AMSORB® PLUS
Safe CO₂ Absorption
Eliminates Hidden Dangers

The World’s First Strong Alkali Free Absorbent
... a Patient Safety First
AMSORB® PLUS – absorbs carbon dioxide (CO₂) from cellular respiration during anaesthesia. Unlike other absorbents it is not capable of degrading vaporous anaesthetic agent. Use of AMSORB® PLUS is supported by an extensive bibliography in peer-reviewed journals.

How AMSORB® PLUS Works

The primary reaction is between CO₂ and calcium hydroxide (Ca(OH)₂) and water. These form calcium carbonate (CaCO₃) and water. Exothermic heat is a by-product of absorption. During absorption, Ca(OH)₂ is continually re-moistened until converted to CaCO₃. Lesser chemicals, calcium chloride (CaCl₂) and calcium sulphate (CaSO₄) prolong the life of Ca(OH)₂ and increase the speed of absorption reaction by maintaining granule strength and optimising hydration.

Chemical Reaction of Absorption

Ca(OH)₂ + CO₂ → CaCO₃ + H₂O

Slightly soluble → Insoluble

Ca(OH)₂ is an ionic compound which is soluble in water at 0.5g/L at 20°C.
- The ions are Ca⁺⁺ and OH⁻
- CO₂ is soluble in water at 1 vol : 1 vol at 20°C
- CaCO₃ is an insoluble ionic compound. Ca⁺⁺ and CO₃⁻⁻
- Reactions take place in solution when particles are mobile and react on collision

A colour indicator is present, changing from WHITE (fresh) to VIOLET upon exhaustion or desiccation. The indicator reacts to changes in granule hydration as absorption progresses; eventually remaining violet-coloured; once absorption is complete. Colouration also results from contact with ambient air or oxygen, if exposed to these.

Medico-Legal Implications

- Carbon monoxide (CO) is produced when passing sevoflurane, isoflurane and desflurane through certain brands of desiccated absorbent. CO is a potentially deadly toxin which users must ensure is not administered to patients, as carboxyhaemoglobin increases can trigger myocardial infarction or cause neurotoxicity in young or anaemic patients.

**AMSORB® PLUS DOES NOT PRODUCE CO**

- Formaldehyde (HCOH) is produced when passing sevoflurane through certain brands of desiccated absorbent. HCOH is a potent inhalation irritant and carcinogen and should never be administered to patients. PONV is caused by HCOH inhalation.

**AMSORB® PLUS DOES NOT PRODUCE HCOH**

- Compound A is produced when passing sevoflurane through certain brands of fresh or desiccated absorbent. Compound A has been proven to be nephro- and hepatotoxic in rats. Its effect in humans has not been established.

**AMSORB® PLUS DOES NOT PRODUCE COMPOUND A**

Coppen et al. The mechanisms of carbon monoxide production by inhalational agents. Anesthesia 2006; vol. 61; pp. 462-468
Knolle E et al. Small Carbon Monoxide Formation in Absorbents Does Not Correlate with Small Carbon Dioxide Absorption. Anesthesia & Analgesia 2002; vol. 95; pp500-505
Yamakage M et al. Carbon Dioxide Absorbents Containing Potassium Hydroxide Produce Much Larger Concentrations of Compound A from Sevoflurane in Clinical Practice. Anesthesia & Analgesia 2000; vol. 91; pp203-209
Product Range

AMAB3000
3.0 litre jerican
Case Quantity - 2pcs

AMAB3200
1.2 litre cartridge
Case Quantity - 12pcs

AMAB3201
1.2 litre cartridge (without sealing gasket)
Case Quantity - 12pcs

AMAB3400
1.0kg bag
Case Quantity - 12pcs

AMAB3800
Prefilled CAN-CAN® absorber, 1 litre for Anmedic anaesthesia workstations
Case Quantity - 6pcs

AMAB3801
Prefilled G-CAN® absorber, 1 litre for GE Healthcare Ansys, Avance and Aespire anaesthesia workstations
Case Quantity - 6pcs

AMAB3802
Prefilled Q-CAN absorber, 1 litre for Anmedic anaesthesia workstations with Q circle system
Case Quantity - 6pcs

AMAB4000
Prefilled BUBBLE-CAN® absorber, 1.3 litre for Dräger anaesthesia workstations excluding Apollo, Pallas and Primus
Case Quantity - 6pcs

AMAB4000/001
BUBBLE-PLATE® Adapter for Dräger anaesthesia workstations
Case Quantity - 1pc

AMAB4000/002
BUBBLE-BLOC® Adapter for Dräger anaesthesia workstations
Case Quantity - 1pc

AMAB4001
Prefilled UNIVERSAL BUBBLE-CAN® absorber, 1.2 litre for Dräger anaesthesia workstations including Apollo, Pallas and Primus
Case Quantity - 6pcs

AMAB4000/001
Prefilled UNIVERSAL BUBBLE-CAN® absorber, 1.2 litre for Dräger anaesthesia workstations including Apollo, Pallas and Primus
Case Quantity - 6pcs

AMAB0001
Limescale removal fluid, 500mL spray
Case Quantity - 1pc

Use of AMSORB® PLUS DOES NOT require approval of the anaesthesia machine manufacturer
**Colour Change**

AMSORB® PLUS colour indicator reacts strongly and quickly to the dehydrating effects of CO₂ absorption or contact with anhydrous gas, such as oxygen. Whilst the colour change is an indication of the hydrated state and remaining capacity, depletion of the absorbent should be determined by capnometry and the absorbent changed when FiCO₂ has exceeded 0.5% volume or 5mmHg.

In the case of NaOH-containing (sodium hydroxide) absorbents, colouration reverts to white when contact with CO₂ ceases, often after a few hours of non-use. This is due to the strongly alkaline nature of NaOH in soda lime. Desiccation of soda lime through contact with anhydrous gas or moisture loss through exposure to ambient air DOES NOT trigger the colour indicator in soda lime and the soda lime can be desiccated but coloured white, thus appearing fresh and safe for clinical use. Soda lime is potentially dangerous to use when desiccated, as CO₂ absorption may continue.

**Fresh Gas Flow 0.5L.min**

Method: In vivo patient model: 1.0kg AMSORB® PLUS. Total volume 500mL, respiratory rate 12 breaths per minute, fresh gas flow 500mL min, O₂, 250mL min, CO₂ added to expiratory limb. Colour change is permanent at the time of CO₂ breakthrough to 0.5% volume and remains provided the granules are not subsequently rehydrated. Not all granules will change colour.

**Composition of AMSORB® PLUS**

**Colour Reversal of Medisorb (GE Healthcare) Soda Lime**

Picture A:
GE Multi-Absorber (REF 8008138)
Colour change at 0.5% FiCO₂

Picture B:
Colour change at 12 hours after test terminated

**Note absence of colour**

**Composition of Market Brands**

<table>
<thead>
<tr>
<th>Product Name</th>
<th>CO₂ Absorption Capacity (L/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMSORB® PLUS</td>
<td>145</td>
</tr>
<tr>
<td>Drägersorb 800+</td>
<td>150</td>
</tr>
<tr>
<td>Sodasorb</td>
<td>148</td>
</tr>
<tr>
<td>Sofnolime</td>
<td>146</td>
</tr>
<tr>
<td>Carbolime</td>
<td>138</td>
</tr>
<tr>
<td>Spherasorb</td>
<td>125</td>
</tr>
<tr>
<td>LoFloSorb</td>
<td>100</td>
</tr>
<tr>
<td>Medisorb</td>
<td>98</td>
</tr>
<tr>
<td>Spherasorb</td>
<td>96</td>
</tr>
<tr>
<td>Intersurgical</td>
<td>75</td>
</tr>
</tbody>
</table>

**Method: accelerated clinical simulation test using 0.5L.min CO₂ in 500mL tidal volume at 12RR using 500mL O₂ as fresh gas flow.**

---

**Table:**

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Duration (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMSORB® PLUS</td>
<td>290</td>
</tr>
</tbody>
</table>

04-05
### Chemical Formulations and Performance

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Brand</th>
<th>NaOH*</th>
<th>Silicates</th>
<th>Other Additives</th>
<th>Permanent Change</th>
<th>CO₂ Carbon Monoxide (CO)</th>
<th>Formaldehyde (HCHO)</th>
<th>Agent Degradation*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMSORB® PLUS</td>
<td>Armstrong Medical</td>
<td>0%</td>
<td>&lt;3% calcium chloride (CaCl₂)</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Drägersorb Free</td>
<td>Dräger Medical</td>
<td>0.5-2%</td>
<td>&lt;3% calcium chloride</td>
<td>NO</td>
<td>YES</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sodasorb</td>
<td>WR Grace</td>
<td>3.7%</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Drägersorb 800+</td>
<td>Dräger Medical</td>
<td>1-3%</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sodasorb LF</td>
<td>WR Grace</td>
<td>&lt;1%</td>
<td>1% quartz</td>
<td>trace phosphonic acid NO</td>
<td>insufficient evidence available</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Medisorb</td>
<td>GE Healthcare</td>
<td>&lt;3.5%</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Spherasorb</td>
<td>Intersurgical</td>
<td>1.3%</td>
<td>4% zeolite</td>
<td>NO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sodasorb</td>
<td>Cafo Etba</td>
<td>&gt;3.5%</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>LoFloSorb</td>
<td>Intersurgical</td>
<td>0%</td>
<td>6.5% silica</td>
<td>NO</td>
<td>Yes</td>
<td>insufficient evidence available</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>


** Independently-published scientific literature

### CO₂ Absorption Capacity

Review of independently-published scientific literature for CO₂ absorption capacity of respective absorbent brands:

<table>
<thead>
<tr>
<th>CO₂ Absorption Capacity (L·kg)</th>
<th>Product Name</th>
<th>Brand</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>205</td>
<td>AMSORB® PLUS</td>
<td>Armstrong Medical</td>
<td>Kobayashi, 2004</td>
</tr>
<tr>
<td>217</td>
<td>Drägersorb Free</td>
<td>Dräger Medical</td>
<td>Koale, 2002</td>
</tr>
<tr>
<td>(155)</td>
<td>Drägersorb 800+</td>
<td>GE Healthcare</td>
<td>Higuchi, 2001</td>
</tr>
<tr>
<td>146</td>
<td>Medisorb</td>
<td>WR Grace</td>
<td>Knolle, 2002</td>
</tr>
<tr>
<td>107</td>
<td>Sodasorb Plus</td>
<td>Intersurgical</td>
<td>Higuchi, 2001</td>
</tr>
<tr>
<td>121</td>
<td>LoFloSorb</td>
<td>Intersurgical</td>
<td>Knolle, 2002</td>
</tr>
<tr>
<td>126</td>
<td>Spherasorb</td>
<td>Intersurgical</td>
<td>Knolle, 2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Struys, 2004)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Struys, 2004)</td>
</tr>
</tbody>
</table>

Koale E et al. Anesthesia & Analgesia 2002; vol. 95; pp650-655
Struys MMRF et al. Anaesthesia 2004; vol. 59; pp584-589
Higuchi et al. Anesthesia & Analgesia 2000; vol. 91; pp434-439
**Gas Toxicity**

**Agent Degradation**

Some absorbents negatively impact patient safety. Their continued use raises ethical questions. Inability to determine when some absorbents are desiccated and hence potentially dangerous, demands that a safe absorbent is used. Many absorbents are known to degrade anaesthetic vapour to produce toxic levels of CO and HCOH, when desiccated. CO is a toxin with affinity for haemoglobin greater than 200% for 15 mins

- AMSORB PLUS
- Dräger

**Adsortion of Anaesthetic Vapour**

<table>
<thead>
<tr>
<th>Product</th>
<th>Brand</th>
<th>Adsorption of 2% Isoflurane by desiccated % in mins</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMSORB PLUS</td>
<td>Armstrong</td>
<td>99% for &gt;60 min</td>
</tr>
<tr>
<td>Drägersorb 800+</td>
<td>Dräger</td>
<td>50% for 33 mins</td>
</tr>
<tr>
<td>Intersorb Plus</td>
<td>Intersurgical</td>
<td>26% for 16 mins</td>
</tr>
<tr>
<td>LofloSorb</td>
<td>Intersurgical</td>
<td>31% for 20 mins</td>
</tr>
<tr>
<td>Spherasorb</td>
<td>Intersurgical</td>
<td>20% for 15 mins</td>
</tr>
</tbody>
</table>

**Publication**


**Cost of Adsorption**

<table>
<thead>
<tr>
<th>Time unit (min)</th>
<th>FG (mL/m)</th>
<th>Vapourer (%)</th>
<th>Vapour loss (%)</th>
<th>Molecular weight (g/mol) at 20°C at 157mmHg</th>
<th>Liquid loss (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>500</td>
<td>8</td>
<td>50</td>
<td>200,053</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$2.40</td>
</tr>
</tbody>
</table>

**Agent Adsorption**

Anaethetic vapour condenses on desiccated soda lime and on new generation absorbents containing molecular sieve zeolites, quartz or silica. This process, called adsorption, temporarily binds anaesthetic vapour within the absorbent. Knoille (2002) reported adsorption using LofloSorb (Intersurgical, UK) of 89% of the inflow of 0.5% isoflurane for over 60 minutes, in combination with production of CO. Adsorption is characterised by condensing and accumulation of the vapourised agent on the absorbent granules and re-vapourisation of the agent when canister temperature rises during CO₂ absorption, creating potential for reduced narcosis or blood toxicity from excessive drug exposure. This effect is greater at low fresh gas flow rates and when soda limes and LofloSorb are used.

Clinical signs of adsorption will include inspired concentrations of the anaesthetic agent being different to the vapouriser setting. Recollection, by the patient of the surgical event or pain during surgery is possible, given inadequate anaesthesia. Use of muscle relaxants could mask a patient’s response to surgical stimuli, allowing patient awareness to go unchecked. Also, the cost of adsorption of vapour into the absorbent should be considered when choosing a brand of absorbent.

**Adsorption of 2% Isoflurane by desiccated 2% in mins**

<table>
<thead>
<tr>
<th>Product</th>
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<tr>
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<td>31% for 20 mins</td>
</tr>
<tr>
<td>Spherasorb</td>
<td>Intersurgical</td>
<td>20% for 15 mins</td>
</tr>
</tbody>
</table>

**Publication**

Alkalinity of Soda Lime

NaOH Concentration Increases as Soda Lime Desiccates

Exponential increases in alkalinity triggers degradation of anaesthetic vapour to toxic inhalants. Safe disposal of soda lime must take account of increases in alkalinity brought about by desiccation. Manufacturers of absorbents cannot declare the pH of their material at any stage, as determination of pH requires the absorbent sample to be converted to a solution. Adding water to a sample of soda lime allows NaOH and NaCO₃ to dissolve in water, thus lowering the alkalinity of the material to provide a misleading pH value. A declaration of pH for disposal of soda lime is inaccurate as it does not reflect the actual pH of the material. In some jurisdictions, alkalinity above certain thresholds requires special disposal methods to comply with environmental legislation. AMSORB® PLUS is free from strong base chemicals and therefore cannot become strongly alkaline. Disposal is with non-contaminated clinical waste for landfill.

Alkalinity Increases as Moisture Decreases

Progressive dehydration causes a 5-fold increase in the alkalinity of soda lime.

Desiccation

Retrograde Flow in Absorbents

Gas flow desiccates all absorbents. Retrograde flow occurs when fresh gas flow is left running during non-use of an anaesthetic machine. Gas may pass over the top of the absorbent canister and desiccate the absorbent. In subsequent use of some absorbents, degradation of the anaesthetic agent may occur in conjunction with agent adsorption. NaOH-containing absorbents will NOT change colour during gas flow desiccation. Instead they remain white but may be desiccated. Desiccated soda lime may absorb CO₂. Colouration of AMSORB® PLUS confirms desiccation. Desiccated AMSORB® PLUS will not absorb CO₂. To avoid retrograde flow, fresh gas flow should be turned off during periods of non-use of the anaesthetic machine.

AMSORB® PLUS Rate of Dehydration

Moisture retention from passing 1.0L.min. O₂ through 1.0kg of fresh AMSORB® PLUS and fresh soda lime. AMSORB® PLUS compares favourably to other absorbents in resisting moisture loss.
Background

**Benefits of Prefilled Canisters**

Prefilled canisters containing AMSORB® PLUS offer convenience and user safety. They facilitate rapid ‘switch-out’ of exhausted material without interruption to mechanical ventilation. CO₂ accumulation in the breathing circuit can be avoided.

**Absorbent Heat**

Absorption of CO₂ by AMSORB® PLUS produces heat. The amount of heat depends on rate of respiration, fresh gas flow rate and the shape and volume of the absorber canister. An increase in gas temperature does not reduce the efficiency of the reaction; in most cases it improves it. A peak temperature of 45°C may be observed with AMSORB® PLUS. Such temperature has a positive effect on maintenance of core body temperature and mucociliary function during surgery.

Clinical reports show use of sevoflurane, in combination with certain desiccated absorbents, creates conditions for anaesthetic agent degradation to flammable by-products CO and HCOH as a precursor to extreme heat leading to fire in the absorber canister.

Struys et al. reported that temperatures within an absorber canister of fresh or desiccated AMSORB® PLUS did not exceed 40°C. Additionally, end-users have not reported elevated temperatures, nor have extensive in-house tests shown increased temperatures under any conditions. It logically follows that the chemical basis and sequelae for elevated temperature or fire is not possible when using AMSORB® PLUS, given its chemical make-up and inability to degrade anaesthetic vapour.

**Humidity Management in Breathing Circuits**

Condensed water observed in the breathing system may originate from moisture in the patient’s breath and from water produced by the exothermic reaction of absorption of CO₂. It may evaporate as the canister heats up and may condense on cooler parts of the apparatus. This is normal. A water trap can be used in the breathing circuit to collect water condensate. Alternatively, there may be a drainable water collection sump located on the absorber canister. This should be drained regularly.


Kowhting IU et al. Spontaneous Ignition, Explosion, and Fire with Sevoflurane and Barium Hydroxide Lime. Anesthesiology 2004; vol 101; pp. 534-537


**AMSORB® PLUS and Bacteriostasis**

Digestive enzymes of bacterial organisms such as MRSA and VRE are known to be susceptible to neutralisation by alkaline solutions. The weakly alkaline composition of AMSORB® PLUS provides an inhospitable environment for such organisms. Use of a breathing filter at the patient-end of a breathing circuit is a useful adjunct in protecting patients from respiratory-borne infection. These filters provide a sufficient level of protection against infectious liquid- and air-borne organisms such as HIV, MRSA and VRE, as such organisms are more likely to be found in the tubing system, connecting the patient to the absorber system, than in the absorber itself. If AMSORB® PLUS is intended to be used on a patient known to be infected with a contagious organism, the absorbent canister should be replaced before and after such use.

**Disposal Considerations**

Dispose of AMSORB® PLUS as per the hospital’s waste management programme for non-contaminated clinical waste. The material is safe to handle during its disposal. Unlike soda limes, AMSORB® PLUS does not contain strong base chemicals. Therefore, the material is non-hazardous, making it suitable for landfill. It will break down into harmless compounds.

**Storage Requirements**

AMSORB® PLUS does not deteriorate in storage when in sealed containers at ambient humidity above 15°C. If exposed to ambient air it will absorb CO₂ and lose moisture to the air, either of which will deplete hydration and cause colouisation to appear. Prefilled canisters should be kept within outer box packaging until use as light can damage the colour indicator.
## Machine Compatibility

Armstrong Medical Limited guarantees the unlimited compatibility of AMSORB® PLUS on anaesthesia machines in which loose-fill CO₂ absorbent is to be used or on those machines for which we provide a prefilled absorber canister.

### Guaranteed Unlimited Compatability

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Description</th>
<th>Case Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMAB3201</td>
<td>1.2 litre cartridge</td>
<td>12pcs</td>
</tr>
<tr>
<td>AMAB3201</td>
<td>1.2 litre cartridge (without sealing gasket)</td>
<td>12pcs</td>
</tr>
<tr>
<td>AMAB4000</td>
<td>1.0kg bag</td>
<td>12pcs</td>
</tr>
<tr>
<td>AMAB4000</td>
<td>Prefilled CAN-CAN® absorber, 1 litre for GE Healthcare ADU II anaesthesia workstations</td>
<td>12pcs</td>
</tr>
<tr>
<td>AMAB4001</td>
<td>Prefilled G-CAN® absorber, 1 litre for GE Healthcare Anesthesia Asiax, Avance &amp; Aespire anaesthesia workstations</td>
<td>6pcs</td>
</tr>
<tr>
<td>AMAB4002</td>
<td>Prefilled Q-CAN absorber, 1 litre for Anmedic anaesthesia workstations with Q circle system</td>
<td>6pcs</td>
</tr>
<tr>
<td>AMAB4000</td>
<td>Prefilled BUBBLE-CAN® absorber, 1.3 litre for Dräger anaesthesia workstations excluding Apollo, Pallas and Primus</td>
<td>6pcs</td>
</tr>
<tr>
<td>AMAB4001</td>
<td>Prefilled BUBBLE-CAN® UNIVERSAL absorber, WHITE to VIOLET 1.3 litre for all Dräger anaesthesia workstations including Apollo, Pallas and Primus</td>
<td>6pcs</td>
</tr>
<tr>
<td>AMAB4000/001</td>
<td>BUBBLE-PLATE® Adapter for Dräger anaesthesia workstations</td>
<td>1pc</td>
</tr>
<tr>
<td>AMAB4000/002</td>
<td>BUBBLE-BLOC® Adapter for Dräger anaesthesia workstations</td>
<td>1pc</td>
</tr>
<tr>
<td>AMAB0001</td>
<td>Limescale removal fluid, 500mL spray</td>
<td>1pc</td>
</tr>
</tbody>
</table>

### Typical Performance Data

- **Absorption of CO₂**: >19.0% weight gain
- **Moisture Content**: 10 - 18%
- **Clinical Simulation Test (500mL CO₂ min)**: >240 min/kg
- **Bulk Density**: 70 - 84%
- **Hardness**: >90%
- **Sieve Test**
  - Retained on 8.00mm sieve: NIL
  - Retained on 4.00mm sieve: <7.0%
  - Retained on 2.36mm sieve: BALANCE
  - Passing 2.36mm sieve: <7.0%
Frequently Asked Questions

**What are the advantages of using AMSORB® PLUS over other available absorbents?**

- Does not generate CO under any clinical conditions; does not generate Compound A or any like compounds when used with sevoflurane; does not generate HCOH or methanol when used with sevoflurane
- Irreversible colour change, when fully exhausted; optimum CO\textsubscript{2} absorption; low resistance to gas flow; low dust levels with consistent granule size
- Non-corrosive to skin.

**What anaesthetic agents can be used with AMSORB® PLUS?**

AMSORB® PLUS can be used safely with anaesthetic agents halothane, enflurane, isoflurane, desflurane and sevoflurane. No fresh gas flow restrictions apply.

**Does AMSORB® PLUS adsorb anaesthetic vapour?**

Completely desiccated AMSORB® PLUS has least ability to adsorb anaesthetic vapour when compared to other absorbents (Knolle, 2002). Note that desiccated AMSORB® PLUS is incapable of absorbing CO\textsubscript{2} and therefore will not be in clinical use.

**When to cease using AMSORB® PLUS?**

This is determined by capnometry. The absorbent is changed when FICO\textsubscript{2} has exceeded 0.5% volume or 5mmHg. CO\textsubscript{2} breakthrough to 0.5% volume or 5mmHg may be associated with colouration of 50% of the total height of the absorber canister.

**Why does utilisation time vary?**

Utilisation time is influenced by the following factors:
- Fresh gas flow rate; metabolic CO\textsubscript{2} production; tidal volume; respiratory rate
- Shape and volume of the absorber canister and design of breathing circuit
- Humidification management in the breathing circuit.

**Sometimes exhaustion is indicated by physiological signs or capnometry before the colour changes – why is this?**

It may be that the apparatus is not working properly or is incorrectly assembled. There may be channeling of gases through the middle of the absorber canister. Condensed water may be interfering with the composition of sampled gases. Absorbent granules may have absorbed water which is preventing CO\textsubscript{2} absorption.

**Should water be added to AMSORB® PLUS?**

This should NEVER be done.

**What is the cause of water condensation in the breathing circuit?**

This may originate from moisture in the patient’s breath and from water produced by the exothermic reaction of absorption of CO\textsubscript{2}. It may evaporate as the canister heats up and may condense on cooler parts of the apparatus.

**What makes AMSORB® PLUS heat up? Does this mean the granules are not working?**

The reaction whereby CO\textsubscript{2} is absorbed is exothermic (heat is spontaneously generated from the chemical reaction). The amount of heat depends on rate of respiration, fresh gas flow rate and the shape and volume of the absorber canister.
Armstrong Medical manufacture a complete range of disposable respiratory products for anaesthesia and critical care applications. For supply of these products or any product within the Armstrong Medical range, please contact your local representative.

All Armstrong Medical products are manufactured to quality systems under ISO 13485 and EC Directive 93/42/EEC. For reliability, the properties of AMSORB® PLUS must conform to carefully controlled parameters and this applies not only to the chemical composition but also to the size of granule, its moisture content and porosity.

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