AMSORB® Plus

Safe CO₂ absorption that eliminates dangers, saves money and decreases environmental footprint
**AMSORB® Plus –** absorbs carbon dioxide (CO₂) from cellular respiration during anaesthesia. Unlike other absorbents it is not capable of degrading vapidorous 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**

\[
\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}
\]

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⁻ • 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**

Coppens et al. The mechanisms of carbon monoxide production by inhalational agents. Anaesthesia 2006; vol. 61; pp. 462–468
Product Range

Use of AMSORB® Plus DOES NOT require approval of the anaesthesia machine manufacturer.

**AMAB3000**
5.0 litres jerican
Case Quantity - 2pcs

**AMAB3201 1kg**
1.2 litres cartridge
(without sealing gasket)
Case Quantity - 12pcs

**AMAB3400**
1.0kg bag
Case Quantity - 12pcs

**AMAB3801**
Prefilled G-CAN® absorber, 1.0 litres
for GE Healthcare Aisys, Avance and Aespire anaesthesia workstations
Case Quantity - 8pcs
Product Range

AMAB3803
1.4 litres prefilled CARE-CAN
Case Quantity - 8pcs

AMAB4001 1kg
Prefilled UNIVERSAL BUBBLE-CAN® absorber,
1.2 litres for Dräger anaesthesia workstations
including 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

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

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**Fresh Gas Flow 0.5L/min**

Method: in vitro patient model. 1.0kg AMSORB® Plus. Tidal 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.

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**When to exchange?**

**Avance®**
Use until FiCO₂ exceeds 5mmHg, then exchange canister mid-case.

**Aestiva®**
Use until top canister shows total colour change, then exchange both canisters between cases.

AMSORB® Plus is NOT the same as soda lime.

No production of CO or Compound A (even when desiccated). Low flow and closed-circuit techniques are safer, even with sevoflurane.

Discard as non-hazardous waste. AMSORB® Plus exhausted pH <12.5, is safe for landfill and breaks down to harmless inorganic compounds.

---

**Use low flows <1 L/min total FGF**

**Wait to exchange**
Until FiCO₂ is 0.5% vol. or 5mmHg

**No red bags**
Discard as non-hazardous waste
## Composition of AMSORB® Plus:

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca(OH)$_2$</td>
<td>Calcium hydroxide</td>
<td>77 - 88%</td>
</tr>
<tr>
<td>CaSO$_4$•0.5 H$_2$O</td>
<td>Calcium sulphate hemihydrate</td>
<td>0.6 - 1.5%</td>
</tr>
<tr>
<td>CaCl$_2$</td>
<td>Calcium chloride</td>
<td>2.0 - 3.5%</td>
</tr>
<tr>
<td>Colour indicator</td>
<td></td>
<td>Trace</td>
</tr>
<tr>
<td>H$_2$O</td>
<td></td>
<td>10 - 18%</td>
</tr>
</tbody>
</table>
### 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 Colour Change</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>YES</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>insufficient evidence available</td>
</tr>
<tr>
<td>Sodasorb®</td>
<td>WR Grace</td>
<td>3.7%</td>
<td></td>
<td>NO</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Drägersorb® 800+</td>
<td>Dräger Medical</td>
<td>1-3%</td>
<td></td>
<td>NO</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sofnolime®</td>
<td>Molecular Products</td>
<td>&lt;3.5%</td>
<td></td>
<td>NO</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Carbolime™</td>
<td>Allied Healthcare</td>
<td>3%</td>
<td></td>
<td>NO</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</td>
<td>NO</td>
<td>insufficient evidence available</td>
</tr>
<tr>
<td>Medisorb®</td>
<td>GE Healthcare</td>
<td>&lt;3.5%</td>
<td></td>
<td>NO</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>
</tr>
<tr>
<td>Sodalime</td>
<td>Carlo Erba</td>
<td>&gt;3.5%</td>
<td></td>
<td>NO</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>
</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>AMSORB® Plus</th>
<th>Drägersorb® Free</th>
<th>Drägersorb® 800+</th>
<th>Medisorb®</th>
<th>Sodasorb®</th>
<th>Intersorb Plus™</th>
<th>LoFloSorb™</th>
<th>Spherasorb™</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>205</td>
<td>155</td>
<td>186</td>
<td>146</td>
<td>107</td>
<td>121</td>
<td>126</td>
<td>73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Brand</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMSORB® Plus</td>
<td>Armstrong</td>
<td>Kobayashi, 2004 (Struys, 2004)</td>
</tr>
<tr>
<td>Drägersorb® Free</td>
<td>Dräger</td>
<td>Knolle, 2002</td>
</tr>
<tr>
<td>Drägersorb® 800+</td>
<td>GE Healthcare</td>
<td>Higuchi, 2001</td>
</tr>
<tr>
<td>Medisorb®</td>
<td>WR Grace</td>
<td>Intersurgical</td>
</tr>
<tr>
<td>Sodasorb®</td>
<td>Intersurgical</td>
<td>Intersurgical</td>
</tr>
<tr>
<td>Intersorb Plus™</td>
<td>Intersurgical</td>
<td>Intersurgical</td>
</tr>
<tr>
<td>LoFloSorb™</td>
<td>Intersurgical</td>
<td>Intersurgical</td>
</tr>
<tr>
<td>Spherasorb™</td>
<td>Intersurgical</td>
<td>Intersurgical</td>
</tr>
</tbody>
</table>

Kobayashi S et al. *Journal of Anesthesia* 2004; vol.18; pp277-281
Knolle E et al. *Anesthesia & Analgesia* 2002; vol. 95; pp 650-655
Struys MMRF et al. *Anesthesia* 2004; vol. 59; pp 584-589
Higuchi et al. *Anesthesia & Analgesia* 2000; vol. 91; pp 434-439
**Gas Toxicity**

**CO Production**

Review of independently published scientific literature for CO production of respective absorbent brands:

<table>
<thead>
<tr>
<th>Product</th>
<th>CO Production (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMSORB® Plus</td>
<td>Dragersorb® 800+</td>
</tr>
<tr>
<td>Dräger</td>
<td>Intersorb Plus®</td>
</tr>
<tr>
<td>Intersurgical</td>
<td>LofloSorb®</td>
</tr>
<tr>
<td>Intersurgical</td>
<td>Medisorb®</td>
</tr>
<tr>
<td>GE Healthcare</td>
<td>SodaSorb®</td>
</tr>
<tr>
<td>Intersurgical</td>
<td>Spherasorb®</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Peak CO (ppm) from Desiccated Absorbent</th>
<th>0</th>
<th>620</th>
<th>548</th>
<th>525</th>
<th>13,317</th>
<th>9,045</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand</td>
<td>Armstrong</td>
<td>Dräger</td>
<td>Intersurgical</td>
<td>Intersurgical</td>
<td>GE Healthcare</td>
<td>WR Grace</td>
</tr>
</tbody>
</table>

Struys MMRF et al. Anaesthesia 2004; vol. 59; pp. 584-589  
Knolle E et al. Anesthesia & Analgesia 2002; vol. 95; pp. 650-655  
Fang ZX et al. Anesthesia and Analgesia 1995; vol. 80(6); pp. 1187-1193

**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 oxygen. HCOH is a potent respiratory tract irritant and carcinogen and has been shown to cause post-operative nausea and vomiting.

All absorbents desiccate through clinical use as well as through exposure to ambient air or gas flow. Absorbent hydration cannot be managed during use. In absorbents other than AMSORB® Plus, colouration, if present, is not a reliable indication of hydration. In all absorbents, the chemical reaction of CO₂ absorption forces moisture from the material. In many brands, this exponentially increases alkalinity; potentially enabling the absorbent to become sufficiently desiccated to degrade anaesthetic whilst continuing to absorb CO₂.

APSF (Anesthesia Patient Safety Foundation) states that absorbents that significantly degrade anaesthetic agents should not be used. This followed earlier notification by Abbott Laboratories that their drug Ultane (sevoflurane) was involved in adverse reactions with CO₂ absorbents.

Agent Adsorption

Agent Adsorption - Patient Awareness

Anaesthetic 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. Knolle (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 Anaesthetic Vapour

<table>
<thead>
<tr>
<th>Product</th>
<th>Company</th>
<th>Adsorption of 0.5% isoflurane (%: mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMSORB® Plus</td>
<td>Armstrong</td>
<td>89% 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>31% for 20 mins</td>
</tr>
<tr>
<td>LoFloSorb™</td>
<td>Intersurgical</td>
<td>26% for 16 mins</td>
</tr>
<tr>
<td>Spherasorb™</td>
<td>Intersurgical</td>
<td>20% for 15 mins</td>
</tr>
</tbody>
</table>

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.

Publications

Knolle E et al. Small Carbon Monoxide Formation in Absorbents Does Not Correlate with Small Carbon Dioxide Absorption. Anesthesia & Analgesia 2002; vol. 95; pp650-655
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 NaCO$_3$ 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.

**Time and CO$_2$ Absorption**

Disposal Hazard Above 4% NaOH

Patient Safety Hazard
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 CO$_2$.

Colouroation of AMSORB® Plus confirms desiccation. Desiccated AMSORB® Plus will not absorb CO$_2$. To avoid retrograde flow, fresh gas flow should be turned off during periods of non-use of the anaesthetic machine.

In addition to causing soda limes to become prematurely exhausted without the user’s awareness, leaving the fresh gas flow on during periods of non-use is an extremely expensive practice regularly occurring in a significant percentage of hospitals. With AMSORB® Plus, coloration from retrograde flow alerts users to this expensive practice so they can devise protocols to reduce or eliminate its occurrence.
**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. CO$_2$ accumulation in the breathing circuit can be avoided.

**Absorbent Heat**

Absorption of CO$_2$ 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.

**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 CO$_2$. 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.

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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 colouration to appear. Prefilled canisters should be kept within outer box packaging until use as light can damage the colour indicator.
**Guaranteed Unlimited 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.

**Selection of Anaesthesia Machines**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model/s</th>
<th>1.2 litre CARTRIDES AMAB3201</th>
<th>CAN-CAN® AMAB3800</th>
<th>G-CAN® AMAB3801</th>
<th>BUBBLE-CAN® UNIVERSAL AMAB4001</th>
<th>CARE-CAN AMAB3803</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anmedic</td>
<td>Falcon, Kite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dräger Medical</td>
<td>Cato, Cicero, Fabius, Julian, Zeus</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Dräger Medical</td>
<td>Apollo, Primus, Palas</td>
<td></td>
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<tr>
<td>GE Healthcare</td>
<td>ADU II, Aliseo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>GE Healthcare</td>
<td>Aestiva, Excel, Modulus</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>GE Healthcare</td>
<td>Aspire, Aisys, Avance, Amino</td>
<td></td>
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<tr>
<td>Mindray/Datascope</td>
<td>AS3000</td>
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<td>Penlon</td>
<td>SP Prima</td>
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<td>Siemens</td>
<td>Kion</td>
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<td>Spacelabs</td>
<td>Frontline, Sirius</td>
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</tr>
<tr>
<td>GE Healthcare</td>
<td>Carestation™ 600 series</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Many of the world’s leading hospitals, universities and medical organisations use AMSORB® Plus because it is safer, easier to use, better for the environment and more cost effective.

Ask your local representative for a complete list.
# 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.
- No secondary vaporization effect removes risk of complications/dangers including reduced narcosis or blood toxicity from excessive drug exposure (especially applicable to smaller, sensitive patients, i.e. children’s hospitals).
- Permanent colour change eliminates possibility of accidentally using expired product.
- Dust is non-caustic and less harmful to techs breathing in dust during canister changes.
- Safe to handle during disposal.
- Better for the environment... unlike soda lime, is non-corrosive and safe for landfill where it breaks down into harmless inorganic compounds.
- Significant product savings due to ability to SAFELY use through to exhaustion (FiCO\textsubscript{2}).
- Anaesthetic savings due to less adsorption of volatile anaesthetic.
- Anaesthetic savings due to lack of degradation.
- Anaesthetic savings due to ability to safely use lower flows.
- Waste and disposal savings due to ability to dispose of as non-hazardous waste.
- Time savings due to reduced frequency of canister changes.
- Significant cost savings due to reduced post-operative resource utilization, including nursing time, patient warming supplies, and time spent in post-operative unit.
- Significant cost savings due to elimination of all potential complications related to anaesthetic breakdown, including additional laboratory tests, hospital days, medical/legal expenses.
- Permanent colour change: increased user confidence and ability to reliably tell at a glance current state of product.
- Prefilled canisters available for all common anaesthesia machines mean hospitals can simplify their ordering and obtain all their absorbent from one source. Most hospitals purchase multiple different soda limes from different manufacturers because they have more than one type of anaesthesia machine.
- Ability to safely deliver low flow anaesthesia for extended time periods.
- Knowing exactly when to change eliminates guesswork, increases confidence, and decreases waste.
- Anaesthesia machines equilibrate faster, are less sluggish, and more accurately deliver desired drug percentages.
- Wealth of independently published peer reviewed literature is a great resource for end users (especially applicable to teaching hospitals).
- Granules reduce likelihood of gas channelling and optimise absorption performance.
- Dust is non-corrosive and not harmful to metal machine parts.
- Reduced instance of headache and PONV.

## 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.

## Why does AMSORB® Plus adsorb less 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.
AMSORB® Plus is the world’s first CO₂ absorbent to be free of strong alkali. AMSORB® Plus offers significant clinical, cost and environmental advantage.

**AMSORB® Plus is easier to use:**
AMSORB® Plus retains its desiccated colour change. Available in prefill cartridges compatible with most common anaesthesia machine brands.

**AMSORB® Plus is safer:**
Unlike other absorbents, AMSORB® Plus is incapable of anaesthetic degradation and does not produce harmful by-products.

**AMSORB® Plus is better for the environment:**
AMSORB® Plus is free of strong-base chemicals, therefore, the material is non-hazardous, safe to handle during handling and disposal, and is suitable for landfill.

**AMSORB® Plus is cost effective:**
AMSORB® Plus demonstrates the least potential to delay inhalational induction at any flow rates. Mannion et al. 2011 demonstrated 25.7% annual anaesthetic gas savings.

**AMSORB® Plus is designed for low flow anaesthesia:**
AMSORB® Plus is safe for use at low and minimal flow rates. It will not adsorb anaesthetic agent and is not capable of agent degradation.
Armstrong 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 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.