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Technically Speaking

Adding a Little Sanity to Diving

By Bill Nadeau

Even at the recreational diver level, diving over 60fsw (18msw) requires attention to narcosis and carbon dioxide retention. Now that all of the larger training agencies in the world are recognizing extended range diving (diving below 130fsw/39msw) there has been a greater interest in the use of helium in a standard diving mix. Heliox/trimix are no longer gases that have been reserved for the 200fsw/60msw and deeper range. Many divers are now incorporating a breathing medium known as "Normoxic Trimix" for diving ranges between 100fsw/30msw to 200fsw/60msw. Normoxic Trimix applications are simple to employ, safer than air and increase the diver's ability to really enjoy a dive.

Trimix is comprised of three (tri) gases; nitrogen, oxygen and either helium, neon or hydrogen. The third gas is nearly always helium as neon is expensive and hydrogen somewhat unstable. "Normoxic Trimix" is a breathing mix with no less then 21% oxygen and no more then 25-30% helium. One of the great things about a normoxic trimix is that it can be breathed right from the surface eliminating the need for a second stage bottle. In fact an ideal normoxic trimix dive to 150fsw/45msw will actually have an EAN25 (25% oxygen) incorporated into it accelerating the off-gassing process. For dives below 200fsw/60msw a portion of the oxygen is replaced by helium to eliminate hyperoxia at depth. This mix cannot be breathed at the surface.

Helium has been used in diving applications for a very long time. It was first suggested by Elihu Thomson that helium could be used as a medium that could augment oxygen and nitrogen in a breathing mix. Only small quantities were available and very costly. It was not until the early 1900s that the United States actually discovered vast quantities of helium in Texas giving them an 'exclusive dealership' and bringing the cost of the gas to within a reasonable rate. By 1924 heliox mixtures were being researched by the US Navy and the Royal Navy but quickly abandoned after a high number of DCI incidents occurred. In the 1930s civilian exploration of the gas picked up starting with the Heliox decompression tables designed by Edgar End and used by Max Nohl during his record setting dives. Very quickly deep dives and saturation expeditions began employing helium as a standard mix in various types of diving apparatus.

During World War II the United States Department of Defence banned the exportation of helium fearing that it may be used by Germans in their dirigibles. Soon after helium became a demand unmet by the supply. This slowed the research and application of mixed gases for some time. Research resumed again after a number of naval disasters prompted rescue efforts in deep waters. Hans Hass, a Swiss mathematician along with a physicist named Buhlmann generated a

set of dive tables to a 1000fsw using helium. The record setting dive made by Hass proved the validity of his tables and helium use.

Helium is a very light gas and not very dense. Due to its physical and chemical structuring it has very little narcotic effect on the body making it ideal for deeper diving. By augmenting helium into our breathing mix we are able to reduce both the fraction of oxygen and the fraction of nitrogen thereby reducing a diver's susceptibility to hyperoxia, hypercapnia (CO_2 retention) and nitrogen narcosis.

Helium can also be considered a fast gas or gas that likes to enter our tissues before any other gas. Like nitrogen it is inert (our bodies can not metabolize it) and is stored in our tissues when under pressure. The fact that it enters and leaves at different rates than nitrogen means that traditional off-gassing times as calculated through the use of dive tables and air computers no longer apply. (Although Normoxic Trimix tables are very close to regular air tables). Mixed gas dive tables take into account this phenomenon but rely on divers following a profile even more precise than that of airespecially since the nature of helium off-gassing requires deeper and more frequent stops.

A normoxic trimix at the surface begins to become hyperoxic at depths below 218fsw (72 meters) so trimix for dives deeper than 180-200fsw (60-66 meters) will need to have an oxygen content of less than 20-22%. It is recommended that for technical dives bottom mixes not exceed PO_2s of more than 1.5ATA for open circuit divers while closed circuit rebreather divers maintain a set point of no more than 1.4ATA.

Helium also provides a buffer against the nitrogen reducing the narcotic potential of a breathing mix. Air typically has 79% nitrogen but if a mix is prepared so that the nitrogen content is reduced, say by half (40% nitrogen) then that particular mix has only half the narcotic potential. A diver on trimix with 40% nitrogen in their mix (a 18/42 trimix) will experience approximately the same level of narcosis as a diver on air at half of his depth (all things being equal).

As mentioned earlier helium has very different on-gassing and off-gassing rates than nitrogen. This characteristic offsets traditional air and nitrox tables, adding to the complexity of decompression profiles. The amount of helium in a mix and the depth it is being breathed will effect this rate.

Today thousands of divers around the world are venturing safely into new domains using normoxic trimix and trimix gases. It is proving that without a doubt mixed gas operations can provide a means to dive deeper, longer and with a clear mind.