PROPER TESTING OF ODORANT CONCENTRATION LEVELS

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ABSTRACT

Proper odorant monitoring is required to keep natural gas utilities under compliance with federal and state regulations. These monitoring requirements are generally handled through a combination of events including; injection rate calculations, customer complaint calls, routine service personnel tests, odor concentration tests and chromatographic analysis. In the world today it is critical to have appropriate documentation to support proof that proper odorization of natural gas is occurring. This process will ultimately protect the public and hopefully keep us all from litigation.

REQUIREMENTS FOR ODORIZATION

Odorization of natural gas is regulated under Federal Department of Transportation (DOT) Title 49 Part 192.625. The code basically states "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 the lower explosive limit, the gas must be readily detectable by a person with a normal sense of smell."

This regulation since it was first introduced has always led to considerable discussion in regards to exactly what is a person with a normal sense of smell? We as humans all have varying abilities through our olfactory senses to detect odors. It has been proven in scientific studies that age, gender, physical ailments such as allergies and cigarette smoking all effect one's ability to detect odor. This has left us with a very "qualitative" means of detecting odorant through the use of the nose and a testing device that provides us the gas in air mixture. Many then ask the question why not use a more "quantitative" means to provide us with the odorant concentration?

We have odorizers that can provide us extremely accurate volumes of odorant being put into the gas distribution system. We also have extremely accurate means of measurement to determine gas volumes downstream of the odorizer. This then becomes a very simple mathematical computation of odorant volume verses natural gas measurement. This sounds all well and good but we must certainly remember that there are many other factors which affect the quantity and quality of the odorant that can be completely out of our control.

FACTORS WHICH AFFECT ODOR QUANTITY

We talk about accurate means of computing volumes of odorant put into the natural gas distribution system. How are we then able to determine that the *odorizer is functioning* properly at all times? We have many types of odorizers that employ several means of dispensing odorant into the distribution system. Many of these systems are affected by *contaminants in the odorizer* and are we able to identify when this is occurring? A natural gas company must certainly determine which type of odorizer; injection, bypass or wick that is best for each particular piping application.

We are in the age of industry deregulation and open access within our natural gas transmission piping networks. We are now able to get natural gas from numerous geographic locations including; the Gulf of Mexico, West Texas, Oklahoma, Western Canada and the Plains States to name a few. We once knew consistently well where we were getting our natural gas and what quality and *natural occurring odorants* were contained in this source. We now have a "blend" which can certainly affect chemical reactions with different odorant blending in the pipeline.

This open access and "blending" now allows for various gas quality issues including the formation of *distillates* in the pipeline that can literally absorb odorant from the natural gas stream. Steps must be taken to insure that when the formation of liquids is occurring that they are removed from the system.

Other factors involve *pipe wall absorption* in the case of newly installed plastic pipe. Generally higher concentrations of odorant are added during the initial commissioning of a new pipeline to in affect "pickle" the line.

Internal corrosion of steel pipelines can produce internal contaminants that can react chemically through *oxidation* and certainly affect odorant concentration.

FACTORS WHICH AFFECT ODOR QUALITY

We have mentioned *physical ailments* in the case of allergies and smoking. These conditions can certainly affect one's olfactory senses and their ability to detect the smell of odorant.

It is certainly possible for natural gas to travel through the soil from pipeline leaks and have odorant removed by *soil absorption*. A gas company must determine the appropriate blend of odorant for their particular geographic location.

The presence of external odors within the dwelling such as cooking, perfumes and cleaning products can certainly cause a *masking* and or a *distraction* situation and not allow an individual to differentiate the smell of odorant.

ODORANT CONCENTRATION INSTRUMENTS

The current regulation for odorant concentration testing is primarily met with the use of electronic instruments. These instruments all employ the use of the human nose as stated in the regulation to determine the gas in air mixture at which an individual can detect the smell of odorant. There are currently three (3) instruments available for this use.

BACHARACH ODOROMETER

This instrument is manufactured by the Bacharach Instrument Company and employs the use of a flow meter with glass and steel floats where conversions with a calibration chart for gas density and concentration are required.

HEATH CONSULTANTS ODORATOR

This instrument is manufactured by Heath Consultants Incorporated and employs the use of solid-state electronics for the digital display of gas in air mixtures.

YZ INDUSTRIES DTEX

This instrument is manufactured by YZ Industries and employs microprocessor-based electronics and internal data logging of gas in air mixtures.

Regardless of the type of portable electronic instrument that is utilized, it is imperative that when conducting odorant concentration "sniff" tests that the gas company employees are fully trained and experienced in the use of the instrument. The operator must be familiar with the operating manual to insure that they are following manufacturers operating procedures. Many gas companies conduct annual testing of their employees to insure that they are familiar with the testing device and that they in fact can detect the smell of odorant. One such example would be to present the testing device to each gas company employee on an annual basis and allow them to run a test. This not only provides training that the employee understands the use of the particular instrument but also determines each employee's ability to detect the odorant. As mentioned earlier just like with the public we to will have employees with varying abilities in their olfactory senses which must be known and documented. We must also follow the manufacturer's recommendation in regards to the calibration of each instrument to insure that the device is maintained and functioning properly.

ODORANT MONITORING PROGRAM

A comprehensive odorant monitoring program involves several other pieces of information besides the odorant "sniff" test with the odorant concentration instrument. Yes, this is the requirement but most natural gas companies employ other means to insure that proper odorant is maintained in the distribution system.

Accurate records should be maintained on *odorant injection rates* and along with measurement records we can determine odorant levels in relation to gas volume. It is also important to keep complete records in relation to *odorizer inspections* to document proof of properly maintained and functioning equipment.

The tracking of *customer leak calls* to central dispatch is extremely important. A natural gas company generally has system averages throughout the year of daily leak calls. This is a direct result of how well your odorization program is working. We will always have leaks within the distribution system, in customers' homes, pilot lights and in the street and when this occurs the public must be able to detect the odor and make the call. In the event these averages increase could signify that the odorant is being put in the system at a more substantial rate than normal. In the event the leak call averages drop could signify that there may be problems at the odorizer or in the piping network to initiate further action.

The simplest verification that natural gas has an odor is generally done by the customer service technician on *daily routine calls.* A simple box checked as "yes" or "no" on the service form that odorant can be detected at an appliance or meter set in the case of a change-out. This will not verify that the odorant is detected at the appropriate concentration but it will signify that it does have an odor either absent, weak or strong.

The *odor concentration meter tests* will be performed on a periodic basis throughout the year and documented with the appropriate forms. We must remember that the more random tests that are conducted throughout the distribution system the better informed we will become on the effectiveness of our odorization program.

The use of "quantitative" analysis instrumentation such as *titrators, analyzers* and *chromatographs* for the chemical analysis is another vital step in odorant monitoring. These instruments provide for real-time determinations of total sulfur and in many cases individual mercaptan and sulfide component levels.

A combination of all the mentioned items will provide a natural gas company adequate records on the success of their odorization program. We must remember that conditions are continually changing and we must be

aware of the occurrences within our system. We need to analyze each piece of information and act accordingly when one or a combination of items looks out of the normal. Investigations must them be carried forward and solutions provided to insure adequate odorization.

CHROMATOGRAPHIC ANALYSIS

The use of titrators, analyzers and chromatographs are several methods employed for quantitative sulfur analysis. A variety of detectors are used including lead acetate tapes, chemiluminescence, flame photometric and electrochemical technologies. These detector technologies provide for total sulfur calculations and in many cases for complete component separation. These concentrations can generally be displayed in a variety of forms from grains, parts per million and pounds of odorant per gas volume. These instruments can be configured for laboratory use where samples are brought in or placed directly on the pipeline for real-time calculations. A number of communications packages are available for transfer of information directly to a centralized gas control. These "quantitative" methods of determining actual odorant concentrations in the gas stream does not meet the Federal requirement for odorant reporting under DOT 192.625. It does however, provide another piece of information in terms of evaluating the overall effectiveness of the odorization program.

A variety of manufacturer's including but not limited too the following are available:

Del Mar - Sulfur Lab 2000

This instrument is manufactured by Del Mar Scientific and have various models employing lead acetate tape and GC columns for the detection of total sulfur and sulfur species.

Barton - OM-10

This instrument is manufactured by Barton Instruments and has various models employing an electrolytic analyzer / titration cell for the detection of total sulfurs.

OdorEyes Systems - Accu/Line

This instrument is manufactured by OdorEyes Systems and employs the use of an electrochemical sensor to measure total sulfurs.

Galvanic Applied Sciences Inc. - Model 801W, Model 902, Model 801P

This instrument is manufactured by Galvanic Applied Sciences Inc. and have various models employing lead acetate tape technology for the determination of H_2S levels and alternate readings between total sulfurs and H_2S.

Houston Atlas - Scout H2S Analyzer

This instrument is manufactured by Houston Atlas and utilizes lead acetate tape technology for the determination of H_2S levels.

Scintrex - OVD-229

This instrument is manufactured by Scintrex and utilizes the electrochemical cell in a portable application for the detection of individual sulfur components.

Applied Automation - Process Gas Chromatograph

Applied Automation offers a number of models of gas chromatographs for the detection of sulfur components.

Ionics - Sievers 355 Sulfur Chemiluminescence chromatograph for analysis of sulfur compounds.

Heath Consultants Incorporated / Chromatosud - AirmoMedor

The original MEDOR was developed by Gaz de France in the late 1970's and manufactured by Heath Consultants/Gastech through the 1980's and early 1990's. Most recently Heath Consultants has combined efforts with Chromatosud the original manufacturer of the MEDOR in France to distribute and upgrade existing units in the United States. The original MEDOR in the United States has gone through many transformations utilizing interface operating systems from Hewlett-Packard, Spectra-Physics and Perkin-Elmer. Heath Consultants / Chromatosud now offer a new "windows" based system utilizing airmoVISTA software. This allows upgrades of existing MEDOR technology with the addition of an electronic interface module, airmoVISTA software and the appropriate communications package software. The airmoMEDOR continues to provide the user a complete breakdown of individual mercaptan and sulfide components utilizing an electrochemical detection cell in a chromic acid solution.

These are primarily the more common titrators, analyzers and chromatographs that are commonly seen in the marketplace. We must remember that there are a wide variety of manufacturer's that custom configure instrumentation for the detection of sulfur related compounds for various pipeline, petrochemical and refinery applications. Regardless of the manufacturer, the information derived from this type of instrumentation provides yet another piece of the puzzle to insure that proper odorization is occurring.

CONCLUSIONS

We can now see that the huge task of insuring that a proper odorization program has been implemented and maintained involves information gathering from a number of sources. There is actually no "one" piece of information

that solely allows us to see the effectiveness of our odorization program but rather involves a combination of "pieces" to complete the puzzle. In the world today we must pay critical attention to our odorization programs to protect life, property and insure complete **PUBLIC SAFETY**. We must remember that odorant in the pipeline is the public's primary leak detector and without this warning our public could be in serious danger in the event a leak goes unnoticed. A well documented and maintained program will certainly help us in the event of litigation.

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