



SUMMARY

The Mines Gas Flare application expands the activities of Biogas Technology Limited into a new area, i.e. reduction of methane, a potent greenhouse gas, usually vented into the atmosphere from operational and closed coal mines. Due to variations in gas flow and quality, caused by mine operating regime and changes in barometric pressure, it is impossible to safely utilise all the methane vented from collieries.

The first flare of this type has been developed by Biogas Technology and installed on site during the beginning of 2003. Since then seven flare rigs have been installed and operated on mines gas in the UK.

Biogas Technology Limited is proud of the fact that we are the only supplier of this kind of equipment in the UK.

Initial development of the flare rig underwent rigorous scrutiny of the customer as well as vetting by the Mines Inspectors and Health and Safety Executive.

Under Environment Agency guidance no open flares are permitted on landfill / onshore flaring sites except in emergency circumstances. This enclosed flare provides much higher combustion efficiency than a traditional open flare. The height of the flare provides flame retention time sufficient to effectively destroy methane and other gases present.

Biogas Technology's experience with landfill gas flares indicates that the combustion efficiency of the mines gas flare over time will not deteriorate, due to the less aggressive nature of the mines gas, use of stainless steel burners and ceramic liner within the flare.

This new system developed and installed by Biogas Technology has resulted in lots of interest from potential customers in the UK and abroad.

TECHNICAL DESCRIPTION

The flare stack and associated equipment provides a fully integrated system to safely flare mines gas ("fire damp gas") with methane content 27-50% v/v in air, ventilated from an underground mine. This flare set can accommodate mines gas under pressure, with automatic flare and vent stack operation. The system is fully integrated with the control system of the existing vent plant or any other equipment (e.g. boiler station) located at the mines site.

The whole system is designed to optimise flaring of mines gas for total destruction of methane and other associated hydrocarbons inline with the guidelines for *Guidance on Landfill Gas Flaring* issued by the UK Environment Agency.

The plant receives a mixture of firedamp gas and air from the mines ventilation system. The gas passes methane and oxygen analysers before entering the flare. The gas then is being dewatered, routed through system of pipes and valves into the burners located in the flare stack; ignited and safely combusted.

The system comprises of a Biogas flare stack, skid mounted process pipework and instrumentation. Gas can be delivered at a variable flow rate up to 2000Nm³/hr. The gas delivery rate is permanently monitored, and the plant is automatically adjusted to accommodate changes in flow and gas quality. A vent stack is also incorporated so that potentially explosive mixtures of gases can be disposed of safely.

A control panel located within a safe area within the system houses all the controls and indicators necessary to operate the system.

Cabling between the control panel and the system active components pass through sealed glands and barriers, isolating all electrical contacts from the main area of the enclosure to eliminate all risk of sparking close to the pipeline. This approach resulted in offering the customer a cost effective solution.

TECHNICAL DATA

Footprint of the flare / vent	m x m	6 x 2 / 1 x 1
Height of the flare stack / vent	m	8.1 / 9.9
Minimum footprint of a typical compound	m x m	20 x 8
Methane content in the gas	% v/v	27 - 50
Nominal gas flow rate	Nm ³ /hr	400 – 2000
Nominal gas delivery pressure	millibar (g)	100 – 500
Combustion efficiency	%	>99
Flame temperature	°C	1000
Retention time	s	≥0.3

SAFETY

The flare incorporates over thirty safety features, e.g. shut down on low methane, high oxygen, low and high pressure, low and high flow rate, flashback, flame out, ignition failure and many others.

The alarm is sent to an operator in case of high condensate level in the knock-out-pot, sensor's failure and any shut downs. All alarms are generated automatically and the operator is immediately notified.

Some of the safety critical sensors have been duplicated and backed up by hardwiring. Therefore, even in the unlikely event of control software failure the system will still respond to the transgressions on the sensors.

All the pipework is purged with safe mixture of gas prior to the ignition. Purging time is calculated on site specific basis and confirmed during commissioning.

An extensive HAZOP (**HAZ**ard and **OP**erability) study had been carried out during the design stage. The design with specific emphasis on the safety aspect was approved by the customer and passed tight scrutiny of Mining Inspectors and Health and Safety Executive.

The design has been backed up by calculations on the safety of the burner's performance, extent of potentially explosive atmospheres around the flare, PES (**P**rogrammable **E**lectronic **S**ystems in safety related applications) checks and extensive risk assessments compliant with strict colliery regulations.

CONTROL AND OPERATION

The system is equipped with an automatic process control. The flame temperature in the stack is kept at 1000°C by automatic adjustment of combustion air. The pressure regulating valve ensures backpressure in the gas supply line as requested by customer.

The flare can be operated from the screen integrated with control panel or remote PC or laptop from the control room or any other location.

Interface signals with the colliery installations are generated automatically. They are used to communicate with customer's system and adjust performance of the flare to the changing circumstances.

The flow meters installed have been proved for the mines gas application. Calculation of current mines gas and methane flow rate, cumulative methane flow in units specified by the customer (e.g. t, kg, m³) is performed instantaneously. The figures are corrected to normal temperature, pressure and methane content in the gas.

This accurate information is crucial for the customer to claim his carbon credits from the emission trading schemes.

SERVICE AND MAINTENANCE

Biogas Technology provides the customer with extensive technical support, help with setting up commissioning programme on site, cost-effective post-installation service and maintenance programme and operators training.

