APPLICATION NOTE

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Measurement of O_2 concentrations in vacuum distillation column in petroleum refining

Industry: Refinery
Product: TDLS

Introduction

O_2 measurement in hydrocarbon vapor is used for safety monitoring in vacuum distillation columns in petroleum refining. With conventional paramagnetic oxygen analyzers, O_2 concentrations are obtained through an extractive sampling system, which conditions the sample prior to being analyzed. Sample systems cause measurement response time delays, which are very critical in safety systems. Moreover there are many problems related to maintenance and operational costs of sample systems. The process gas to be measured contains high concentration of H_2S that leads to quick corrosion of the sample system and analyzer. Another issue when using sampling systems is the sample is not representative of the process after the sample has been conditions and dew point of the sample has been modified, which affects the volume concentration of the sample.
The TDLS200 Laser Analyzer is the solution to all these problems.

Expected Benefits

- High-speed response to meet all requirements of safety control
- Continuous monitoring of O_2 concentration in-situ
- Eliminates the need for sampling and reduces the maintenance and running costs of the sampling system

Process Overview

The vacuum distillation column is used to distill the residual oil from the atmospheric distillation column. The distillation must be performed at absolute pressures as low as 2 to 15 kPa so as to limit the operating temperature to less than 370 to 380°C and to avoid hydrocarbons cracking processes. The presence of oxygen in the process can be caused by leakages and can lead to explosion. Thereby there are rules to control the O_2 level in vacuum columns. At level 2 to 5 % O_2 the alarm and purging of vapor line by inert gas has to be switched on. That is why high-speed response and high reliability are required for O_2 measurements.

Advantage

1. vs Conventional Paramagnetic O_2 Analyzer

Conventional Paramagnetic O_2 analyzer cannot be used in-line measurement.

The TDLS200 is capable of directly measuring the O_2 concentrations in the vapor line, instead of conventional paramagnetic oxygen analyzers that perform measurements through a sampling system. When using traditional analyzer systems, since the application is for a process working under depression (vacuum), a pump is required. The deeper vacuum the more difficult it is to provide the proper pump. Sometimes it results in seal failure and air leakage and failure measurement results.

2. vs Other TDL Analyzers

The shape of O_2 absorption spectrum become very sharp under this vacuum condition, which is difficult for other TDL analyzers to measure O_2 concentration accurately.

But only TDLS200 can measure O_2 concentration accurately under such vacuum condition by True Peak integration (area) method. For the pressure variation test data, see next page.

Vacuum Distillation Column

YOKOGAWA

Solution Details

Measurement System

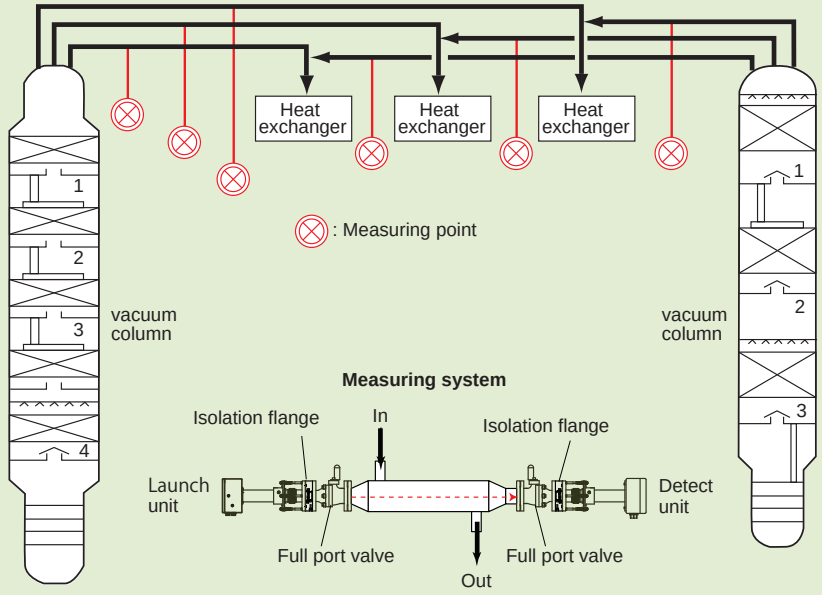
TDLS (O_2 Analyzer):

TDLS200-S-X1-2-5/Z
Z: Very low pressure

Isolation Flange:

IF200-□□-□□-SS-12-1-N
Selection of Isolation Flange:
Material; 316/316L SS,
Sapphire Window; for O_2,
O-ring Material; Kalrez 4079
Note: It is needed the suitable pressure class of the used flanges.

Measuring points of vacuum distillation column

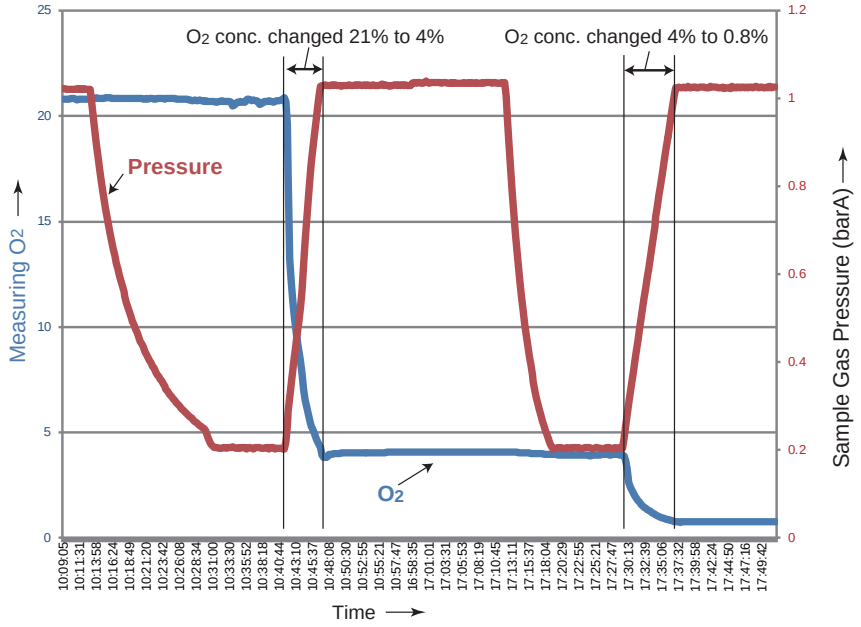


Pressure Variation Test Data

This graph shows O_2 measurement on 21%, 4%, 0.8% level under condition which gas pressure change from 1 BarA to 0.2 BarA by TDLS200, and shows the measurement done stably and correctly without influence of pressure change.

O_2 absorption spectra shape is big changed by pressure change, but the spectrum peak area change to pressure proportionally, so TDLS200 can compensate pressure influence correctly.

Measurement Value of O_2 Concentration under Pressure Change 1 BarA to 0.2 BarA



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