Centrifuge inerting in the chemical industry

Description of the application



The process of separation of products can be a hazardous exercise and the measurement of oxygen is critical to prevent breeches in plant and personnel safety.

Centrifuges are purged with nitrogen prior to charging with product.

The oxygen level is then monitored in the purge vent line to ensure adequate inerting.

Typical oxygen levels

It is the volumetric concentration of oxygen that is important rather than the oxygen partial pressure. Oxygen levels of less than 2%vol are required, although concentrations lower than 0.1%vol are often achieved.

The LEL (Lower Explosive Limit) in a particular vent line will depend on the flammable gas mix. For hydrogen this will be 4%vol O_2, but for other solvents 8%vol may be OK. It is normal to work with a good margin of safety and so O_2 levels are often controlled to 2%vol or less. Actual levels of 1%vol are typical.

Process conditions

Pressure: The vent line is under slightly elevated pressure. Typical pressures are from 0 to 40 mbar, although pressures higher than 40 mbar are possible due to back pressure. These variations may be measured by using an external pressure measuring device to ensure reading accuracy is provided.

Temperature: Ambient.

Gas composition

During purging only O_2 and N_2 will be present, but during and after the process many different gas mixtures could be encountered. As well as solvents, HCl, water, dust and hydrogen are common.

Material requirements

Hastelloy is most common in newer installations and is usually required because of the presence of wet HCl. In this case the oxygen sensor should be Hastelloy as well. If retrofitting to an existing stainless steel centrifuge then a 316 stainless steel sensor will suffice.

O-rings are generally made of Viton. If there is risk of water condensation on the membrane, then a Gortex membrane can be used.

Sampling



The Orbisphere sensor is mounted directly in the line, using a Satron PASVE valve. The sensor should always be horizontal. The Valmet device allows the sensor to be withdrawn from the line without breaking the line. Sensor operation can also be checked without removing the sensor.

Sensor calibration and verification

The PASVE valve allows the sensor to be withdrawn from the line to a test position without breaching the line. A typical verification sequence to ensure that the sensor can respond to both high and low oxygen concentration is as follows:

As the centrifuge purging cycle is started, the sensor is automatically withdrawn from the line to the test position and compressed air is blown gently past.

The sensor must respond to this by rising to between 20% and 21% before the sensor is then turned back into the line. By this time, it is expected that the centrifuge inerting will be almost complete, and so the sensor signal should fall rapidly.

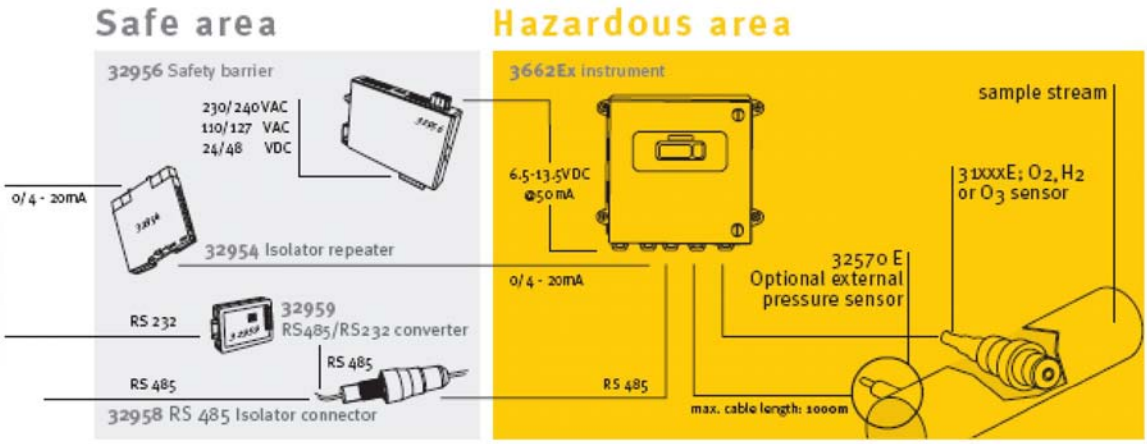
The test is complete if the reading drops below 2% within 3 minutes of the sequence start. If this is completed satisfactorily, then the centrifuge may be charged with product. Since a failure of the test could be due to incomplete inerting within that time, a second identical sequence is carried out if required.

Sensor materials

Since the O_2 sensor is in direct contact with the chemical substances, chemical resistance is a must. All wetted parts of Orbisphere's sensors are 316L stainless steel; as required, the sensor head can be made from other materials, such as Hastelloy C276.

The sensor protection cap allows the use of a Gore-Tex water separation filter in applications where water vapor may condense onto the sensor. Kalrez washers are recommended instead of silicone to avoid swelling. Sensor head and sensor socket or flow chamber O-rings should be of Viton or Kalrez.

Installation schematic



Recommended systems components

Model	Description
3662EX/106	Instrument ATEX, Substance measured: Oxygen, Configuration: Wall, Number of channels: 1, Temp. units: °C, Membrane 29552A, Measurement type: PO2, Thermal cut-off, Current output, Voltage output, RS485 serial output: requires 32958 for installation in hazardous area, Instrument voltage: 6.5 – 13.5 VDC by 32956.X. Intrinsically safe, Special sensor cable: 32515E, Special sensor: 311XXE, CO2 insensitive, Measurement units: %/ppm.
31120E.11	EC Sensor, Substance measured: Oxygen, Sensing head material: Stainless Steel, Guard ring: Silver, Maximum pressure: 50 bar, O-Ring: Viton, Intrinsically safe.
32001.01	Flow chamber in stainless steel (316) with 6 mm fittings. Supplied with EPDM O-rings.
32515E.03	3 meter sensor cable for 366xEX, 5 wires. Supplied with 2 connectors, 2 sleeves with 32515E label.
32956.B	Intrinsically safe power supply incorporating DIN rail mounting safety barrier, for 3662Ex. For use in the safe area. 230 VAC
32954	Isolator repeater for 4/20mA current output. Must be installed in a safe zone if current output is utilized. For 3662EX
32696	Windows PC software ATEX3660 for 3660Ex and 3662Ex. Program in English, French, and German.
32706	Maintenance kit for oxygen electrochemical sensors. Includes membranes 29552A, electrolyte 2959, membrane holding ring 29229.01, and tools for sensor maintenance. (Replaces 32706L & 32706M.)

Options

Model	Description
31120E.14	EC Sensor, Substance measured: Oxygen, Sensing head material: Hastelloy, Guard ring: Silver, Maximum pressure: 50 bar, O-Ring: Viton, Intrinsically safe.
32956.A	Intrinsically safe power supply incorporating DIN rail mounting safety barrier, for 3662EX. For use in the safe area. 110 VAC
32956.C	Intrinsically safe power supply incorporating DIN rail mounting safety barrier, for 3662EX. For use in the safe area. 24/48 VDC
32959	Converter RS232/RS485 for 3662Ex. Battery powered; batteries not included.
32538.02	2 meter RS232 cable, to connect the converter (32959) to a computer for the 3662Ex. Supplied with 2 female 9D connectors.
32958	Isolated Ex connector RS485/RS485 for 3662Ex.