Gas Scrubbers for Gaseous Fueled Generator Sets

Information Sheet # 38

1.0 Introduction:

Gaseous fueled generator sets are used extensively for many applications. In most commercial and industrial applications, generator sets running on natural gas and LPG have a reliable source of gas from the utility company or LPG supplier. However, when gaseous fueled generator sets in Oil & Gas applications are using wellhead gas the quality of the gas can vary considerably.

This information sheet discusses the issues involved when applying a generator set to run on wellhead gas and the need for natural gas scrubbers and other filtration devices in order to ensure the quality of fuel going into the engine.

2.0 Operation of Generator Sets in Oil & Gas Field Applications:

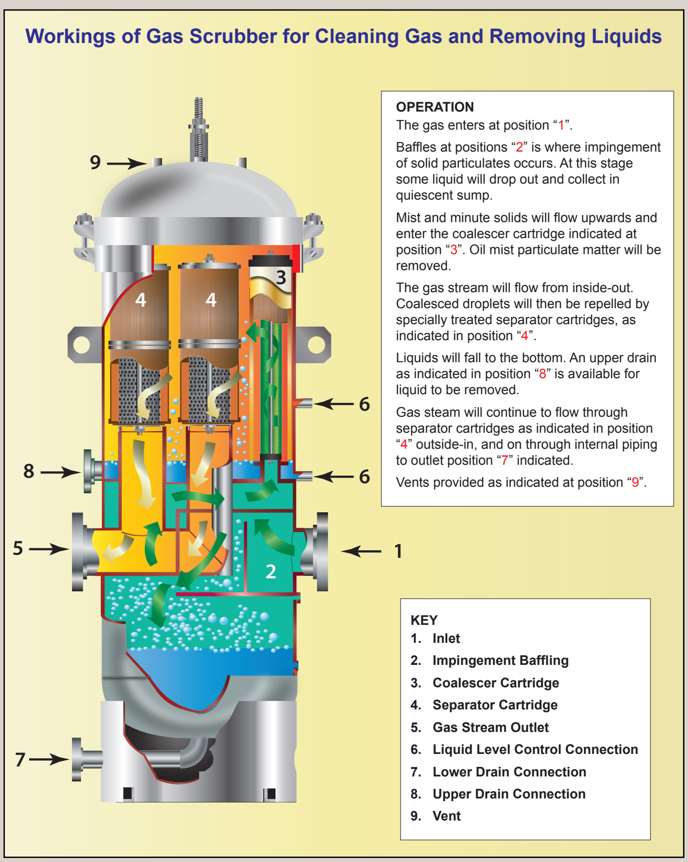
In the past, small quantities of wellhead gas were considered unusable and normally flared off at well sites. More recently, generator sets in remote field operations are frequently powered by spark-ignition (SI) reciprocating engines fueled from local wellhead gas. Much of the growth is the increase in drilling for natural gas using fracturing technology termed "fracing". Fracing operations are usually remote from the utility supply and require on-site generator sets to power numerous pieces of drilling equipment such as electric power drawworks, rotary tables, etc.

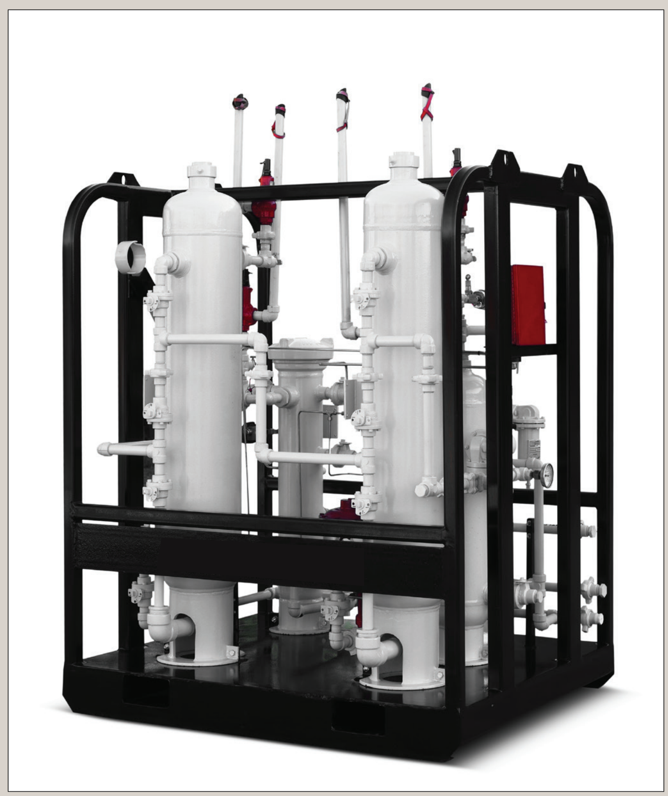
Also, having a generator set running on wellhead gas is much more economical than using a diesel powered unit requiring the high expense of transporting diesel to a remote drilling location.

3.0 Impurity Issues When Using Wellhead Gas:

Unprocessed wellhead gas is called sour gas if it contains more than 5.7 milligrams of hydrogen sulfide (H_2S) per cubic metre of natural gas. Contaminants are a serious concern with wellhead gas, if not removed it can seriously damage the engine. Harmful gas components include H_2S, halogen acids, HCN, ammonia, salts and metal-containing compounds, organic halogen, sulfur, nitrogen, and silicon-containing compounds, and oils.

In combustion, halogen and sulfur compounds form halogen acids, SO_2, some SO_3 and possibly H_2SO_4 emissions. These acids can also corrode downstream equipment. In the fuel combustion process nitrogen oxidizes into NOx. To prevent corrosion and erosion of engine components, solid particulates must be kept to very low concentrations.





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4.0 Engine Manufacturers Recommendations for Wellhead Gas Applications:

Each engine manufacturer has recommendations and specifications for the natural gas supply to be used to avoid a reduction in the performance of their engine. The specifications detail the variations in maximum and minimum percentages of calorific value, and all elements in the natural gas. Any engine warranty can be denied should the operator ignore these specifications.

5.0 Potential Damage to Engines Using Wellhead Gas:

Any remaining solid particulates in the fuel are the most damaging of all impurities in wellhead gas. Particular care needs to be taken to treat the natural gas (NG) before it is applied to a SI engine. Apart from possible corrosion to internal components, any impurities (detailed in clause 3) can shorten engine life, lessen reliability and reduce power output. Also, impurities can increase engine exhaust emissions and invalidate the Environmental Protection Agency (EPA) certification designated to the engine.

6.0 Solutions to Engines Using Wellhead Gas:

The primary solutions to ensure that correct gas specification is being used by the engine is the adoption of natural gas (fuel) scrubbing, droplet separation and filtration.

Gas scrubbers and water separators are pre-treatment devices and have to be placed between the wellhead gas supply and the engine fuel inlet to ensure fuel contamination does not exceed the manufacturer's specifications.

Note: *If landfill gas is the fuel source it frequently contains chlorine compounds, sulfur compounds, organic acids and silicon compounds, all of which also require pre-treatment.*

7.0 First Stage Pre-treatment of Wellhead Gas:

Liquid water and oil condensates are separated from the "wet" gas. In some instances both heaters and scrubbers are installed.

Heaters elevate the gas temperature to avoid formation of ice-like methane hydrates, while the gas scrubber removes any solid particles. First stage pre-treatment devices will treat and remove the principal impurities such as water, separate any natural gas liquids (NGL) and remove sulfur and carbon dioxide.

8.0 Second Stage Pre-treatment of Wellhead Gas:

Second stage pre-treatment removes any water vapor that may be present in solution by either absorption or adsorption dehydrating processes. The absorption process is when water vapor is taken out by a dehydrating agent. The adsorption process is when the water vapor is condensed and collected.

Glycol dehydration is a frequently employed absorption process using a liquid desiccant to absorb the water vapor from the gas stream, either by diethylene glycol (DEG) or triethylene glycol (TEG) put into the "wet" stream with glycol particles sinking to bottom of the collector body after absorbing the water vapor. Solid desiccant dehydration for the adsorption method is usually accomplished with two or more towers filled with solid desiccants such as silica gel where the water vapor in the wet NG is sequestered on the surface of the desiccant.

9.0 Sulfur and Carbon Dioxide Removal:

Wellhead NG can contain significant amounts of sulfur and carbon dioxide which should be removed before the NG is used as fuel.

The process to remove hydrogen sulfide is similar to the glycol dehydration described under 8.0. Most frequently, the NG is bubbled through a tower containing an amine solution having an affinity for sulfur. The amine solution is typically then regenerated. It is also possible to use solid desiccants such as iron sponges to remove the sulfur and carbon dioxide.

10.0 Alternate Gas-Processing Technologies:

Small scale systems are packaged with functions that can include acid gas removal, dehydration, nitrogen rejection and NGL recovery.

Acid gas removal. In general, potential acid gases to be removed from NG streams are CO_2 and H_2S. CO_2 is essentially a neutral compound and is removed via formation of carbonic acid in most cases. H_2S is more reactive and easier to remove.

11.0 Packages:

Suitable packaged units containing the necessary elements to handle the particular NG are assembled in a heavy-duty frame that protects them from any field operational knocks and/or damage. These are mounted on a steel skid base for ease of handling and movement on site as one piece of portable equipment. Any pressure vessels utilized should meet appropriate American Society of Mechanical Engineers (ASME) codes.

Constituent (NG = Wellhead Gas)	Natural Gas	LPG	Digester Gas	Landfill Gas
	Percentages			
Methane CH_4	80 - 97	0	35 - 65	40 - 60
Ethane C_2H_6	3 - 15	0 - 2	0	0
Propane C_3H_8	0 - 3	75 - 97	0	0
Butane C_4H_{10}	0 - 0.9	0 - 2	0	0
Higher C_xH_x	0 - 0.2	0 - 20	0	0
Carbon Dioxide CO_2	0 - 1.8	0	30 - 40	40 - 60
Nitrogen N_2	0 - 14	0	1 - 2	0 - 13
H_2	0 - 0.1	0	0	0
Lower Heating Value (LHV) (Btu/scf)	830 - 1075	2500	300 - 600	350 - 550

Source: SFA Pacific, Inc.; North American Combustion Handbook