molecular

C A S E S T U D Y

Atmospheric control in confined environments

Case Study

Atmospheric control in confined environments

Molecular Products Ltd was contacted by a South African diving support company with a query regarding the performance of their system running in two different size chambers.

The chambers were 18m^3 and 6m^3 respectively holding between six and nine people. The customer had found that while the larger of the chambers could control the carbon dioxide satisfactorily for a period of six to seven hours. Between changes, the same system in the smaller chamber was not exhibiting good control necessitating much more frequent changes. We were asked to make comments.

Full Conditions

Chamber size	18	6
Occupants (max)	9	9
Recirculation fan speed	120m^3/hr	120m^3/hr
Pressure (atmospheres)	4	4
Gas mixture	15% Helium 85% Air	15% Helium 85% Air
Scrubber volume	24 litres	24 litres
Equivalent weight Sofnolime®	21.6kg	21.6kg
Total CO_2 production (9 occupants)/hr at STP	298 litres	298 litres

There are a number of observations to make regarding this system.

- The small chamber is very tightly packed with occupants
- The carbon dioxide production rates are quite high
- Absorption rates are affected by elevated pressures but since the temperatures are at ambient these effects should not be too great per se and four atmospheres is not especially challenging
- The fan recirculation rate is very high passing the entire volume of the chamber through the absorber between 6 and 20 times each hour
- The residence time within the absorber averages 0.7 seconds which while less than the optimum 1 second, is not especially short

Our technical team ran several complex mathematical models to cope with various scenarios and the above case demonstrates a 'type 2' scrubbing scenario. This is because the high recirculation rate means that not all the carbon dioxide is being removed per pass. In addition the scrubber is working with a generally low standing concentration which reduces its efficiency somewhat.

The models indicated that several countervailing effects were occurring simultaneously to produce some rather complex conditions.

The helium gas probably produced extra cooling effects by conduction heat from the exothermic reaction away quickly. This would reduce the efficiency of the Sofnolime®.

The very rapid recirculation rate has already been mentioned.

In the upshot it was recommended that the fan speed be reduced to get closer to a recommended 600 litres/min = 36 m^3/hr.

So, a counter intuitive solution resulted in increased utilisation of the Sofnolime® and the bonus of reduced power consumption by the fan.

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