

Continuous Measurement of Process Oxygen for Claus Sulfur Recovery Unit (SRU) Start-ups and Shut-downs

During start-up and shut-down, any time a sulfur recovery unit (SRU) transitions from ambient temperature through fuel gas warm up to the introduction of acid gas, measurement of O₂ stoichiometry is critical. Historically, operators have manually taken samples using a portable electrochemical type O₂ analyzer. While giving more or less satisfactory results, the requirement for more stringent operating limits, hazard exposure and the non-continuous nature are reasons to consider a permanent solution. A fixed system that draws a continuous sample during the operational transition period, without intervention from operations or analyzer maintenance, can be rationalized. AMETEK Process Instruments has extensive experience making a continuous process oxygen measurement in Claus SRUs and has developed a system specifically for start-up and shut-down applications.

The motivation from the operator's perspective is a combination of safety and operational requirements. The environmental permit requires most refineries to start up the entire sulfur recovery plant (SRU + tail gas treating unit) in a single sequence with zero tolerance for emission exceedences. More frequent manual sampling is not a consideration, as this would bring increased exposure to personnel. As it turns out, the continuous measurement of O₂ in an SRU process stream is not new. AMETEK developed and supplied ~45 systems for Superclaus™ where excess O₂ is measured in SRU tail gas before a subsequent generation of the catalyst obviated the need for the measurement.

The detection principle is based on tunable diode laser spectroscopy (TDLAS) which measures "actual O₂" and is widely applied in process O₂ applications where the background gas has flammable components. TDLAS has become a favored method of oxygen analysis in the last decade, replacing both zirconia based stack gas analysis as well as paramagnetic process analysis and is well proven.



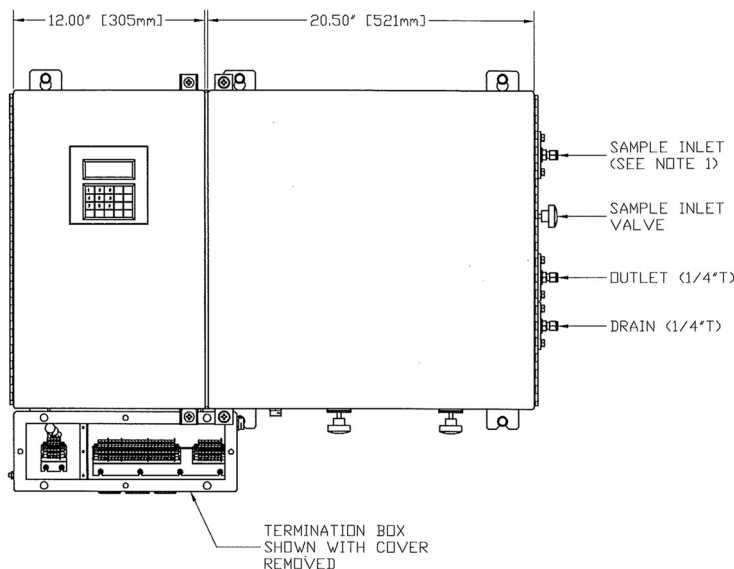
Analyzer module (ASR probe not shown)

A major advantage, particularly over the paramagnetic technique, has been the ruggedness of the method. Laser lifetimes (MTBF) are in excess of ten years and there are no sensitive elements of the analyzer in contact with sample, a particular advantage in this application. There is consequently no regular replacement spares requirement for this technology.

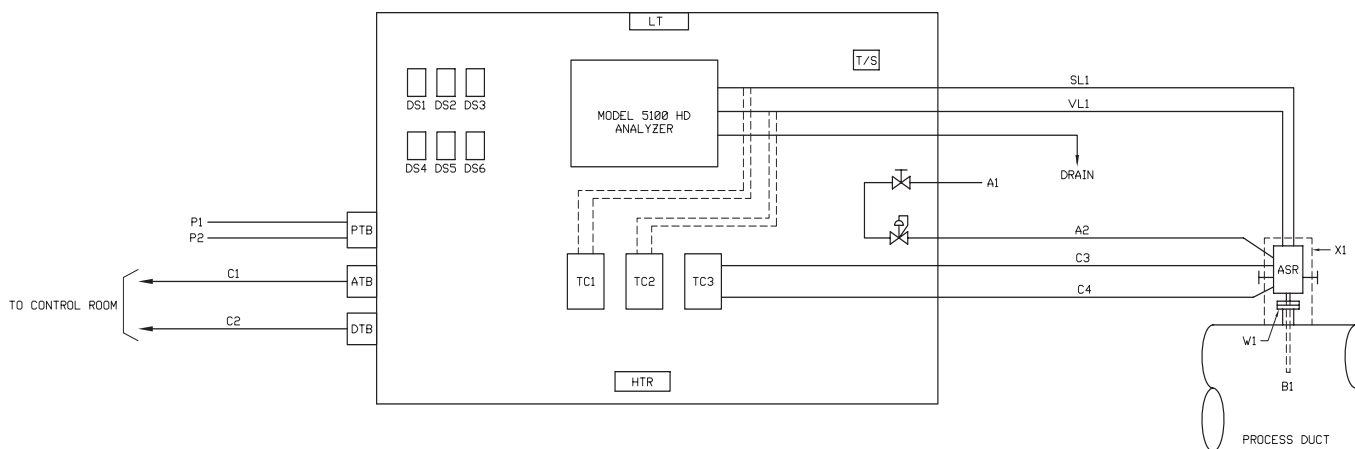
The sample handling for the continuous measurement technique could be quite conventional provided fuel gas was the only mode. However, when acid gas is cut in, the sample conditioning must contend with sulfur vapor and liquid; hence, the sample handling requirements are similar to a tail gas "ratio" analyzer. While the

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measurement is not required after acid gas has been introduced and in steady state, there is a period that the analyzer light path must be maintained above the sulfur vapor dew point. The sample system is designed for this duty. It utilizes the "Advanced Sulfur Reduction" (ASR) probe from the 900 series tail gas analyzer as well as a heated oven fully integrated into the TDLAS analyzer. Sample can be taken from the outlet of the first, second, third or final condenser. Operational requirements vary according to local operating procedures. Sulphur Experts Inc.™ recommends in their seminars that the fuel gas warm up burn strategy should be right at stoichiometry or no more than 0.02% excess, if possible, and to be certain to prevent free oxygen from reaching the hot catalyst. This requires "city" gas as a fuel source and accurate flow metering for both air and fuel gas. The continuous O₂ measurement is a degree of detail that ensures protection of the catalyst, prevents emission episodes and most importantly provides a level of protection for operations personnel.



Please contact AMETEK to discuss this application if further detail is required.



Flow diagram of one stream sampling for one SRU



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