

## Appendix 16: Terms

*If the definitions given here are not sufficiently enlightening, refer to the relevant chapter.*

- Acid Digestion:* The “first phase” of biogas generation, where complex molecules are broken down into simpler molecules, such as the fatty acids, CO<sub>2</sub> and H<sub>2</sub>.
- Acidic:* Having a low pH. Having an excess of H<sup>+</sup> ions.
- ACR:* Absorption cycle refrigerator—a refrigerator which has no compressor.
- Aerobic:* In the presence or with the help of free, gaseous oxygen.
- AF:* Acid forming.
- Agitation:* Mixing.
- AKA:* Also known as; alias.
- Alkaline:* Having a high pH; basic. Having a lack of H<sup>+</sup> ions.
- Ambient:* Surrounding, environmental; usually referring to temperature.
- Amino acids:* The building blocks of protein.
- Ammonia:* The molecule NH<sub>3</sub>.
- Ammonium:* The ion NH<sub>4</sub><sup>+</sup>
- Anaerobic:* In the absence of free, gaseous oxygen.
- Anaerobiosis:* Life processes in the absence of free oxygen.
- ASE:* Usually alternative sources of energy; in my usage, ancient sources of energy.
- Basic:* Chemically speaking, having a lack of H<sup>+</sup> ions; alkaline.
- Batch feed:* A load, generate, and clean-out type of biogas generator.
- BHP:* Brake horsepower; measured horsepower, as contrasted with rated horsepower.
- Biogas:* Gas produced by the action of life.
- Biological energy:* Energy available to life, most generally from or with the assistance of other life forms.
- Btu:* British thermal unit—a measure of heat energy.
- Bubble pump:* A pump which pushes liquid up a tube or pipe by bubble power.
- Buffer:* A pH shock absorber. A buffer system inhibits the pH from changing rapidly.
- Bunsen burner:* A simple burner of the kind commonly found in appliances such as stoves.
- cal:* Small calorie, a measure of heat energy in SI units.
- Cal:* One thousand small calories; S1 unit.
- Carbohydrates:* Compounds containing carbon, oxygen, and hydrogen.
- Cellulases:* Enzymes which help decompose cellulose.
- Cellulose:* The main compound in wood and paper.
- Centimeters of water:* A way of expressing pressure measurements.
- Cetane number:* A rating for fuels intended for diesel engines.
- Change of phase:* Moving from a solid to a liquid, or from a liquid to a vapor.
- CH<sub>4</sub>:* Methane.
- C/N:* Carbon/nitrogen ratio.
- Colloidal gel:* A jello-like suspension of solids in a liquid.
- Combustion:* Loosely speaking, burning.
- Compression ratio:* The greatest volume of a cylinder (with the piston at the bottom) divided by the least volume (with the piston at the top).
- Conduction:* Heat transfer by contact.
- Continuous feed:* Generators into which slurries are daily or more constantly put.
- Convection:* Heat transfer by the motion of fluids; air currents, for example.
- Conversion efficiency:* The percentage of one kind of energy, transformed into another useful kind; mechanical motion into electricity, as one example.
- Cubic centimeters per gram VS added:* A measure of biogas production, where the amount of VS decomposed is not considered.
- Cubic centimeters per gram VS decomposed:* A measure of biogas production, where the amount of VS decomposed is important.
- Culture:* A population of bacteria, used to establish a population in a biogas generator.
- Design heat load:* The amount of heat required, per unit time, to keep a structure of generator warm under the worst weather conditions ordinarily experienced in that location.
- Diesel:* An engine which has no spark plugs; air alone is compressed into the cylinder, and the fuel is injected when combustion is desired.

*Digestion:* The biological breakdown of organic materials.

*Digestor:* Here, an anaerobic composter designed primarily with the digestion of organic matter in mind, rather than the efficient production of biogas.

*Draft tube:* A tube which assists the development of a convection-type current in a generator when gas is recirculated into the tube.

*Dry digestion:* Digestion at above 100% solids.

*Dry slurry:* Slurry with more than 10% solids.

*Dual fuel engine:* An engine using both a liquid and a gaseous fuel simultaneously.

*Dung:* Manure, usually without urine.

*Dynamic head:* The total force a pump must overcome to pump a fluid through a system.

*Dynes per square centimeter:* A means of measuring pressure.

*Ecosystem:* The interactive web of life which covers the whole planet, or the web of life in one small portion of it— such as a pond or a biogas generator.

*Effective volume:* That portion of the generator which is used, and/or how well it is used to produce biogas. For example, if only eight cubic meters of a ten cubic meter generator is full of slurry, the generator cannot have more than 80% effective volume.

*Effluent:* The used slurry, sludge, supernatant, or scum.

*Energy:* Whatever has energy has the ability to do work. That definition includes us.

*Entraining air:* Mixing air or some other gas into a primary gas stream.

*Entropy:* An annoying tendency of energy to become less useful and less concentrated.

*Enzymes:* Chemicals which help form and break down molecules.

*Extracellular enzymes:* Enzymes which operate outside the bodies of small biogas buddies.

*Facultative:* Switch-hitters, able to be either anaerobic or aerobic.

*Fatty acids:* The major general food source of the methane bacteria.

*Film:* When speaking of heat transfer, this term refers to the surface of gas or liquid which touches an object, that resists the flow of heat from or to that object, into or out of the main body of the gas or liquid.

*Float much:* Those substrates which refuse to make easily pumpable slurries.

*Flocculation:* The tendency of algae to coagulate under certain conditions. See Chapter 18: On Growing Substrates, p. 80.

*Fluffing/percolation:* The process described by one researcher which indicated healthy dry digestion. See Chapter 10: Percentage of H<sub>2</sub>O, p. 46.

*Food pyramid:* The food chain, another reason to believe that all flesh is grass.

*Force:* The cause of motion.

*FS:* Fixed solids; ashes.

*Gas-diesel:* An engine which is designed to operate on both diesel fuel and biogas, where both are injected into the cylinder for firing. Sometimes used incorrectly to describe engines which have been adapted to run on both fuels, rather than an engine which is designed to do so.

*Gas digestion:* The second stage of biogas generation, during which the CH<sub>4</sub> of the biogas is produced.

*Gasholder:* Usually, a container, open at the bottom, floating on water, for the collection of biogas.

*Generation:* Here, the production of biogas.

*Generator:* Here, the word is used to describe an anaerobic compost unit that is designed primarily to efficiently produce biogas.

*Grass roots research:* Homegrown, relevant information.

*Head:* The vertical distance to which a liquid must be pumped to get it from source to point of use.

*Heat:* Thermal force.

*Heat load:* The amount of heat required per defined period of time, to keep a structure of generator warm, under the prevailing weather conditions.

*Heat of vaporization:* The amount of heat required to evaporate a unit volume of a liquid with no change in temperature or pressure.

*High-rate generators:* Biogas generators which operate at optimum parameters— optimum temperature, low HRT, high rate agitation, etc.

*HRT:* Hydraulic Retention Time; the number of days an average unit volume of slurry stays in the generator.

*Hybrid generators:* A two-stage biogas generator design consisting of a larger batch-fed, cold, acid-producing phase, and a smaller continuous-fed, methane-producing, heated phase. Alternatively, it would be any generator which separates acid and methane production.

*ICE:* Internal Combustion Engine.

*Incandescent lamp:* A gas-powered light with a mantle.

- Inches of water*: A way of expressing pressure measurements.
- Injector*: That part of a Bunsen or Fisher burner which injects gas into a tube where it is mixed with air prior to burning.
- Inoculation*: Adding a culture of anaerobic bacteria to a generator.
- Intensive animal production*: Flesh-factory or feed-lot animal production.
- Ions*: Loosely speaking, atoms or molecules with a positive or negative charge.
- Kinetic*: Energy in motion.
- Latent heat of vaporization*: The amount of heat required to evaporate a unit volume of a liquid with no change in temperature or pressure.
- Lignin*: A common compound in plants which resists digestion.
- Lime*: Here,  $\text{CaCO}_3$ — calcium carbonate.
- Lime water*: Here,  $\text{Ca(OH)}_2$ — calcium hydroxide.
- Litmus paper*: A pH test paper.
- Loading rate*: The total weight of VS fed into the generator each day divided by the volume of the generator.
- Low technology*: A technology available to mom, pop, and the kids: AKA low tech, kitchen sink technology.
- Mantle*: A net of material which incandesces and gives light when it is heated.
- Median*: The middle value, midway between highest and lowest. This is not “the average” in the common sense of the word.
- Mesophilic*: Middle-lovers (referring to anaerobic bacteria that enjoy temperatures from 20° to 40°C, 70°-105°F).
- Metabolism*: The cellular mechanics of life—the process of using biological energy.
- Methane*:  $\text{CH}_4$ , the main combustible gas in biogas.
- MF*: Methane forming.
- Millimeters of mercury*: A way of expressing pressure measurements.
- Mix well*: Those substrates which make pumpable slurries— chiefly the different manures.
- Moderate-rate generators*: Biogas generators which operate near optimum temperature, but with longer HRTs and less agitation than might be used.
- Molecules*:  $\text{CH}_4$ ,  $\text{CO}_2$ ,  $\text{H}_2\text{O}$ , and their brethren and sistren.
- Non-lignin C/N*: The C/N based on the available rather than the total carbon. Because lignin is so common, a significant part of the total carbon is tied up in the lignin, and not available to the biogas process.
- Obligate*: Oxygen kills obligate anaerobes. (O<sub>2</sub>? Won't do.)
- Octane number*: A rating of fuels intended for use in spark-fired engines.
- Open flame burner*: A burner which does not mix air with the gas prior to burning.
- Open-tube manometer*: A low-cost device for measuring pressure.
- Orifice*: Commonly, a hole. Here, part of a burner.
- Parameters*: Factors or conditions which affect a situation.
- pH*: A measure of the acidity of a solution.
- Photosynthesis*: Another miracle. The process by which plants turn sunlight into stored energy.
- Plug flow generators*: Biogas generators in which there is no mechanical agitation, where the slurry supposedly flows along in more or less discrete plugs so that the effluent is composed only of older slurry.
- Potential*: Energy at rest, in storage.
- Pounds per square inch*: A way of expressing pressure measurements.
- Power*: Force through a distance in a certain time.
- Power of ten*: Mathematical term describing a simple way to keep track of the decimal point.
- Psycrophilic*: Cold-loving anaerobic bacteria. (Referring to temperatures from 9° to 5°C, 32° to 40°F.)
- Radiation*: Heat transfer by infrared or radiant energy.
- Reciprocal*: Exchanging the numerator and the denominator.
- Ripe sludge*: Old sludge, effluent sludge.
- Ruminants*: Cud-chewing, cloven-hoofed mammals.
- Sand or grit*: Sand or grit: That portion of slurry that falls to the bottom of the generator.
- Scrubbing*: Removing unwanted gases from biogas so that it ends up being more nearly pure methane.
- Scum*: The floating and often impermeable mass of material above the supernatant.
- sec<sup>-2</sup>*: This means  $\frac{1}{\text{sec}^2}$ , or per second squared.
- Seed*: A culture of anaerobic bacteria.
- Significant digits*: A simple way of showing the accuracy of measurements.

*Sludge*: The settled portion of the slurry; mud-like, semisolid mass.

*Slurry*: The mixture of a substrate and water which is put into the biogas generator to produce biogas.

*Soaps*: Here, the alkali soaps of the fatty acids.

*Soil amendment*: Fertilizer.

*STP*: Standard Temperature and Pressure; generally 0°C and one atmosphere pressure.

*Substrate*: Organic material used to generate biogas or make slurry.

*Supernatant*: The liquid portion of the slurry which floats above the sludge.

*Target C/N*: The C/N we want to achieve in mixing substrates.

*Temperature*: Measurable result of the application of heat.

*Thermophilic*: Heat lovers: Referring to thermophilic bacteria, which enjoy temperatures from 40° to 60°C (104° to 140°F).

*Toxic mechanism*: The process by which poison, poisons.

*Toxins*: Poisons.

*Transfer*: Here, to move energy from place to place.

*Transform*: Here, to change one energy form into another.

*Trench generator*: A simple plug flow generator built in a long trench.

*TS*: Total solids; dry weight.

*Urea*: A nitrogen-containing chemical related to ammonia and found in urine.

*Viscosity*: Thickness, as in the different thickness of cold or warm molasses.

*VS*: Volatile solids; organic matter.

*Washout time*: The minimum HRT based on the time required for the MF bacteria to replenish their numbers at a certain temperature.

*Wet slurry*: Ten or fewer percent solids slurry.

*Work*: Force through a distance.