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APPLICATION NOTE

On-line monitoring of total sulfur at combined cycle gas power plants

Thermo Scientific SOLA iQ On-line Sulfur Analyzer

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Keywords
- Gas turbine
- Steam turbine
- Combined cycle gas
- Heat Recovery Steam Generator (HRSG)
- On-line monitoring
- Total Sulfur

Introduction

The Thermo Scientific™ SOLA On-line Sulfur Analyzers are used extensively in many oil and gas related industries for determination of total sulfur in many types of liquid and gas hydrocarbon samples, analysis ranges can be as low as 1ppm or up to 100% sulfur. With thousands of systems installed the SOLA utilizes field proven Pulsed UV Fluorescence technology to provide a continuous measurement of total sulfur with very fast response times to changing sulfur concentrations and excellent linearity and precision specifications. All sulfur species are converted into SO_2 by combustion in a process that is consistent with ASTM and ISO standards for total sulfur determination in the lab and online. This low maintenance and robust analyzer is equipped with a simple to operate graphical user interface, has extensive self-diagnostics and will communicate continuous real-time analysis data to the plant via a range of industry standard protocols.

Using both gas and steam turbines, cogeneration or combined-cycle power plants deliver higher energy efficiency and electrical output as compared to the conventional simple cycle gas plants.

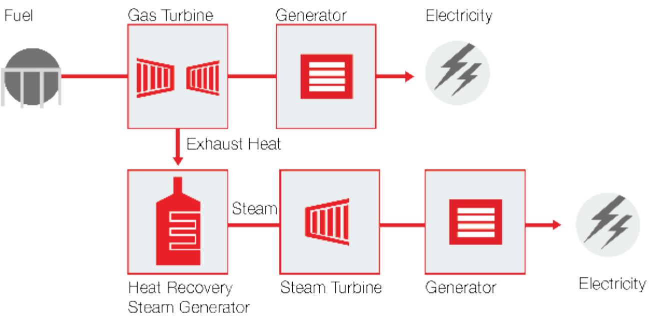

Figure 1 Waste heat recovery cycle source

- The gas turbine compresses air and mixes it with heated fuel. The hot air-fuel mixture moves through the gas turbine blades, making them spin. The fast-spinning turbine drives a generator that converts the spinning energy into electricity.

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• The Heat Recovery Steam Generator (HRSG) captures exhaust heat from the gas turbine, creates steam and delivers it to the steam turbine.

• The steam turbine sends its energy to the generator drive shaft, where it is converted into additional electricity.

Gas Turbine manufacturers provide specifications covering the fuel quality permitted for use in a gas turbine. Compositions of gaseous fuels (i.e. natural gas, LNG, LPG etc.) can vary quite widely depending on their sources.

Sulfur as a contaminant of potential concern

There are several concerns relative to the levels of sulfur contained in the fuel gas supply.

One of which is corrosion in the low-temperature section of the waste-heat recovery unit (HRSG) and the downstream stack. This is caused by the formation and condensation of sulfur acid. The acid is formed in the combustion process from the sulfur introduced into the system with the fuel.

As shown in Figure 2, the hot exhaust gases pass through several steam drums in the HRSG and release heat to produce superheated steam. If the flue gas at the latter stages, notably the evaporator, the economizer and the stack, are below its acid dew point, the gaseous acid will start to condensate and cause serious corrosion problems for the equipment.

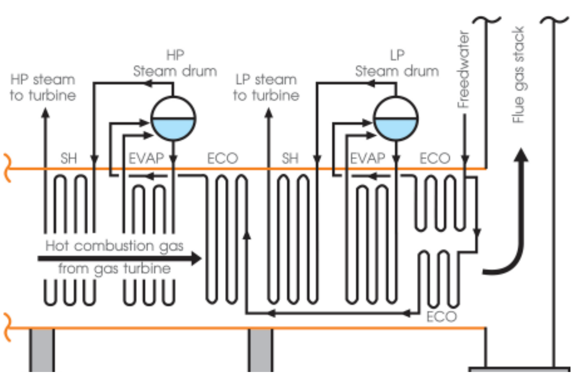

Figure 2 HRSG Soure

Another concern would be Selective Catalytic Reduction (SCR) deposition. Units utilizing ammonia injection downstream of the gas turbine for NO_x control can experience the formation of deposits containing ammonium sulfate and bisulfate on low temperature evaporator and economizer tubes. Such deposits are quite acidic and therefore corrosive. This may degrade HRSG performance (Figure 3) and increase backpressure on the gas turbine, thereby reducing output and revenue.

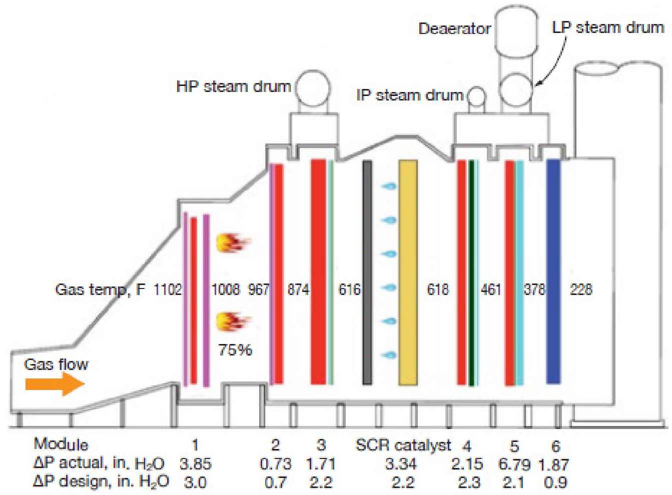

Figure 3 HRSGs experiencing rapid pressure drop. Fouling by ammonium bisulfate was attributed to amonnia reagent bypassing the SCR catalyst.

There is also environmental concern due to the discharge of acid gas. Sulfur combusts producing mainly sulfur dioxide emission to the atmosphere, which react in the presence of moisture resulting in acid rain.

On-line monitoring of total sulfur

Sulfur is usually present as either Hydrogen Sulfide (H_2S) or carbon as Carbonyl Sulfide (COS) in the natural gas. Typically, the gas supplier will limit H_2S to a concentration of less than approximately 20ppmv by removing sulfur in a treatment system.

Figure 4 SOLA iQ on-line total sulfur analyzer

With our field proven SOLA iQ on-line total sulfur analyzer, the plant users can determine the actual fuel sulfur level received. With the verified gas fuel sulfur concentrations, thermoscientific

the operators can further calculate the acid dew points of the fuel gases and specify appropriate design for the equipment. For example, the stack exit temperatures on the waste-heat recovery unit controlled to stay higher, and boiler feedwater temperatures elevated to prevent acid gas condensation within the chimney or the economizer, so as to prevent metal corrosion and reduce maintenance and repair costs.

The understanding of the contaminants in the supplied gas fuels used in gas turbine is critical to achieve the high energy efficiency of the overall system, minimize maintenance requirement and prolong the component lifetime.

On-line process mass spectrometer for determination of fuel gas properties

Use the Thermo Scientific™ Prima PRO Mass Spectrometer for determination of fuel gas composition and properties including calorific value and heat value (Wobbe Index), stoichiometric air requirement & combustion air requirement in real-time. This ultra-low maintenance, well proven technology is used at many power generating facilities, providing faster and more precise measurement of fuel gas properties than conventional calorimeters. **Learn more about fast online monitoring of fuel gases.**

Summary

The installation of a reliable and continuous total sulfur analyzer at the combined cycle gas power plant provides plant operators with reassurance that the sulfur content of fuel gases will not exceed those likely to result in the formation of acid gas, this rapid determination of sulfur content in the fuel gas enables plants to maintain operating conditions that will minimize the risk of corrosion, minimize maintenance and maximize efficiency.

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