ODORIZER
APF-NGO

APADANA PETRO FARAYAND

Knowledge is our difference

APADANA PETRO FARAYAND odorizers are designed and manufactured to safely odorize natural gas, propane, biomethane (renewable natural gas), and biogas.

Usage:

- City Gate Stations
- Distribution Pipelines
- Municipalities
- Renewable Natural Gas (RNG), Biogas, and Biomethane Odorization
- Grain Dryers
- Industrial Plants

Different Types:

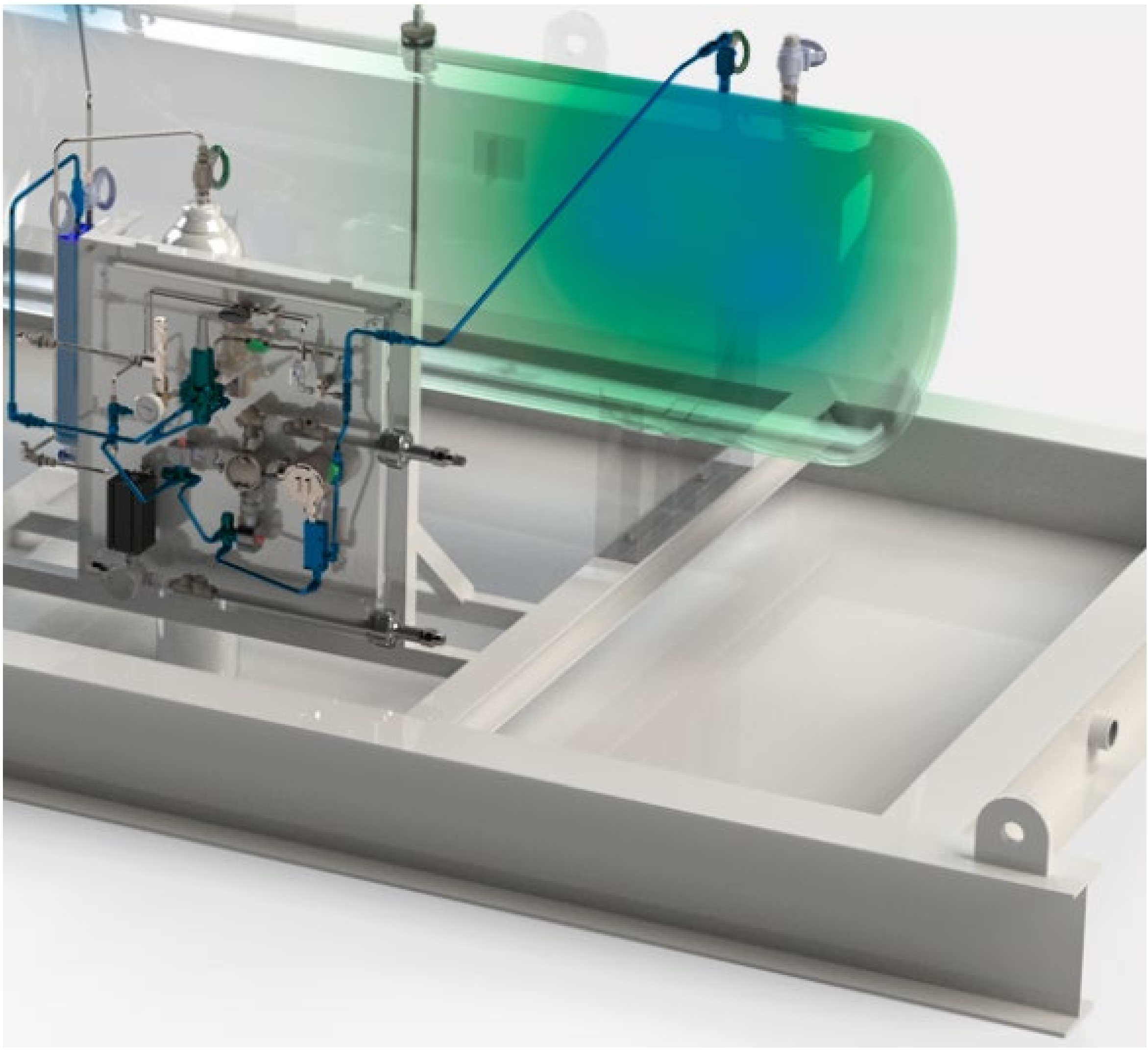
- By-pass odorizer
- Injection odorizer

Introduction

Network operators transport natural gas through gigantic gas transport networks to power plants, industrial operations and, using local networks, to private households. At distinct hubs, large quantities of gas arrive that are subsequently funneled into different sub-networks and various directions. A gas pressure controller and measuring system ensures compliance with mandatory safety regulations and processing without a hitch. It also regulates the inlet pressure to the required outlet pressure rating. At this stage, the gas is usually odorized—a measure intended to make the unintentional escape of gas recognizable early on for everybody. Thus, safety risks and accidents can be prevented, and gas leaks can be detected in a timely manner. Natural gas odorization is an important safety measure, not just for gas purchasers and customers. Formerly used city or cookery gases had a strong intrinsic odor and rarely required odorization. Meanwhile, the commonly used natural gas is cleaned and almost odorless. In order to be able to immediately detect leakage in the gas network, the natural gas odorization is mandatory as a safety measure. The gases added during the odorization generate specific warning odors. This prevents the formation of explosive gas/air mixtures, which are highly dangerous. The odorants used in the odorization of natural gas must fulfill special safety requirements. Their odor must be perceptible even at a high dilution, and unmistakably induce the association with gas leakage. The odorant must therefore smell unpleasant and distinctive. Volatile organic sulfur compounds are frequently used as odorant. Their typical savor is evocative of the smell of rotten eggs. Often the odorless saturated sulfur heterocycle tetrahydrothiophene (THT) is used in concentrations of 12 to 25 mg/m^3. Frequently, also mercaptan mixtures are in use.

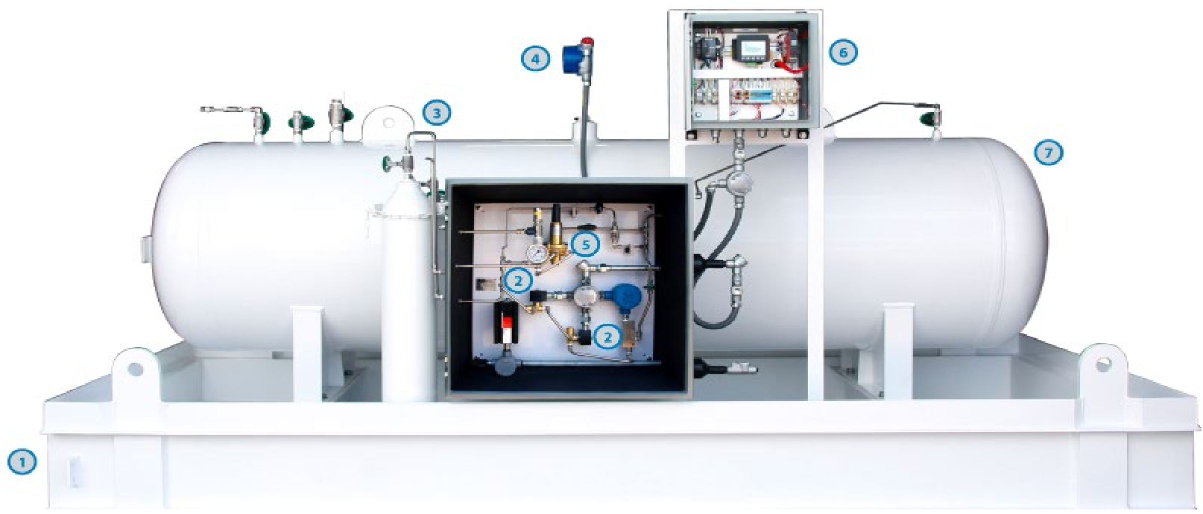
Odorant Injection Techniques

1. The flow of gas in the pipeline is typically metered so that liquid odorant can be injected periodically. For example, a few drops of odorant will suffice for a 30 m3 flow of natural gas. When the gas flow meter indicates that such an amount of natural gas has flowed through the pipe, another aliquot of liquid odorant is injected into the pipeline. This process is then repeated, and even though the injection is performed periodically, the odorant diffusion within the gas provides adequate levels of odorant throughout the pipeline, assuming the time between injections is not too great.
2. Another odorization technique involves bypassing a small amount of natural gas at a slightly higher pressure than that of the main distribution pipeline through a tank containing a liquid odorant. This bypass gas absorbs relatively high concentrations of odorant while it is in the tank, and then returns to the main pipeline. The odorant, now volatilized, diffuses throughout the pipeline in much the same manner as described in the previous method.



Components

1. Skid: Our design ensures to keep the ground odorant-free in the event of a tank leak.
2. Solenoids: Low-wattage primary and backup solenoids control the flow of gas through the saturation tank and into the pipeline. Each time a solenoid opens, the controller uses a flow switch to confirm positive flow. If the primary solenoid fails to close, an over-odorization alarm activates and the backup solenoid automatically takes over flow management.
3. Gas Inlet and Filter: Pipeline gas enters the system and immediately flows into the integrated F-5 Filter/Dryer. Liquids and unwanted particles are filtered out of the gas before it is saturated with odorant.
4. Electronic Level Indicator: The electronic level indicator continuously measures the tank odorant level in inches, pounds, or gallons. Odorant level data is stored on the PLC in real-time for instantaneous remote monitoring.
5. Regulator: The integrated regulator maintains the required pressure differential between the gas inlet and gas outlet. A stabilized pressure differential allows the system to evenly distribute odorant to the pipeline system, regardless of varying downstream pressures that can be associated with peak gas usages.
6. Controller: The PLC continuously monitors changes in gas flow rate and automatically adapts the amount of odorized gas released into the pipeline. System status and alarms can be remotely monitored via Ethernet or modem. The system alarms conveniently make the information about operational issues available for assessment prior to going on-site. The system history is logged to a microSD card in CSV format to track important data and settings.
7. Tank: Vaporized odorant saturates natural gas inside the tank proportional to pipeline flow. With the tank located downstream of moving parts, system leaks that might occur from normal wear-and-tear remain odorant-free. Multiple tank sizes are available to accommodate different capacities or flow rates for convenient long-term odorization.



Advantages at a Glance

1. Modular design

You are free to choose: Standard **odorizing systems** are designed to be highly modular and consist of various components which enables us to meet your requirements in a manner that is as flexible as possible.

2. Customized units

Whatever your requirements are, we will find a solution: APADANA PETRO FARAYAND builds a complete customized system with standard modules or special components for you.

3. Microflow metering pumps

High metering accuracy: With our proven micro metering, we guarantee accurate and reliable metering of the odorant.

4. Field-proven control and regulation systems

For smooth operation: Our systems have field-proven controls for hazardous areas.

5. Global commissioning

With our global service network, we take your equipment into operation and provide technical service directly at your location - both onshore and offshore.

6. Flexible design

You can rely on over 20 years of experience in the design of pumps, systems and units: During the project phase, we respond flexibly to design changes or adjustments required.

7. Maintenance and service

No matter if maintenance, spare parts or repair - our service technicians are well trained and available worldwide. Thus, we guarantee fast response and smooth operations.

8. Suitable for all odorants

APADANA PETRO FARAYAND **odorizing systems** are suitable for all common odorants in the industry: EM, DMS, TBM, THT. Simply let us know your personal requirements.

9. International standards

APADANA PETRO FARAYAND pumps, systems and units are compliant with major international standards such as DVGW G280, WHG, PED, ISO 9001, ASME, ATEX and TA-Luft. Of course, you can also define your own standards.

What about Hydrogen?

There is no doubt that hydrogen will play an important role in the future of energy. With the advent of hydrogen-based fuels cells, the odorization of hydrogen has become an issue. Here another problem emerges, since common odorants may have a negative impact on the performance of the fuel cells, since commercial odorants act as poisons for the catalysts used in hydrogen-based fuel cells, most specifically for proton exchange membrane fuel cells. Chemical compounds based on mixtures of acrylic acid and nitrogen compounds have been adopted to achieve sulfur-free odorization of the gas. In the use of natural gas and other petroleum gases to generate hydrogen for fuel cell applications, sulfur-free natural or petroleum gases are needed, or else a desulfurization step must be incorporated in the reforming process, which adds further cost to hydrogen generation. Fuel cells are sulfur intolerant due to sulfur poisoning of the noble metal catalysts used. If sulfur-containing odorants are used, it would be necessary to remove sulfur-containing materials, like mercaptan odorants, from the feed gas using materials like zinc oxide. However, some sulfur-containing materials, like thiophenes, cannot be removed by zinc oxide and may require a specific hydrodesulfurization process, using hydrogen gas, to remove sulfur. A further complexity for hydrogen fuel comes from the nature of the hydrogen flame propagation. When gases burn in air, their flames propagate upward with greater ease than they propagate downward. This is primarily due to the natural upward convection of hot burnt gases. For petroleum gases, propane and methane, the upward and downward propagating lean limits of combustion are approximately the same. However, for hydrogen, since they differ by a factor of 2.5, the amount of odorant needed for leak detection in hydrogen could be >2.5 times that needed for methane or propane. The higher quantity of the odorant needed for hydrogen odor detection further complicates the sulfur poisoning problems for hydrogen gas used in fuel cells.

Odor-fading

One specific problem of odorization is odor-fading. The gas may be satisfactorily odorized at the source, but if it no longer has the necessary odor impact and intensity by the time it reaches the customer, escaping gas can remain undetected and result in a serious fire or explosion hazard. Basically, three causes of fading may arise:

1. Oxidation, the formation of disulfides in the presence of iron oxide and traces of oxygen

2. New pipe materials may cause adsorption or absorption of the odorant on to the surface of a plastic pipe

3. Gas quality problems may cause masking or reaction of odorant components with impurities in the gas stream.

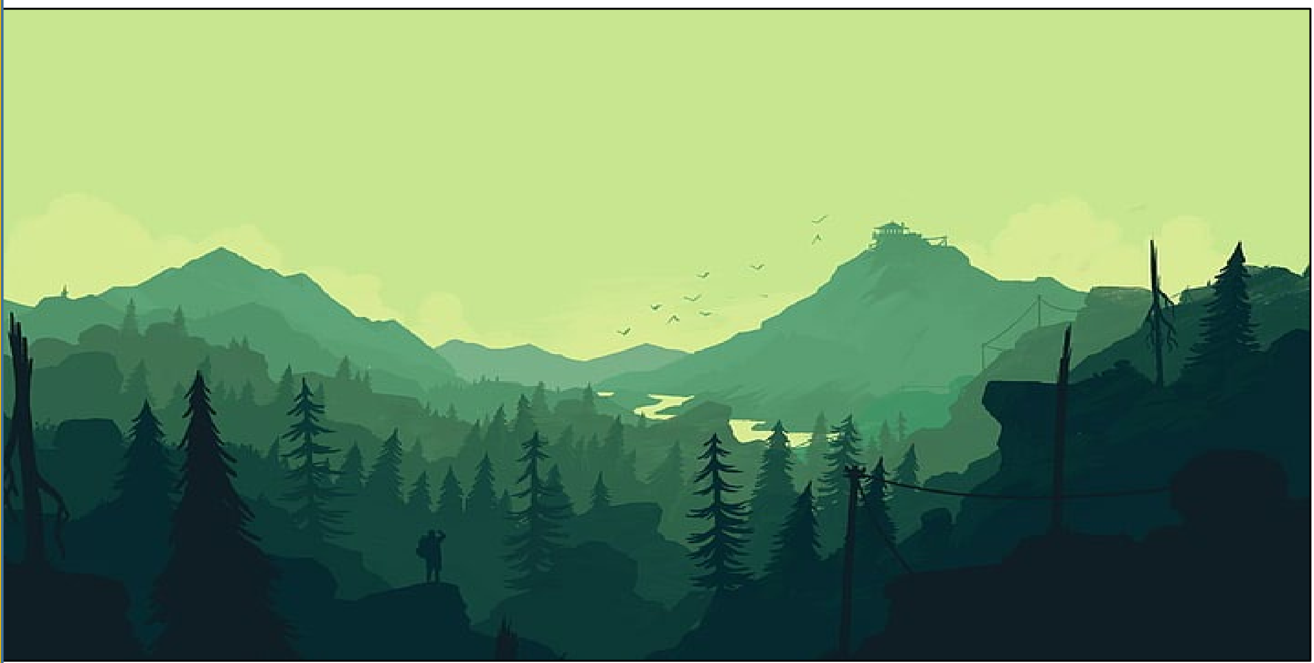
The presence of rust and air within a pipeline may act as a catalyst for the oxidation of mercaptans, resulting in compounds that do not smell at all. On the other hand, sulfide components are much more resistant to oxidation. Dry gas is the easiest to odorize and does not cause odor-fade. Condensed liquids in the pipeline may absorb components of the odorant. Odor masking may also occur because of the odor imparted by any impurities present in the gas. Odor-fading from odorized liquefied petroleum gas stored in carbon steel containers can occur by catalytic effects of the containers. To postpone this effect, the respective steel surfaces can be deactivated by treating them with a deactivating agent before exposure to the liquefied petroleum gas. Examples of such deactivating agents are benzotriazole, tolyl triazole, mercaptobenzothiazole, benzothiazyl disulfide, or mixtures of these compounds. It has been suggested that a mathematical model and adequate software should be developed to predict odorant fade.

Environmental Problems

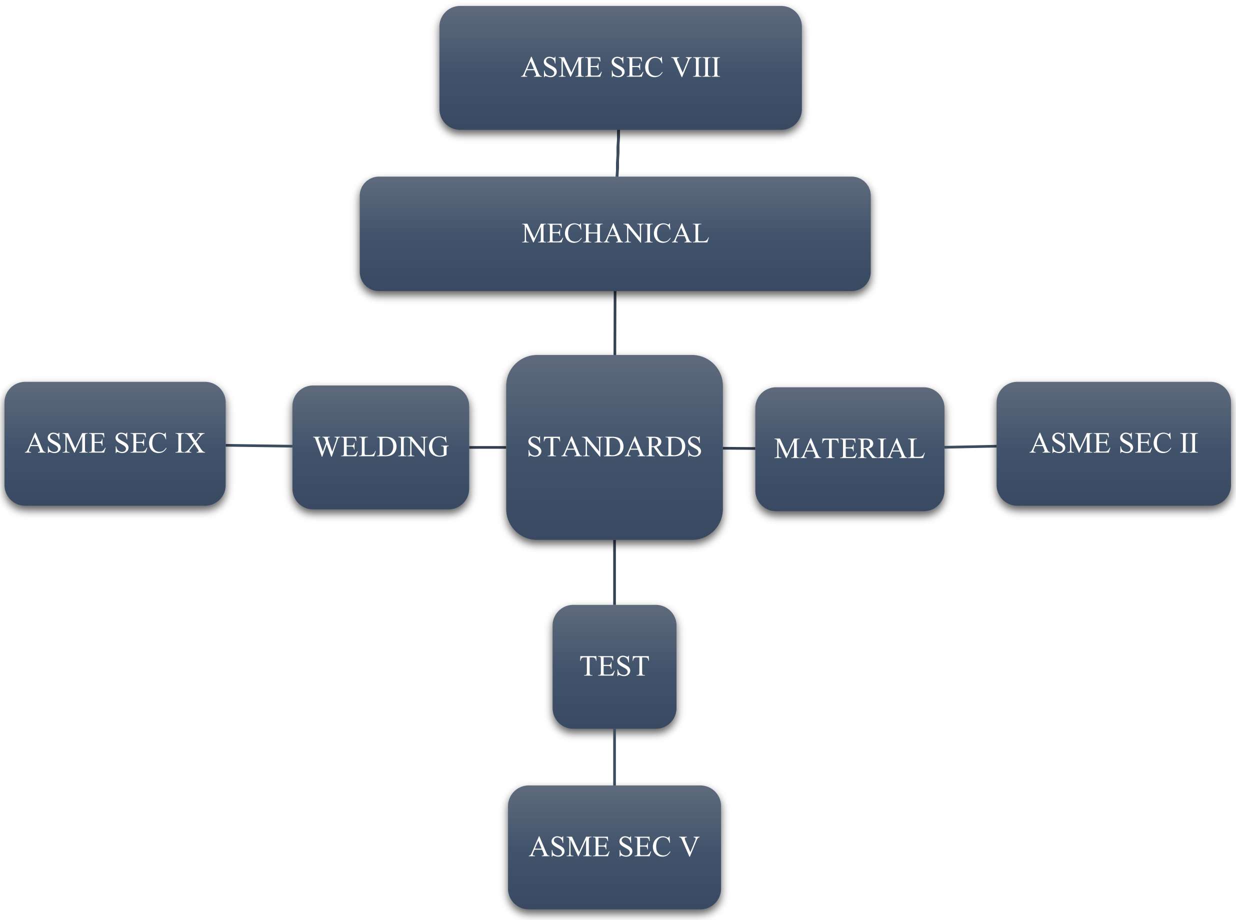
If natural gas for storage in natural reservoirs is odorized with sulfur compounds, then a possible environmental impact can result. Some of the odorant is lost in formations. If the loss occurs in a reservoir adjacent to an aquifer, it could contaminate the water and cause environmental problems. When gas is drawn off, water is also often injected into the reservoir. A case was described in which the respective water had a strong characteristic odor. A stripping column has been recommended to overcome this problem. Contaminated groundwater can be decontaminated by reaction with iron. This technique was proposed to remedy groundwater that was contaminated with ethyl mercaptan in situ. Studies suggest chemical reactions with iron rather than an irreversible surface adsorption. Gas odorizers can be removed by extraction, similar to the usual glycol dehydration and desulfurization process. Another cleaning process for the removal of tetrahydrothiophene uses an advanced oxidation technique, consisting of water treatment by UV radiation in combination with a dose of hydrogen peroxide. It is possible to keep the concentrations of odorant and condensate in the effluent below 0.1 ppb.

Knowledge is our difference…

We believe that investment in research and development is an essential component for long-term success. Computational Fluid Dynamics is a reliable tool for design optimization, troubleshooting, and product development. Flow distribution is critical in all gas-liquid and liquid-liquid vessels. CFD modeling is used by engineers at APADANA PETRO FARAYAND to simulate flow conditions and vessel geometry. The modeling provides a close approximation of the fluid flow and temperature profile inside the vessel.



STANDARDS


ASME SEC VIII
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