

# Technical report:

## Performance testing of Sofnolime 797 and other diving grade soda lime samples at depth

### Objective

To assess the performance of Sofnolime 797 at depth under realistic diving conditions – using the ANSTI test facility at Ambient Pressure Diving Ltd (APD)

### Background

The performance of Sofnolime 797 is well documented at ambient pressure and has been used extensively under very diverse conditions and depths for many years, using both air and mixed gas systems. However there is little high quality data under documented, controlled but realistic diving conditions. Therefore the opportunity was created to run controlled testing under actual dive conditions using the ANSTI test facility at APD. This facility has the capability of simulating wet dive conditions at pressure (depth) in cold water, whilst controlling the breathing rate and measuring the circuit gas concentrations of CO<sub>2</sub> and O<sub>2</sub>.

### Method

The test protocol and operational procedure for the equipment has been established by APD and was used for this work. The tests were run using a standard Inspiration rebreather dive set, run at 40 litres per minute breathing rate (2 litres tidal volume x 20 breaths per minute as per EN14143). The test set was charged with a standard carbon dioxide absorber unit filled with the sample of the soda lime to be tested. Each absorber was weighed and the weight of soda lime used recorded.

The set was assembled in its normal diving configuration in the test chamber. The test chamber contained water cooled to 4°C and automatically maintained at this temperature. The gas analysers were calibrated with standard calibration gasses and the flow rates checked before and during each test. The rebreather unit was immersed and sealed in the test tank and dived to the test pressure within 1 minute of the start of introducing CO<sub>2</sub> flow to the breathing machine. This ensured that the start of each test was essentially the same, minimising the test time the unit was not at the dive test depth.

Each test was run with 1.6 litres per minute of CO<sub>2</sub> added to the circuit (EN14143). The elapse time to the initial CO<sub>2</sub> breakthrough to reach a partial pressure of 0.5 kPa and 1.0 kPa was recorded. The ANSTI test system records the circuit operating parameters including the work of breathing from the circuit pressure monitoring, temperature and pressure in the breathing circuit and test chamber.

At the end of each test the unit was brought back to surface conditions and the absorber removed. The absorber unit was disassembled and samples taken from the inlet, outlet and the bulked mixed contents. These samples were numbered and analysed at MPL for water content and carbonate content to allow an accurate measurement of the total amount of CO<sub>2</sub> absorbed during the test cycle.

Connection to breathing machine  
(mouthpiece)

CO<sub>2</sub> absorber housing



Inspiration rebreather in place ready to start test

## Results

Table 1 – Comparison of material performance at depth

Soda lime	Depth	Data points	Average Capacity	Duration
	Metres	N	Litres/kg	Minutes
Sofnolime	40	6	82	143
797	20	2	107	184
Other dive grade	40	4	57	99
	20	2	82	139

Based on carbonate content analysis at the end of each dive  
The other dive grade soda lime tested was Divelime – Intersorb 812

### Dive duration and CO<sub>2</sub> performance

The main objective of the testing was to gain a better understanding of the performance of Sofnolime 797 at diving pressure. The opportunity was also taken to assess another commercially available dive grade soda lime for comparison. This was undertaken at 40 metre and 20 metre water gauge equivalent pressure. The testing was carried out in water at between 3.3°C and 4.9°C with a mean temperature of 3.9°C. The exhaled air temperature was controlled to 28°C +/- 1°C.

The results in Table 1 indicate that Sofnolime 797 averaged 82 litres CO<sub>2</sub> per kg capacity at 40 metres in the Inspiration rebreather dive set (on a dry weight basis). This equates to average dive duration of 122 minutes to a partial pressure of CO<sub>2</sub> of 1 kPa at 40 metres.

The result for the two 20 metre dives indicated a capacity of 107 litres CO<sub>2</sub> per kg capacity at 20 metres in the Inspiration rebreather dive set. This equates to average dive duration of 184 minutes to a partial pressure of CO<sub>2</sub> of 1kPa at 20 metres.

From these numbers the dive duration is reduced by an average of 22% on moving from a 20 metre to 40 metre dive. The shallow dive performance of the Inspiration under these conditions is circa. 200 minutes giving a calculated 8% duration decrease in the first 20 metres. It therefore appears that the duration is decreased by approximately 10% for the first 20 metres and a further 20% on descending a further 20 metres to 40 metres.

Based on the same calculations and assumptions the other dive absorber material gave a capacity of 57 litres CO<sub>2</sub> per kg at 40 metres and 82 litres CO<sub>2</sub> per kg at 20 metres with corresponding dive durations to 1kPa partial pressure of CO<sub>2</sub> of 99 minutes and 139 minutes respectively. This gave a reduction of 28% on moving from 20 to a 40 metre dive under the same conditions.

Comparison between the Sofnolime 797 and the other dive absorber indicates that, by both CO<sub>2</sub> capacity and by duration, the competitor material was approximately 20% at 20 metres and 30 % at 40 metres less effective than Sofnolime 797 when averaged over both sets of data (a total of 14 dives).

### Conclusion

- The APD ANSTI test facility provided a good reproducible and realistic dive test environment.
- The expected dive performance of Sofnolime 797 at low water temperature and at high pressure with air was confirmed.
- The carbon dioxide absorption capacity of Sofnolime 797 was found to decrease slightly but by a predictable and reproducible amount as pressure (depth) increased in 4°C water.
- Based on the available data it appears that the dive duration is decreased by circa. 10% at 20 metres and 30% at 40 metres compared to surface absorber durations (when using relatively small 2-3 kg absorbers).
- A competitor material was measured and found to offer at least 20% less duration at both 20 and 40 metres compared to Sofnolime 797 used in the same dive profile and equipment.