Udder Health and the Confinement Freestall Barn

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The use of freestall barns for total or seasonal confinement of dairy cattle has gained widespread acceptance by U.S. dairymen since their introduction in Snohomish, Washington in 1960. During this same period, many dairies have successfully implemented mastitis control procedures directed at contagious *Streoptoccus agalactia* and *Staphylococcus aureus.* These events have probably worked together to explain the more frequent reports of coliform mastitis problems in the last 25 years. It is my objective here to discuss some of the principles involved in changing environmental factors in order to reduce coliform mastitis losses.

Identifying the problem

Use of organic bedding in freestalls is a very common practice in the industry. This bedding becomes readily contaminated with urine and feces which help support high bacteria populations. To determine if the bacteria in the bedding are related to the mastitis cases in the dairy it will be helpful if you can establish an epidemiological link. This requires that we do a bacteriological analysis of the bedding to determine the type and quantity of bacteria present and see if it matches the isolates obtained from clinical mastitis cases.

A typical laboratory procedure could include the following steps. Obtain a surface sample of bedding from the udder contact area of the stall. A 10 pm. portion of the material is weighted into a beaker and put into an oven overnight. The overnight weight loss of the sample represents the moisture content of the bedding. Perform dilutions of a 1 gm. sample with water so as to make a 1:100 and 1:1000 dilution of bedding material. After thorough agitation, plate an .01 ml sample of each dilution on blood agar and Mackonkeys. By choosing the most readable plate one can estimate the lactose fermenter count and the non-lactosae fermenter count. An estimate of the Klebsiella count can be made as well. For this procedure to be most meaningful, the identification must be done at the species level. Generally it is estimated that pathogen densities greater than one million per gram of bedding would be required for an organism to pose a substantial threat (1).

Coliform mastitis cases may result from wet udders during milking and/or teat end impacts from the milking machine. You have a good chance of controlling this by the use of sanitizers on the teat pre-milking and, more importantly, by thoroughly drying the udder before milking. Proper milking equipment function and design are of course also important. Use of liner shields or anti-impact claw designs may further reduce the new infection rate on a dairy. (2.3). Certainly these latter two areas should be aggressively pursued as a way of measuring the relative influence of factors outside the parlor (4). Coliform mastitis problems that persist, in spite of employing these very useful parlor techniques, suggests a need to control bacteria populations in the barn more directly.

The objective of a good dairy barn is to provide a peaceful, clean, health promoting environment for milking. We fall short of this ideal when cows become dirty or mastitis pathogen populations in bedding soar to dangerous levels. I suggest we look at this as two separate problems although there is some overlap. First we have a whole host of barn design and management techniques that relate to improving cow cleanliness. Also we may wish to utilize known principles for modifying or suppressing bacteria populations in the bedding itself.

Freestall barn management

Manure contamination on the udder is largely a function of facilities design. The average Holstien cow can produce over 100 pounds of waste per day. Where we used to allow one acre per head on pasture we now typically allow about 45 square feet per head in confinement barns. Splashing of manure onto the udder or into the stalls is an ongoing management concern. The total square footage per head and the frequency of scraping determines manure accumulation and likelihood of udder contamination. A high stall per cow ratio leads to greater manure concentration and splashing. One strong argument in favor of 3 X milking is to give an opportunity for 3 X scraping to significantly improve cow cleanliness over 2 X scraping. Automated barn floor scrapers or flush barns would presumably offer additional benefits as frequency of floor cleaning goes to 6x, 12x or even hourly. The quality of the scraping job will be influenced by the unevenness of the concrete floor. The use of a rubber edge on the blade is quite helpful. Repairs to correct low spots in the concrete where water accumulates may be indicated. If scraped manure is spilling into the stalls then adjustments in scraping frequency, scraping pattern or the blade capacity is required. Additional management opportunities to improve cow cleanliness include cleaning the holding pen and traffic alleys between milking strings. Finally cow activity can be regulated by discouraging running in the barn or providing temporary isolation for heat cows.

Freestall design

Early freestall designs usually called for dimensions of 4′ wide by 8′ long for large adult Holstiens. Contamination of the stall with urine, feces, and vaginal discharges is a common consequence of stalls even as short as 7′. Today it is suggested that a 7′ stall length is close to optimum in spite of this contamination problem (5). The consequence of shorter stalls is increased problems with acceptance and comfort. Positioning devices such as neck bars or brisket boards have been used to prevent cows from moving to the front of the stalls (figure 1). This tends to keep the rear end of the cow out over the alley where it is difficult for her to contaminate the stall when either standing or lying down (figure 2,3). The neck device is typically a pipe or a cable suspended about 3′6″ to 4′ above the bedding surface and 5′6″ in from the outside of the curb. When properly positioned this will prevent the cow from standing with all four feet in the stall. This is usually very successful on 7′ stalls but it is essential that the pipe be heavy enough or the cable tight enough so that cows respect it. A work of caution here. On stalls 7′6″ and longer, the pipe or cable will have to be at least 2′ from the front of the stall to do any good. This is enough space to allow the cows' withers to get caught in front of a cable or a ridged pipe and may result in severe injury. In this situation a movable pipe is recommended. This is accomplished by either putting the pipe on a hinged arm or hanging it by a chain. Additionally a brisket board may be used to keep cows from lying too far forward. The brisket board lies at the bedding level with its surface tilted away from perpendicular about 30 degrees. It should allow about 5′6″ to 5′9″ of cow usable space between it and the outside of the curb.

FIGURE 1. Typical sawdust freestall.

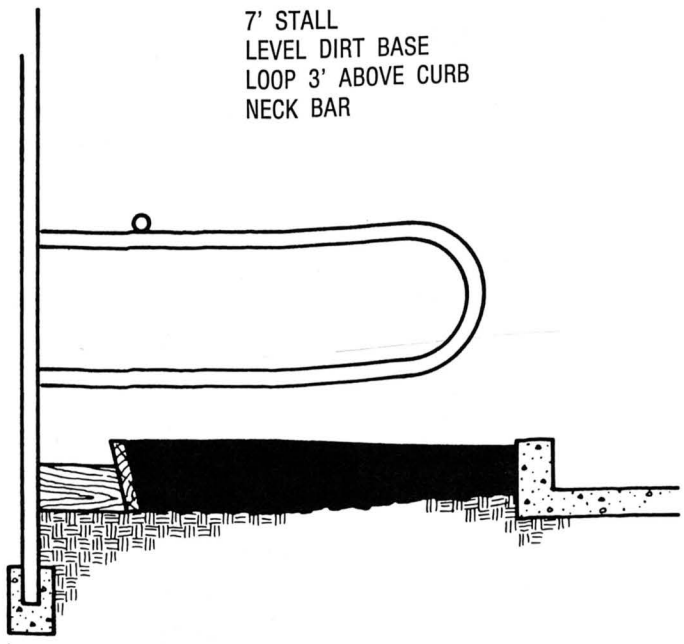


FIGURE 2. With properly positioned neck bar, cow actually has some difficulty getting into the stall with all four feet. This discourages her from contaminating the stall and encourages her to lie down.

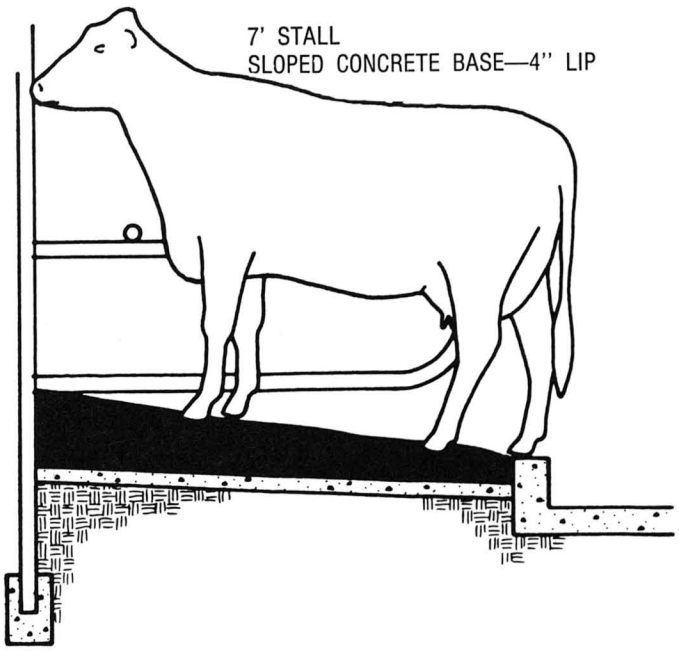
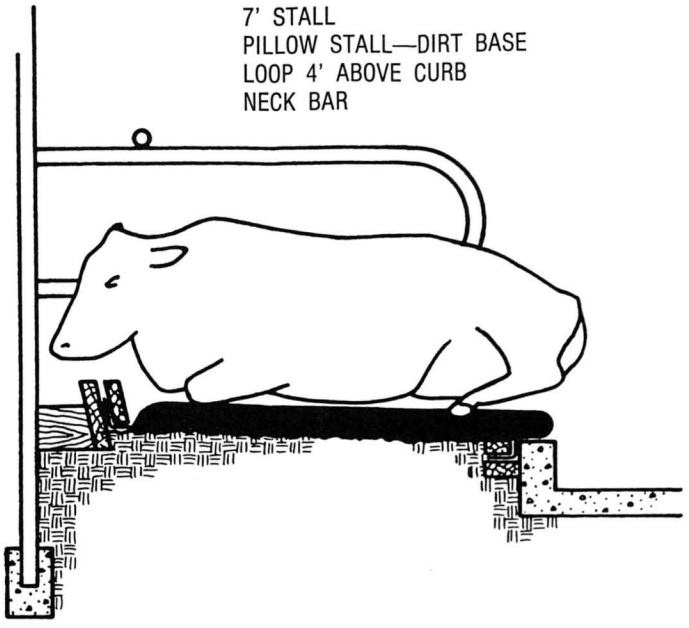


FIGURE 3. With properly positioned brisket board, rear end of the cow hangs out over the curb.



Another stall feature that affects cow position is the stall base. When bedding material gets knocked out of the stall, soft earthen base materials start to erode to form holes. Cows may attempt to scoot further forward to keep from rubbing the rear curb, and hence increase contamination of the stall. Teat injuries may increase as cows attempt to climb out of these holes. A number of techniques for establishing a

stable firm base will prevent holes from forming and keep the cows higher and further back in the stalls. Cementing the bottom of the stall is one of the more common methods used (figure 4). Wooden planks and cinder blocks have also been used for the same purpose. Beware that bedding depths less than 3″ over these hard bases may cause physical stress such as abrasions and abscesses on the hock. The use of tires embedded in the stall (figure 5) is a more forgiving base material and with proper installation will give long service (6). It is good to note here that as stall base material is firmed and elevated, it becomes necessary to use a hanging neck bar (figure 6) or go to a loop that is 4′ above the curb (figure 7).

FIGURE 4. Commonly used concrete base to prevent erosions in bottom of stall.

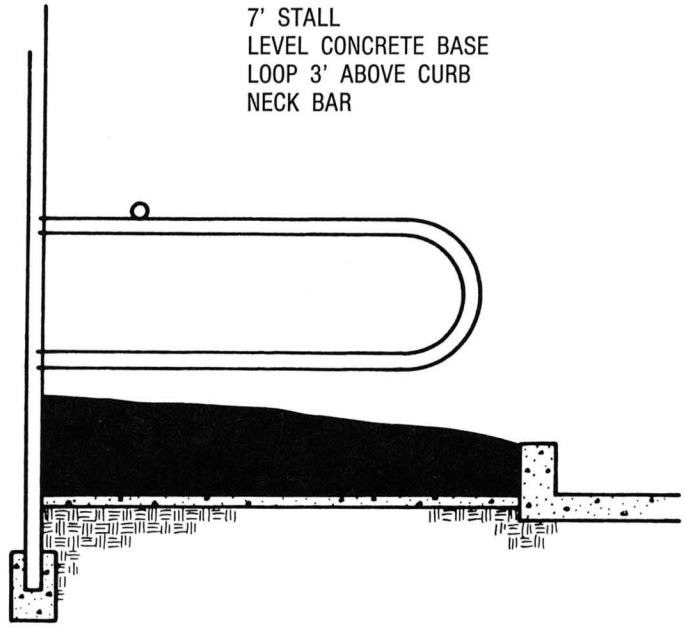


FIGURE 5. Tires shown properly imbedded in dirt base of stall.

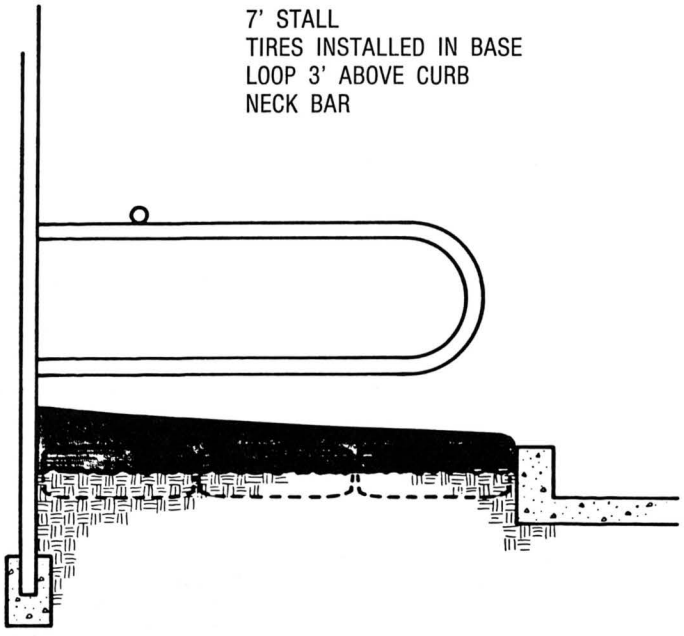


FIGURE 6. Example of hanging neck bar installation.

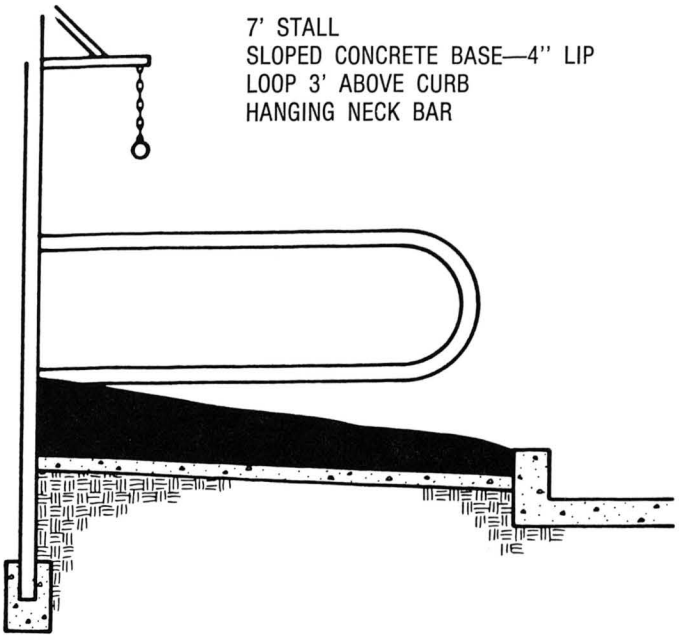
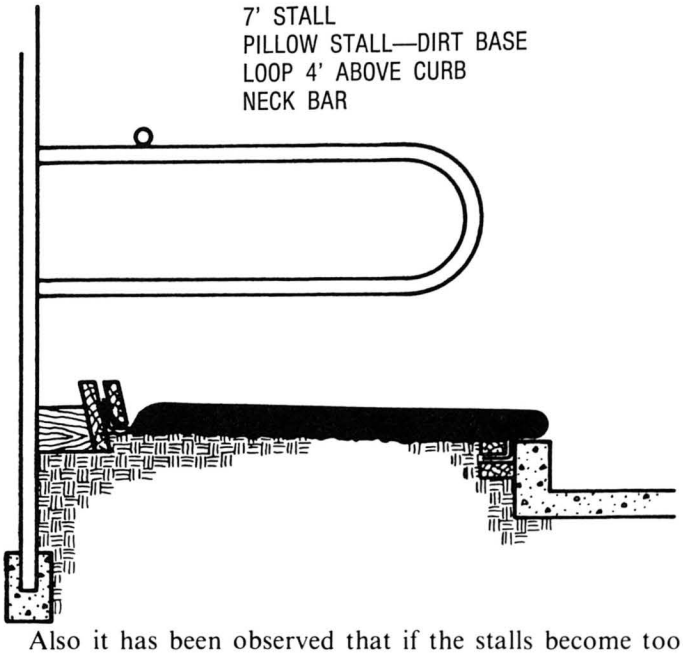


FIGURE 7. Example installation of pillow stall on dirt base.



Also it has been observed that if the stalls become too uncomfortable cows may stand excessively causing fatigue stress. Physical stress should not be substituted for bacteriological stress in attempting to improve freestall design. It certainly can be argued however that too much emphasis on a large deeply bedded stall has often subjected cows to dangerous bacteria populations.

Bedding management

Sawdust and shavings are probably two of the more common choices of bedding for freestall barns. Wood based

products have been commonly associated with mastitis outbreaks caused by high populations of Klebsiella pneumoniae that come up within 2 to 3 days after the stalls are bedded (7). As with all organic bedding, *E.coli* numbers tend to increase to dangerous levels as it becomes more contaminated out around day 7 to 10. Putting down new bedding more frequently (two to three times a week) is a technique used to keep coliform numbers lower (1). This may be counter productive in the case of a Klebsiella problem on sawdust as these populations tend to peak earlier.

Bedding materials vary widely in moisture, nutrient content, and bacteria populations as they arrive on the farm. Bacteria need moisture in order to multiply. Therefore it is logical that kiln dried bedding will have lower bacteria populations than moist bedding. In some farms due to ventilation problems or too humid climates, it is practically impossible to keep the bedding dry enough in the stalls to do any good. New kiln dried shavings may have 12% moisture but within a day it can rise to 25% or 45% moisture in the wet barn air. Research has shown a significant correlation between rainfall and Klebsiella pneumonia populations in sawdust bedding (8).

Bacteriocidal chemicals such as hydrated lime have been used to treat bedding to lower the bacteria counts without proven success. This procedure is probably of benefit by its drying influence as much as anything else but it cannot be expected to "sterilize" the bedding. Disinfectants simply do not work well on rough organic surfaces. Other harsher chemicals have been proposed. One must keep in mind that these techniques must be consistent with the safe and healthful harvest of a human food product.

Bacteria need nutrients in order to grow. The advantage of sand as bedding is that it is lacking in carbon and nitrogen. The more crystalling-like it is and the less loamy, the better. Sand can become contaminated with manure and so bacteria can be cultured from a sand bedded stall. But the bacteria numbers remain extremely low as there is no additional nutrient source for them to grow on. Another beneficial feature of sand is that water does not cling to it as it does to the fiber of organic substrates. Extremely low moisture contents are measured even in conditions of high relative humidity.

Another principle in the control of bacteria in bedding is that certain strains of bacteria flourish in certain substrates and not others. Earlier it was mentioned that *Klebsiella pneumoniae* is frequently isloated from sawdust bedding. This same organism has not been reported to be found in straw bedding. Although mastitis problems with both *E. coli* and Streptococcus uberis have been reported, I suggest straw bedding can be specifically recommended as an alternative to sawdust if you have a *Klebsiella pneumoniae* problem.

Processed manure solids have been used as a bedding in recent years (9). One recommendation that has been put forward for processing the bedding is to dry it. In arid climates this is relatively easy and effective. Composting of manure solids has been shown to reduce coliform numbers provided that the temperatures in the compost stack get high enough. After putting the material into freestall barns, coliform populations including Klebsiella pneumonia, have been seen to return. The great variation in processing conditions of outside drying or compost piles will likely result in varying experiences in the field.

Manure fermented in Biofermenters (TM) is subject to a controlled aerobic environment 185 F for five days (10). These temperatures appear to destroy all coliform organisms, but the material is not sterile since the process itself is caused by bacterial action. Repeated sampling of this material after it is introduced in the stall showed a high count of nonlactose fermenters followed by a gradual increase in numbers of lactose fermenters as is the case for composted manure solids. Notably absent from the bacteria populations of used fermented bedding is *Klebsiella pneumonia* (11). The explanation for this latter observation is unknown, but we may speculate that a separate protective principle is in operation in the bioconverted material that can be used to discourage this pathogen.

A final promising area for biological modification of the freestall environment is the use of synthetic bedding surfaces which provide no additional nutrient sources to contaminating bacteria. These devices are typically installed to also offer the benefit of a firm stable stall base to help with cow position. Cow pillows (figure 7) are made by placing an inert envelope of tough polypropylene woven fabric around a filling of sawdust (12, 13). This offers the advantage of the comfort of sawdust without the exposure to its associated flora. In my opinion ordinary rubber mats are unacceptably hard and require some organic bedding for cow comfort. Use of dry bedding or preferably lime on these synthetic surfaces is needed to control moisture.

It would be nice to always be able to offer a specific effective control procedure whenever a specific diagnosis is made. The suggestions presented here are offered as guiding principles to be used in developing control recommendations. Careful evaluation of specific environmental conditions may reveal interactions that would tend to alter the relative importance of the various control procedures. Typically a mixture of control procedures is indicated as there is usually a number of causative processes operating concurrently. Also one must beware that successful control of one organism may result in an increase in the frequency of udder disease caused by another organism.

References

1. Bramley AJ: The control of coliform mastitis. Proc 24th Annu Meet National Mastitis Council: 4-17, 1985. 2. Griffin TK, Mein GA, Westgarth DR, et al.: Effect of deflector shields fitted in the milking machine teatcup liner on bovine udder disease, J Dairy Res 47:1-9, 1980. 3. Britten AM: Are you "shielded" from your milking machine hazards?, Dairy Herd Mgmt. 21 (8):7-8, 1984. 4. Bramley AJ, Godinhoks KS, Grindal RJ: Evidence of penetration of the bovine teat duct by Echerichia coli in the interval between milkings, J Dairy Res 48:379-386, 1981. 5. Irish WW, Martin RO: Design considerations for free stalls, in Dairy Housing II. St Joseph, Mich.,

American Society of Agricultural Engineers, 1983, pp.108-121. 6. Hogson AS: Surface materials for free stalls. Dairy Free Stall Housing: Proceedings of the Dairy Free Stall Housing Symposium. Harrisburg, PA, Northeast Regional Agricultural Engineering Service, 1986, pp 39-44. 7. Eberhart RJ, Natzke RP, Newbould FHS, et al.: Coliform mastitis—a review, J Dairy Sci 62:1-22, 1979. 8. Thomas CD, Jasper DE, Rollins MH, et al.: Enterobacteriaceae bedding populations, rainfall and mastitis on a California dairy, Prevent Vet Med 1:227-242, 1983. 9. Carroll EJ, Jasper DE: Distribution of enterobactiaceae in recycled manure bedding on California dairies, J Dairy Sci 61:1498-1508. 1978. 10. Roybal J: Fermenting waste for feed, fertilizers, and bedding, Dairy Herd Mngmt 21 (4) :32-40, 1984. 11. Britten AM: Is alternative bedding the answer to your mastitis problems?, Dairy Herd Mngmt 21 (9) :38-43, 1984. 12. Glore R: Upholstered freestalls as an aid to control of coliform mastitis. Proc 18th Annu Conv AABP:157-158, 1985. 13. Sponaugle TM: New Bedding material helps control mastitis. Farm J Dairy Extra: 12, 14, May 1985.