Some facts about Hydrogen and Helium gas

Hydrogen

- Hydrogen gas consists of Hydrogen molecules
- The molecule consists of two atoms (therefore H_2)
- The atom has only one electron
- The nucleus of the hydrogen atom consists of only one proton.
- Each Hydrogen atom weighs 1g/mole. The molecule therefore weighs 2 g/mole.

Helium

- Helium is the second lightest atom. One nucleus of a Helium atom consists of two protons and two neutrons. That is why one atom weighs 4g/mol.
- Helium atoms do not combine into molecules. That is why it is called an inert gas, which consists of free atoms.

Physical properties

- Hydrogen gas has a much lower viscosity than helium. The viscosity of helium is actually higher than the viscosity of air. Hydrogen/nitrogen mixtures have higher viscosity than hydrogen, but still lower than air.
- Hydrogen spreads quicker in a given volume because of its high molecular velocity
- It finds and passes through leaks faster
- It is easier to flush out and vent away and therefore gives less background interference.
- Hydrogen molecules do not stick to surfaces as easily as Helium atoms. This gives less problems with background interference from gross leaks or from residual gas in tested objects.
- Hydrogen, Helium and Methane are the only naturally occurring gases lighter than air.

Origin

- Hydrogen gas is produced from by electrolysis of water or steam treatment of natural gas (methane). Helium can not be produced. It is extracted from natural gas from the few natural gas sources that has high enough (a few percent) content of helium. These are mainly in the U.S.A. Helium is therefore a non-renewable natural resource, the price of which is constantly going up.

Background

- In spite of the fact that Hydrogen is also produced by various biological processes the atmosphere only contains 0,5 ppm Hydrogen, but as much as 5 ppm of Helium.
- Even if pure hydrogen gas has a low density and tend to rise mixtures of hydrogen/nitrogen does not rise spontaneously. Neither will they hydrogen component in such mixture separate from the nitrogen component and form flammable concentrations under the ceiling. According to the laws of

INFICON AB

Box 76, SE-581 02 Linköping, Sweden
Tel: +46 (0)13 35 59 00, Fax: +46 (0)13 35 59 01
www.inficon.com E-mail: reach.sweden@inficon.com

thermodynamics two substances fully miscible in each other will not separate spontaneously. If this was they case one would not be able to store gas mixtures in bottles.

Safety

- If Hydrogen (H_2) and Oxygen (O_2) are mixed and heated they react and create water vapour (H_20). During this process more heat is generated which may (if the concentration is high enough) ignite the surrounding gas. If this process propagates we have an explosion.
- At low concentrations of Hydrogen (<4% in air) not sufficient heat generated to ignite the surrounding gas.
- At concentrations in the range 4-12% the combustion may spread only if actions are taken to prevent the generated heat from dissipating. It is a common misconception that hydrogen will explode as soon as the concentration exceeds 4%. This is not true. It may explode only if conditions are favourable for spontaneous propagation of combustion.
- When concentration exceeds 18% the combustion can spread itself quickly in the gas. If it propagates faster than the speed of sound then we have a detonation, a bang.
- At Hydrogen concentrations higher than 75% there is not enough Oxygen left for the gas to ignite. This is the upper explosion limit.
- If you use the recommended tracer gas of 5%H_2/95%N_2 and mix it with air there will either be too little hydrogen or too little oxygen to constitute a combustible gas mixture. Hence this gas mixture is classified as non-flammable. The actual limit being 5.7%.
- The mixture 10%H_2/90%N_2 is commonly used in the industry because it is flammable only under certain conditions. This mixture is however classified according to ISO10156 as Flammable Gas and should only be used after due safety considerations and approvals.

INFICON AB

Box 76, SE-581 02 Linköping, Sweden
Tel: +46 (0)13 35 59 00, Fax: +46 (0)13 35 59 01
www.inficon.com E-mail: reach.sweden@inficon.com