MSA Chemgard® Infrared Gas Monitor **for Detection of Volatile Organic Compounds**

Volatile organic compounds or VOCs are "Hydrocarbon compounds that have low boiling points, usually less than 100º C, and therefore evaporate readily." - Art, 1993.*

Volatile organic compounds (VOC) can be defined as any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions, except those designated by EPA as having negligible photochemical reactivity. **

VOCs include a wide range of chemicals and can be emitted from a variety of industrial materials including adhesives, sealants, primers, solvents, and propellants. Industrial processes that produce and use these product types may potentially produce VOCs within production environments. Worker exposure to certain VOC levels can result in short- and long-term harmful health concerns. VOC exposure can affect workers based upon short-term high-concentration exposure; workers can also be affected from low concentration long-term exposure. For this reason, it is necessary to understand VOC types present and how to effectively monitor these VOCs to limit worker exposure.

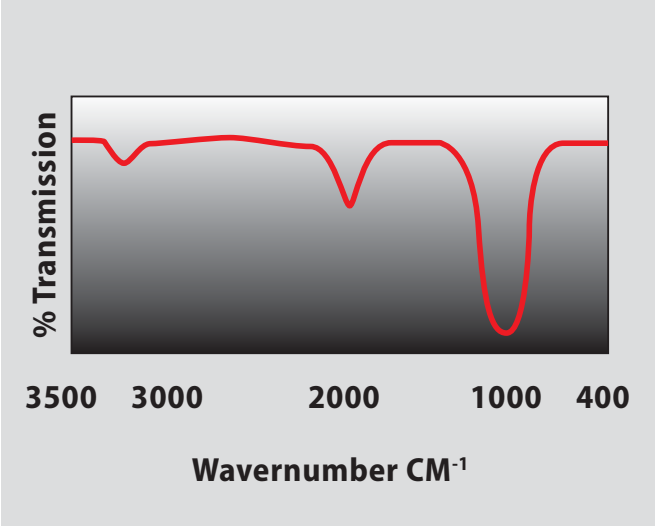
Federal OSHA (Occupational Safety and Health Administration) has published a Permissible Exposure Limit (PEL) for as many as 500 VOCs that may be found in workplaces or industrial environments; these exposure limits are typically expressed in parts per million (ppm) or sometimes as milligrams per cubic meter (mg/M3). VOC compounds may also be present, depending upon the types of operations occurring.

VOCs are also expressed in family groupings:

- **Alkanes** – Saturated hydrocarbons that consist of hydrogen and carbon atoms bonded exclusively by single bonds. Examples include methane, hexane, heptane, and ethane.
- **Aromatic hydrocarbons** – The simplest aromatic hydrocarbon is benzene; other compounds include toluene and ethyl benzene.
- **Chlorinated hydrocarbons** – Hydrocarbon molecules with chemically bonded chlorine. An immense number of chlorinated hydrocarbon forms exist; common examples include chloroform and carbon tetrachloride.
- **Chlorinated fluorocarbons** – Chemical compounds derived from hydrocarbons where all hydrogen atoms are replaced by fluorine. Examples include trichlorofluoromethane and dichlorodifluoromethane.

Hydrocarbon monitoring is essential for worker safety. MSA offers the **Chemgard® Infrared Gas Monitor**, a photoacoustic infrared monitor to fit the needs of these demanding applications.

The Chemgard Monitor uses photoacoustic infrared technology to detect the presence of VOCs. Photoacoustic infrared instruments introduce a gas sample to the monitor's measurement chamber; the sample is exposed to a specific infrared light wavelength. If the sample contains the gas of interest, that sample will absorb an amount of infrared light proportional to the sample's concentration of gas present.



However, photoacoustic infrared analysis extends beyond simply measuring the amount of absorbed infrared light. Photoacoustic infrared technology observes what happens to the gas once it has absorbed infrared light. The molecules of any gas are always in motion, and as they move inside the measurement chamber, they generate pressure. When a gas absorbs infrared light, the molecule temperatures rise and move more rapidly. As a result, pressure inside the measurement chamber increases, creating an audible pulse that is detectable by an extremely sensitive microphone inside the photoacoustic infrared monitor.

Because the optical filter passes only a particular light wavelength for the gas in question, a pressure pulse indicates gas presence. If no pressure pulse occurs, then no gas is present.

Pressure pulse magnitude indicates concentration of gas present. The stronger the pressure pulse, the more gas that is present. The monitor's sensitive microphone detects the smallest of pressure pulses, enabling detection of even the lowest gas levels.

The optical filter is a necessary instrument component; its selection determines VOC types to be measured. Each VOC has its own optimal infrared absorption; this absorption curve is defined as the **infrared spectrum**.

Specific gases absorb light at specific wavelengths, allowing gases to be identified by measuring light absorption at these wavelengths. The optical filter is used to pass only the particular band of wavelengths for the gas of interest. By widening the optical filter, one can observe additional gases. However, widening the filter too much opens the door for excessive cross-sensitivities.

MSA has optimized the filter process to allow one to measure each family of VOCs with one instrument. Therefore, most alkanes can be measured with one instrument. The same is true for other VOC families. Due to the difference in chemical structure of each VOC category, one Chemgard Monitor is needed for each VOC family, as a single monitor cannot be used to monitor two VOCs from different VOC families.

**Art, H.W., 1993, Volatile organic compounds, in Art, H.W., ed., A dictionary of ecology and environmental science: New York, New York, Henry Holt and Company, p. 581.*
***Code of Federal Regulations, 40: Chapter 1, Subchapter C, Part 51, Subpart F, 51100*

For more information,
please see MSA's ***Photoacoustic Infrared Technology for Detection of Refrigerant Gases*** *white paper.*

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