Dive Gases

One of the great advances in diving in the past ten years has been the gases used in diving. Whereas originally the only choice was air, there is now a wide range of choices available to divers. All of these gases have allowed greater bottom times, depths, and/or safety, despite early fears and outright banning by PADI, the Cayman Island Watersports Operators Association, and other organizations. The gas that started this revolution is nitrox, sometimes called Enriched Air Nitrox, Oxygen Enriched Air, or Safe Air. It is simply a mixture of oxygen and nitrogen, of which air (21% oxygen, 79% nitrogen) is a special category. The principle upon which nitrox works is simple. Oxygen is metabolized and is not considered part of the inert gas load, which can lead to decompression sickness (DCS), or the bends. By increasing the oxygen content above 21%, the percentage of the inert gas nitrogen is reduced, creating a "virtual" shallower depth on the body from a decompression standpoint. This allows either longer bottom times or more safety margin from DCS for shorter bottom times. There is also the benefit of reduced nitrogen narcosis, although this is a debated and small benefit at best.

There is a price to be paid, however. Oxygen is toxic with increased pressure. The main danger for recreational divers is a central nervous system (CNS) convulsion, which in itself is not harmful, but the unconsciousness and drowning afterwards is. This risk is minimized by limiting the depths which nitrox mixtures are used. For the common nitrox mixtures of 32% and 36% oxygen, the maximum operating depths (MOD's) are 110' and 90' respectively. Therefore, nitrox is not a deep gas and is most useful on long shallow dives (increased bottom time), intense repetitive shallow dives such as those found on liveaboards (increased safety margin), or in the specialized depths of 100'-120' (reduced narcosis, increased safety margin, and/or increased bottom time).

Disadvantages of nitrox are the previously mentioned CNS toxicity, an increase in tank fill costs, and the possibility of needing special cleaning and maintenance for tanks and regulators. Most shops charge approximately double the amount of an air fill for a nitrox fill. Higher oxygen content can accelerate combustion events, so special rubber materials and oil-free cleanliness are necessary above the commonly accepted limit of 40% oxygen. Unfortunately, not all shops and manufacturers accept this limit and may demand special equipment servicing above 22% oxygen.

There is another use of nitrox that has also become popular with deep technical diving. It is used as a gas to speed up, or accelerate, decompression. The same properties that make nitrox desirable for shallow dives also make it desirable for shallow decompression stops and allow a diver to leave the water quicker than if just using low-oxygen bottom gas. Technical divers have also popularized trimix, the other revolutionary gas in diving. This is a gas consisting of oxygen, nitrogen, and helium. The purpose of the helium is to reduce nitrogen narcosis since helium is non-narcotic. Diving air at depths greater than 100' can produce drunken symptoms that increase with depth until they become debilitating. A trimix mixture displaces some of the nitrogen with helium to produce a "virtual" shallower narcosis depth. Since the goal of trimix is to keep the debilitating nitrogen narcosis at equivalent air depths (EAD's) of generally less than 100', trimix is usually used at depths deeper than 120', which is nitrox's 100' EAD limit.

Because oxygen is toxic at increased depth, the helium of trimix is also used to limit the amount of oxygen. Trimix mixtures can be hyperoxic (>21%), normoxic (18%-21%), or hypoxic (<18%). A typical hyperoxic trimix would be 25-20 (25% oxygen, 20% helium, and remainder nitrogen), which is usable to 150' and has nitrox-like oxygen content. A normoxic trimix would be 20-35, which is usable to 200' and has air-like oxygen content. A hypoxic trimix would be 16-50, which is usable to 260' but cannot be breathed on the surface due to the very low oxygen content. An additional benefit of trimix is that helium has a much lower viscosity than nitrogen and allows easier breathing at depth under high pressure. This reduces stress on the diver and reduces the chances of hypercapnia, or carbon dioxide poisoning, from inefficient lung ventilation. Hypercapnia is the major culprit suspected in the phenomena called "deep water blackout."

There are, of course, some negative aspects to trimix. First, helium is an expensive gas, and fills can range from $30-$100 each. This is one reason why heliox (pure helium and oxygen) is rarely used, why trimix is rarely used as a recreational diving gas at depths less than 120', and why technical diving is so expensive in addition to the investment in specialized equipment and training. Another disadvantage of helium is that it is an excellent thermal conductor, which can lead to rapid heat loss and chilling of the diver, especially if used for drysuit inflation. Independent drysuit inflation systems using argon or air are recommended when diving trimix to minimize this heat loss. Finally, helium has different physical properties than nitrogen and therefore requires specialized computer-generated decompression tables to dive it. Air and nitrox tables are generally inappropriate for use with trimix. Fortunately, this is easily solved with a wide variety of available decompression software programs that are available on the commercial market.