



molecular

C A S E S T U D Y



**Disposable absorber cartridges  
for low flow anaesthesia**

# Case Study

## Disposable absorber cartridges for low flow anaesthesia

Molecular Products Ltd is a major manufacturer of disposable cartridges filled with our USP grade of Sofnolime® for low flow anaesthesia.

Low flow anaesthesia is the method by which patients are anaesthetised using a closed breathing circuit and very small amounts of anaesthetic agent (e.g. desflurane, sevoflurane etc). These anaesthetics are both expensive and flammable, plus it would be undesirable if they were routinely allowed to escape into the atmosphere where theatre staff would be continually exposed to low concentrations. A closed circuit system requires that exhaled air has the carbon dioxide removed and small amounts of oxygen and even smaller amounts of extra anaesthetic added. The absorber's purpose is to remove the carbon dioxide.

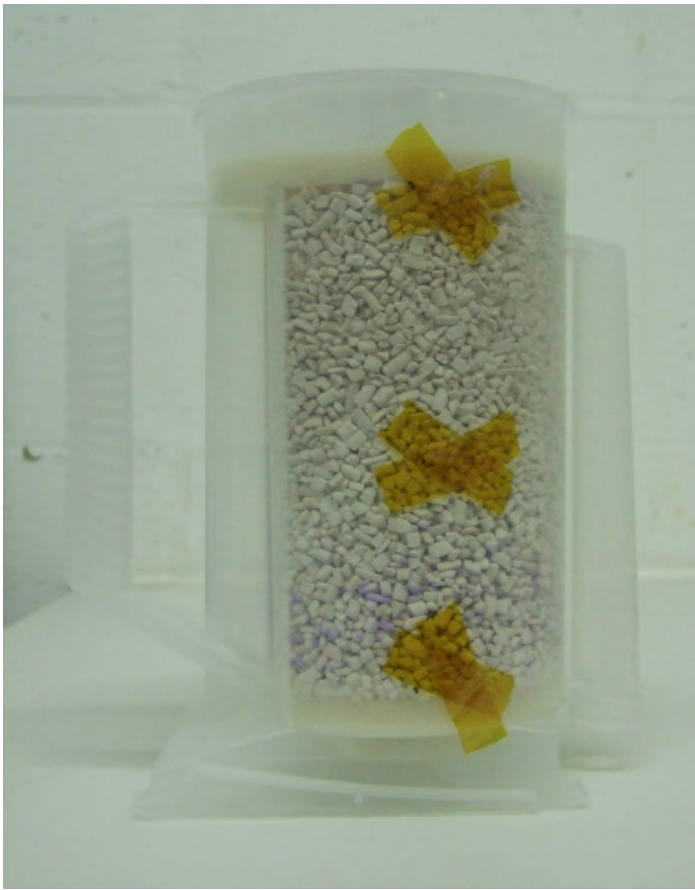
In 2008 a major customer reported that one of their users in a major hospital group in the USA was experiencing low durabilities with these canisters.

The absorbers are routinely filled with 'indicating' material i.e. there is ethyl violet dye added. As the soda lime absorbs CO<sub>2</sub> the material changes colour from white to violet or, when other indicators are added from pink to white. However, the interpretation of this moving band is quite complex since the leading edge of the violet band represents the rear edge of the reaction zone. The picture opposite shows an absorber run to 0.5% CO<sub>2</sub> at the outlet, which is considered the end-point. Since the violet band has **NOT** reached the bottom, a common misinterpretation is that there is plenty of capacity remaining.



Figure 1

There are further complications inasmuch as the colour change fades with time. Thus, over night the absorber may revert to a completely white appearance. If put back into use the next day it may therefore appear to rapidly become exhausted.



**Figure 2**

T = 1286 mins

This photograph illustrates an absorber run to exhaustion (Figure 2), inverted and left for 12hrs 26 mins. The colour has almost completely faded and a casual observer could easily conclude that this was an almost unused canister:

Despite many exchanges of photographs and full discussions about the characteristics of soda lime the end user remained dissatisfied.

To resolve the situation Molecular Products undertook to run a series of controlled tests using anaesthetic and the latest machine in order to ascertain longevity of disposable canisters under conditions as close to actual use as possible. Breathing and respiration rates were simulated by injecting CO<sub>2</sub> into the circuit.

This included running the canisters intermittently, which replicates the duty cycles often seen in actual use, rather than the unrealistic continuous tests routinely performed. It is this type of duty cycle which increases the likelihood of uncertainty arising regarding the state of the canister:

A formal report was produced including many photographs correlated with carbon dioxide traces that indicated longevities which exceeded those initially guaranteed by Molecular products upon the introduction of the units several years before (> 6hrs).

By performing a well documented series of trials using actual machines and producing photographs and timed CO<sub>2</sub> traces Molecular was able to give the confidence to the OEM customer to confront the end user's enquiries. Armed with this information the OEM sales force was able to conduct further investigations which determined that their end user procedures were allowing canisters to be used when exhausted but after the indicator had faded, so giving rise to complaints of premature failure and poor longevity.

Further training was introduced and these types of queries have...faded away!