COMPARISON OF CATALYTIC HYDROTHERMAL GASIFICATION AND ANAEROBIC DIGESTION

Catalytic Hydrothermal Gasification (CHG) and Anaerobic Digestion (AD) are similar in that both can produce methane from wet organic material. AD has been used for many centuries, while CHG is a much newer and more technologically advanced process. Here are some comparisons between the two. Additional technical descriptions of CHG are given throughout the Genifuel website, particularly in the Technology tabs and the Presentations section of the News & Archives tab on the website.

1. The starting point is that AD is a biological process whereas CHG is a thermochemical process. This allows CHG to be more uniform, precisely controllable, and repeatable in its performance regardless of feedstock.

2. A CHG system is substantially smaller than an AD system, and is portable if necessary to reconfigure a facility. Once an AD tank is built, it is generally going to be permanent.

3. A cost comparison between a CHG system and an AD system is hard because there are so many variations of AD. However, in general a CHG system will cost about the same as a reasonably sophisticated AD system.

4. A CHG system will give higher gas yield than an AD system because the conversion is much more complete. A CHG system will convert around 99% of the volatile organic material, while an AD system will convert between 40% and 60% typically. In practice a CHG system will yield between 60% and 120% more gas (methane).

5. Because AD achieves less complete conversion (digestion), it leaves a large amount of undigested sludge. Very high-end AD systems with multiple stages can sometimes achieve slightly more digestion, but digestion will never be nearly as complete as a CHG system. This means AD systems of all types will leave a large amount of sludge to be removed. On average, the amount of AD sludge left will be around 50% of the incoming material.

6. A CHG system will digest essentially all of the organics (per #4 above), and therefore the only thing left is water and inorganics. Most of the inorganics are in the water, such as sodium chloride, potassium chloride, calcium and magnesium chlorides and carbonates, etc. The salts of phosphorus and sulfur will be precipitated up front in a precipitation tank and will be collected as a clay-like material. This material is very dense and does not make up much cubic volume (a few percent of the incoming solids).

7. All the outputs of a CHG system (gas, water, and clay-like precipitate) are sterile, which is not true with AD. The outputs of a CHG system also have no odor, and

the water is clear. There are no tars or heavy oils to clean or remove.

8. Both the water and the clay-like precipitate contain valuable plant nutrients (including essentially all the N, P, and K in the feedstock, as well as micronutrients) and therefore can be recovered and used as fertilizer.

9. The gas produced by a CHG system is much cleaner than the gas produced by an AD system. Both will have methane, carbon dioxide, and water vapor, but the CHG gas will contain no sulfur, nitrogen, or siloxanes. By comparison, AD gas may contain all of these, especially sulfur. Therefore AD gas will need substantially more cleanup (which is expensive) compared to CHG gas.

10. A CHG system will have about 10% to 12% parasitic loss (i.e. it will need about 10% to 12% of the methane to power the system). This figure is rarely reported for AD systems, but because of the pumping, sludge removal, sludge transportation, gas cleanup, etc. the parasitic losses in AD are at least as high as CHG and probably higher.

11. AD systems are low-pressure systems (essentially atmospheric). CHG systems operate at a higher pressure, around 3,000 psi. The higher pressure of CHG is extremely useful if the gas cleanup specification requires removal of carbon dioxide from the methane. This is because the common carbon dioxide removal technologies--such as pressure-swing adsorption (PSA) and membrane separation--both require a large pressure differential. In CHG this pressure is free, while in an AD system it requires expensive gas compression.

12. If the output gas is going to be inserted into a pipeline or used for transportation fuel as CNG or LNG, then the gas must be purified to about 98% methane. As described in #11, this is much easier with CHG. An additional point is that the higher pressure of CHG (3,000 psi) is the same pressure generally used for CNG delivery. In this case as well, CHG avoids much of the expense of gas compression to CNG standards, while AD gas must be compressed at high cost. The same is true (though at lower pressures) for insertion into a pipeline.

13. While CHG uses higher temperatures and pressures than AD, it can be built from common grades of stainless steel and does not use any exotic (i.e. expensive) alloys. The catalyst is commercially produced in large quantities and has good life based on previous experiments.

14. CHG has been developed and tested on a wide range of materials over a 30-year period, and works similarly on almost anything organic that can be made into a water slurry.