Gas Distribution Equipment for Laboratory Pipelines

Impurities -What Are They? What Do They Do? Where Do They Come From?

The Importance of Keeping Gas Purity & Integrity

Below is a list of common detectors used in gas chromatography. As shown in the Table of Page 6, the gases used for different detectors are similar in name but often different in terms of purity levels. Below is a list of contaminants and their impacts on the analytical equipment performance.

DISCHARGE IONIZATION DETECTOR (DID)
Enemies: Trace levels of oxygen, moisture and hydrocarbons
Impact: Reduce detector response and affect baseline stability

ELECTRON CAPTURE DETECTOR (ECD)
Enemies: Moisture, oxygen and trace of halocarbons
Impact: Reduce detector response, cause baseline shift and create negative peaks

FLAME IONIZATION DETECTOR (FID)
Enemies: Hydrocarbons, oxygen, moisture
Impact: Decrease detector sensitivity and damage chromatographic columns

FOURIER TRANSFORM INFRARED DETECTOR (FDIR)
Enemies: Impurities absorbing in the same waveband of species, moisture and oxygen
Impact: Inaccurate response and interfere with infra red spectra

HELIUM IONIZATION DETECTOR (HID)
Enemies: Trace of hydrocarbons, oxygen and moisture
Impact: Affect detector stability

MASS SPECTROSCOPY DETECTOR (MS)
Enemies:Traces of impurities with equivalent mass of the species
Impact: Inaccurate response

PULSE DISCHARGE ELECTRON CAPTURE DETECTOR (PDECD)
Enemies: Moisture, oxygen and trace of halocarbons
Impact: Reduce detector response, cause baseline shift and create negative peaks

PULSE DISCHARGE HELIUM IONIZATION DETECTOR (PDHID)
Enemies:Trace levels of oxygen, moisture and hydrocarbons
Impact: Reduce detector response and affect baseline stability

PULSE DISCHARGE PHOTO IONIZATION DETECTOR (PDPID)
Enemies:Trace levels of oxygen, moisture and hydrocarbons
Impact: Reduce detector response and affect baseline stability

PULSE DISCHARGE PHOTO IONIZATION DETECTOR (PDPID)
Enemies:Trace levels of oxygen, moisture and hydrocarbons
Oxidizer and contaminants in fuel gas
Impact: Reduce detector response and affect baseline stability
Interfere with detector response

THERMAL CONDUCTIVITY DETECTOR (TCD)
Enemies:Trace levels of oxygen and hydrocarbons.
Impact: Reduce detector sensitivity and corrode filament of detector

The Multiple Sources of Impurities in a Gas Distribution System

We have just seen that hydrocarbons, moisture, oxygen and halocarbons (to a lesser extent) are the main gas stream contaminants. These contaminants can find their way into the piping system in many ways. The list below is
certainly not exhaustive.

GAS CYLINDERS
Unless the purity (aka grade) of the gas selected is inadequate for the intended purpose - like using industrial grade helium for a GC-MS, it is very unlikely that the source of contaminants is the gas cylinders. Gas companies are analyzing gas purity either in cylinder batches or individually. But, because mistakes can happen, contaminants have been found in gas cylinders.

PIPELINE INSTALLER
Pipeline installers are not all made equal. While several installers have competent and experienced personnel, the lack of knowledge of the not so fortunate installers can lead to fairly disastrous installs (even with the best intention in mind). The sources of contamination by a poor pipeline
installation are countless: leaky joints, oily tools and hands, bad purges (if any), poor inerting (if any) while brazing/welding , wrong materials installed, etc.

PIPING AND TUBING
It is better to have a clean medical grade copper pipe than a dirty stainless steel pipe. Nowadays, several stainless steel tubes and pipes are imported from overseas in ship containers. Humidity is gradually building up causing
accumulation of lime and dust to stick better inside the tubes and pipes. Wholesalers are often keeping those tubes/pipes on their big pipe racks uncapped and therefore open to atmosphere where dust and debris gradually build up.

GAS EQUIPMENT
The poor selection of gas equipment can lead to serious gas contamination. Off gassing of rubber materials such as Neoprene diaphragm regulators will inevitably be visible to most detectors. That's why it is not recommend to use regulators designed for welding or for medical applications in high purity applications. Airborne contaminants (moisture, oxygen and carbon dioxide) find their way into gas streams from several locations; valves with packing (ball valves and needle valves) and forged body regulators to name a few. Even good three-piece medical ball valves are not suitable for high purity applications. Although the cost could be prohibitive, the best type of valve is definitely the packless diaphragm valve. Should ball valves or needle valves be used for high purity applications, a good quality instrumentation needle valve or ball valve (Swagelok type) will greatly limit the damages compared to medical ball valves for example.

END USER
Chemists and lab technicians have not been trained to properly handle high purity gas equipment. Many times gas cylinder regulators have changed gas service by simply changing the CGA inlet connection. Worse yet is when end users are inadequately connecting a series of gas chromatographs with old and worn out fittings.