

PROPER TESTING OF ODORANT CONCENTRATION LEVELS

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INTRODUCTION

Today's business environment requires the natural gas industry to perform many critical functions; such as, measurement, gas control, and odorization. Accurate measurement is a complex process involving a variety of equipment, procedures and people. The result is an accurate accounting of gas bought and sold. Gas Control is also a complex process that requires a sophisticated communications network and experienced personnel, resulting in a reliable supply of natural gas for transportation or distribution. However, the odorization program is the most difficult and most important of any function performed by the natural gas industry. The result is a safe public.

A comprehensive odorization program includes a safe method of delivery, a consistent technique of introducing it into the pipeline, an accurate monitoring program, and a reliable reporting system. Many times a company is required to deliver large quantities of odorant in populated areas or deliver smaller amounts to multiple rural locations. In either case it is important to establish policies and procedures to safely handle and deliver the chemical. Next, a company must select the equipment that will consistently introduce the desired amount of odorant into the pipeline. In addition, the company must determine strategic locations for the equipment to ensure even distribution of the chemical that is injected. Finally, the most important aspect of the odorization program is establishing an accurate testing method and a reliable reporting structure.

An accurate test method is the most important element within an odorization program because it is the final and most definitive technique of assuring your company that the public is safe. Another vital part of the process is a reliable recordkeeping program. Maintaining detailed information of tests performed will allow a company to optimize the amount of odorant injected, confirm compliance, and be proactive when reacting to necessary changes within the system.

Establishing test methods and reporting techniques is a complex issue. It is complex because a variety of factors must be considered when defining policies and procedures. This paper will examine the following critical factors...

- Odorant's reaction to differing types of natural gas and flow conditions.
- Instruments available.
- Test Methods.
- Reporting techniques.

REGULATION, LITIGATIONS and SAFETY

Title 49 Part 192 of the Code of Federal Regulations is the safety standard that governs gas pipeline transportation and pipeline facilities. This regulation is written as a minimum performance standard. It sets the level of safety to be attained and allows the pipeline operator discretion in achieving that level. Portions of section 192.625 are paraphrased as follows...

- (a) A combustible gas in a distribution line must contain a natural odorant or be odorized so that at a concentration in air of one-fifth of the lower explosive limit, the gas is readily detectable by a person with a normal sense of smell.
- (b) After December 31, 1976, a combustible gas in a transmission line in a Class 3 or Class 4 location must comply with the requirements of paragraph (a) of this section (Some exemptions exist. See complete regulation for details).
- (f) Each operator shall conduct periodic sampling of combustible gases to assure the proper concentration of odorant in accordance with this section. Operators of master meter systems may comply with this requirement by-
 - (1) Receiving written verification from their gas source that the gas has the proper concentration of odorant, and
 - (2) Conducting periodic "sniff" tests at the extremities of the system to confirm that the gas contains odorant.

- Regulation, Litigation and Safety

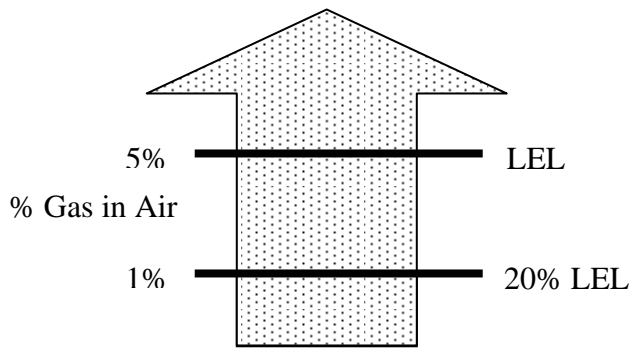


Figure 1. Percent Gas in Air & Lower Explosive Limit (LEL).

The office of pipeline safety describes this as a minimum standard that is written in performance based language. The wording is intended to allow the industry to develop its own means of meeting the standard without compromising the required level of safety.

Avoiding litigation is another serious factor considered by companies when formulating test methods and reporting techniques. While it is important, if too much weight is given to this approach it can have a counterproductive result. It will stifle new technology and the presentation of new ideas in the false hope of avoiding a lawsuit.

Supplying a safe product for public consumption is the real achievement that must be met without fail. Since many federal and state regulations are purposely written in generic terms and are intended to establish minimum levels of safety, meeting them can not be our focal point. Even though litigation is a very real issue it can not be the primary factor in establishing policy.

Consider this question; would our industry still monitor odor levels in natural gas if there were no regulations to follow, or threat of a lawsuit? The answer is an obvious yes. The reason is because the primary factor that influences how we do business really is safety for the consumer, not meeting a minimum standard in a vague regulation, or trying to avoid legal action that could come without notice or cause.

ODORANT and NATURAL GAS

Today's odorant blends are extremely odorous, volatile, and flammable. The characteristics of an acceptable odorant blend include a "gassy odor", low odor threshold, high odor impact, resistance to pipeline oxidation, and good soil penetrability.

An odorant blend is present in natural gas to make it detectable at a safe level. The performance of the blend is constantly changing and is dependent on gas composition, velocity, and construction materials. The type of natural

gas being transported from one geographic region to another can be very different. Many times, gas composition and flow conditions are inconsistent within the same distribution system. Different types of natural gas and how they can affect a chemical's performance are...

Dry Gas-Not Naturally Odorized: Is the easiest type of natural gas to odorize. However, during a low flow situation adsorption may occur.

Wet Gas-Not Naturally Odorized: Condensed liquids in the pipeline absorb odorant compounds. Masking may occur if the gas has its own strong smell.

Dry Gas-Naturally Odorized: Contains methyl and ethyl mercaptan which can cause oxidation of TBM to disulfides, which have low vapor pressure and low odor impact.

Wet Gas-Naturally Odorized: It is almost impossible to adequately odorize this type of gas. Some blends work well with the presence of liquids but not with natural mercaptans. Other blends work well with natural mercaptans but not significant amounts of liquids. The only solution is to clean up the gas or find another supply.

Additional factors that constantly impact the effectiveness of an odorant blend,

- New carbon steel pipe will react with odorant to create non-odorous iron sulfides.
- Low flow conditions can result in the adsorption of odorant on the pipeline surface.
- Rust, dust and dirt result in odor loss due to adsorption.
- Odorant on the pipe wall can be oxidized by iron oxide resulting in a loss of odor.
- Naturally occurring mercaptans reaction to the odorant blend producing less odorous disulfides.
- Masking of odorant by heavier hydrocarbons.
- Scrubbing/Dissolution of odorant by condensate.

- Absorption of odorant by water, hydrocarbons, and oil in the pipeline.

It is clear that composition of the gas stream can vary, and operating conditions can change within the same distribution system or in a transmission line from region to region. If a change like this occurs, it is unrealistic to expect the warning agent to perform with the same degree of effectiveness.

INSTRUMENTS

The natural gas industry is currently using three instruments to perform the required air dilution, or “sniff” test. They are Dtex manufactured by YZ Industries, the Odorator manufactured by Heath Consultants, and the Odorometer manufactured by Bacharach Instruments.

These instruments are designed to deliver a known quantity of air to a sniff chamber. Additionally, they allow a precise amount of natural gas to be introduced into the air flow by way of a flow valve. As the operator opens the flow valve to introduce an increasing percentage of natural gas to the airflow, their nose is placed into the sniff chamber. The instant an odor is detected the percentage of gas in air is recorded. Testing techniques and methods vary among manufacturers.

The goal of each instrument is to provide accurate, reliable and consistent test results. In order to accomplish this goal certain factors should be considered and components examined. Such as;

- Gas Inlet: connects to the gas supply.
- Internal Regulator: internally regulates the inlet pressure.
- Flow Valve: used by the operator to control the amount of gas that enters the mixing chamber.
- Flow Sensor: to accurately detect the amount of gas entering the mixing chamber.
- Mixing Chamber: thoroughly mixes the gas and air.
- Fan: moves the gas/air mixture to the sniff chamber. Fan speed must be constant and compensate for both temperature and altitude.
- Sniff Chamber: used by the operator to smell the gas/air mixture.
- Air Intake: draws fresh air into the mixing chamber.

In order to achieve maximum accuracy the instrument should compensate for temperature and altitude. Variations in temperature and elevation during a test can have dramatic effects on the percentage of gas in air recorded by the instrument and operator. Differing conditions will result in the gas/air ratio being either

overstated or understated. Another important issue to consider is the requirement that the test must be performed in a safe area, unless the instrument has received approval to be operated in a hazardous area.

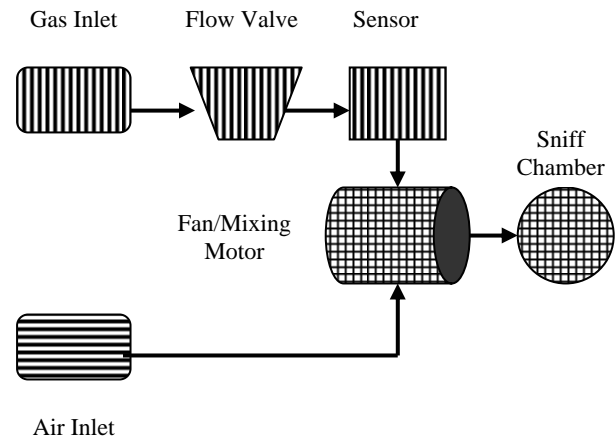


Figure 2. Gas Dilution Instrument Flow Chart

REPORTING TECHNIQUES

The reporting process must have integrity. The test results, details and comments of sniff tests must be accepted as accurate and valid. The “sniff test” database is one of the most important records maintained by a company. These records can confirm that goals are being met and adequate levels of odorant are present in the system. In addition, the information can be used by company personnel to pinpoint areas where odorant levels need to be increased or decreased. An adequate database will document that the correct action was taken in a timely fashion.

The data contained in these records will be examined by operating personnel, management, and regulators. The process used to collect the data will also be examined. If the data can be manipulated the test records will not receive serious consideration. Consider credit cards and ATM machines. We use them because we have confidence in how they are used. Consumers are also confident that records are accurate and can not be easily manipulated. Sniff test records are important and the same procedures should be adopted. For example,

- Authorization: password / pin number.
- Limited access.
- Confirmation of each transaction.
- Time & date stamp of event.
- Avoid the necessity to write or recall from memory.
- Retrieve specific historical data.

CONCLUSION

Natural gas is combustible and does not have color or odor; yet it is used in homes, schools and businesses every day of the year. Introducing a warning agent into the pipeline system is the only way to make natural gas safe to use. The most important task a gas company can perform is to accurately confirm the presence of the warning agent. A secured process that will accurately record the test results is equally important. To be successful each company should review the applicable regulations, confirm the odorant blend is compatible with operating conditions, perform an instrument evaluation, and establish a reporting process that can not be easily manipulated.

REFERENCES

- 1) American Society for Testing and Materials. D 6273-98: Standard Test Methods for Natural Gas Odor Intensity.
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- 3) "A Review of Applicable Odorization Practice Regulations". O.G. McClinton, Jr. U.S. Department of Transportation.
- 4) Skunk Tips: "Odorant Blend Rationalization". Michael Usher. Elf Atochem North America.

