

Hydrogen Cooled Generators TCD Process Gas Analyzer

Basics and background

Gaseous hydrogen can be used as a cooling agent in large generators due to its highly efficient cooling performance. This is because hydrogen has a low density, high specific heat, and the highest thermal conductivity of all gases. Helium was considered as a coolant as well, however its high cost hinders its adoption despite its non-flammability.

Hydrogen cooled generators require coolant monitoring for economic reasons (cooling efficiency for maximum productivity and the reduction of friction losses) as well as for safety reasons (avoidance of explosive gas mixtures).



Solution – Use of a thermal conductivity process gas analyzer

During the startup phase, purging with inert gas (normally CO₂, sometimes Ar) will displace the unwanted air. The second step is the displacement of the inert gas by H₂. This process is controlled by measurement of

0 to 100% CO₂ (Ar) in air and then 0 to 100% H₂ in inert gas.

During the shutdown phase, these two steps are performed in reverse thus preventing explosive gas mixtures from developing.

During normal operation small leakages of air into the H₂ may be tolerable. In this case the continuous measurement of 80 to 100% H₂ in air allows the control of the H₂ purity. A threshold alarm can be set to avoid the hydrogen level falling below a set value.

For the different operating phases 3 different kinds of measurements using a thermal conductivity analyzer are required. The three measurements are ideally accomplished with a single TCD analyzer using different range linearization curves and providing range identification.



Operating state	Procedure	Measuring task	Measuring range
Maintenance: filling of hydrogen	1. Purging with inert gas 2. Purging with H ₂	inert gas in air H ₂ in inert gas	0 - 100% CO ₂ (Ar) 0 - 100% H ₂
Normal operation	Cooling gas purity monitoring	H ₂ in air	80 - 100% H ₂
Maintenance: discharge of hydrogen	1. Purging with inert gas 2. Purging with air	H ₂ in inert gas inert gas in air	0 - 100% H ₂ 0 - 100% CO ₂ (Ar)

Conclusions

LFE's CONTHOS 3 – TCD gas analyzer implements 3 independent, switched measuring ranges. Each range is optimized for the particular phase of generator operation. This includes the suppressed range of H₂ in air for the monitoring of hydrogen purity during normal generator operation for optimized efficiency and safety.

LFE can provide the CONTHOS 3 – TCD gas analyzer in a general purpose version or in an Ex p hazardous area version with ATEX certification for ex zones 1 and 2.

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