PAC | Application Note

Gas sample conditioning system for moisture removal in process gasses

- Selective Removal of water in Gaseous samples
- No loss of analytes
- >90% removal of water vapor
- Inert flow path

Keywords: Membrane dryer, Gas sample conditioning, Moisture management

INTRODUCTION

The AC dryer box is designed to remove water vapor from process gasses prior to injection on a gas chromatograph for analysis. Removing water vapor from the sample increases the lifetime of the columns used in the instrument, which are sensitive for water. >90% of the water vapor is removed from the sample.

PRINCIPLE

The AC Dryer box houses a Perma Pure MD™ membrane dryer, which is a moisture exchanger which transfers water vapor between two opposite gas streams. The dryer consist of a Nafion® polymer tube surrounded by an outer tube. Dry purge gas flowing over the outer surface of the Nafion® tubing continuously extracts water vapor from the gas stream inside the tubing. The driving force is the difference in water concentration on the opposite sides of the tubing wall. The purge gas then carries the water vapor away.

SELECTIVITY

The AC Dryer Box has an inert flow path for the sample. The membrane dryer is selective to polar compounds (oxygen bound) like alcohols, ethers and aldehydes. These components are totally or partially lost from the sample.

VALIDATION

The AC Dryer Box is validated by performing two experiments: The removal of water vapor and the absorption (loss) of sulfur components.

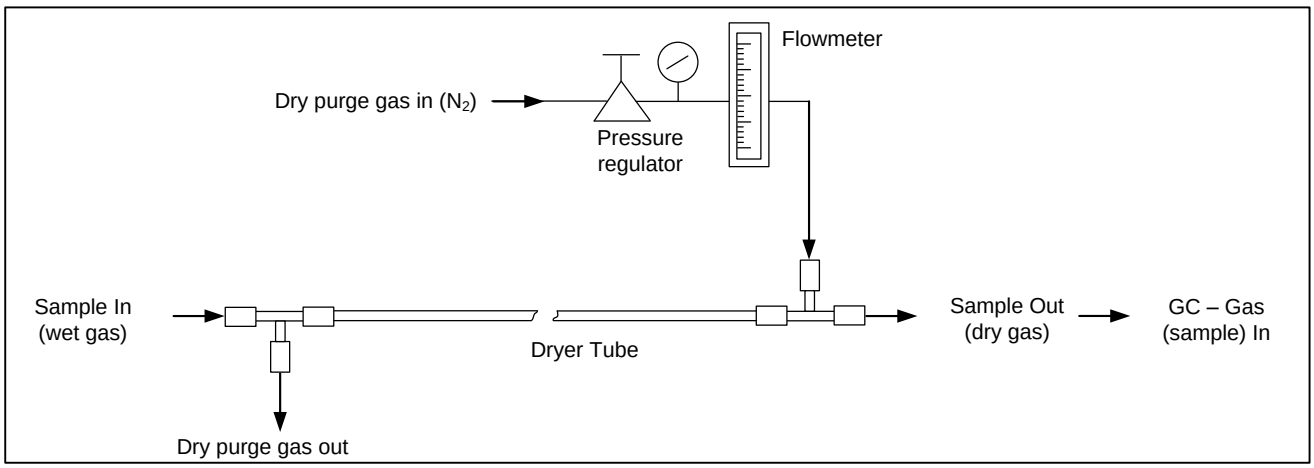

Figure 1. Plumbing diagram AC Dryer Box

REMOVAL OF WATER VAPOR

The removal of water vapor is tested by setting up a Gas Chromatograph with a gas sampling valve, S/SL inlet, capillary column and TCD. To quantify the water a certified permeation tube (G-Cal) is used. By putting a nitrogen flow over the permeation tube a known amount of water is transferred to the analyzer. The tests are performed with a nitrogen flow of 10 mL min over the permeation tube, resulting in a concentration of 0.7 vol% of water.

The system is calibrated by taking the average response factor of three successive analyses (0.7 vol%) without the dryer box in flow (table 1)
After the calibration the dryer box is placed in the flow path and ten successive analyses are performed (table 2)

The dryer box has a drying performance of 94%

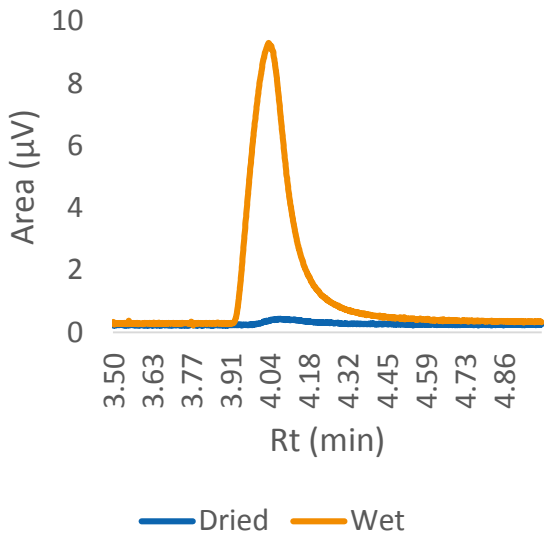

Figure 2. Overlay of an analysis with and without dryer box

Analysis	Amount (Vol %)	Area	RF
1	0.7058	83.9	0.0084
2		86.0	0.0082
3		84.8	0.0083
Average		84.9	0.0083

Table 1. Water calibration results

Injection	Area	Amount (ppm vol)	Drying performance (%)
1	4.67	388	94
2	4.62	384	95
3	4.68	389	94
4	4.95	411	94
5	4.63	385	95
6	4.80	399	94
7	4.69	389	94
8	4.73	393	94
9	4.76	396	94
10	4.85	403	94
Average	4.74	394	94
RSD	2.2	2.2	0.1

Table 2. Dryer box results

SULFUR ABSORPTION

To test the inertness of the dryer box a system is set up with a GSV, S/SL inlet, capillary column and SCD. Sulfur gasses with low ppm sulfur components are analyzed (≥10 successive runs) with and without the dryer box in the sample flow path. The deviation from the analyses without dryer box with the analyses with dryer box are calculated from the average concentration of the runs. (see table 3). The deviation lies within the repeatability of the system

The dryer box shows a good inertness towards the sulfur components.

Table 3. Average (n ≥10) deviation between analyses with and without dryer box in flow path

Component	Concentration (ppm)	Recovery (%)
SO_2	9.1	100.7
H_2S	9.6	100.4
COS	9.8	100.1
MeSH	9.8	100
EtSH	10	100.4
DMS	10	99.4

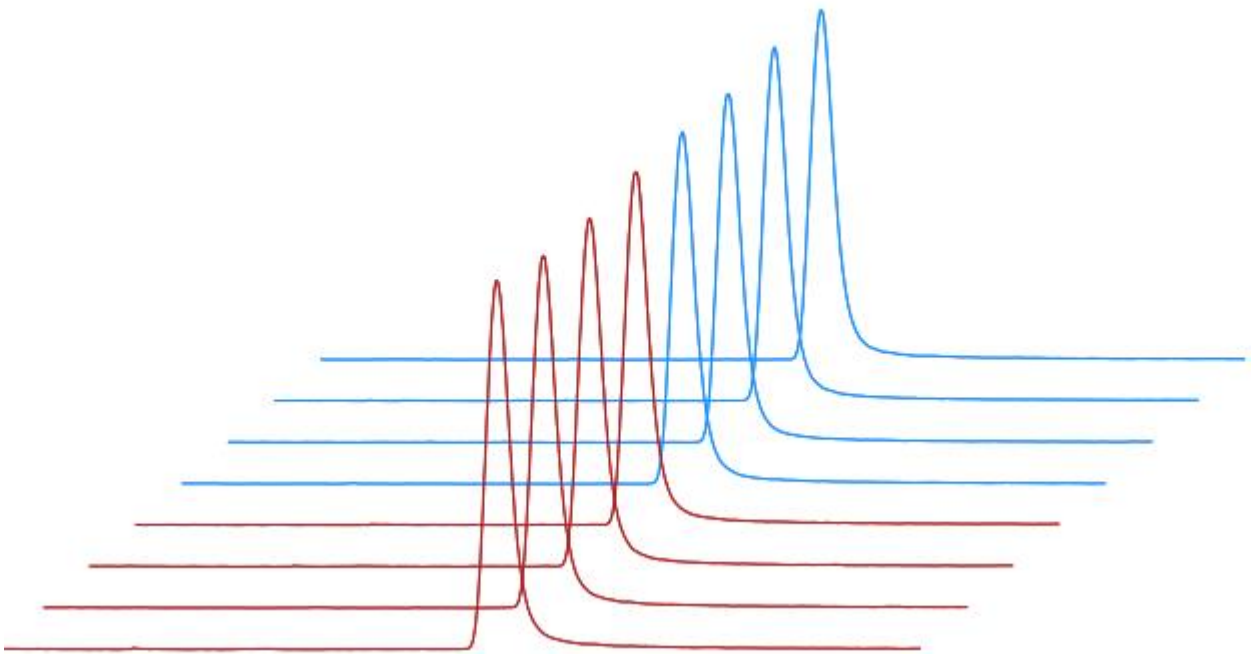

Table 3. Overlay of 4 run with dryer SO2 (red) and 4 run without dryer (blue)

Conclusion

The AC Dryer Box provides an effective solution for the removal of moisture from gaseous samples with a efficiency of >90%+. By Removing moisture vapor from gaseous samples will increase column lifetime and decrease instrument downtime.

The selectivity toward moisture provides excellent compatibility with gaseous sample like natural gas, refinery gas and process streams.

Sales Part No	Description
68100.040	AC Dryer Box
Efficiency Moisture Removal	>90%
No loss of analyte	