



A fact sheet produced by the American Association of Equine Practitioners indicates, “The average 1,000-pound horse produces 50 pounds of manure and urine per day.”

## What’s in the Air

### IMPORTANCE OF MANAGING AEROSOL PARTICLES’ IMPACT ON HORSES & HUMANS IN THE BARN

By **AMANDA DUCKWORTH**

**HORSES ARE KEPT** in stalls for many reasons, ranging from convenience to medical requirement, but the end result is the same: waste removal will be necessary. While an obvious takeaway, it is one that can have a serious impact on a horse’s quality of life if ignored. It also has the potential to negatively affect caregivers as well as the environment at large.

Maintaining a tidy barn begins with properly mucking stalls on a daily basis, and it also involves fully stripping stalls from time-to-time to achieve next-level cleanliness. Keeping stalls orderly and

properly cleaned is messy work and not the most glamorous side of caring for horses, but it is a cornerstone that has wide-reaching implications when it comes to barn management.

The American Association of Equine Practitioners provides a detailed fact sheet titled “The Importance of Cleaning to Disinfection,” which was reprinted by the University of Kentucky’s Department of Veterinary Science’s Equine Disease Quarterly.

“The average 1,000-pound horse produces 50 pounds of manure and urine per day,” explained researchers. “Add on

to that other body fluids that potentially contain pathogens (nasal discharges, abscess material, blood, etc.), and a significant organic load exists in the average horse stall. Any surface that needs to be disinfected (treated with chemicals in order to kill pathogens) must be cleaned of dirt and organic material first.

“Cleaning a stall takes detergent and manual labor. Power washers should not be used to avoid aerosolizing pathogens. Despite advertising claims, no ‘one-step’ product exists that can be sprayed on a dirty stall and effectively kill pathogens.”

Aerosol particles within a barn environment can impact not only the horses but their caregivers as well. In September 2022, Applied Sciences published “Particulate Matter Concentrations and Fungal Aerosol in Horse Stables as Potential Causal Agents in Recurrent Airway Disease in Horses and Human Asthma and Allergies.”

“Exposure to bioaerosols associated with horse stable indoor environment and their health effects on people and horses has recently become of particular interest,” explained researchers. “Moreover, increasing frequency of recurrent airway disease (RAO) among horses made it necessary to search for the most probable causal agents of this disease and methods of their eradication.”

The study, which took place in two horse stables in Poland, was designed to determine levels of particulate matter and concentrations of airborne fungal aerosols. Samples were collected both indoors and outdoors at both locations, during stable weather conditions.

The indoor measurements were done four times: early morning, morning feeding time, mid-day when the horses were outdoors, and during afternoon activity, which included horses coming back to the stable, cleaning activities, and afternoon feeding. A total of 90 samples were gathered at each stable, including 18 samples outdoors and 72 samples indoors, for a total of 180

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collected samples study-wide.

Researchers concluded the three most prevalent fungal species were *Walleria sebi*, *Aspergillus penicillioides*, and *Epizococcum nigrum*, which are all highly allergenic and potentially involved in the occurrence of RAO in horses.

“Spores of the detected fungi can penetrate deeply into the respiratory system. Therefore, this study suggests that examinations of particulate matter and fungal aerosol concentrations, along with species composition assessment, should be regularly conducted in horse stables,” concluded researchers. “To our best knowledge, this study is the first one to contribute, by the combination of culture-based, physicochemical, and molecular methods, to the understanding of factors affecting the occurrence of

recurrent airway obstruction (RAO) in horses kept within stables.

“Moreover, we examined the airborne-related factors that may contribute to the occurrence of human allergic reactions and respiratory diseases, as horse stables are not only the working environment, but are also used in recreation by a variety of people. Our study demonstrated that the daily activities performed in horse stables, such as feeding or cleaning of horses, contributed largely to the increased levels of particulate matter and the fungal components of bioaerosol.”

Atmospheric Pollution Research published a related study, “Identification of airborne particles and fungus spores concentrations within horses stables” in February 2021.

“Horses are used mainly for sports and leisure activities and are predominantly kept in closed individual straw-bedded stalls for a long time during the day, especially in cold weather,” explained researchers. “Horses may therefore be exposed to high concentrations of particulate matter and microorganisms from the bedding and fodder material. The dangers posed by exposing the horses to high pollutant concentrations for a long period are respiratory diseases.”

For the study, researchers examined two stables in Germany for possible correlations between particulate matter and mold spores in a typical barn environment. Similar to the Poland-based study, fluctuations occurred depending on activity taking place in the stable.

“High diurnal fluctuations in concen-

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trations were observed due to the daily activities in the stables,” concluded researchers. “Fine particles were dominant in the air, especially with a size 0.3–0.4  $\mu\text{m}$ . Mold concentrations in the stables ranged from 3.9 to  $5.9 \times 10^5$  CFU/ $\text{m}^3$ . The most common mold genera were Eurotium, Wallemia, and Cladosporium. The latter two were found in the straw and hay. A limited prognosis occurred of the mold fungus concentration in horse stables on the basis of airborne particle concentration.”

While straw is considered the standard choice for bedding material, there are numerous selections on offer, and in addition to keeping horses comfortable, how bedding can affect the equine respiratory tract is always a consideration. What material is best ultimately can depend on the design of a barn, as well as the individual horses occupying it, and multiple studies have been done on the subject. In August 2018, the Journal of Equine Veterinary Science published “The Effects of Bedding Type in Stalls and Activity of Horses on Stall Air Quality.”

“When horses are in stalls, they are exposed to airborne particulate matter (PM) (aerosol), including the airborne particles released from stalls’ bedding materials because of horses’ activities,” explained researchers. “The aerosol particles are inhaled by the horses and can be a factor in their health and racing performance.”

For the study, researchers used four different stall bedding materials—straw, shavings, STREUfex, and Woody Pet—to assess the potential for inhalation and exposure to airborne particulate matter. The barn stabled 12 horses and had a solid concrete ceiling. The hayloft above the barn was empty during the study.

“The use of straw resulted in the lowest concentration of airborne PM in all three size fractions, whereas the use of Woody Pet resulted in the highest,” researchers concluded. “We found significantly lower aerosol concentrations for the activity type sleeping than for eat-



Research finds that aerosol particles in barns can impact the health of horses and their caregivers



**CLEANING A STALL TAKES DETERGENT AND MANUAL LABOR. POWER WASHERS SHOULD NOT BE USED TO AVOID AEROSOLIZING PATHOGENS. DESPITE ADVERTISING CLAIMS, NO ‘ONE-STEP’ PRODUCT EXISTS THAT CAN BE SPRAYED ON A DIRTY STALL AND EFFECTIVELY KILL PATHOGENS.”**

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ing and walking. The use of shavings, STREUfex, and Woody Pet resulted in a higher concentration of airborne particles compared to straw when bedding was disturbed by the horses’ activities.

“The findings point to the importance of choice of bedding with minimal aerosol-generation potential because different bedding materials demonstrated

substantially different levels of generated PM, particularly in response to more intense types of horses’ activities. The resuspension of the settled PM by the horses blowing and poking into horizontal surfaces within the stalls is a likely cause of acute aerosol inhalation exposure. In addition to selecting bedding materials with the lowest aerosol-generating potential, we recommend evaluation of interventions such as regular wet cleaning and elimination of horizontal surfaces such as window sills accessible to horses in the design of stalls.”

A similar study, “The effect of stable bedding materials on dust levels, microbial air contamination and equine respiratory health,” was published by Research in Veterinary Science in December 2017.

“Bedding material is an indispensable item for stable maintenance,” explained researchers. “The primary function of bedding is to absorb moisture, keep the stable floor dry, and produce a healthy microclimate in the stable. The bedding material is also crucial to provide comfort to the horses and allows them to manifest their natural behavior. Cushioning properties of bedding materials are very important during horses’ lying, standing up, and lying down.

“The choice of bedding material affects the quality of air in a stable and,

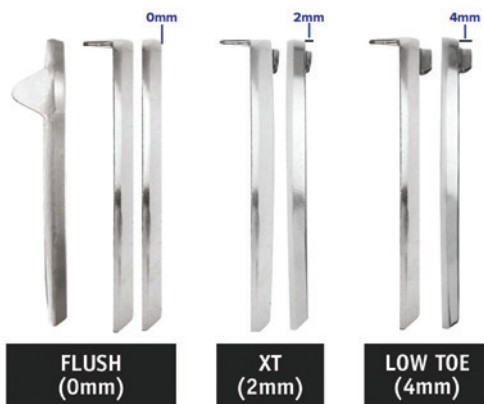
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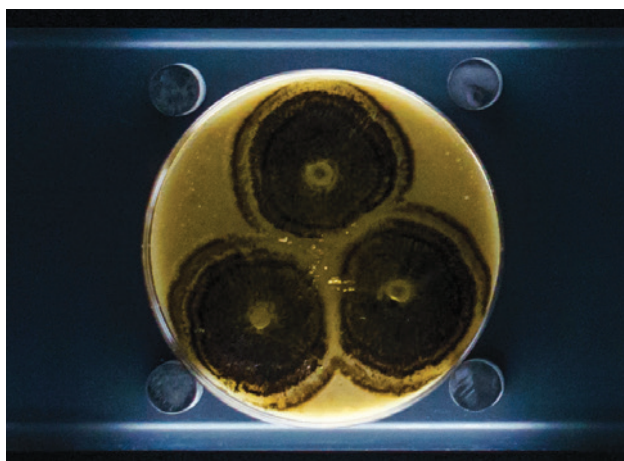
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Recurrent airway disease in equines has led to studies on probable casual agents, such as bedding



Fungi commonly found in barn environments, such as *Epizococcus nigrum*, are highly allergenic

consequently, the respiratory health of horses and humans. The risk of respiratory problems can be mitigated by improving the quality of air in the stable. The choice of bedding material is particularly important in cold climate conditions where horses are kept indoors throughout the year.”

For the study, researchers analyzed the impact of three common bedding materials in straw (S), peat with shavings (PS), and crushed wood pellets (CWP) on air contamination and the condition of the equine respiratory tract.

“Mechanical dust contamination was lowest for PS and highest for CWP,” concluded researchers. “Bacterial contamination (in CFU – colony forming units) was highest for PS and lowest for CWP. Fungal air contamination was lowest for CWP and highest for S and PS.

“An analysis of physiological indicators revealed that all horses were clinically healthy regardless of the type of applied bedding. The type of bedding material did not exert a clear influence on arterial blood biochemistry or the results of endoscopic evaluations of the respiratory tract; however, the use of alternative for straw bedding materials improved endoscopy results.”

As general environmental concerns grow globally, the effect of the waste created by horses has also come into the spotlight, and researchers are also looking into how horse stables impact things on a larger scale. In February 2019, the *Journal of Equine Veterinary Science* published “Determination of Phosphorus and Nitrogen Environmental Load From Six Different Bedding Types Used in an Equine Facility.”

“Around the world, the public increasingly scrutinizes the environmental impact of livestock production and facilities,” explained researchers. “Livestock industries compete with other agricultural industries for land, air, and water,



One study showed that daily activities performed in stables, such as feeding and grooming, “contributed largely to the increased levels of particulate matter and the fungal components of bioaerosol.”

and it is generally believed that livestock industries have a greater negative impact on these resources than do many other industries. According to the Food and Agriculture Organization, some of the main contributors in the livestock sector to greenhouse gases are methane and nitrous oxide emission from manure.

“Regulations outlining animal emission rates and manure management practices are being redefined across the United States due in part to environmental concerns specific to phosphorus (P) and nitrogen (N) concentration of animal waste. Both P and N in animal waste are transferred to surface water through runoff from rain and leaching into the ground, increasing the amount of these nutrients in a body of water.”

For the study, researchers wanted to learn more about the true environmental impact of both the amount of waste created by horse operations and the phosphorus (P) and nitrogen (N) in the waste. They examined these issues using six types of equine bedding—peat moss (PM), wood shavings (WS), wood pellets (WP), straw (ST), chopped straw (CS), and corn cob hulls (CC)—for seven days each. Every day, waste was removed, weighed, mixed,

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## Barn Management

and a 10% sample was saved. All samples were pooled at the end of the seven-day period and a representative sample was analyzed.

“As expected, amount of waste removed depended on type of bedding used and usually influenced amount of new bedding added,” researchers concluded. “Amount removed and added directly impacted projected yearly use. Nitrogen and phosphorus did not differ among clean bedding sources but did differ in waste material, potentially from the different absorption properties of each bedding.

“Daily waste removed was highest in ST, followed by CS, WS, WP, PM, and CC. Concentration of P in the waste bedding removed was highest in PM, followed by



As fundamental as it sounds, keeping stalls and facilities tidy while also evaluating potential contaminants, has a bearing on equine and human health

basic items of care provided to equines, but the best and healthiest way to do it for man, beast, and the planet continues to be an area of study. **BH**

CC, CS, WS, WP, and ST. Concentration of N in the waste bedding removed was highest in PM, followed by WP, CC, CS, ST, and WS. These results reveal differences in contribution of P and N to the environmental load of six typical bedding materials used in horse facilities. The knowledge gained from these results can be used to improve nutrient management practices in horse facilities.”

Bedding down a horse’s stall is one of the most

basic items of care provided to equines, but the best and healthiest way to do it for man, beast, and the planet continues to be an area of study. **BH**

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