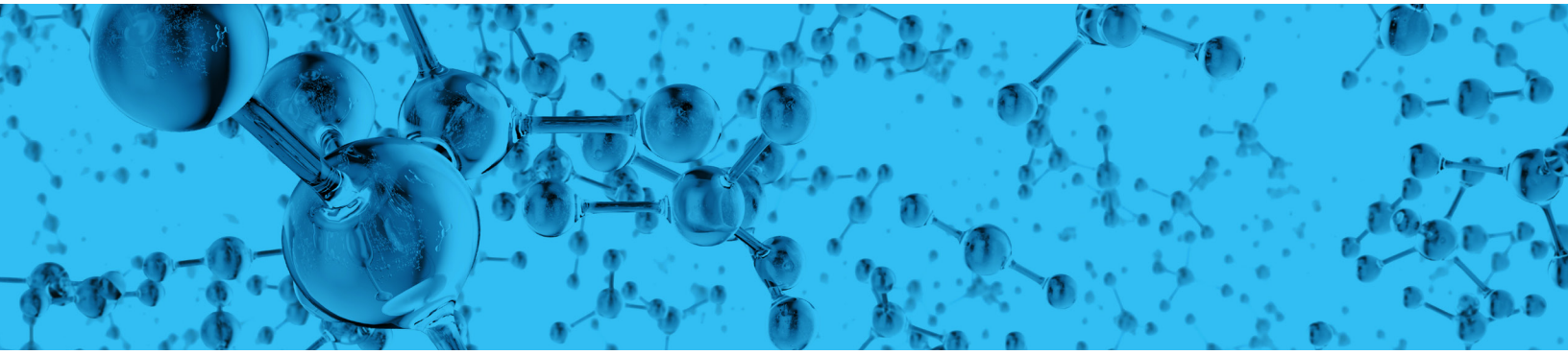
Gas Speciation Services

Biogenic vs. Thermogenic Methane



Identifying the source(s) and composition of alleged stray gas can be challenging. It may be due to the site operations, a natural condition, or a combination of both. It may be non-threatening. Or it could pose a significant risk.

With the right partner, however—one with a proven protocol and technical expertise—you can achieve clarity based on sound science.

Quick Methane Facts

1. Methane is the principal component of natural gas. It's colorless and odorless in its pure form but with a hydrogen sulfide odor like rotten eggs under some conditions.
2. Methane itself is non-toxic but can be a safety concern because it has a flammable range in air of 5-15 percent. Methane concentrations in air approaching 10 percent of the lower end of this range (e.g. 0.5 percent) should typically be managed from a safety standpoint, regardless of the source.
3. Economic deposits of methane form naturally in the ground over millions of years. Known as thermogenic methane, it's discovered and produced as part of our energy reserves. With the exception of landfill gas which is sometimes tapped to supply localized needs, essentially all commercially-supplied gas is thermogenic.
4. Biogenic methane forms near the surface whenever organic material decays, without sufficient oxygen (e.g. found within swamps, landfills, compost piles, manure, and buried construction debris).
5. Methane can dissolve in groundwater (well water). Typically, dissolved methane doesn't pose any safety risk unless it leaves solution and mixes with air in a confined space near an ignition source.

Biogenic or Thermogenic?

Biogenic methane is quite common. And it could be the source of your alleged stray gas. But when human health and safety is at risk, you must have the defensible data to know for sure. On the positive side, that knowledge will help you decide when you need to assess or halt operations and when you can proceed safely.

At Apex, we use time-tested, peer-reviewed, applied research accepted by regulatory agencies to differentiate thermogenic from biogenic methane. We pair that with a protocol that works to help you pinpoint the origin/potential source(s) and plan your path forward.

Proven Protocol

Working with specialty laboratories, and drawing from decades of research, we established a protocol for stray gas speciation that our clients turn to time and time again. Our oil and gas clients use it to understand pre-fracking gas baseline data, determine whether their gas field production operations are related to any observed stray gas in water wells or structures, and assess pipeline leaks.

www.apexcos.com

APEX

To develop defensible conclusions regarding methane source(s), our protocol involves:

- Using a variety of methods, including Summa cannisters and laboratory-proprietary apparatus, to collect samples.
- Applying specialized and tiered analytical methane differentiation techniques to test the gas samples.
- Carefully interpreting the data using multiple lines of evidence and the principles that include the following:
  - Thermogenic methane is produced by thermal cracking of heavier hydrocarbons and some of the more volatile heavier hydrocarbons like butane, pentane and hexane are often present. However, the absence of these heavier hydrocarbons is not proof that the methane is biogenic.
  - Biogenic methane (typically almost 100 percent pure) is produced by low temperature biological processes and butane, pentane and hexane are usually absent from its pure form.
  - Hydrocarbon species testing are not 100 percent conclusive in most cases. To increase certainty, we always also look at the stable isotope ratios for carbon and hydrogen in the methane.
  - Individual isotope testing results are cross-plotted and typically fall into one of three methane genesis regions. However, some samples may plot in inconclusive areas between regions. This can occur due to mixing of methane from different sources or other factors and requires expert interpretation.

Search for Certainty

When our team of experts determines typical screening tests are insufficient to determine the source of methane, we expand our testing program to pursue definitive results. We may discern spatial or temporal trends or perform broader testing to look at isotopes in carbon dioxide, ethane, propane, or heavier gases which can help to evaluate whether multiple sources for gas exist.

If necessary, we perform testing for radioactive Carbon (^{14}C) or Hydrogen (^{3}H or Tritium) that can improve interpretive certainty. ^{14}C has a half-life of 5,730 years, so essentially all thermogenic methane is radiocarbon dead (e.g. it's millions of years old). If we see any ^{14}C, then some contribution from biogenic methane is expected. Tritium has a half-life of about 12 years, so if any Tritium is present at all, some contribution from a very young source for methane is expected (e.g. from a landfill or contemporary swamp gas).

Our tiered and multiple line of evidence approach is comprehensive. For example, we review site-specific factors that could confound data interpretation. These include possible spills of gasoline or natural gas condensate in the vicinity, the presence of landfills or compost piles, mixing of methane from multiple sources, natural seeps of thermogenic methane from shallow gas shales or coal seams, and methane oxidation, to name a few. We are committed to defensible data, every step of the way.

Beyond Investigation

With our protocol, we can help you determine your risk(s), define the origin and identify potential sources of stray gas, delineate the extent of any migration/stray gas plumes. But beyond those services, we can also help you implement measures to ensure public health and safety; evaluate natural background gas concentrations in the area; conduct periodic monitoring to define trends and confirm a remedy; help you proactively understand and address any contributing factors that may affect migration pathways; provide litigation support; and seal/remediate any root causes, if necessary. At Apex, we're here to help.

www.apexcos.com
info@apexcos.com • (800) 733-2739

APEX