Background

Sour gas combustion

Combustion of natural gas is the preferred form of energy for the next decades. In spite of renewable energy projects being developed and funded strongly, a reliable source of energy must create the backbone of our national grids.

Approximately 40% of the world's natural gas reserves are sour, meaning that H2S and CO2 is present most of the time. Among these sour reserves, more than 13% contain H2S in excess of 10%.

Removing the undesired acid gases from highly sour gases is a costly operation. The size and cost of the acid gas separation units and the acid gas-handling facilities (transformation of the H2S into sulfur and forming/shipping of the produced sulfur, or acid gas compression/pumping and re-injection facilities) increase with the amount of acid gases to separate. In the meantime, the exported volume of sales gas decreases because of the reduced hydrocarbon content of the inlet raw gas and the increased auto-consumption for gas treatment. Consequently, the technical cost per volume of exported sales gas is roughly doubled every 20-25% of additional acid gases present in the raw gas.

Sulfur, the traditional sub-product from the production of gases containing high amounts of H2S, formerly represented a substantial part of the revenues drawn

Action principle

The problem with the sulphur

With this background given above it is obvious why refineries worldwide tend to use sour gas as a basic fuel in combine cycle gas turbines to run their thermal processes. The heat generated during combustion is recovered in a recovery boiler.

Two corrosion effects are common in connection with sour gas combustion:

1. Sulfide stress cracking

Sulfide stress cracking (SSC) is a form of hydrogen embrittlement which is a cathodic cracking mechanism.

Susceptible alloys, especially steels, react with hydrogen sulfide, forming metal sulfides and atomic hydrogen as corrosion byproducts.

Atomic hydrogen either combines to form H_2 at the metal surface or diffuses into the metal matrix.

Since sulfur is a hydrogen recombination poison, the amount of atomic hydrogen which recombines to form H_2 on the surface is greatly reduced, thereby increasing the amount of diffusion of atomic hydrogen into the metal matrix.

This aspect is what makes wet H_2S environments so severe.

Example of corrosion of Economizer wing tubes

2. Formation of SO_3 and its condensation to sulfuric acid

Due to the high excess air in the combustion, the conversion rate of $SO_2 \rightarrow SO_3$ is strongly increased and can reach 10-20%.

So even a small amount of sulfur in the fuel can cause a considerable amount of SO_3 that will condense on the economizer tubes and form sulfuric acid.

Cold end of economizer

Benefits

Solving the problem with PentoMag

Cold end of economizer with PentoMag treatment. The formation of sulfuric acid is strongly reduced compared to the previous picture. No visible strains of acid running down to the bottom.

PentoMag 4122W is a complex of organic magnesium and dispersant agents specifically built for neutralizing sulphur compounds in natural and process gas firing turbines.

PentoMag 4122W contains highly reactive MgO to neutralize SO_3 and sulfuric acid in the gas phase. Economizer tubes and boiler walls are protected from sulfuric acid in the liquid phase because PentoMag 4122W forms a protective film on the metallic surfaces. No direct contact of the acidic molecules is possible with the pipes.

Ask your question online about PentoMag 4122W

Dosing skid

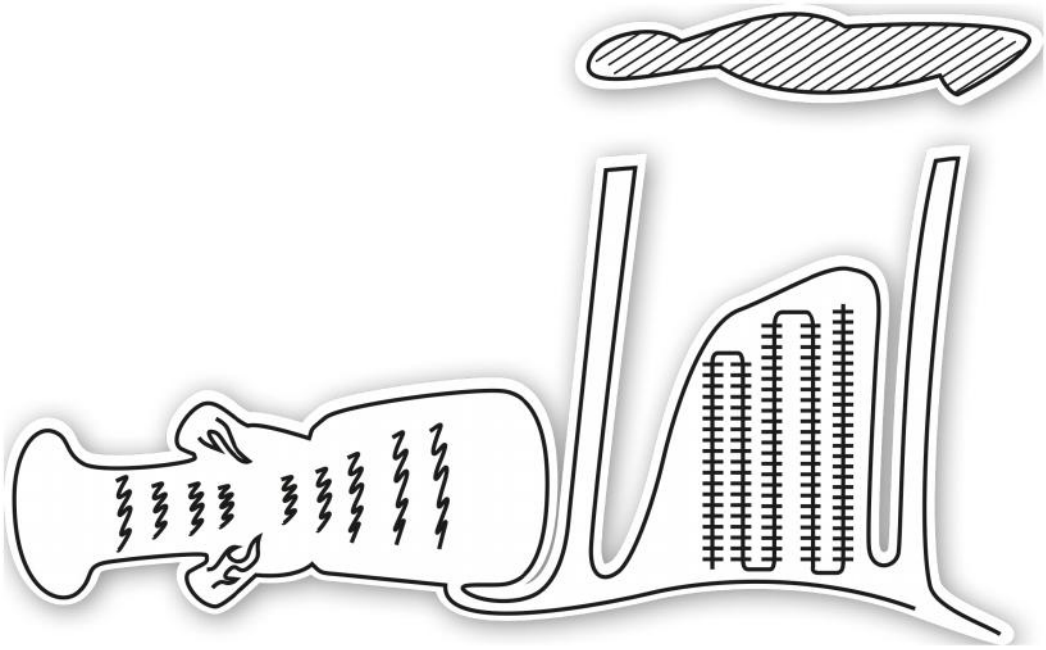
Application

Both corrosion effects are most active at temperatures below acid dew point. It is therefore advisable to inject PentoMag 4122W after the gas turbine.

The MgO activity is effectively covering the path from dosing point to the chimney, protecting all metal parts below condensation temperature. In cases of frequent starts and stops, it is advisable to inject PentoMag 4122W before the damper of the

bypass. As the bypass cools off, it will suffer from s not treated properly.

Pentol produces water cooled injectors that allow direct injection on the most affected surfaces. PentoMag 4122W is sprayed into the combustion chamber by means of compressed air.



Pentol provides the dosing system

Maintenance

Dosing rate

Pentol can provide laboratory analysis of fuels as well as SO3 monitoring systems for emission measurements.

The correct dosing rate is calculated on the H_2S content in the fuel gas. Because of the absence of dust during combustion, it is difficult to control the dosing rate during operation, it has to be calculated regularely to prevent corrosion in the recovery boiler.

Typically, PentoMag 4122W is applied 1:1 to the SO_3 content. For plants that have operated without treatment before, the dosing rate should be doubled or even tripled to neutralize existing acid in the boiler.

Efficiency

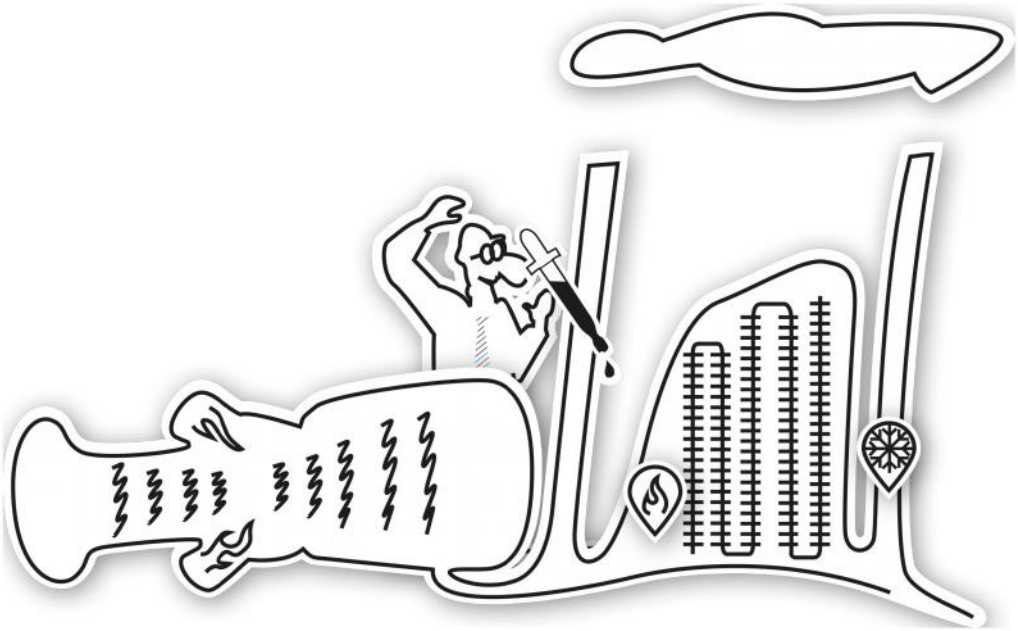
Environmental impact

Neutralisation of SO3 will have a positive impact on the plume on the chimney. Depending on flue gas temperature on the chimney, the white/blueish plume can be completely removed.

Results

- No corrosion of the cold end area of the recovery boiler

- No corrosion in the chimney
- Reduction of visible plume on chimney
- Increase of lifetime of the recovery boiler
- Longer runtime of the boiler, less steam leaks due to corrosion



Pentol provides the dosing system

Next steps

We need to get in touch personally.

Questions regarding function, support, and sales are answered via online chat support and e-mail to sales@pentol.net, as fast as possible.

Start a conversation