# Gas Chromatography Problem Solving and Troubleshooting

***Question:***

I was instructed to install water and oxygen traps on my carrier gas line to improve sensitivity. After installing the traps I did not obtain better sensitivity. Is there a problem with my traps or their installation?

***Answer:***

It is unlikely that there is a problem with the traps. Upon installing a gas trap, the amount (if any) of sensitivity improvement depends on the detector and the original gas purity. If a detector does not respond to oxygen or water, or is affected by their presence, installing a water or oxygen trap has little impact on sensitivity. For example, an FID does not respond to water or oxygen, thus lowering their concentration in the carrier gas does not significantly affect sensitivity. Conversely, an ECD is very sensitive to water and oxygen, thus lowering their concentrations may result in a significant increase in sensitivity.

If sensitivity improvement occurs, it is usually evident as a decrease in the baseline noise and/or absolute level. Figure 1 illustrates this effect for a GC–MS system. The upper baseline trace is for the water present in a cylinder of ultrahigh-purity helium, whereas the bottom baseline trace is for oxygen. When no trap is used (left portion of the baseline trace), the absolute baseline level and noise are 3–4 times higher than the baseline obtained when a trap is used to purify the carrier gas (right portion of the baseline trace). Note that if the scan range of a mass spectrometer is above *m/z* 32, this amount of improvement will not be observed. Because water and oxygen are not being detected, a significant decrease in the baseline level and noise would not occur. This is another example of a detector's response characteristics having an influence on the amount of sensitivity improvement with gas traps. Although the water and oxygen concentrations are lower, the mass spectrometer is not directly affected (i.e., it is not responding to water or oxygen). There may be a secondary or indirect effect due to a higher concentration of water or oxygen; however, the change in the baseline would not be as dramatic as seen in Figure 1.

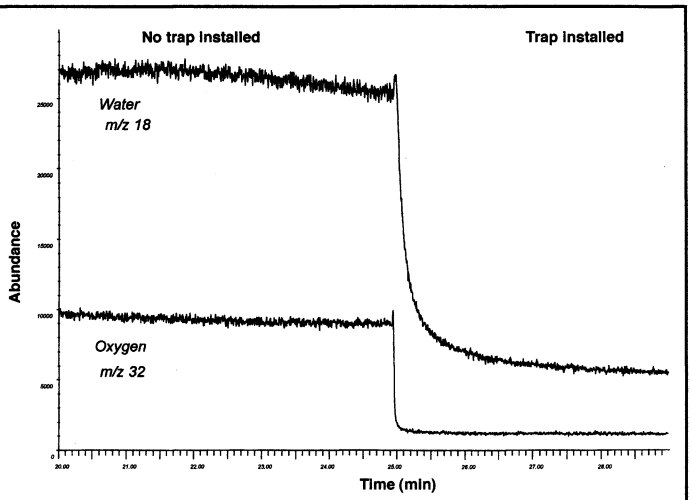


**Figure 1.** Baseline trace with and without a gas trap installed. Carrier gas: ultrahigh-purity helium. Trap: combination water, oxygen, and hydrocarbon trap. Extracted ion chromatograms using GC–MS system with a 30-m deactivated fused-silica tubing column installed. The trap was installed in the carrier gas line with an in-line valve to enable bypassing of the trap. The background signal was collected with the trap off-line (left portion). Upon switching the valve and placing the trap in-line, a drop in the background signal and noise occurred (right portion).

The amount of sensitivity improvement is often dependent on the concentration of the impurities in the original carrier gas. A lower grade or lower purity carrier gas benefits the most from gas traps because the impurity concentrations are reduced to values much lower than in the original gas. Using gas traps for a carrier gas that is already very pure results in a small decrease in the impurities relative to the original concentrations. For this reason, there is debate whether gas traps are needed for very high-purity carrier gases. If using a gas trap does not improve sensitivity, it does not always make sense to use a trap due to its cost and maintenance requirements (i.e., monitoring and replacement).

The purpose of *Chromatography Problem Solving and Troubleshooting* is to have selected experts answer chromatographic questions in any of the various separation fields (GC, GC–MS, HPLC, TLC, SFC, HPTLC, open column, etc.). If you have questions or problems that you would like answered, please forward these to the *Journal* editorial office with all pertinent details: instrument operating conditions, temperatures, pressures, columns, support materials, liquid phases, carrier gas, mobile phases, detectors, example chromatograms, etc. In addition, if you would like to share your expertise or experience in the form of a particular question accompanied by the answer, please forward to JCS Associate Editor, *Chromatography Problem Solving and Troubleshooting,* P.O. Box 48312, Niles, IL 60714. All questions/answers are reviewed to ensure completeness. The *Journal* reserves the right not to publish submitted questions/answers.

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Associate Editor

There is one other factor to consider when deciding on the use of gas traps. At elevated column temperatures, oxygen and water significantly accelerate the rate of stationary phase degradation. Longer column life is obtained at lower water and oxygen concentrations. This is especially evident for polar stationary phases or when a column is routinely used at or near its upper temperature limit. Again, the impact of a gas trap is greater for lower grade or lower purity gases. When using higher grades of carrier gases, factors other than carrier gas purity often affect column life. Harmful sample compounds and contaminants as well as carrier gas leaks usually degrade column performance long before the trace levels of oxygen or water in the carrier gas can reduce column life.

The same sensitivity issues need to be considered when determining whether detector gases will benefit from gas traps. The sensitivity of ECDs and ELCDs are improved with water and oxygen traps installed in the detector gas line. A hydrocarbon trap is recommended for PIDs due to their high sensitivity to many organics. Most combustion detectors (e.g., FID, FPD, and NPD) do not significantly benefit from traps on their gases unless the qualtity of the gas is poor or the detector is being operated at its extreme sensitivity level.

Upon expiration, many gas traps not only stop purifying the gas, they also introduce other contaminants into the gas. For this reason, traps need to be monitored and changed before they expire. Installing a gas trap also means introducing two or more fittings into the gas line. This increases the probability of a leak occurring. Depending on the location of the leak, premature trap expiration or contamination of the gas with air may occur. More diligent leak-checking is required to prevent these types of problems. For critical applications or for the highest purity gases, metal- or glass-bodied traps should be used. Plastic-bodied oxygen traps should be avoided because plastics are permeable to air and water. This also means that copper or stainless steel tubing should be used as gas lines.