Manure solids for bedding

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Scarcity of bedding has pushed farms to explore different bedding strategies. Use of dried manure solids (DMS) as bedding is being considered by many farms. One of the concerns includes possible elevated levels of environmental pathogens that may negatively affect udder health and milk quality. Cornell Waste Management Institute conducted research to study six farms using different DMS bedding strategies. There were three using DMS directly from the separator, two drum and one windrow composted and one digested/separated (Table 1).

The research found that sand bedding started out "cleaner" than DMS, but once in the stalls, the bacterial load of several organisms was highest in sand. In addition, DMS with the least bacterial numbers in the unused tended to have the highest bacterial numbers in the used bedding. Bacteria in the unused bedding had little to no effect on bacteria in the used, indicating that bacterial levels in used bedding depend more on bacterial levels in fresh manure additions and stall cleanliness than bedding before it is placed in the stalls. Levels of *Streptococcus*, *Klebsiella* and gram negative and positive bacteria were significantly higher on the teat ends of cows bedded on DMS vs. those bedded on sand, but SCC and mastitis for those cows did not differ among bedding materials.

Mastitis differed among farm/bedding strategies (FBS), but bacteria levels and properties of bedding had no effect on mastitis incidence, while lactation number, stage of lactation and SCC did have an effect. Decreased levels of *Klebsiella* in the used bedding increased the odds of having an abnormal SCC for one FBS, and decreased moisture and fine particles in the used bedding increased the odds of having an abnormal SCC for a different FBS. For all others, abnormal cell counts were affected only by season, lactation number and milk production.

Table 1: Description of Bedding Practices at the Six Study Farms

Farm	Bedding Strategy Employed
A – Drum1	Separated, drum composted 24 hrs., piled one day, spread on concrete 3 times/wk.
B – Windrow	Separated, windrowed under roof for 10 days, spread on mattresses 6x/wk.

C – Digested	Digested, separated and piled. Used on mattresses directly from separator in fresh cow pens. Re-bed 3 x/week. Whole herd now on DMS.
D – Separated1	Separated, piled 7 days or used right from separator, spread in deep beds 2 x/ week.
E – Drum2	3 treatments-Separated, drum composted 3 day, deep beds 2x /wk (5/06 -9/06 only)
Separated2	Separated, piled, deep beds 2x /wk
Sand	Sand in deep beds 1x/week.
F – Separated3	Separated, piled 7 days, deep beds 2x/ wk.

Bacteria in Bedding

An important thing we learned was that just because the level of one bacteria is high in one type of bedding, does not mean that levels of other bacteria measured will be high, nor will they stay consistently high in that bedding. Therefore, bedding sample analysis for bacterial levels will not necessarily return useful information for enhancing herd health.

Average levels of *Escherichia coli* and *Klebsiella* were very low in all of the unused bedding. There were significant differences between populations of these two pathogens only between sand (significantly less) and two or three of the "green" DMS strategies. There was no *E. coli* found in unused drum and windrow composted DMS or in sand, and no *Klebsiella* in unused sand and one of the drum composted bedding materials over the study period.

E. coli levels in used bedding did not differ (Table 2). Average *Streptococcus* levels were significantly higher in used sand bedding than in all others except one "green" system. *Klebsiella* (which was absent from the unused bedding in one of the drum composted strategies) was found in significantly higher levels in the used bedding from that strategy than several other strategies. Although sand started out "cleaner," used sand had significantly higher levels of the bacteria analyzed (except *Klebsiella*) than at least one or more bedding types.

For all bacteria (except *Streptococcus*), the three Farm E levels did not differ, indicating that bacterial levels in used bedding may be from fresh manure and stall maintenance, rather than how "clean" the bedding is when it is put in the stall. The systems that started out with "clean" bedding tended to have significantly higher levels of bacteria in used bedding indicating the bedding may have started out too clean (i.e. no competition from other

bacteria).

It is often assumed that the cleanliness of the unused bedding has an effect on the bacterial population of the used bedding. But our data suggests that other factors not studied play a more important role.

Table 2: Average Bacterial Levels in Used Bedding in each Farm/Bedding Strategy (FBS) Over the Study Period on a Volume Basis (log cfu/ml).

	Farm A	Farm B	Farm C	Farm D	Farm E			Farm F
Bacteria	Drum1	Windrow	Digested	Separated1	Drum2	Sand	Separated2	Separated3
E. coli	3.8^{a}	3.2^{a}	6.7^{a}	2.3^{a}	5.8^{a}	5.6^{a}	2.9^{a}	4.3^{a}
Streptococcus	16.7^{b}	16.8^{ab}	16.5^{b}	17.0^{ab}	16.4^{b}	17.4^{a}	16.7^{b}	16.7^{b}
Staphylococcus	4.7^{a}	0.8^{ab}	3.4^{ab}	3.3^{ab}	5.4^{a}	3.8^{a}	2.5^{ab}	0.3^{b}
Gram negative	12.0^{ab}	13.6^{a}	9.9^{b}	13.6^{a}	12.5^{ab}	13.2^{a}	13.9^{a}	12.7^{ab}
Klebsiella	13.7^{a}	9.8^{bcd}	7.4^{d}	12.8^{ab}	12.3^{ab}	10.4^{bcd}	12.8^{ab}	8.7^{cd}

Values in each row with different letters are significantly different.

Physical Properties in Bedding

As expected, moisture and OM in both used and unused bedding were significantly lower in sand than other bedding. Fine particles were significantly higher in used sand bedding and tended to be lower in DMS in deep beds. DMS in deep beds tends to compress from the cows' weight, and DMS on mattresses falls off, or spreads out.

Teat Ends

There were significant differences for *Klebsiella*, gram negative and gram positive bacteria (significantly higher counts on cows in the DMS pen versus cows in the sand pen) on the teat ends of cows bedded on green DMS and cows bedded on sand. The percent of fine particles in the used bedding had a significant effect (either by itself or in conjunction with other bedding properties and/or bacteria) on the level of bacteria found on the teat ends for half of the bacteria analyzed. *Streptococcus*, *Staphylococcus* and *Enterobacter* levels all decreased when the percent of fine particles increased in the used bedding. Bacterial levels in the used bedding had an effect on several bacterial levels on teat ends, but only in the case of

Klebsiella were they the same bacteria. About 32% of cows on DMS had SCC higher than 200,000, as did 36% of those on sand.

Mastitis

The odds of getting mastitis for heifers was significantly affected by cell count (more than 100,000 cells/ml were more prone), while the odds of getting mastitis for cows was significantly affected by FBS, season and abnormal cell count. Bacterial levels and properties of the bedding had no effect on the incidence of mastitis. SCC was a significant variable for all FBS. Stage of lactation, milk production and season also had an effect, but not for all FBS.

When the three FBS at farm 5 were analyzed together, type of bedding did not have an effect, but the amount of moisture and particles < 2mm in the used bedding, as well as milk production were all positively correlated with mastitis incidence.

SCC

The odds of having an abnormal SCC for cows were affected by FBS, season (less in winter), lactation (more for higher lactations), and stage of lactation (more for increased days in milk). Abnormal cell count for heifers was affected by FBS and season (less in winter). There was a negative correlation with *Klebsiella* levels in the used bedding (more *Klebsiella*, fewer animals) for one drum composted strategy, and a negative correlation with moisture and fine particle for the digested strategy. Both of these are opposite what would be expected. Otherwise, it was season, lactation number and milk production.

Conclusions

This study suggests that properly managed DMS can provide an economic benefit without compromising herd health. As with any bedding, keeping the stalls free of fresh manure and urine will help insure that DMS bedding is properly managed and will provide cows with a clean, comfortable space in which to lie. In addition, one DMS strategy is no better/different than any other in terms of the product produced, so choose a DMS strategy that is affordable and fits into your normal farm procedures.

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For more information:

• For complete study results: http://cwmi.css.cornell.edu.

• The authors wrote about the economics of dairy manure solids in the June issue of PRO-DAIRY's The Manager. Find the article at http://cwmi.css.cornell.edu.

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