

## Outline

Ammonia is a compound of nitrogen and hydrogen with the formula  $\text{NH}_3$ . It is a colourless gas with a characteristic pungent smell. Horses excrete urea in both urine and faeces and this is rapidly converted to ammonia. Ammonia molecules tend to be deposited in the upper and proximal lower airways where they primarily cause mucosal irritation, inflammation and dysfunction, promote mucus secretion and airway narrowing and disrupt defences against other inhaled particles.

## Ammonia Levels in Stables

Ammonia levels in stables vary greatly, and while the exact levels where ammonia becomes detrimental to a horse are unknown, veterinary research has shown that ammonia levels in an average stall can exceed 200 parts per million (PPM).

Concentrations of Ammonia rise in stables when deep litter bedding is used, if horse boxes are poorly ventilated and where there is poor drainage of urine. These conditions are particularly common in colder climates where ventilation is often limited.

Furthermore, ammonia concentrations vary depending on height above bedding with concentrations approximately two-fold at floor level. As horses frequently eat off the floor, have their heads down or lie down they can be exposed to high levels of ammonia and concentrations as high as 740ppm have been recorded in poorly ventilated, regularly mucked out looseboxes.

To put this in perspective, The Health & Safety Executive has set a 15 minute exposure limit for gaseous ammonia for humans at just 35PPM and the recommended maximum levels for pig sheds is less than 7PPM. In effect horses, owners and stable workers can be exposed to very high and unhealthy amounts of ammonia.

## Ammonia and Airway Diseases

Like many noxious gases, ammonia probably acts additively or synergistically with other inhaled non-infectious or infectious agents, or exacerbate pre-existing disease processes

such as asthma, or modulate T-lymphocyte responses and decrease pulmonary immunity. Heaves (Inflammatory Airway Disease (IAD) or Recurrent Airway Disease (RAD)) is a very common condition in horses. IAD and RAD are known to be caused by inhaling irritants like dust and ammonia and/or allergens. Ammonia may also enhance the Inflammatory response in airways induced by other dust agents, particularly endotoxin and bacteria, and therefore may be an important additive component in the generation of IAD in racehorses.

While ammonia levels in stalls will inevitably have peaks and troughs, it is long term low-level exposure to noxious gases that more commonly results in airway inflammation than acute exposures.

In the beginning horses with ammonia induced airway disease will suffer from decreased stamina and will tend to cough during exercise. Prolonged exposure leads to horses that have an increased respiratory effort even at rest that can progress to difficulty breathing. In extreme cases, horses with RAD will lose weight due to the difficulty of breathing while trying to eat.

## Horseboxes and Trailers

Ammonia can build up in trailers and horseboxes just as easily as in a stable. One research group found that horses exposed to high ammonia levels (40-130PPM) in a trailer for 40 hours had several deleterious changes in their respiratory tracts, developed a cough, and had increased nasal secretions. The microscopic lining of the airways was also abnormal. Specifically, the cilia that help clear debris from the airways in the lungs were abnormal or were shedding, and the cells of the tissue lining the airways had degenerative changes.

## Foals

It is usual to assume that the effects of ammonia are more harmful to foals rather than adult horses, and this is not just because they are younger and less developed. Foals usually spend longer lying down than adults and even when standing are closer to the



ground where the concentrations of ammonia are higher.

It is not uncommon for a foal to have a respiratory tract infection between the ages of two and six months. Ammonia inhalation can exacerbate the respiratory disease, which can lead to pneumonia.

## Treatment & Prevention

In an ideal world, horses with RAD are pastured 24 hours a day or as much as possible, however in northern climates this is not always possible, especially in winter.

Prevention is better than cure has long been a true saying, and with no simple solution available from the veterinary cabinet it is important to focus on environmental management. Experts advise that this is the single most important factor in ammonia reduction and the improvement of respiratory health for horses in general. In particular, owners should focus on the horses 'breathing zone', the two foot sphere around the horses nose from where he draws his breath.

The following steps are recommended:

- Muck out stalls as frequently as possible.
- Provide adequate ventilation that is efficiently exchanging air at a level that is at least as low as the horses head.
- Test stall ammonia levels to monitor changes
- Improve protein quality. Crude protein will create significantly higher levels of ammonia in urine.
- Use a safe and environmentally friendly ammonia reducing product.



## Ammonia Reducing Products

Using a product that reduces the amount of ammonia present in the barn or stall can significantly assist in the control of ammonia levels and in some cases can reduce the 'elbow grease' required. Additionally some products will encapsulate dust and provide further advantages. The most popular options:

### Lime

Traditionally lime based products have been used in barns and stalls. These products have the disadvantage that they do not actually absorb or neutralise the odour, they just cover it up. Some are also caustic which is not recommended.

### Natural Minerals

These products use a mixture of minerals that tend to include ingredients such as earth, clay

and natural minerals. While these products are non-toxic, moisture absorbing and trap ammonia they add to the workload of the owner or workers. Apart from absorbing ammonia there are little other benefits to their use.

### Enzyme Based Products

This type of product can reduce ammonia levels contains microscopic organisms that break down the ammonia forming molecules in urine and faeces, instead of just absorbing the ammonia like the mineral based products. In simple terms this is using one type of bacteria to eat the problem bacteria. While this type of product is widely used in a number of different applications to remove odours, research has shown that enzyme based products may be responsible for triggering things like asthma on their own.

## Data Sources

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