Alternative Solutions to Helium

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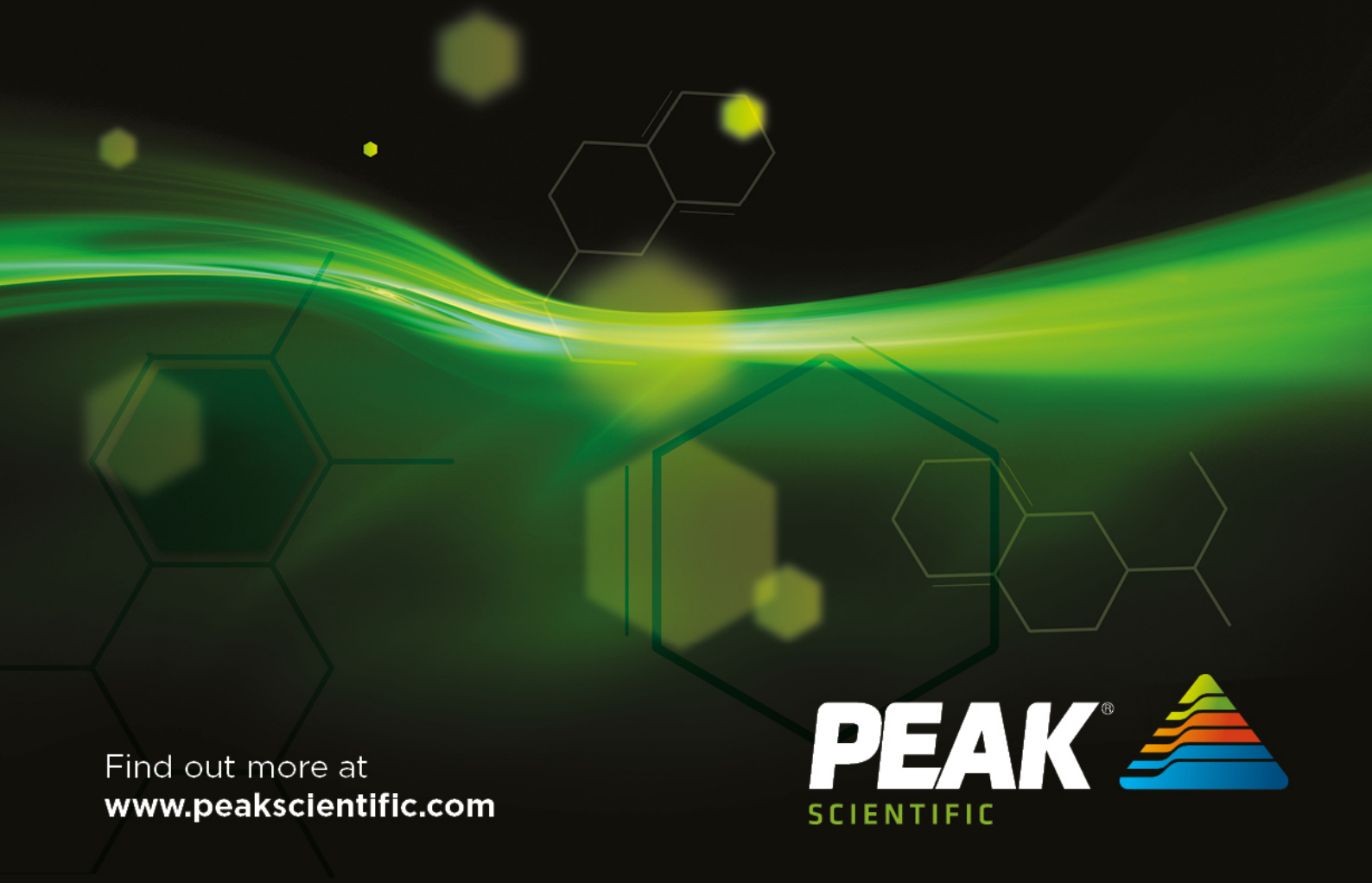

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Helium shortage

Helium is well known as Helium that makes balloons and airships float and in its liquid form, Helium is used in a variety of applications including cooling for magnets in Magnetic Resonance Imaging (MRI) scanners, cooling infrared detectors, and as a superconductor coolant in the large hadron collider at CERN.

Helium is distilled from natural gas deposits that have collected in the presence of Uranium and Thorium. These radioactive elements produce Helium when they undergo alpha decay1 and the gas remains trapped along with the natural gas until it is extracted. The presence of Helium together with natural gas was first discovered in 1903 in Kansas2 and since then the physical qualities of Helium (inertness, lightness, extremely low liquid temperature) have made its use essential in a number of areas in industry and science, as well as it being a mainstay at birthday parties. In levels of 0.3% by volume in natural gas deposits, Helium is deemed to be worth extracting3 and some natural gas deposits are reported to contain up to 7% Helium by volume.

A brief history of the Helium shortage

In 1925, the US established the National Helium Reserve (NHR)4, located in plains of Texas, and from 1929 the US was world's largest producer of Helium, with the Bureau of Mines coordinating extraction and refining programs. Helium was primarily produced for military use and until 1960 the federal government was the sole producer of Helium in the US. In 1960, Congress amended the Helium Act to provide natural gas producers with incentives to extract crude Helium and sell it to the government. Much of this Helium was stored at the NHR and prices were fixed with a view to cover the costs of the program and to pay off debts. However, post-war federal Helium demand was lower than predicted and with private demand far exceeding federal demand, in 1996 the US government passed the Helium Privatization Act (HPA). The HPA was an attempt to wipe out the site's $1.4 billion debt, through selling off all of the US national reserves by 2015. Private US companies have not moved in to refine Helium in the quantities expected and the potential supply problem has prompted other countries to begin extracting Helium, and refineries are now producing Helium in a number of countries worldwide including Russia, Qatar, Algeria and Australia.

Why is there a shortage of helium?

In 2012 the US produced an estimated 78% of the world's Helium of which around 30% came from the NHR4. The shortage of Helium has been caused by a number of factors, including worldwide refinery equipment failures and shutdowns5 with scheduled maintenance in several of the world's natural gas refineries disrupting supply. These factors coupled with an increasing demand for Helium from newly industrialised countries such as China, mean that we are moving even closer to a worldwide shortage with customers already seeing stark price increases and supply problems as private companies struggle to meet the demand. A look at the figures published by the United States Geological Survey (USGS) shows that while the volume of Helium extracted from natural gas fields has remained steady over the past 5 years, consumption from the NHR has steadily increased. In the same period, exports of US helium have risen to 60% of the total6, and with the NHR rapidly emptying the current situation appears to be unsustainable. Worldwide Helium demand far exceeds production and therefore alternatives to Helium must be sought for a number of technologies.

Potential alternatives to Helium

Cryogenics

Applications requiring temperatures of below -256°C will still require liquid Helium, but alternatives are currently available for cooling of MRI scanner magnets and other applications requiring super conductors. Liquid Nitrogen can be used in some cooling systems and there are now a number of companies who specialise in water-cooling 'chiller' solutions for cooling of MRIs.

Shielding gas for welding

Helium is commonly used as a shield gas for non-ferrous welding. Argon can be used instead of Helium and is preferred for certain types of metal.

Balloons

Helium is used for lots of lighter than air applications and Hydrogen is a suitable replacement for many where the flammable nature of Hydrogen is not an issue.

Purge gas

Helium and Argon are commonly used as purge gases thanks to their inertness, but Nitrogen is probably the most widely used purge gas in industrial applications and scarcity of Helium is likely to lead to an increase in use of alternatives for these applications.

Controlled atmospheres

Helium is commonly used in controlled atmosphere applications, but Nitrogen offers a cheaper viable option for long-term storage of foodstuffs.

Deep sea diving gases

Helium is commonly mixed with oxygen to prevent deep sea divers developing Nitrogen narcosis symptoms, but Hydrogen/Oxygen mixtures are also used for deep diving and may be increasingly used as Helium prices rise.

Gas Chromatography

Hydrogen offers a number of advantages to Helium for gas chromatography including lower cost, availability through electrolysis of water, and improved sampling speed. Many chromatography laboratories are actively changing from using Helium to Hydrogen for carrier gas.

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