Spinning manure into gold: management separation systems

Many of us remember the childhood fairy tale of Rumpelstiltskin, a small man who helped a young lady in distress spin straw into gold to satisfy a king. We can picture the wooden spinning wheel and large pile of golden straw and realise that this is impossible.

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How can a wasteful product like straw be turned into gold? Many producers look over their animals and operation with pride and clarity, but when it comes to their manure system they may have the same helpless feeling as the young miller's daughter sitting at the spinning wheel with a room full of straw.

The difference between the origins of the fairy tale and the reality of today is that we have the technology to turn a once difficult to manage product like manure into a 'golden' product for plants. Manure contains vital nutrients, organic matter and bacteria that can be extremely beneficial when used properly.

The advances in soil testing, predictive forecasting and precision agriculture have created a beautifully detailed picture of nutrient levels, field conditions and management opportunities. In addition, our understanding of nutrient conversion, plant nutrient uptake and yield impacts provide us the knowledge and motivation required to better manage our manure and agronomic relationship.

Manure separation

Primary separation of coarse particles and fibres has been used for various reasons on dairy farms. Often the liquid effluent after separation is used back on the dairy for alley cleaning or stored in a lagoon to be spread through an irrigation system. While primary separation has a minimal investment, the effectiveness of separating nutrients into the liquid fraction is quite low. Over 90% of the nutrient value remains with the liquid effluent.

Further separation steps are required to partition nutrients into different usable streams. One critical component of separation is to evaluate the cost and value of creating a separate nutrient stream. We cannot expect to be profitable by going through a process that takes one manure stream into multiple streams that we handle in the same manner.

The system must create a solution to a problem, not create new ones. Additionally, with any separation system nutrients are not created or destroyed from the process, the same amount of land is needed to make proper agronomic use of the nutrients generated on the dairy.

One specific example is nitrogen, some systems reduce the amount of nitrogen lost to the atmosphere and as a result create additional nitrogen to be accounted for in a nutrient management plan. This balance actually works well since nitrogen is often the limiting factor in corn yield, however, if nitrogen and other nutrients can be stabilised and exported off the farm, it can generate revenue.

Certain manure derived products can be an excellent substitute for mined mineral nutrients such as phosphorus and potassium. There are a few companies currently installing systems that can provide saleable nutrients through fertiliser distribution channels.

Goals and outcomes

The sheer volume of material coupled with the logistics of hauling have led producers to consider advanced separation systems. In some cases, the motivation is regulatory enforcement or environmental compliance driven. In addition to historic cases involving negligent use of manure nutrients from livestock farms, there are landmark cases pending against traditional row crop nutrient practices that will lead to wider adaptation of cover crops and split nutrient application practices.

Regardless of the motivation here are some common goals of installing a system:

- Concentrated nutrients in less volume:
- Reduced manure hauling costs by spreading more liquid close to home.

• Impact of reducing the number of heavy loads on the road.
• Ability to maintain nutrient distribution across farm ground by cost-effectively spreading nutrients on fields further away.
● Reduced time to agitate manure storage and homogenise nutrients.
● Removal of large particles for nozzle or micro-drip irrigation.
● Manure-to-water systems that reduce the volume to haul or store.
● Nutrient partitioning to match crop needs.
• Timing of nutrient application (have a product available to land apply).
• Split nutrient streams into crops individual needs.

An investment to thoroughly consider

When evaluating a system, a proper business case is critical to determine the success and complexity of a system. Capital and operational costs of systems can be quite expensive and often inversely related to each other. Certain filtration systems may be less expensive initially, but can have high operational costs due to daily polymer costs, cost to clean the equipment and power consumption.

Moreover, some additional farm equipment may be required to make use of the different streams from the process.

Some of the cost benefits of a system cannot be measured directly and need a careful pencil to account for:
● Increased crop yields:
• By timely nutrient application.
• By being able to plant sooner or double crop.
• By reducing compaction on fields by not hauling during wet conditions.
● Neighbourhood benefits:
• Reducing traffic during hauling season on the road.
• Potential for reduced odour.
• Environmental responsibility by better nutrient management.
● Opportunity to create a saleable product from manure nutrients.
● Potential for reducing manure storage requirements (Manure-to-water systems).
● The freedom to consider and choose your system before regulations are put in place.

System building blocks

Several advanced manure separation systems are in operation across the globe. Like manure from a farm, each system is unique in design and operation. Many systems use technology adapted from the waste water treatment industry with varying levels of success. Equipment may include:
● Slope screen separators.
● Gravity belt thickeners.
● Screw presses.
● Decanter centrifuges.
● Micro and vibratory screens.
● Dissolved Air Filtration (DAF) systems.
● Membrane filtration.
● Ammonia stripping.
● Reverse osmosis.

Systems are comprised of different building blocks of equipment from the above list designed to work together for the best performance and cost. At this time systems are installed and designed for continuous operation. Mobile systems traditionally do not have the throughput capacity to meet the needs of modern farm sizes.

Building a modular system is beneficial as farms grow and regulations progress, creating different performance standards over time. Some master planning needs to be done in the beginning, but systems can easily be added on to as needs and finances change.

Conclusion

As the equipment solutions provider and the livestock producer look to design a system, the first step must be to establish a partnership understanding. The livestock producer needs to understand that seemingly small management changes in the barn can have detrimental effects to the operation of the separation system.

Frequency and amount of bedding, cow cooling and ration changes can change the recipe of the product to the separation system. Additionally, the separation system needs to be adaptable to changes in the manure and create products that economically fit into the farms' cropping system.

A functional manure separation and nutrient partitioning system comes with many benefits, but those benefits come with costs.

Unlike the miller's daughter who had to make a deal with a small man who helped her turn straw into gold, we do not have to guess Rumpelstiltskin's name or be forced to give up our firstborn child.

We, as in the equipment solutions providers and farmers however, do have the opportunity to partner up in spinning manure into gold, while benefitting the livestock operation, the neighbours and the environment. ■