Argon and Diving

In the December, 2002, issue of *Diver* magazine, there was an article called "Argon and Diving" by Dr. David Sawatzky in their Diving Medicine section of the magazine. Georgann Wachter showed this article around to some of the more advanced divers who use argon in their drysuits to help keep them warm during deep dives using trimix, a helium-based non-narcotic gas mixture. The article had some controversial findings and recommendations that have had people talking. Therefore, it might be a good idea to comment on the article and explain the concepts. Be warned, however, the discussion and points below are just the writer's opinions.

The reason argon is used in the first place is to keep divers warmer. Argon has a low thermal conductivity (18 mW / m K) and is completely inert. This creates an insulating layer of gas in the drysuit which reduces heat loss to the surrounding water. An independent inflation system is required since argon can't be breathed (no oxygen) and is very narcotic when used in breathing mixtures. An argon inflation system consists of a small (5-20 cu. ft) bottle mounted somewhere on the diver, the first stage of a regulator mounted on the bottle, and a drysuit inflator hose attached to the regulator. A small relief valve is also usually added to one of the low pressure ports of the regulator in case the first stage should fail and allow full bottle pressure downstream. This prevents the inflator hose from exploding or the drysuit inflator mechanism from going into free flow. That would be bad. Lots of discussion can be generated about what exact size of bottle to use and where it should be mounted, but generally it is placed on the belt loop or backplate and is big enough to allow several dives but small enough not to be in the way.

The controversial part of the article states that in a recent set of controlled experiments, divers could not tell the difference between air and argon in their inflation systems. This is due to air's thermal conductivity (26 mW / m K) being only a little higher but almost the same as argon. The experiments suggest the small difference between the two gases is imperceptible to the average diver. The author then drew the conclusion that argon inflator systems are unnecessary and, in fact, dangerous because they are extra equipment, extra complexity, and there is a danger that a pure inert gas might accidentally get breathed. Instead, better drysuit underwear was espoused as the solution for divers being cold.

The one point the author overlooked is the trimix aspect of the issue. Helium has a very high thermal conductivity (152 mW / m K), so trimix tends to quickly chill divers who are using their back gas to inflate their drysuits. This is not to say this should never be done because some divers have a good thermal tolerance and/or may be diving in warm enough conditions where this is not a problem. Certainly, an independent inflation system does impose extra cost, gear, and complexity and should be eliminated if possible. But if divers using trimix find

themselves significantly chilled, there may be no other choice but to use an independent inflation system. Better drysuit underwear may not be enough to completely eliminate the chill of trimix.

The big point the article SHOULD have made is that air is just as reasonable of a gas to use as argon. The few extra percent gain in performance using argon versus air may not be important. Additionally, a lot of logistical trouble and cost can be saved by using air instead. If diving while on travel, argon may not always be available or may be costly to buy. Argon fills can be especially annoying if refilling the inflator bottle has to be done after every day's diving in addition to getting the main tanks filled. However, if air is used instead of argon, the inflator bottle can be filled at the same time the diver's main tanks are being filled and without any additional cost since the bottle is very small and will probably be filled for free.

Since the inflation system's bottle can be filled every day, the inflator bottle's size can be driven down since it no longer has to hold several day's worth of argon for logistical reasons. Furthermore, argon is usually only available at 2000-2400 psi, and the higher 3000 psi pressure of an air fill allows the bottle to be smaller. Pre-flushing a drysuit several times with argon also becomes unnecessary since the suit is already filled with air, and this again serves to decrease the necessary gas volume of the inflator bottle.

There is also the small advantage that air is breathable and safer than using a pure inert gas like argon. However, this argument does not really hold water (excuse the pun) since there is already the presence of pure helium and oxygen in trimix diving operations, so good gas mixing and oxygen measurement discipline are really the solutions to this problem.

Unlike what the article stated, independent inflation systems are necessary. It does illustrate, however, that perhaps it would be better to refer to such systems as something other than "argon inflation systems" since the argument for using argon instead of air is not strong and may not be necessary.