How a diving carbon dioxide absorber works.

In order to better understand the factors that effect the duration of the absorber it is helpful to have a basic understanding of how the process works. The basic process is that sodalime is used to absorb carbon dioxide gas by chemically reacting it with calcium hydroxide (hydrated lime) to form calcium carbonate (chalk). This reaction occurs in the absorber of a diving re-breather set.

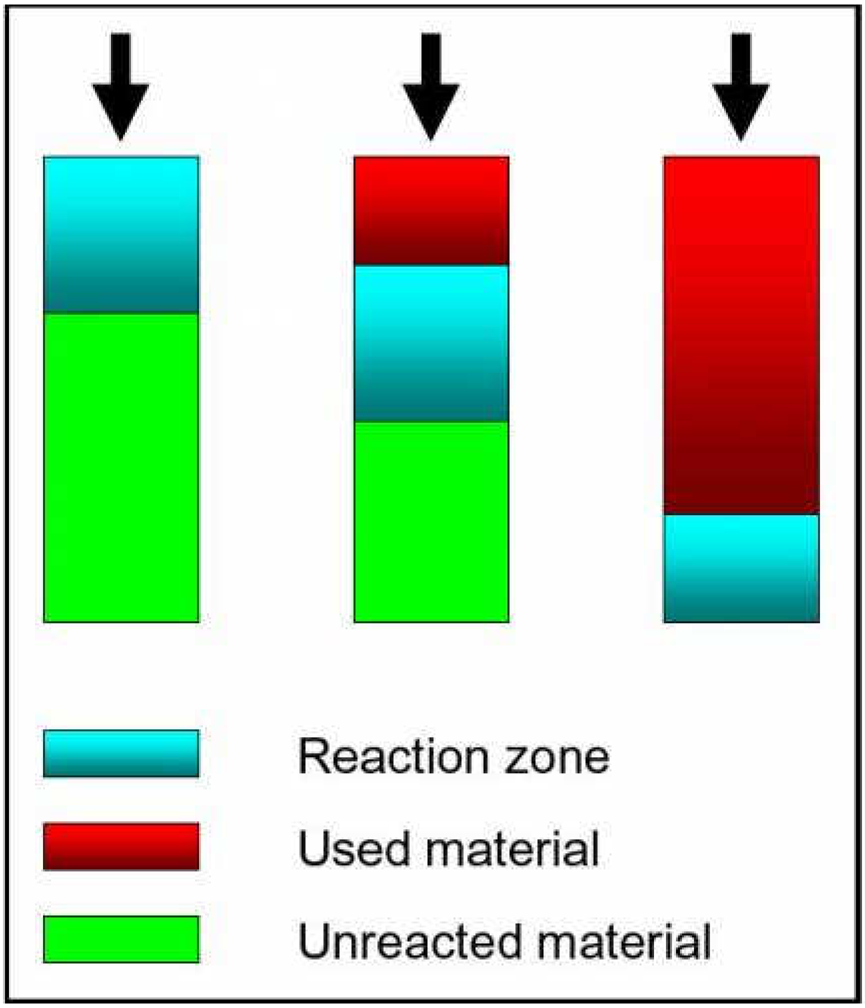

Figure 1 - reaction zone moves through the absorber

The rate of reaction of the carbon dioxide gas with the sodalime and the amount of carbon dioxide produced by the diver will both effect the available duration but, less obviously, so will the gas flow rate.

In use the absorber consists of three zones shown in Figure 1. The unused material shown in **green** which has an intrinsic carbon dioxide capacity that is not dependant on the rate of reaction or the size of the absorber; a reaction zone shown in **blue** that essentially has no carbon dioxide capacity and the used or exhausted material shown in **red**.

The reaction zone (**blue**) moves forward into a volume of unused Sofnolime (**green**) and continues until the reaction zone reaches the end of the absorber when breakthrough of the carbon dioxide starts to occur. It leaves behind it a volume of exhausted or used material (**red**) made up of mostly calcium carbonate.

The remaining usable capacity is therefore determined by how much of the unused Sofnolime (**green**) is available for the reaction zone to move into. The total usable capacity is simply the amount of carbon dioxide that the whole unit can absorb before an unacceptably high breakthrough of carbon dioxide occurs. It is made up of the reaction zone, which essentially has no capacity, and the capacity of the unused remaining material.

The outlet of the absorber therefore contains no carbon dioxide until breakthrough occurs, at which point the outlet carbon dioxide level will slowly rise.

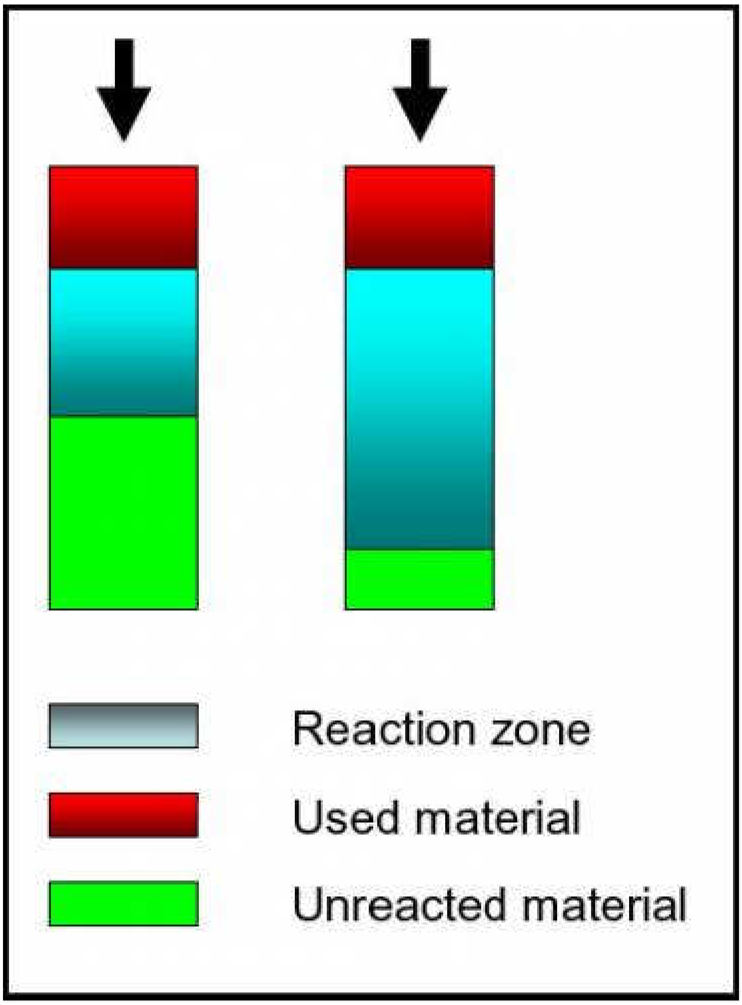

Figure 2 - effect of reaction zone size

In Figure 2 it can now be seen that if the reaction zone (**blue**) is a large proportion of the total absorber, then because it has no capacity, the total usable capacity is reducedas there is less material left to be used (**green**). So, what we need is a small reaction zone volume (**blue**) and a large amount of remaining unreacted material (**green**) with a high intrinsic capacity.

So how do we keep the reaction zone small? We can use a highly reactive sodalime such as a diving grade of Sofnolime which, because it reacts quickly, keeps the reaction zone small. We can also keep the gas flow rate as low as possible. If the gas flow is reduced, the time taken for the gas to move through the absorber will be longer. Because the reaction zone volume is determined by the time taken for the carbon dioxide to react, a slower gas flow rate will make the reaction zone smaller. This is achieved by keeping your work rate low and breathing steadily.

There is no magic way to increase the absorber capacity but a basic understanding of the way it works can allow us all to make the most of the high intrinsic capacity of Sofnolime.

Dr Mike Clarke – Molecular Products Ltd - 2007

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