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C A S E S T U D Y

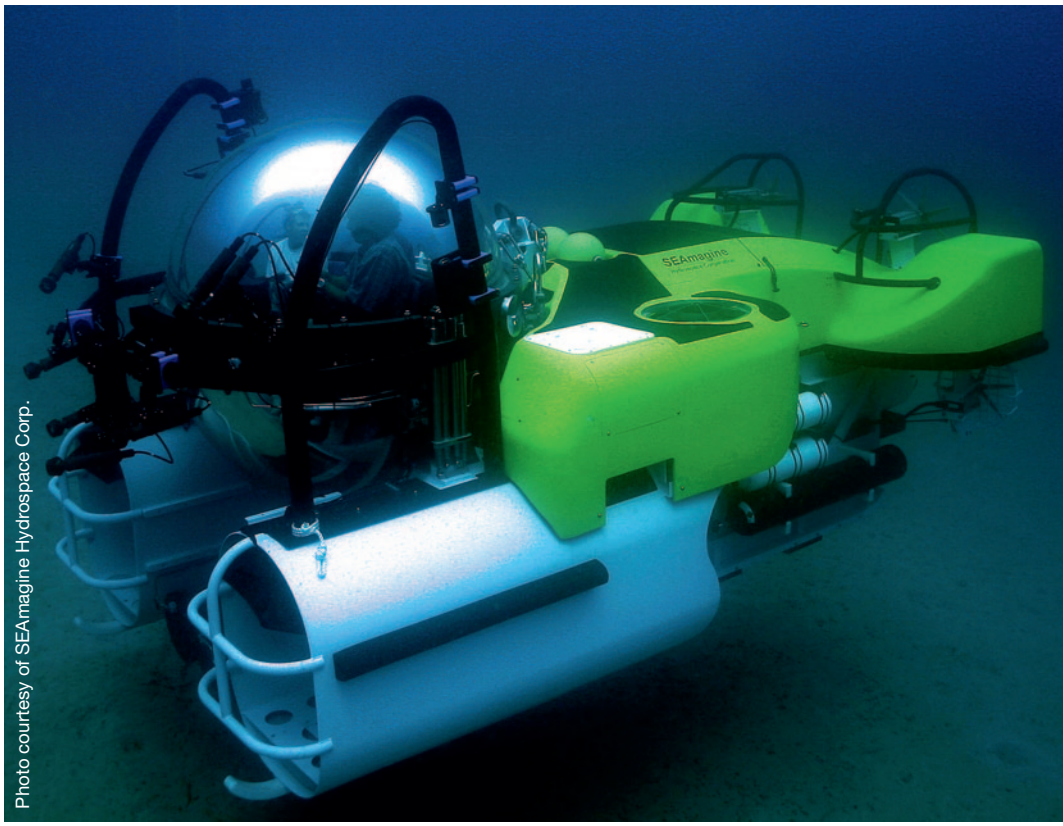


Photo courtesy of SEAmagine Hydrospace Corp.

Substitution of Lithium Hydroxide by Sofnolime® 797 Grade

Case Study

Substitution of Lithium Hydroxide by Sofnolime® 797 Grade

This note details the specification and marketing of soda lime versus lithium hydroxide for a military application.

Gas Consulting is an Italian company based in Milan. Their first contact with Molecular Products Ltd was in October 2006 with a RFQ for CD grade Sofnolime®, to which we responded. An interregnum then ensued until May 2008.

During this month an enquiry was made about oxygen generators and lithium hydroxide for a military shelter.

Details of Molecular Products' EO2-26™ Oxygen Generator were sent and MIL-L-20213E specification LiOH, quoted as requested.

At this stage a detailed specification was requested since it was deemed that a soda lime product could, under appropriate circumstances, provide an equivalent performance, with a lower biohazard, at a more economical price to the customer. Lithium hydroxide also has a more vigorous exothermic reaction than $Ca(OH)_2$.

The specification as transmitted was for a safe haven.

Capacity: 70 persons

Volume of safe haven: 1500 m^3 (which is quite big)

Duration: 7 days (which is a long endurance)

Recirculation flow rate: 13500m^3/hr (9 air passes per hour)

Scrubber volume not stated. This is a crucial piece of information since this is required to calculate residence time without which no grasp of efficiency can be gained. Operating temperature: 20°C

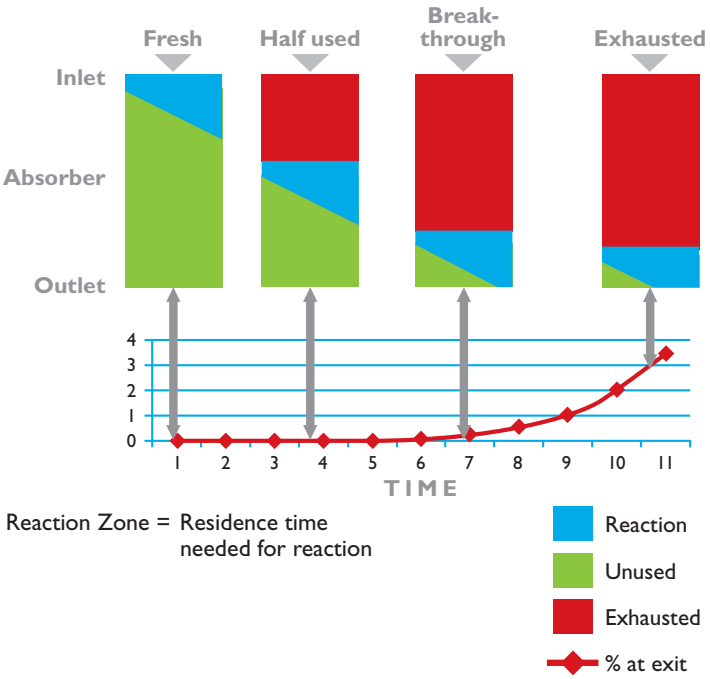
70 persons entrapped produce 40,000+ litres CO_2 /day (70 x 24(litres CO_2/hr) x 24hrs x 7 days = 282240 litres total requiring a minimum of 1,344kg and a maximum of 1,882 kg of soda lime. **This is a very large requirement.**

Depending upon the way the absorber works the capacity will vary from 210 litres CO_2/kg minus an allowance for the mass transfer zone (this is for a slow recirculation rate - 2 to 3 passes/hr - with a long residence time >0.5 secs, implies a very large absorber) to 150 litres CO_2/kg (high recirculation rate with relatively short residence time < 0.3secs and CO_2 being absorbed inefficiently but having several contacts because it passes through multiple times).

The second method is very energy inefficient.

The diagram below only illustrates the first mode of operation. In the second mode the standing concentration of CO_2 would be greater and there would be measurable - though low - concentrations of CO_2 emerging from the absorber from time base 1 and would in some ways mimic the position between time bases 7 and 8. However, this would persist as a steady state until beyond time base 7.

How an absorber works



Reaction Zone = Residence time needed for reaction

Although there was one crucial piece of information missing - the scrubber volume - it was possible to state that soda lime could be substituted and within the available volume for the scrubber provide an equivalent performance at a lower price and biohazard. At this stage it was unknown whether either solution was appropriate merely that soda lime could match whatever performance was being achieved.

Lithium hydroxide (LiOH) has a theoretical capacity of 468 litres CO_2/kg STP soda lime ($Ca(OH)_2$+3%NaOH) has a theoretical capacity of 263 litres CO_2/kg STP

Therefore lithium hydroxide appears a far better absorbent. However, it has a bulk density of somewhat less than 0.5g/cm^3 c.f. soda lime of around 0.9g/cm^3.

So, weight for weight lithium hydroxide does provide a superior absorption performance, but volume for volume soda lime can be similar.

i.e. 468litres x 0.5kg/litre = 234litres/litre LiOH
263litres x 0.9kg/litre = 236.5litres/litre soda lime.

There were also questions raised by the customer about performance at low temperatures. This is not usually a consideration for safe havens since they are generally in relatively benign environments (+4° to +40°C)

The file below was quite informative in providing background information when answering such queries.

As the enquiry moved towards order stage the specification changed quite significantly with enclosed volume, number of persons and recirculation rates all changing rapidly and it became clear that the end user was considering soda lime for more demanding duty. Under these circumstances the only practical way to move forward was to ensure that at all times the volume of soda lime recommended provided an excess of overall capacity and to constantly remind the customer of the need to balance standing concentration, recirculation rates and residence time of the atmosphere in the absorber cartridge(s). Molecular Products Ltd was able to rule out several projected combinations thus saving the end user much time

After a correspondence lasting five months Molecular Products Ltd received an order for a trial quantity of N1025P40L02 for a submarine application.