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Fig. 10-54 Feed chute. *This homemade chute directs dried feed, dropping it from the outlet near the top of the tanks adjacent to the motor, alongside the tank, and into the auger lifter exiting to the right.*

impact in our co-products section (see Chapter 11), but let's examine the ins and outs of its production.

The decision on whether to use tanks or ponds for our small-scale methane production boils down to this: Tanks work best when there is little space, and more money. Ponds (deeper than six feet) are best if you've got lots of space but less money.

Making Methane Using Tanks

If you find a nice big tank needing to be hauled away for free, you can turn it into a methane digester. The ideal proportion is a length-to-diameter ratio of about 5:1. Shorter than this, and the tank will not fully digest the material flowing into it.

Baffling the tank to force the fermentation to take a sinuous route also aids in production. An intermittent agitation by a horizontal shaft with paddles will gently circulate the bacteria without swirling up sand or other objects, which act like meteors, smashing our little workers.

The great thing about alcohol plants is that you often have a surplus of hot water. **Methanobacters** (methane-making bacteria) like a toasty environment, even warmer than yeast like. To really crank up gas production, use the low-grade hot water (about 140–150°F) in heat exchange tubing in the bottom of the tanks or in a jacket to heat the fermenting liquid to 100°F.

It's important to not let the tank lie on the ground and to give it a good eight inches of insulation to help keep the temperature stable. In fact, an even better strategy than using a heat exchange coil is to either use a jacket or set the tank in a bath where the hot water is introduced under the center of the tank. This is a very good system for using water that is not much good for other purposes, being down in the 100–120°F range. The overflow from the bath can be run into a nice hot tub for you and the crew to enjoy, since it will be a toasty 101–104°F.

If you are using tanks instead of a pond, it's easiest to work in batch mode versus continuous mode. This usually means methane production will peak in about 30 days and then drop off to near zero in two months, in a typical bell curve. Heating the tanks can reduce processing time to as little as 20 to 40 days. Using four tanks, starting one per week, will even out your gas production so that it will seem continuous. These residence times are for manures. Residence times for all-liquid stillage can be as little as five days, meaning your digester can be much smaller and produce the same amount of gas.

The disadvantage with tank methods is that you generally end up with a 60/40 mix of methane and carbon dioxide in the gas. If you use a tank system, you'll want to clean the gas of the carbon dioxide (in a countercurrent packed column with water) to more or less purify it—so as to have a better gas to burn, since carbon dioxide is not flammable. The water now containing the carbon dioxide can be used in an algae-growing tank.

The other alternative is to have a tall gas storage tank. The heavier carbon dioxide will naturally settle to the bottom, and you can bleed it off with a valve connected to the bottom of the tank; use a carbon dioxide gauge to tell when you've finished bleeding off the noncombustible gas.

For long-term use in an internal combustion engine, such as a cogenerator, you should scrub the methane, if you use the tank method, to remove hydrogen sulfide gas, which causes engine wear and acid rain when the sulfur is released to the air. The best treatment is prevention. If you are successful at keeping the tank between pH 7.0 to 8.5, not only will you get more methane faster, but you will reduce the production of hydrogen sulfide

gas to a level not worth worrying about. But if you smell even a hint of rotten egg odor in your final effluent, the tank gas should be bubbled through a countercurrent column with very alkaline water flowing down and gas going up. Water with baking soda is the best way to remove the trace sulfur in the gas.[2]

Making Methane Using Ponds

In general, though, I favor the pond system for methane production. In a pond deeper than six feet, the lower depths are always anaerobic, which makes them an ideal area in which to produce methane.

A corral built in the bottom of a ten-foot-deep pond will prevent oxygen-laden water from **convecting** to the anaerobic area in the corral. You flow your stillage into the bottom of the corral. As the bacteria begin to devour bits of organic matter and produce methane, the particles start to float up. But before they've gone too many feet, the methane bubble breaks loose and continues up to be collected. The bit of organic matter drops back down to the bottom, as the bacteria continue to eat it. Then it's up for another balloon ride. The gas has to travel though almost ten feet of water, which strips the carbon dioxide pretty well.

This makes methane of nearly 85% purity, which is usable either for alcohol production heat or, better yet, to be run through an internal combustion engine to produce both electricity and hot water.

You collect the methane by suspending a tent of impervious fabric over the corral, fastened to its top. The bubbles will follow the tent to its apex, which is open to an inverted 55-gallon barrel, still underwater, to collect the gas. If the top of the inverted barrel is held under a floating dock exactly 11 inches underwater, the pressure of the gas in the barrel is exactly the right pressure to run natural gas appliances.

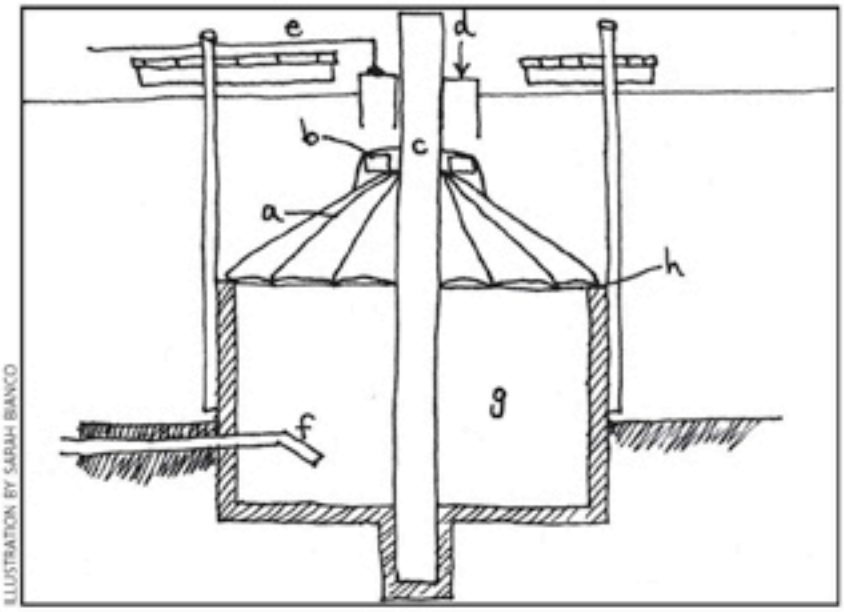

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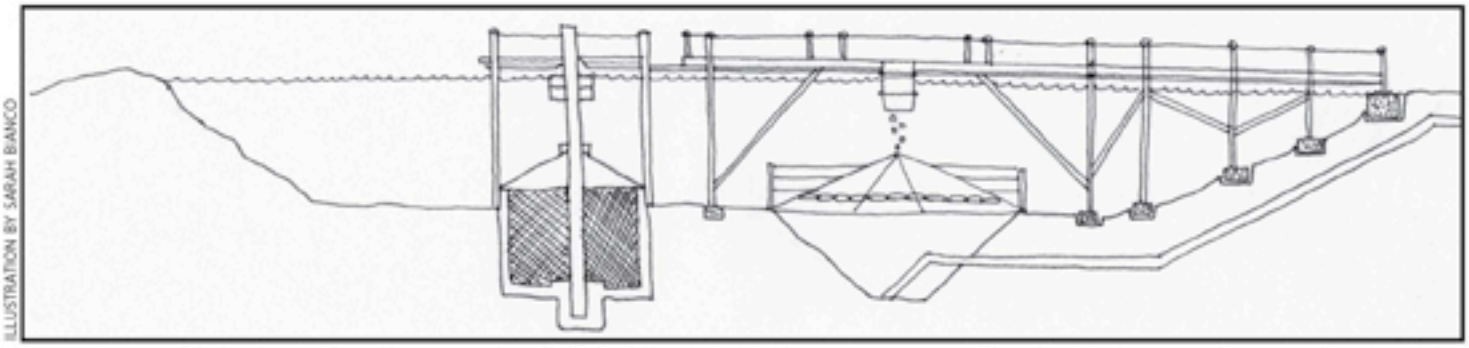
Fig. 10-56 Compact pond-type digester. *This is a compact configuration of a pond-type digester: a) underwater tent to direct methane to be collected; b) floating collar; c)central support column; d) open-bottomed tank to collect the gas; e) gas line leading to shore; f) feedstock input line; g) area where digestion to methane occurs.*

Most likely, however, you will run the methane through a pipe under the bottom of counterbalanced, inverted, open-bottomed tanks in the pond. The tanks will float higher and higher as the methane fills the tank and displaces water. The weight of the heavy tank provides pressure when a line from the top of the tank takes gas to where it is needed. At the house, or plant, a **pressure regulator** reduces the pressure from **line pressure** to 11 inches **water column**, which is about 0.5 psi. (Gas appliances are rated by water column inches; 11 inches water column is equal to the amount of pressure created if a tank were submerged 11 inches under water.)

If you are producing surplus gas, and the floating tank reaches its highest point and gas is about to overflow out of the open bottom of the tank, the gas is then drawn into a two-stage compressor, where it can be stored in a tank on land just like propane. It is then piped to where you need it after going through

Fig. 10-55 Pond-style methane digester. *This type of methane digester is less expensive to build than tank-based systems. The trade-off between the two is that pond systems take up more space and are slightly less efficient at producing methane.*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