

The fascinating world of manure spreader tribology

A little horse sense is all you need to deal with this product's unique lubrication challenges.

By Dr. Robert M. Gresham
Contributing Editor

There's a pretty catchy title. The manure spreader, invented a few hundred years ago (an early horse-drawn John Deere version is shown in figure 1.), is yet another tantalizing tribological taste of our industry at work.

I recognize that more than a few of you may be exclusively urbanophiles, but for the agrarianly inclined this is an exciting machine of great importance to society that overcomes tribological challenges in a cost-effective manner. Once again, I'm constantly intrigued by the wide diversity of applications that engage the tribologically oriented mind. So, here we go!

First, a manure spreader manages a significant hygienic issue in an ecologically sound manner by recycling nutrients to the soil and increasing the amount of top soil such that more nutrients can be grown to feed livestock. Left to accumulate, manure can pose serious runoff problems and can result in bacterial, fungal and insect infestation, odor and an absolutely displeasing landscape. This is not trivial, as the average horse generates 25 lbs. per day plus any urine soaked bedding, left over hay, etc. You can soon create a small mountain of very biologically live material in no time at all—great for the garden and flower beds, though.

For people with livestock, this task is carried out 24/7, every month of the year,

weather most certainly not withstanding. Figure 2 shows a manure spreader in action on a good day—it is only raining lightly.

So what about the tribology of a manure spreader? As you can see, it is essentially a two-wheeled wagon. The wheel bearings are sealed bearings from the manufacturer and, thankfully, require little maintenance—that's just about all the good news. In Figure 3, looking into the bed, we see two chains on either side with simple angle iron pieces spaced evenly running from chain to chain. As the chain is pulled toward the back of the wagon, the manure is fed slowly into whirling paddles that spread and disperse the manure evenly out the back.

These chains are inexpensive metal stampings. This means that they have relatively sharp edges that preclude coatings or most lubricants to protect them from corrosion. Further, the bearing surfaces are also rough, adding to friction and wear, but they are inexpensive (see Figure 4 on page 60).

These chains have another



Figure 1.



Figure 2.



Figure 3.

CONTINUED ON PAGE 60



A manure spreader manages a significant hygienic issue in an ecologically sound manner by recycling nutrients to the soil and increasing the amount of top soil such that more nutrients can be grown to feed livestock.

remarkable property: they only seem to break at below 20 F, especially if it's windy and snowing. As time goes on, constant exposure to the elements, manure, urine and wet bedding eventually corrode and weaken the chain. The stresses of winter, frozen "pay load," ice, etc., put more strain on the chain, increasing the probability of failure. Repair is simple enough, the tension on the chain is released, the chain is bent into position where with just a few light taps of a hammer the old link is removed and the new one installed. This repair, of course, happens only out in the field, only on a cold, windy, snowy day—hopefully during daylight.

The manure must first be dug out of the spreader, by hand, to get access to the chain. The "light taps" of the hammer are actually a bare-handed, knuckle-busting, expletive-deleted operation that takes only a few seconds. Yeah, right!

Interestingly, while I was working for E/M Corp. some years ago, we developed a heavy asphaltic product, containing a high level of corrosion inhibitors, for the mining industry. This product actually works pretty well on these chains to slow their rate of failure, both from friction and corrosion. The material was diluted in a solvent that made its application by aerosol practical and after the solvent evaporated left a relatively dry-to-the-touch, self-healing coating that the manure did not overly stick to. It never occurred to us at the time to try to sell it to the agricultural community.

The next area of scintillating tribological interest is the ratcheting mechanism that pushes the manure into the whirling paddles to spread the manure. As shown in Fig-

ure 5, this mechanism is driven, in this case by another chain, like a big bicycle chain that, when engaged, runs off a large gear attached to the wheel of the wagon—as the spreader is moved, the chain is moved. The mechanism has a large ratchet gear and a couple of smaller sprockets (all iron castings) that turn on stationary journals. Each of these must be regularly greased with a good molybdenum disulfide-containing grease, preferably also containing corrosion inhibitors.

Fortunately with regular maintenance, these greases perform well, and failures are rare. There are normally shrouds that cover this mechanism. Nonetheless, manure, rain and related detritus get in and around the mechanism. Indeed, in the picture (Figure 5) you can readily see the corrosion on the forward shroud (to the right) that covers the bicycle chain running to the drive gear wheel.

Finally, there is an idler sprocket (see Figure 6) at the front end of the conveyor chain that needs regular lubrication, as well. This sprocket runs on a solid stationary journal and is allowed to float along the journal, as lateral stresses are put on the chain by clumps of manure, ice, etc. Again, the grease performs well in this relatively clean environment.

Clearly, manure spreaders aren't designed by "rocket scientists," otherwise they would all be made of titanium or perhaps a mix of aluminum, stainless steel and composites. All bearings would be sealed for life. The cost of the thing might be over \$100,000. Thus, if rocket scientists had existed back then, we would still be using our great-grandfather's sempiternal, mint condition manure spreader.

Nevertheless, a manure spreader represents another victory for tribology. With significant moving parts that operate in a very harsh environment, the spreader works reliably day-after-day with minimal maintenance and is relatively inexpensive to purchase. <<

You can reach Bob Gresham, STLE's director of professional development, at rgresham@stle.org.

