Tech Note

Residual Gas Analyzers for Contamination Checking

Residual Gas Analyzers (RGAs) have been used in vacuum research applications for 25 years. Their role has changed in the last 10 years, as they have moved from purely a research instrument to a production tool. As a production tool, the RGA can increase productivity, improve product yield, increase throughput and reduce costs, all of which ultimately increases profits.

However, it is up to the user to determine how the tool can best meet the needs of a specific application. Leybold Inficon, as an RGA manufacturer, can help users determine the most cost-effective ways to use RGAs. This Tech Note is concerned with how the RGA can be used for contamination checking.

Many production vacuum systems work at two distinct pressure ranges. The first, typically called base pressure, is a method of cleaning the vacuum chamber and its parts before the production process begins. If the base pressure of the vacuum system is less than 1E-4 Torr, a standard RGA can be mounted to the vacuum system to monitor the base pressure. The second pressure range, process pressure, is typically several decades higher and is created by adding various gases used in the particular process.

Common Methods To Detect Contamination

Several methods can be used to determine if a tool is contaminated. The first and simplest is to use an ion gauge to check if the background pressure level in the chamber is higher than normal. The problem with this method is that if there is a pressure increase, there is no indication of what may be causing it. A second method that allows the user to have access to a lot more information is to use a residual gas analyzer. RGAs take up minimal equipment space and allow users to collect atomic mass data that can be interpreted as different gas species in a system.

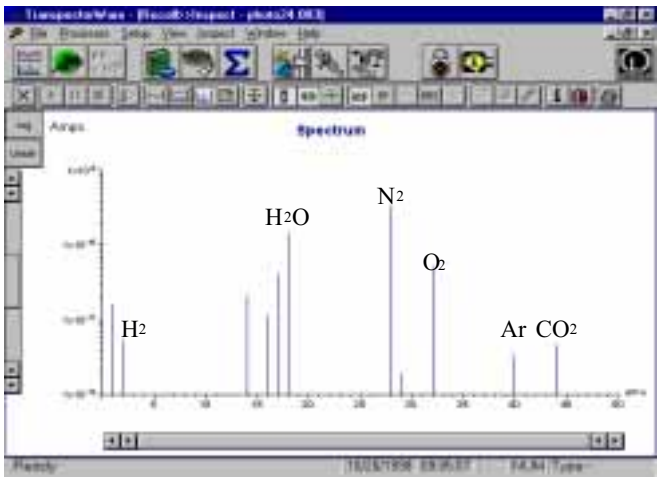

Figure 1: Air and Water Contamination Spectra

Troubleshooting Contamination

Vacuum system contamination can come from a variety of sources. The most common is an air leak from the fittings or welds of a vacuum chamber. Air leaks can be very serious because many processes are adversely affected by excess oxygen and water. Air leaks also raise the background pressure of the vacuum chamber. The data from an RGA allows users to establish the process' normal gas "signature," and a change in it will alert the user to possible contamination as the cause. An example of this would be a new 4:1 ratio of nitrogen (mass 28) to oxygen (mass 32), signaling air contamination, or a significant increase in water (mass 18) (Figure 1).

An RGA also can be used to measure helium (mass 4) while a vacuum system is being leak-checked by spraying helium around suspected connections or welds.

Contamination also can be caused by the parts brought into the chamber to be processed. The parts can have excess water or other solvents on them. The user may suspect these contaminants but be unsure of their precise composition and

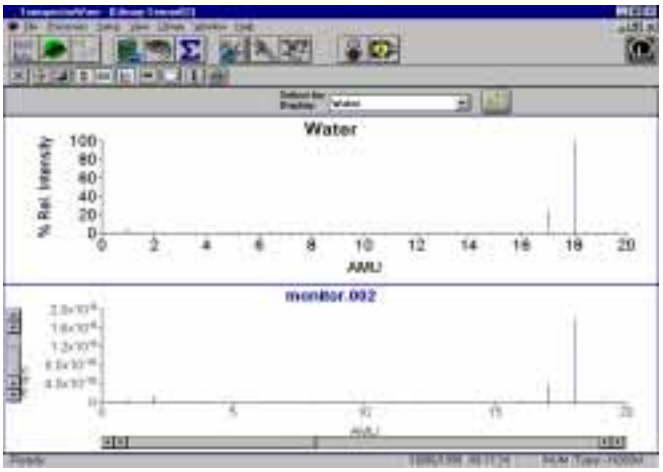

Figure 2: Water Library File Compared with Current Data

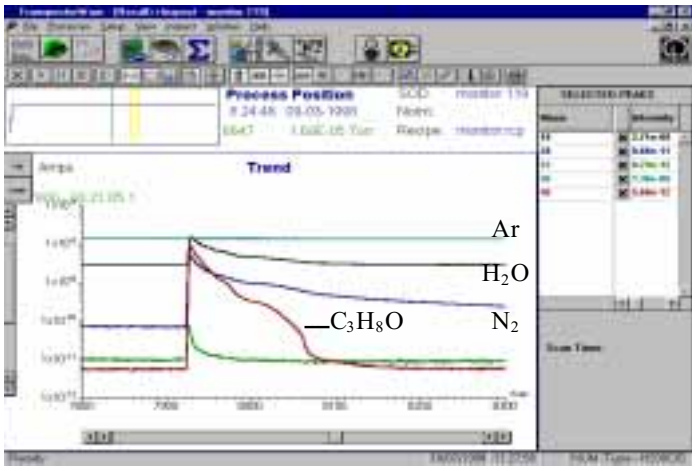

Figure 3: Isopropyl Alcohol and Air Contaminating a Process

hence their origin. Most RGA software packages have built-in spectrum libraries for comparison. Figure 2 shows how an RGA can display a library file such as water on top of current data, allowing the user to confirm the presence of a specific contaminant.

Residuals from previous production stages also can contaminate the vacuum system. For example, residuals from solvents like acetone and alcohol desorb under vacuum from cleaned parts and may remain in the system. Figure 3 shows a burst of isopropyl alcohol and air that contaminated an argon process. The argon is shown by its smaller peak (mass 36), while the isopropyl alcohol (C_3H_80) is shown as mass 45 and the air is shown as mass 28 (nitrogen). The increase in the water peak (mass 18) is most likely present within the air as well as dissolved in the alcohol.

Trigger levels for contaminants can be set with most RGA software. They can be used to alert the operator of a problem as well as to actuate a relay. Figure 4 shows air (the spike at mass 28) exceeding a predetermined trigger level of 1E-8 amps and closing off the upper setpoint of relay #1.

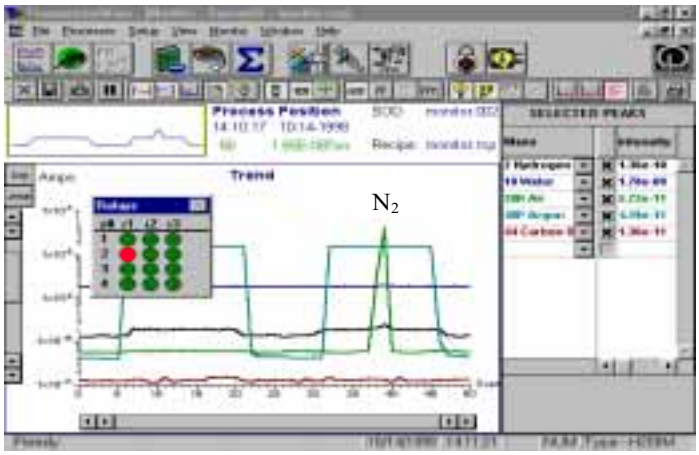

Figure 4: An Air Excursion (Mass 28) Activates the Upper Setpoint Of Relay #1

The residual gas analyzer is an invaluable instrument for contamination control. In today's business environment, downtime and poor yields mean lost dollars. A residual gas analyzer can quickly provide the information needed to avoid these problems, paying for itself in the process. Because of its unique capability not only to alert the operator of a problem but to help in its solution, the RGA stands out from other types of contamination checkers.

LEYBOLD INFICON

The Instrumental Difference™

Two Technology Place
East Syracuse, NY 13057 USA
(315) 434-1100
TFX(315) 437-3803
E-mail: reachus@inficon.com

P.O. Box 1000
FL-9496 Balzers, Liechtenstein
(+41) 75-388-4525
TFX (+41) 75-388-5431
E-mail: reachkh@bi.balzers.net

Bonner Strasse 498
D-50968 Cologne, Germany
(+49) 221347-0
TFX (+49) 221-347-1250
E-mail: reachus@leyboldvac.de