The HangLine

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The Birth of the Helium Analyzer

By Bill Nadeau

A mixed gas diver must appreciate the characteristics of oxygen and helium and how they react with each other and the human body. Helium, for example is a very light gas, far less dense than oxygen or nitrogen. Owing to it's physical and chemical structuring it has relatively minute narcotic effects on the body and is ideal for deep diving. By incorporating helium into our bottom gas supply, we reduce both the fraction (and partial pressures) of oxygen and nitrogen subsequently lessening a diver's susceptibility to hyperoxia, carbon dioxide retention and narcosis.

Testing the Atomox prototype on my rebreather. Inset: the latest Atomox Heliox model.

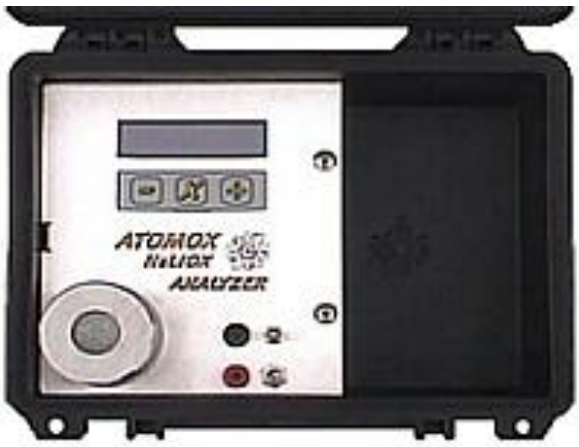
Helium has also been labelled a fast gas, by that we mean it enters and leaves our body ahead of other gases and like nitrogen it is inert, stored in our tissues when under pressure. Because it enters and leaves our tissues in a different manner from other gases means that traditional off-gassing rates as represented in air tables and computers no longer apply. Decompression tables designed for mixed gas diving take into account the unique way helium effects decompression profiles, it also requires that a diver follows his profile even more closely then he would for an air dive, especially since the nature of helium off-gassing requires deeper and more frequent stops.

Up until the year 2000, accuracy in blending mixed gases was heavily dependent on math calculations and an adjustment for ideal gas laws. Unlike nitrox where the final mix could be analyzed using an oxygen analyzer, final helium concentrations in trimix gas mixtures were determined solely on blending principal. During a trimix program a student of mine, Larry Hill asked why with all of the technology we had today no one has ever incorporated a helium analyzer into mixed

gas blending methods. Larry was a successful dive shop owner from Idaho and possessed a keen interest in safe deep diving activities. He was always curious about new ways to minimize risk and improve the quality of diving by enhancing the experience of the 'deep dive'. As far as I knew helium analyzers existed but were such specialized instruments that nobody had ever modified one so that it could be used for SCUBA applications.

Larry returned a few days later after having consulted with an engineering friend of his who believed he had a solution. I told Larry that if his friend could come up with an inexpensive way to accurately measure helium concentrations in high pressure gas mixes he would revolutionize the gas blending industry. A few short months later Larry's friend, Brad Gilmour had constructed the prototype of what would eventually become a technological masterpiece in mix gas diving. Myself, Larry and a few other active gas blenders were bequeathed with the task to run the Atomox Helium Analyzer through a test and trial period. I called Brad to let him know how impressed I was with his prototype and was floored when he told me that he was concerned that it was only designed to provide .01% accuracy. I replied that this would not be a problem as the most sophisticated oxygen analyzers sample to within .1% and even if the Atomox was 100 times less accurate it would still be a success as most mixed gas dive tables are based on a 10-20% variation in helium content.

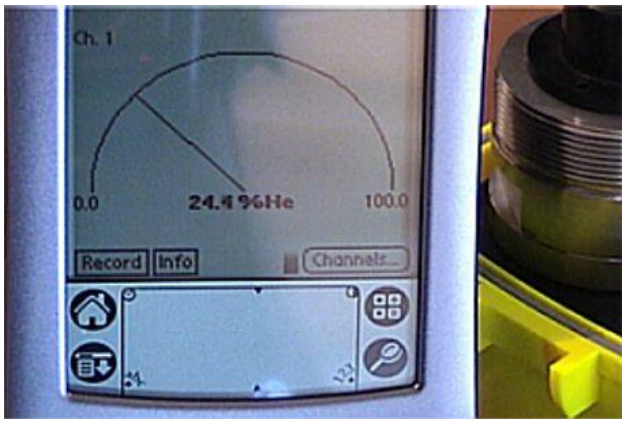
The unit proved to be an overwhelming success and was quickly picked up and distributed by Dive Rite Manufacturing out of Lake City in Florida. Atomox now produces the most sophisticated mixed gas analyzers on the market. For standard open circuit mixed gas diving, the Atomox allows divers to re-use, dilute and 'sweeten' mixes as many times as desired and still know exactly what the fraction of helium in their tanks is. In the past the general rule was too dump the mix in a set of tanks after the second dive because the margin of error was too great when calculating gas content with ideal gas laws. We also discovered that small high-pressure tanks (like those used in rebreathers) were very susceptible to significant errors with ideal gas blending techniques, likely because of



the unique characteristics of helium. In some cases we found the helium content in the smaller steel cylinders to be more than 20% off what we estimated it would be.

I have been using the production model of Atomox Helium Gas Analyzer now for a number of years and have used it to blend and test thousands of trimix and heliox gas fills in a variety of cylinder configurations and environments. The unit has been improved to simultaneously analyze oxygen concentrations. Its accuracy has literally changed the way we approach mixed gas diving. We have also concluded unequivocally that a diver cannot simply rely on mathematics and traditional gas blending methods to safely blend an accurate mix. It is now evident that helium based mixes are extremely vulnerable to ideal gas mix laws and can be more than 30% in error and/or can take more than twelve hours to reach a homogenous state. This robust, reliable unit quickly determines exactly what gas mixing has occurred and is an inexpensive and mandatory component for every mixed gas application. I will never again use a mix, or allow a mix to be used by a student or customer without first testing it with the helium analyzer. To do so otherwise would be irresponsible and reckless.

With helium characteristically entering and leaving the body's tissues ahead of the other gases, traditional tables must be adjusted which adds to the complexity of deep mixed gas decompression profiles. Consequently the concentration of helium in a gas mix combined with the greater ambient pressures complicates overall gas absorption rates. For this reason alone, extended range mixed gas divers need to know the exact FO2 and FHe in their mixes before they dive. If you begin a deep dive with a FO2 greater than what you had planned your dive on, you predispose yourself to oxygen toxicity. Conversely if you are breathing a mix from the surface with a hypoxic gas, originally thought to have a sustainable amount of oxygen, you increase the chances of hypoxia. Both gas blenders and the end users must be fully cognizant to the contents of the tanks and the profile it will be dived. ~ BN



Integrating the Atomox with a Palm.

Accuracy at it's best.

To think that we were once prepared to accept a 20-30% variation/error in our mixing calculations!

Worse yet – think of all the mixes we dumped because 'we just weren't sure!'