APPLICATION NOTE

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Precise Measurement of NOx Concentration of Gas Engine Exhaust to Reduce Cost of Operating NOx Removal Equipment

Industry: Power
Product: Infrared Gas Analyzer

Introduction

Cogeneration systems that improve overall energy utilization by simultaneously generating electricity and heat from a single fuel source have been in the news a lot recently. Distributed generation equipment, a type of cogeneration system, is driven by a gas or diesel engine. Advantages of the gas engine, which is widely used, include high thermal efficiency and secure fuel supply. However, the exhaust is likely to include pollutants such as nitrogen oxides (NOx) because of the high combustion temperature in such engines. To prevent air pollution, it is critical to control the exhaust gases.
NOx removal equipment based on an ammonia injection process is commonly used to reduce NOx emissions. Optimum control of ammonia injection is achieved by NOx measurement, thereby reducing the cost of running such equipment. The highly sensitive and reliable SG750 stack gas analyzer is most suitable for the continuous measurement of NOx concentrations.

Expected Benefits

- Accurately measures NOx concentrations in gas engine exhaust
- Reduces cost of operating NOx removal equipment
- Minimizes need for equipment replacement

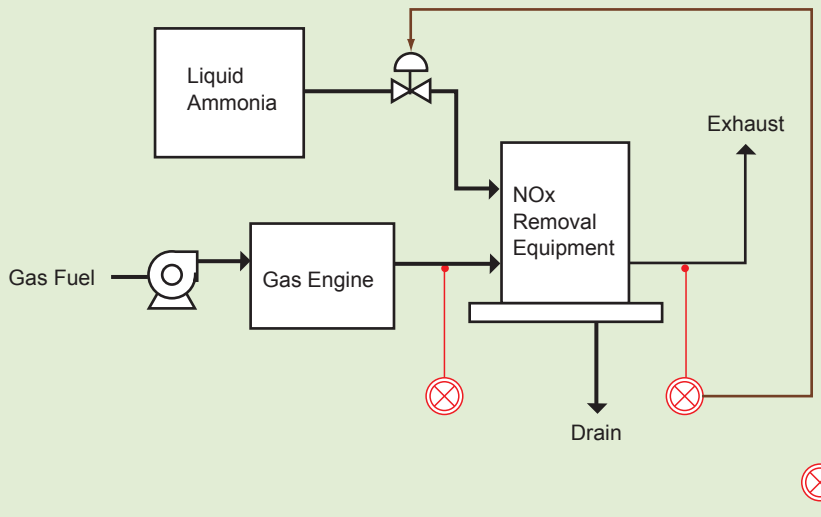
Process Overview

NOx in gas engine exhaust can be reduced by decomposition with a catalyst or the use of a reducing agent such as ammonia. Since solid catalysts have a short life, a more stable wet denitration process using liquid ammonia is generally employed. By mixing exhaust gases with ammonia, NOx is converted to harmless nitrogen and water. The reaction is expressed as follows:

$$NO_X + NH_3 + (\text{catalyst}) \rightarrow N_2 + H_2O$$

The running cost of a liquid ammonia process is high, necessitating NOx measurements before and after the operation of NOx removal equipment to control the amount of ammonia that is injected.

NOx Measurements in Denitration of Gas Engine Exhaust



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Solution Details

Measurement system

Probes:

When sample temperature is from acid dew point (150°C) to 700 °C:

Type M1E Filter Probe; P/N K9219ED

Stack gas analyzer (NOx, O_2):

Model: SG750-A-103NNNNNN1❑❑❑❑.....

External drain separator: P/N K9641EA

Sampling tube: SG8SAP

Standard gas cylinders

Zero gas cylinder for O_2 calibration (Required to be purchased locally)

Span gas cylinder for NO_x calibration (Required to be purchased locally)

Air for O_2 span and NO_x zero calibration

Utilities

Power supply: 100/110/115/200/230 V AC, 50/60 Hz

Power consumption: Max. 600 VA

Field Data

Process Conditions

Measurement Point

Inlet and outlet of NO_x removal equipment, switching measurement points

Measuring Range

Inlet of NO_x removal equipment: 0-5000 ppm

Outlet of NO_x removal equipment: 0-200 ppm

Benefits

By controlling the NO_x concentration to a upper limit specified in the emission regulations, the amount of ammonia injected can be saved.

Reference:

In an exhaust system with a capacity of 1000 m^3, approximately 2.5 kg of liquid ammonia (concentration: 30%) is required to reduce the NO_x concentration in the exhaust gases by 100 ppm.

Notes

An external separator should be used when:

- the SG750 is installed near the sampling point. This may not allow the sample gas to cool sufficiently.
- the sampling tube is long. This may allow drained liquids to accumulate in the tube, causing sample components to dissolve and leading to measurement errors.
- the sampling tube is inclined at an angle of less than 15° to the horizontal.
- drain may form and stay in the sampling tube.

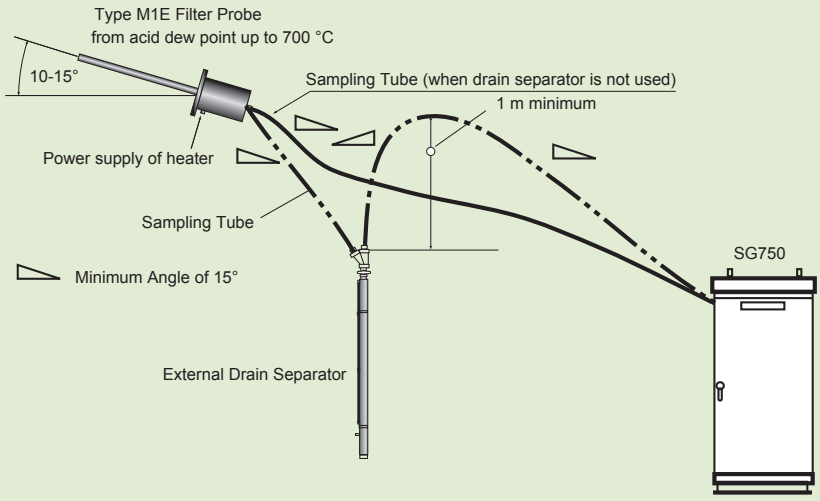
Gas engine exhaust has a high moisture content. Care must be exercised not to allow drain pockets to form in the sampling tube.

Care must also be taken to prevent excessive engine vibration.

Special Notes

- In Japan, NO_x emission regulations apply to gas engines as well as gas turbines and diesel engines and NO_x-O_2 measurement of exhaust is obligatory.
- Since the gas fuel has little sulfur content, sulfur dioxide (SO_2) is not present in the gas engine exhaust.

Installation of Typical External Sampling System



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