

# INOvent<sup>®</sup> delivery system

FOR NITRIC OXIDE THERAPY

## INOvent application update #8

### Analysis of gases in a circle absorber system when using Nitric Oxide

The purpose of this application update is to provide interested users background information on the gas analysis tests performed by Datex-Ohmeda when using the INOvent delivery system with a Datex-Ohmeda GMS absorber system.

#### Test objectives

Tests were performed to determine two things:

1. Are there any by-products generated by reactions taking place between Carbon Dioxide (CO<sub>2</sub>) absorbent (Sodasorb™), Nitric Oxide (NO) (40 ppm) and anesthetic agents (Isoflurane™ or Desflurane™) in a circle absorber system?
2. What is the effect of CO<sub>2</sub> absorbent (Sodasorb) on the levels of NO and Nitrogen Dioxide (NO<sub>2</sub>) when breathing circuit gas is re-circulated through the CO<sub>2</sub> absorber?

#### Equipment

Two types of gas analysis equipment were used, as well as the NO and NO<sub>2</sub> gas monitoring included in the INOvent delivery system.

1. *Perkin Elmer Limited, model Spectrum 2000 Fourier Transform Infra Red (FTIR) Spectrometer* with testing performed using a 8 meter path length gas cell. This is a broad band analytical technique which can detect the wide range of molecules that absorb in the IR spectrum, and is sensitive in the ppm range.

2. *UTI, Detector III/QMA 300 Mass Spectrometer (MS).*

This analytical technique was used to increase the possibility of detecting foreign compounds that may have Infra Red (IR) absorbance peaks that were being obscured by the other gases used in the test (e.g. anesthetic agent). This is because the FTIR gas cell used was very sensitive and this resulted in the FTIR's sensor becoming saturated at certain wave numbers that are associated with the absorbance peak of the anesthetic agent (a 1% v/v concentration is significant when trying to detect gases in the parts per million level, 1% v/v = 10,000 ppm).

#### Method

The tests were performed with 800 ppm NO/N<sub>2</sub> gas from INO Therapeutics, a division of AGA, Inc. A baseline measurement was established with 2 L/min oxygen and 1% v/v anesthetic agent (Isoflurane or Desflurane) through the circle absorber system which was filled with either wet or dry Sodasorb. Nitric Oxide was then delivered at 40 ppm and the resulting gas was analyzed over time (2 hours) to determine if any changes in gas composition could be detected.

#### Results

No new peaks were found in the FTIR spectrum analysis that were different from the background gases when 40 ppm NO was added. This was the case with both wet and dry Sodasorb with Isoflurane. Similar results were found with Desflurane and dry Sodasorb.

No new component fragment ions were found in the MS analysis that were different from the background gases when 40 ppm NO was added. This was the case with both wet and dry Sodasorb with Isoflurane. Similar results were found with Desflurane and dry Sodasorb.

The concentrations of NO and NO<sub>2</sub> going into the absorber were approximately 41 ppm and 1.4 ppm respectively over the length of the test.

When wet Sodasorb (relative humidity of the outlet gas = 55%) was used the NO and NO<sub>2</sub> concentrations coming out of the absorber were approximately 34 ppm and 1.2 ppm respectively over the length of the test.

When dry Sodasorb (relative humidity of the outlet gas <10%) was used the NO and NO<sub>2</sub> concentrations coming out of the absorber were approximately 0.3 ppm and 0.0 ppm respectively over the length of the test.

Tests were conducted with dry Sodasorb because anesthesia machines with a minimum oxygen flow rate can dry Sodasorb during periods of no patient use.

It is not recommended that dry Sodasorb is used.

## Conclusions

Evaluation of the INOvent delivery system and GMS circle breathing system by FTIR coupled with MS produced the following findings:

1. No contaminants were found during the testing.
2. Recirculation of gases through the absorber should be avoided for the following reasons:
  - Wet Sodasorb may not remove all the NO going through the absorber. This will result in higher NO concentrations than those set being delivered to the patient if recirculation of gases is allowed.
  - Wet Sodasorb will not remove all the NO<sub>2</sub> going through the absorber. This will result in higher NO<sub>2</sub> concentrations being delivered to the patient if recirculation of gases is allowed.
  - A reduction in O<sub>2</sub> concentration will occur as nitrogen is the balance gas for nitric oxide and will be present in the recirculated gases.

To avoid recirculation of gases, fresh gas flow rates greater than or equal to the patient minute volume should be used.

This analysis only looked at the use of NO with Sodasorb, Isoflurane and Desflurane. Other CO<sub>2</sub> absorbents and anesthetic agents have not been evaluate for reactive by-products.



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