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GASIFICATION

- Gasification is a thermal process, reacting carbon-based fuels in an oxygen starved environment.
- Typically, the syngas produced in the gasifier, is then combusted in a thermal oxidizer – especially when the fuel is not a very consistent material such as processed wood.
- The product of gasification is heat and biochar – unlike pyrolysis, which produces an oil as well.

GASIFICATION

- When evaluating BMPs for manure, gasification should be included, as it is best suited to play a major role in reducing nutrient discharge issues.
- Some of the key factors are:
  - It eliminates the need for expensive, long distance transportation.
  - Its impact is easily measured, and is not dependent on other factors, such as the weather or soil type.
  - It actually solves the issue, rather than creating the same problem in another location.
  - The process has been identified by NRCS as a best manure management practice - Code 735.

GASIFICATION

- Additional factors:
  - It is economically feasible, and easy to operate
  - There are large-scale systems currently in operation, so it is a proven technology.
  - It co-produces energy to generate additional revenue streams.
  - It retains the valuable nutrients from the manure in biochar – which can easily be used or transported.
  - Can be used for all types of manures – dairy and swine require a drying step using a portion of the waste heat, but this is also already being done, and the technology is proven and in operation.

GASIFICATION

- There are many gasification technologies – obviously, some are better than others, and some can’t process manures.
- There also are a variety of concepts concerning size, applications, and outputs.
- But, the purpose of this presentation is not to debate one technology or application versus another, but to point out that gasification can process all manures and provide an alternative to the land application practices that have created the nutrient discharge issues currently being faced.

GASIFICATION

- The gasification process does provide a method to reduce excess nutrients being land applied.
- The Nitrogen in the manure is largely volatilized, typically 80 to 90% is exhausted in the air emissions stream as N2. Some Nitrogen remains in the ash/biochar, and a very minute fraction is emitted as a form of NOx – better designed systems have lower NOx emissions.
- The Phosphorus is retained in the ash/biochar, but not only is it in a product that is much less volume, easier to handle and transport, but it is also been altered to be at least partially insoluble.

GASIFICATION

- Gasification is an important additional BMP due to its versatility regarding manure feedstocks.
- It can function as a standalone system for materials such as broiler and turkey manure; which can be gasified directly as they are collected from the houses.
- Other manures such as egg layer manure from conveyor houses and cattle operations with manure and bedding mixed can be gasified in conjunction with a waste heat dryer.

GASIFICATION

- Solids separation systems for wet manure can perform without gasification, but the combination of these technologies with a large waste heat source provides an even better solution.

- Finally, farms such as dairies and swine operations which have manures with moisture contents of 88 to 94% can be gasified when combined with dryers and solids separation systems

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- As a specific case study, I will explain the process utilized by Coaltec Energy.
- Our gasification system is very flexible and can handle a variety of feedstocks.
- We have processed all forms of animal manure – dairy, swine, turkeys, chicken broilers, egg layers, horse, and even human biosolids.
- The resulting products will always be some level of energy output and a dry, solid ash or biochar product.

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- We have a system operating on a cattle farm in Ohio.
- There are typically 4,500 cows on site, and they deliver between 35,000 and 50,000 tons of manure to a covered manure barn annually.
- All of the manure remains under roof at all times – except during transport.
- The manure is generally between 50 and 75% moisture when it arrives.
- All of this manure is dried to 20% moisture.

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- Depending on the initial moisture content, 30 to 40% of the dried manure is used for gasifier fuel to provide the heat for the dryer.
- The remaining dried manure is used as a pathogen-free bedding.
- The biochar produced has been sold in various quantities and applications, used for several trials, and also used internally – both on fields and also mixed with the bedding to improve moisture capture and odor control.
- The system has been in operation for 2 years, and assuming results similar to 2013, the system will be paid off next year.

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- Prior to this project, 100% of their manure was being land applied to surrounding fields.
- This example isn’t being used to showcase a specific technology, or calculate the benefits to that particular area and their fields. But, simply to illustrate that gasification projects can provide a solution. Always the overlying issue is the economics.

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- When evaluating the economics, some of the most common benefit streams are:
  - Material handling and disposal cost avoidance
  - Energy value – heating, cooling, process steam, power, etc.
  - Value of biochar
  - Credit opportunities – nutrient, carbon, etc.
  - Tipping fees
  - New business opportunities – expansion, more optimum use of existing infrastructure.

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- For a project to be sustainable and truly provide a solution, the economics need to stand alone, without credits, grants, or other incentives.
- However, it is sometimes important to provide additional help to provide incentives to get farmers to make a change from the status quo.