

Helium supplies endangered, threatening science and technology

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In America, helium is running out of gas. The element that lifts things like balloons, spirits and voice ranges is being depleted so rapidly in the world's largest reserve, outside of Amarillo, Tex., that supplies are expected to be depleted there within the next eight years.

This deflates more than the Goodyear blimp and party favors. Its larger impact is on science and technology, according to Lee Sobotka, Ph.D., professor of chemistry and physics in Arts & Sciences at Washington University in St. Louis.

“Helium’s use in science is extremely broad but its most important use is as a coolant,” said Sobotka, a specialist in nuclear chemistry and physics who collaborates with researchers at several national laboratories.

Generally the larger users of helium (He), such as the national laboratories, have the infrastructure to efficiently use and recycle helium, Sobotka said. The same cannot be said of many smaller scale users.

“Helium is non-renewable and irreplaceable. Its properties are unique and unlike hydrocarbon fuels (natural gas or oil), there are no biosynthetic ways to make an alternative to helium. All should make better efforts to recycle it. “

Drift Away

The helium we have on earth has been built up over billions of years from the decay of natural uranium and thorium. The decay of these elements proceeds at a super-snail's pace. For example, one of the most important isotopes for helium production is uranium-238. In the entire life span of the earth only half of the uranium-238 atoms have decayed — yielding eight helium atoms in the process) and an inconsequential fraction decay in, say , 1, 000 years. As the uranium and thorium decay, some of the helium is trapped along with natural gas deposits in certain geological formations. Some of the produced helium seeps out of the Earth's mantle and drifts into the atmosphere, where there is approximately five parts per million of helium. However ,this helium, as well as any helium ultimately released into the atmosphere by users, drifts up and is eventually lost to the earth.

“When we use what has been made over the approximate 4.5 billion of years the earth has been around, we will run out,” Sobotka said . “We cannot get too significant quantities of helium from the sun — which can be viewed as a helium factory 93 million miles away — nor will we ever produce helium in anywhere near the quantities we need from earth-bound factories. Helium could eventually be produced directly in nuclear fusion reactors and is produced indirectly in nuclear fission reactors, but the quantities produced by such sources are dwarfed by our needs.”

Helium plays a role in nuclear magnetic resonance, mass spectroscopy, welding, fiber optics and computer microchip production, among other technological applications. NASA uses large amounts annually to pressurize space shuttle fuel tanks.

Unlike any other element, helium 4 (two protons, two neutrons) becomes a liquid below 4.2 Kelvin, just four degrees short of absolute zero. When one puts an object next to liquid helium, energy is extracted from the object, making it colder. The energy extracted from the object vaporizes the helium. It is this helium vapor, which, Sobotka claims, should always

be recaptured, to be recycled for future use.

Much of the world's supply of helium lies in a reserve in the Texas Panhandle, better known for the locales of Larry McMurtry's novels, such as "The Last Picture Show," and "Texasville," than as an elemental factory farm.

Scientists haven't even approached mining helium out of the air because costs are too prohibitive.

A rebel, a loner

Both hydrogen and helium, the first two elements, on the Periodic Table, are very abundant in the universe (about 92 per cent and about 8 percent of the atoms, respectively). Helium is rare on the earth while hydrogen is abundant. The reason is that helium is a rebel, a loner, and it does not combine with other atoms while hydrogen does. Hydrogen is one of the two elements that make water. Under standard conditions, there are no combined or molecular forms of helium.

"It's the most Noble of gases, meaning it's very stable, and non-reactive for the most part.," Sobotka said. "Helium has a closed electronic configuration, a very tightly bound atom. If you try to extract an electron from helium, you pay a lot of energy to pull it off. It's very high in ionization energy. It is this coveting of its own electrons that prevents combination with other elements. "

In addition to the Texas panhandle, helium can be found in small regions of Colorado, Kansas and Oklahoma. It is marketed in Australia and Algeria. And Russia has the world's largest reserves of natural gas, where helium certainly exists. But there is no push to market it, as, for the short term, supplies are adequate, though increasingly costly.

Sobotka believes that Russia will be the world's major source of helium in 30 years.

The price of liquid helium is about \$5 per liter, having gone up more than 50 percent over the past year because of what Sobotka calls "conventional" economics. He cited the withdrawal of some companies from the marketplace, and the emergence of others that are not yet in production, as the driving force behind higher prices, and (as yet) a scarcity of the element.

Helium capture in the United States began after World War I, when the primary use of the gas was for dirigibles. Because helium is non-flammable, its use in balloons prevented another Hindenburg tragedy. The U.S. government ran the helium industry for 70 years, but since the mid-90s it has been in the domain of the oil and natural gas industries.

Tell it like it is

"The government had the good vision to store helium, and the question now is: Will industry have the vision to capture it when extracting natural gas, and consumers the wisdom to capture and recycle?" Sobotka said. "This takes long-term vision because present market forces are not sufficient to compel prudent practice."

Helium plays second fiddle to marketing oil and natural gas, and much of it is lost in a process that removes noncombustible nitrogen and helium from the product of prime interest.

"When they stick that straw into the ground to suck out oil and gas, the helium comes out and if it doesn't get captured it drifts into the atmosphere and is lost," Sobotka said. "Helium production is a side industry to oil and natural gas, an endeavor that nobody wants to lose money on. "

Meanwhile laboratories worldwide could make better attempts at conserving helium. They can either use costly machines called liquefiers that can capture, store and reliquefy helium on site, or researchers can take captured helium in gas form, return it to the company that originally sold it to them and receive a monetary return, just as in a deposit on a bottle.

“We have to be thinking of these things,” he said. “Up to now, the issue often hasn’t risen to the level that it’s important. It’s a problem for the next generation of scientists. But it’s incumbent upon us to have a vision, and tell it like it is — a resource that is more strictly non-renewable than either oil or gas.”

Source: Washington University in St. Louis

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