

## **What have we learned about using recycled manure solids for bedding?**

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Organic bedding sources are becoming more expensive and difficult to find. Sand can be considered the ideal bedding source for dairy cows; however, not all producers consider sand a feasible alternative for their operation. Inherent properties of sand can make it difficult to handle in some manure systems. Large amounts of bedding can be obtained from mechanical liquid-solid separation of manure. Cows produce a lot of manure each day! The idea of recycling the fiber from the manure and using it as bedding can be attractive and good for the environment.

Manure solids have been used as deep bedding in California for many years. But our climate is not as arid. Research data on the use of manure solids as bedding material for dairy cows, milk quality and animal welfare on farms using solids, the chemical and bacteriological characteristics of solids, and methods of obtaining solids for bedding in the Midwest US were not available. Therefore, the objectives of our cross-sectional study were to describe management practices, bedding characteristics, and animal welfare, and compare animal welfare in deep bedded vs. mattress stalls. Data collection and summarization was performed by graduate student Adam Husfeldt as a partial requirement for the completion of his Master of Science degree. He is now a dairy producer in South Central Minnesota. I thank Adam for his help on this study.

### **Farm characteristics**

Thirty-eight Midwest dairy operations from Wisconsin (26), Minnesota (6), South Dakota (4), and Iowa (2) were included in our study. Anaerobic digestion preceded mechanical manure solids separation on 50% of the farms, with plug-flow digesters (14) being more common than complete-mix digesters (5). Farms without anaerobic digesters were separating raw manure for bedding (13) or purchasing manure solids from dairies with anaerobic digesters (6). All farms used mechanical screw press separators to obtain solids, and 19 of the 38 farms were utilizing anaerobic digestion prior to mechanical separation of manure. Average herd size of farms using anaerobic digesters was 1755 cows.

On the 13 farms where anaerobic digesters were not used, producers mechanically separated raw manure and either used it without treatment or subjected the solids to mechanical drum-composting for 18 to 24 h at approximately 150°F. Nine herds used separated raw manure solids and 4 herds used manure solids after drum-composting. Average herd size was 1025 cows for farms utilizing a drum-composting unit and 1105 cows for farms separating raw manure solids. Six herds in our study were purchasing digested manure solids from another dairy operation. In these herds, manure solids were stockpiled for a period of 1-3 weeks and used as needed by the dairy producer. In herds purchasing manure solids, herd size averaged 542 cows.

## Bedding material characteristics

Unused bedding moisture was 72.4% ( $\pm 6.0$ ) with a pH of 9.16 ( $\pm 0.2$ ) and contained 1.4% ( $\pm 0.2$ ) N, 44.9% ( $\pm 1.1$ ) C, 32.7 ( $\pm 5.2$ ) C:N ratio, 0.44% ( $\pm 0.19$ ) P, 0.70% ( $\pm 0.21$ ) K, 76.5% ( $\pm 2.5$ ) NDF, 9.4% ( $\pm 2.0$ ) ash, 4.4% ( $\pm 1.6$ ) non-fiber carbohydrates (NFC), and 1.1% ( $\pm 0.5$ ) fat. Total bacterial counts in unused bedding were 4,211,927 cfu (colony forming units)/mL and ranged from 325 to 23,373,500 cfu/mL. Proportionally, samples had 58.0% bacillus species, 37.2% environmental *Streptococci* species, 4.0% *Staphylococcus* species, and 0.9% coliforms.

Used bedding samples had an average moisture content of 50.4% ( $\pm 12.6$ ) and a pH of 9.39 ( $\pm 0.2$ ). These samples contained 1.9% ( $\pm 0.4$ ) N, 43.0% ( $\pm 2.1$ ) C, 22.6 ( $\pm 4.3$ ) C:N ratio, 71.3% ( $\pm 4.1$ ) NDF, and 12.2% ( $\pm 4.2$ ) ash. Total bacterial population in used bedding was 13,285,010 cfu/mL and ranged between 25,100 and 73,036,500 cfu/mL. Proportionally, bedding samples had 51% bacillus species, 39.3% environmental *Streptococci* species, 7.4% environmental *Staphylococcus* species, and 2.2% coliforms.

Bacterial counts among the different types of manure solids were more similar after use as freestall bedding; however, digested manure solids still contained less total bacteria than composted and separated raw manure solids. Coliform bacteria, not present in composted solids prior to use as bedding, were found in amounts similar to that of digested and separated raw manure solids after use as freestall bedding at approximately 145,000 cfu/mL.

## Animal welfare

Fort-five percent of herds were using solids on top of mattresses with the remainder being deep beds. Stall surface was associated with lameness and hock lesion prevalence. Lameness prevalence (locomotion score  $\geq 3$  on a 1 to 5 scale) was lower in deep bedded freestalls (14.4%) than freestalls with mattresses (19.8%). It is interesting to note that lameness prevalence, even for farms using mattresses, was similar to lameness prevalence we have observed in herds with deep bedded sand stalls. Severe lameness prevalence (locomotion score  $\geq 4$ ) was also lower for cows housed in deep bedded freestalls (3.6%) than for cows housed in freestalls with mattresses (5.9%). Again, this prevalence is similar to what we have found in sand-based freestalls. Producers were using large quantities of solids on top of mattresses because the bedding material is readily available. In addition, the prevalence of hock lesions (hock lesion scores  $\geq 2$  on a 1 to 3 scale) and severe hock lesions (hock lesion score = 3) was lower in herds with deep bedded freestalls (49.4%; 6.4%) than in herds with mattresses (67.3%; 13.2%).

Herd turnover rates were not associated with stall surface; however, the percentage of removals due to voluntary (low production, disposition and dairy) and involuntary (death, illness, injury, and reproductive) reasons was different between deep bedded and mattress based freestalls. Voluntary removals averaged 16.1% of all herd removals in deep bedded herds, whereas in mattress herds these removals were 7.9%. Herds utilizing RMS in deep-bedded and mattress based stalls were found to have similar mortality rates. Nearly half of all mortalities were found to occur prior to 60 DIM. Of note is that approximately 15% of deaths were caused by injury. This number is two times greater than sand herds. Floors can get slippery when using solids.

## **Milk quality and udder health**

One major concern expressed by producers considering the use of manure solids for bedding is the possibility of increased somatic cell count (SCC). We found that yearly average bulk tank SCC was 275,000 cells/mL (range - 121,000 to 688,000 cells/mL). This average is not very different from the average in the region (~290,000). Eighteen percent of the herds had a yearly bulk tank SCC less than 200,000 cells/mL and 9% had more than 400,000 cells/mL. All herds used pre and post-milking teat disinfection, individual towels for drying udders, and routine dry cow therapy at dry off.

Cows in this study were on the average cleaner than any other freestall study we have conducted. The lowest percentile herds for SCC (which averaged 186,000 SCC) had an average hygiene score of 2.38 (1-to-5 scale where 1 = clean and 5 = very dirty); the highest percentile herds (average of 430,000 SCC) had an average hygiene score of 2.62. Cleaner cows are easier to prepare prior to milking and are less susceptible to mastitis.

Incidence rates of clinical mastitis in the current study were ~2 times greater than with other types of bedding, suggesting that udder health may be compromised when using solids for bedding or producers using solids are paying closer attention and detecting clinical cases more often.

## **Conclusions**

Differences in the chemical and bacteriological characteristics of digested, drum-composted, and separated raw manure solids were found prior to and after use as bedding. These differences were likely due to the processes of anaerobic digestion and drum-composting. Bacteriological differences were substantial in unused solids but were minor after use as freestall bedding.

The use of solids in deep-bedded freestalls appeared to provide cows with a more welfare friendly resting surface than the use of solids on top of mattresses. Herds with deep beds had a lower prevalence of lameness and hock lesions compared to herds with mattresses. Additionally, the prevalence of severe lameness and severe hock lesions in herds with deep-bedded stalls was lower than those observed in herds with mattresses. When the results are compared to previous studies with sand for bedding, we learned that lameness prevalence was similar, hock lesion prevalence was slightly higher, and cow hygiene was better in herds using solids.

Attention to cow prep at milking time is very crucial. In addition, cows need to be moved slowly and floor surfaces should be cleaned and traction improved to reduce injuries. It appears that excellent cow preparation at milking time, sanitation of milking equipment, cow hygiene, adequate dry cow housing, bedding moisture, and bedding/stall management are critical in maintaining a low SCC when using recycled manure solids for bedding and making it work. These practices are important when using any type of bedding and even more so with recycled manure solids. Overall, solids appear to be a satisfactory bedding option for freestall dairy herds.

(This project was funded by the University of Minnesota Rapid Agricultural Response Fund).