



New York State Cattle Health Assurance Program
Mastitis Module Fact Sheet
Bedding Materials and Udder Health

Bedding and bedding management contribute to cow comfort, udder health and milk quality. A clean, dry adequately bedded stall maintains cow cleanliness, inhibits microbial growth and transfer to teat skin, resists compaction and lessens chapping of teats. A comfortable stall bed encourages resting, minimizes injury and fatigue and accommodates reasonable rates of heat loss.



Figure 1. Examples of clean, dry, well-bedded stalls. The left photo is of freestalls comfortably bedded with sawdust and shredded paper. The right photo is of a properly bedded tie-stall using wood shavings. Note the cleanliness of cows.

In many well-managed dairy herds contagious mastitis has been eliminated or effectively controlled. In these herds environmental pathogens are the major causes of clinical and subclinical mastitis. The primary source of environmental mastitis pathogens is the cows' environment not infected cows, as is the case with contagious pathogens. Environmental pathogens do not tend to colonize teat skin nor do they live on the skin for prolonged periods of time. Populations of environmental bacteria in bedding are related to the number of bacteria on teat skin (ends) and rates of clinical mastitis (1). Effective bedding management should ensure that teats contact a clean, well-bedded surface each time a cow lays down. Adequate amounts of clean dry bedding will insure minimal contamination of teat skin with bacteria.

The type of bedding chosen and daily bedding (stall) management can have a major impact on udder health and the incidence of mastitis infection. Many factors are involved in selection of suitable bedding materials on dairy farms including cost, availability, facilities design, cow comfort, ease of use, waste storage and disposal methods available at the farm. Ideal bedding should be dry, inert (to microbial growth), cost effective, contribute to cow comfort and cleanliness and easily managed.

Bedding materials fall into two basic categories, organic and inorganic. Each has its advantages and disadvantages. Organic bedding materials consist of straw, hay, saw dust, wood shavings, crop residue (corn stalks, cobs, etc.) shredded paper, paper pulp residue, composted or dried manure and similar materials. They are used as bedding because they absorb moisture, are compatible with manure handling systems and are readily available. A major disadvantage of these materials is that they will support rapid growth of environmental mastitis pathogens when they become mixed with manure and water (urine) (1,2,3,7). Contaminating bacteria grow to large numbers within 24 hours. The major pathogens associated with bedding materials are the environmental *Streptococci* (including *Streptococcus uberis*) and coliform such as *E. coli* and *Klebsiella spp.* (1,3,6,7) Many of these organic products already contain high levels of a resident population of potential pathogens shortening the life span of the bedding as an effective barrier to microbial contamination of teat skin. Materials such as paper pulp waste are often delivered in a wet form that supports bacterial growth and may contain bacterial populations that can be measured in the millions to hundreds-of-millions per gram of bedding. Allowing wet bedding to dry prior to use will reduce bacterial concentration thereby extending the useful life of the material. Some environmental mastitis pathogens have been associated with specific types of bedding materials. Use of green, hardwood saw dust containing bark material has been associated with a high incidence of *Klebsiella* mastitis (6) and the use of straw bedding is often associated with increased levels of mastitis from *Streptococcus uberis* infection. Particle size may also influence the population density of pathogens in bedding (1). Pathogen numbers often increase with decreasing particle size. Particle size can become an important factor when developing management schemes for bedding materials and stall maintenance. Bedding materials such as very fine saw dust from furniture construction may be nearly sterile prior to use but the small particle size supports very rapid growth of bacteria requiring more intensive bedding maintenance. Materials of fine particle size are more likely to cover teat skin leading to high population of bacteria on the teats and greater opportunities for intramammary infection (1). Wood products such as shavings, which have a much larger particle size, support slower growth of bacteria.



Figure 2. Inadequately bedded freestall. Note the presence of manure, leaking milk and position of the teats in relation to the dirty stall surface. These conditions represent a major risk for new environmental mastitis infections.

Composted or dried manure solids have also been advocated as bedding material. They have been used successfully on some farms in the southwest where weather conditions contribute to a very dry environment for most of the year. These materials are usually free of most major environmental mastitis pathogens when initially applied however dried manure is an excellent

medium for bacterial growth once moisture from urine and fresh manure are added (5). In the northeast ambient humidity and air temperatures are not conducive to the effective use of dried manure solids or composted dairy waste as a bedding material in respect to reducing teat skin exposure to environmental pathogens (4,5,8). Composting offered little benefit toward net reduction in teat end contamination by coliform bacterial numbers in dairy waste solids (4).

Inorganic bedding materials consist of sand and crushed limestone. Many consider sand to be the gold standard of bedding materials (1,12). It is inert and does not support the growth of bacteria. Sand should be of builders' quality and contain little or no silt or clay. When properly maintained sand provides a very comfortable medium for bedding. Bacteria counts of used sand bedding are often significantly lower than in organic bedding materials. Inorganic bedding such as sand is the ideal bedding material from a bacteriological standpoint. Numbers of coliform bacteria and environmental streptococci found in sand are nearly always lower than numbers found in organic bedding (1,12). Lower bacteria counts are associated with reduced rates of new infections with environmental pathogens (7,8,12).



Figure 4. Sand bedded freestalls. The stalls on the right are properly bedded and groomed. The stalls on the left although clean do not have sufficient sand. The stalls are uncomfortable forcing the cows to remain standing.

Bedding Management: Many factors can affect the cleanliness and bacterial population of bedding (13). The amount and frequency of application is an issue on many of today's farms. Many dairies today bed at weekly intervals and the use of rubber filled mattresses has displaced the use of bedding materials altogether on some farms. Organic bedding materials usually will often reach maximum bacterial populations 24 hours after the material is laid down. Facilities that allow accumulation of excessive amounts of manure, mud or urine will see a more rapid deterioration of bedding quality due to more severe contamination of the bedding. Moisture is an essential ingredient for bacterial growth. Bedding that is rained upon or absorbs moisture from the ground or other sources will have elevated bacteria counts.



Figure 5. Proper storage facilities for bedding must ensure that bedding is kept clean and dry. Exposure to rain or runoff from manure handling facilities or the barnyard contaminate dry bedding and promote bacterial growth.

Additives have been used in an attempt to extend the life of or lower the bacteria counts of bedding materials (13, 8). This is often done when addressing a clinical mastitis crisis situation. Lime (hydrated) added to sawdust or shavings has been shown to increase bedding pH, and reduce its water content. Adding one to two pounds of hydrated lime per stall to bedding inhibited bacterial growth but may or may not reduce the incidence of clinical mastitis. The effect of added lime is short lived (24 hrs.) and requires that lime be added daily. Research indicate that adding the lime to bedding prior to application and mixing just prior to use is the most effective means of reducing the bacterial population of existing bedding materials. Alkalizing and acidifying agents have been used to lower bacterial counts in sawdust and recycled manure (8,9). The antibacterial effects of bedding treatments were related to the pH of the bedding materials. Pretreatment mean concentrations of total Gram-negative bacteria, coliforms, *Klebsiella* spp. and streptococci in recycled manure were 10^5 . Treatment of recycled manure with an alkaline conditioner or hydrated lime lowered the total bacterial count 100-fold (10^3) for approximately 24 hours (8). Many factors can influence the bacterial population of bedding materials including ventilation, cow density, barn design (13), bedding dry matter and bedding storage. Differences in housing and management may overwhelm the effect of adding lime or making more frequent bedding changes on bacteria levels on a cow's teat end (3,9,13). Many aspects of group and herd management must be considered.

Effect of Housing Conditions on Bedding: . Barns with inadequate ventilation will often have a microclimate at the barn floor level that will increase the moisture level of bedding encouraging the growth of bacteria in the bedding. Overcrowding of animals can also contribute to the rapid deterioration of bedding. There are three distinct housing situations present on most dairy farms that influence teat end exposure to environmental pathogens associated with bedding. These are the lactating cow housing, the dry cow and close-up heifer housing and the maternity or calving area (1). Bedding materials and bedding management of these areas is critical to controlling exposure of teat ends to environmental pathogens. Animals are two to twelve times more likely to develop new environmental mastitis infections when housed in the dry cow - close-up heifer group than during lactation. Animals at this stage of gestation are normally immunosuppressed yet housing conditions often expose them to record numbers of bacteria. The maternity pens are also often-neglected areas of bedding management and can contribute to an increase in the new infection rate. Dry cows are often housed on bedded packs. They are frequently overcrowded, poorly drained and inadequately bedded. Proper management of dry cow and maternity facilities is essential for effective control of new environmental mastitis infections.

Monitoring Bedding: Differential bacterial counts can be useful for evaluating bedding quality and management. The laboratory should have experience with differential bacterial counts and both used and unused bedding should be evaluated. To collect used bedding samples several ounces of material should be collected from the last 16 inches of the rear of the stall surface from a half dozen or more typical stalls. The material is placed in a zip-lock bag and labeled. Unused bedding should also be sampled from several areas of the bedding pile.

Conclusion:

Proper bedding management for all production groups is critical for the effective control of environmental mastitis. Inorganic materials such as sand do not support the growth of environmental pathogens and usually result in lower teat end bacterial counts and subsequently a lower new infection rate. Few major differences exist in the bacteria counts of organic bedding material although some specific materials can be associated with higher population or infection rate with specific pathogens (i.e. *Klebsiella* spp and green hardwood sawdust; straw and *Streptococcus uberis*). High moisture levels of organic bedding materials will result in rapid growth of environmental bacteria in the bedding contributing to high populations of bacteria on teat ends. Bacterial populations on organic bedding of small particle size will increase rapidly when contaminated and increase teat end contamination rates. High bacteria counts of bedding under barn conditions are influenced by factors more complex than the type of bedding used. Barn design, ventilation, cleaning frequency, population density are just a few of the factors influencing microbial populations and exposure of cows to potential infection.

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