker. Refuse from the bunker is then fed into the incinerators using refuse cranes. Keeping the bunker at sub-atmospheric pressure means that odour is retained and does not escape.

Gas detection requirement in refuse collection

It is common to find flammable gas CH_4 and toxic gases H_2S, CO and NH_3 in refuse bunkers.

Refuse bunkers are built several metres underground and gas detectors are usually mounted high above them, which makes those detectors hard to service and calibrate. In many cases, a sampling system is a practical solution as air samples can be brought to a convenient location and measured.

Figure 1: A floor-standing control panel with sampling system in a WtE manufacturing facility.

Leachate pool

Leachate is a liquid that drains (leaches) from an area in which waste is collected, and it presents a range of gas hazards. These include the risk of flammable gas (explosion risk), H_2S (poison, corrosion), ammonia (poison, corrosion), CO (poison) and adverse oxygen levels (suffocation).

The leachate pool also presents a generally adverse environment. In particular it generates high humidity, severe gas corrosion and high dust and oil particle concentrations. This environment may become even more complex when events occur such as leachate overflow, corrosive liquids splashing, etc.

Gas detection requirement in leachate pool

Leachate pool and passageways leading to the leachate pool must be monitored for CH_4, H_2S, CO, NH_3, O_2 and CO_2. Various gas detectors should be placed along routes to the leachate pool, with output connected to external control panels.

Combustion and heat recovery

Solid waste is combusted in the specially designed furnace at temperatures of > 850^{o}C, with sufficient air to ensure complete burning of the waste and to prevent the formation of dioxins and carbon monoxide. Heat from the combustion process is used to generate steam; which can be converted to electricity in turbines. Excess waste heat is also used to heat the furnace.

Gas detection requirement in combustion and heat recovery

Detection of O_2 and toxic gases SO_2 and CO is vital in boiler house areas.

Exhaust air scrubber

The flue gas from incineration is highly toxic, as it contains pollutants such as NO_2, SO_2, HCl and dioxin. NO_2 and SO_2 are major greenhouse gases, while HCL and dioxides are harmful to human health.

Flue gas passes through a series of scrubbers and filters and this process removes pollutants such as HCl and dioxin. Particulate or fine ash in the flue gases are removed in electrostatic precipitators (ESP) or baghouse filters. Finally, flue gas exits through the chimney.

Gas detection requirement in exhaust air scrubber

Toxic gases HCl and SO_2 must be monitored before and after scrubber application, to determine the efficiency of the scrubber. In wet scrubber application, gas detectors must be used in the chemical dosing shed.

Ash pit

After incineration, the waste is reduced to ash and sludge, of about 10 percent of its original volume. Ash and sludge are stored in an ash pit before transfer to landfill. Prior to storage and transport to landfill, valuable metals can be recovered through a ferrous separator – such metals can then be fed directly to a steel mill, as secondary raw materials.

Gas detection requirement in ash pit

It is usual to monitor oxygen and toxic CO in ash pits.

4. Monitoring solutions for plant boundary pollutants/odour

In many WtE plants that are located near residential estates, plant boundary monitoring ensures environmental compliance and prevents odour complaints from nearby residents.

Gas detection requirement in odour and toxic gases

Crowcon offers real-time monitoring of odour concentration (OU) and toxic gases including H_2S, NH_3, SO_2 and VOCs. The sampling panel includes aerographic data (wind and humidity). The Gasmaster controller displays real-time readings and allows wireless transmission for remote monitoring.

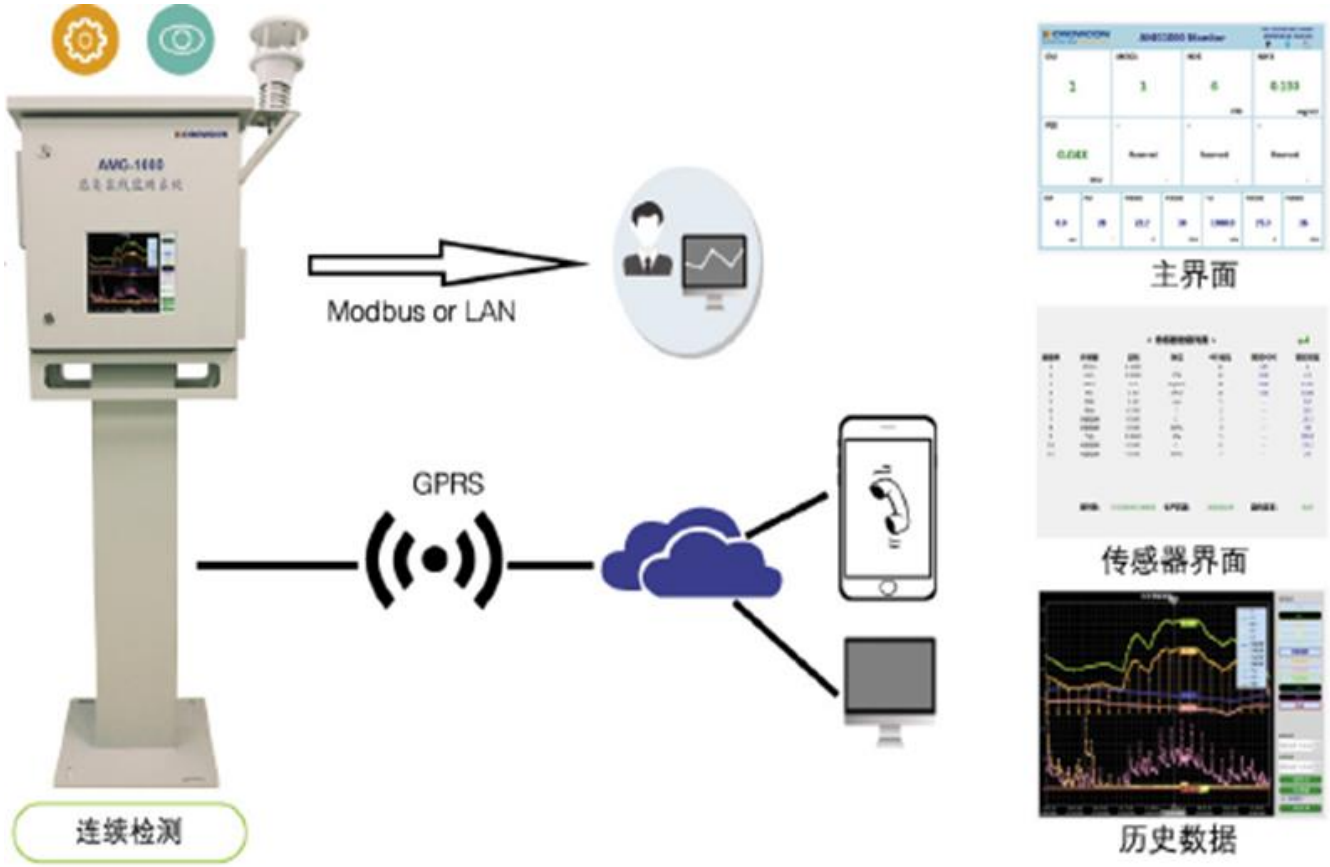


Figure 2: Schematic of an odour monitoring system with various connectivities

CROWCON
Detecting Gas Saving Lives

ABOUT CROWCON

For over 50 years, Crowcon has been developing and manufacturing high-quality gas detection products, securing a reputation for reliability and technical innovation that continuously improves efficiency and safety. Globally respected, and part of FTSE 100 Halma, today, over 500,000 Crowcon devices are in use around the world.

Our vision is to grow a safer, cleaner, healthier future for everyone, every day, by providing best in class gas sensing solutions. The Crowcon range offers both fixed and portable gas detection equipment enhanced with Crowcon Connect, our digital solution, which protects people and places in industries including petrochemical, oil and gas, water, industrial manufacturing and food production. In every case, we combine our expertise with emerging technologies to develop process insights and protection for our customers, improving their operational efficiency and creating safer, cleaner and healthier workplaces.

Find out more at: www.crowcon.com

Contact us at:

UK:
Tel: +44 (0) 1235 557700
Email: sales@crowcon.com

Singapore:
Tel: +65 6745 2936
Email: sales@crowcon.com.sg

The Netherlands:
Tel: +31 10 421 1232
Email: eu@crowcon.com

China:
Tel: +86 (0) 10 6787 0335
Email: saleschina@crowcon.com

United States of America:
Tel: +1 859 957 1039
Toll Free: 800-527-6926
Email: salesusa@crowcon.us

India:
Tel: +91 22 6708 0400
Email: salesindia@crowcon.com