AL RUTAN - THE METHANE MAN

There were just a few of us, collaborating via the Internet in the closing months of 2004, planning for the New Year's Eve debut of Energy Self Sufficiency Newsletter. Me, Steve Spence, Laren Corie, Maria 'Mark' Alovert, Mike Nixon and Al Rutan. The Premiere Issue of ESSN "hit the stands" and life was good.

Then, on 9 January 2005, tragedy came to our renewable energy family. Al Rutan passed on. Death is a natural part of the life cycle and is inevitable. But that in no way lessened our sense of loss as we mourned Al's passing and the loss of his contribution to our movement and to our publication.

For many people, methane production is a very viable component of energy self sufficiency, and Al's writings were a valuable part of our message to you, our readers. Al had contributed several articles to Home Power Magazine before his death, and Ian Woofenden and the Home Power staff have graciously given us permission to reprint those articles.

We are proud to present, once again, Al Rutan's words in the pages of Energy Self Sufficiency Newsletter. Special thanks to Ian and the group at Home Power Magazine for their generosity.

Al, welcome back to ESSN. Your wisdom and knowledge are an indispensible part of our message.
We'll always remember you. ldb

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Prologue to Methane Gas

Al Rutan, the Methane Man

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Alternative Fuels

Gas Use

What about flammable gas? Why consider it? For those of us who spent much of our youth chopping wood to heat and cook at home, the idea of gas is like something from paradise. The idea and the experience of merely turning a valve to have instant flame without all the "bitching" and complaining involved in "go get that wood!" is amazing.

Almost everyone likes the ambiance around a campfire on an outing with friends. But for the day to day fuel needs, we wish to have it as "automatic" as possible, and for being controlled by a thermostat, gas is unsurpassed.

It is clean and uncomplicated. Clean? Yes, clean. There is no soot that collects in a chimney from the burning of methane gas. Does it need to be vented? It should be, if at all possible. The fumes from any type of combustion should be considered suspect.

Potential problems from the burning of methane are minimal. If the combustion is complete, what is produced is carbon dioxide and water vapor. Yet we have no practical assurance that combustion is always as perfect as it could be.
An interesting note historically is the fact that the Indian government some 40 years ago pushed the development of homestead production of methane because so many people were going blind from the effects of burning cow dung for fuel. Our early pioneers had similar experiences from the burning of buffalo chips. Burning raw manure should always be considered a "no-no."

Low-tech methane production information comes from both India and China–two countries with vast populations, huge pollution problems from waste, and an immense need for fuel, which isn't readily available.

At Home

Our interest stems from the fact that homestead methane production is one more way to unplug from a utility company and provide access to energy, which substantially contributes to the quality of life.

So, one has to have the heart for it. Unlike electricity, that is for all practical purposes quite mechanical, gas production means tending to living things, like a flock of chickens, a band of sheep, or milking goats. For abundant gas production, there needs to be a sensitivity to the special needs of the microscopic creatures that produce flammable gas as their waste product. This means providing for their basic wants and–don't laugh–giving them a measure of love. All living things–plants, animals, and people–require love in order to flourish. This need extends even to living creatures that can't be seen with the naked eye.

A person we know who had a methane system one day went up to his tank and gave it a good hefty kick as an experiment. The gas production stopped immediately, and started slowly again only after some time had passed.

Because one must assume responsibility for the care of a colony of living entities, producing gas to burn has another dimension some may need to consider before undertaking such a venture.

The advantages of gas are many-fold. It is so easy to use. It is so controllable. It is relatively easy to store. It can be used automatically. It will even run your vacuum cleaner if you put the methane gas through a fuel cell which will turn the gas directly into electricity. Plus, it is so clean–no soot, no creosote, no ash, and no chopping. What more could you ask?

Making and Using Methane Gas

Methane is a natural gas. The reason it's called "natural" is because it occurs in nature everywhere. It can be the gas found in a swamp or marsh, the gas found in a coal mine, the smell coming from a septic tank or sewer line, or the gas sold to us by a utility company under the title of "natural gas." The product is substantially the same, CH_4.

We've heard that methane is odorless, and it is. Sewer gas we know is not. So what is the difference? When the process that produces gas is underway, there are a variety of gases produced at the same time. All such gases result from microorganisms feeding upon organic matter and producing gas as a waste product. Methane, which is odorless, is one of them.

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All these burnable gases are produced by anaerobic organisms feeding upon organic matter. To say they are anaerobic means they only live when air is excluded from the space in which they are functioning.

They are the same organisms that cause us to have intestinal gas. Each time a warm blooded animal defecates, some of the gas producing organisms are contained in the feces. This is why it can be said that methane occurs virtually everywhere. Wherever air is excluded from the decomposition process, the production of methane and accompanying gases is likely to occur.

Stories are legion about a bunch of guys with nothing better to do than ignite the intestinal gas of one of their particularly "gassy" buddies, and then being amazed at how flammable the experiment was.

The micro-organisms that produce flammable gas are temperature sensitive. They want body temperature in order to function most effectively. In people that is 98.6°F. In a chicken or a pig the body temperature is 103°F. So right around 100°F is the optimum temperature for the process to work most effectively. The action can occur at lower temperatures. As the temperature drops so does the rate at which methane gas is produced.

People will sometimes ask, "Why can't I use the gas off my septic tank to burn in a stove?" The typical septic tank swings through such wide temperature fluctuations, the amount of gas produced is minimal. Each time a toilet is flushed with cold water, the tank goes into "shock." Each time some warm wash water from a bath or shower flows into the tank, it becomes more active until the next shot of cold water. Such tanks are ordinarily in the ground, which stays at a constant 50° to 55°F. The ground is a constant heat sink, draining heat away from the tank. About all one gets from a septic tank, by way of gas, is enough to cause an unpleasant odor. BecauseHydrogen sulfide, which is smelly, is another. It is hydrogen sulfide which gives us the characteristic sewer gas or "fart" smell.

When these gases are encapsulated in the ground over a long period of time, the smell is purged, leaving an odorless gas. The sewer gas smell can be removed easily from the mixture by simply bubbling all the gas through calcium carbonate, which is simple barn lime, and thereby scrubbing it so to speak. The gas becomes odorless. The gas companies re-introduce an odor to odorless gas before selling it as a safety measure so that our noses can detect "loose gas" that could be potentially dangerous.

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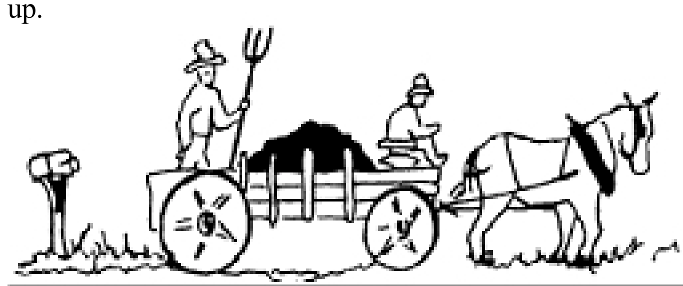

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Key Considerations

It is the concept of a tank which offers us the most practical approach to the task of harnessing the production of methane. Liquid within a tank gives us two immensely important features–transport and the exclusion of air. Both are essential for maximum production.

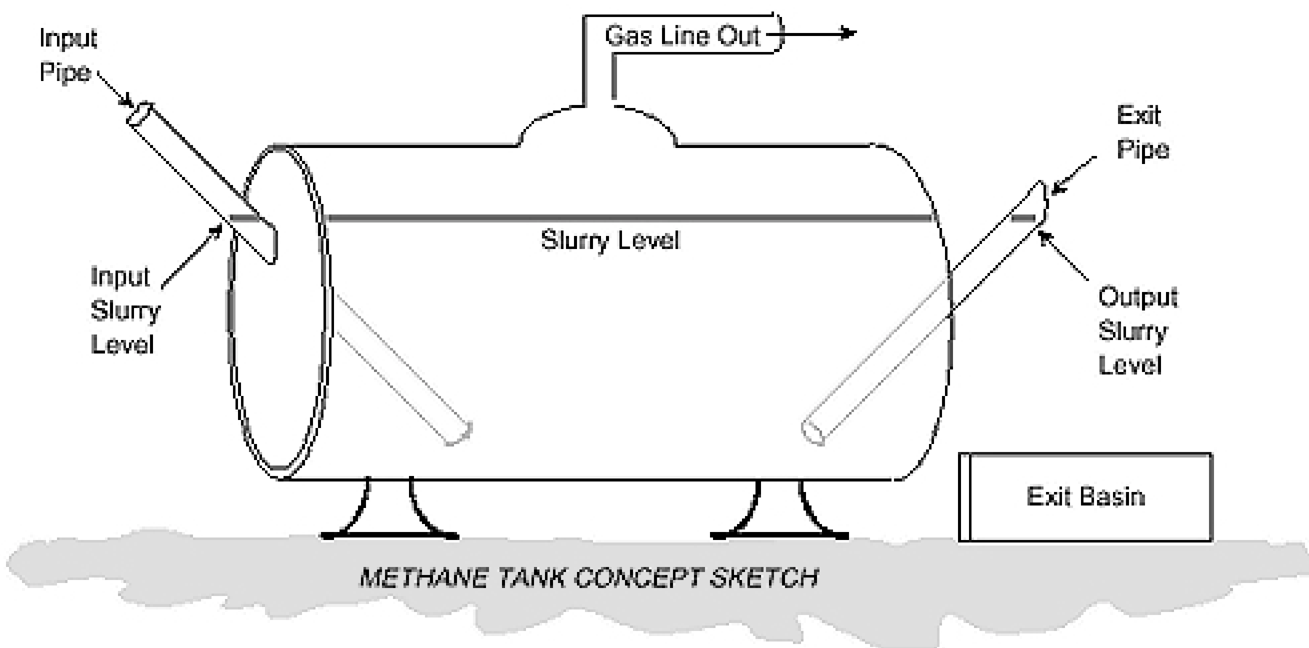
Some methane production occurs in such places as an ordinary barnyard manure pile. The center of the pile is without air and with the heat generated by the pile some methane gas is bound to be produced. If we want to harness the concept, we will need a great deal of gas. A solid pile to give us what we would need would have to be, literally, a small mountain. In a tank, it's an entirely different matter. It is much easier to have the tank "just bubbling away" so that the amount of gas collected in a short time can be significant.

For "home-made methane," our pressure regulator is not any more complicated than a heavy rock on an inflatable gas holding bag, or the weight of a solid yet expandable gas holder floating in liquid. It's not very complicated.

How Much Gas Does One Need?

To estimate the amount of gas needed, the average family of four burns somewhere around 200 cubic feet of gas a day. This covers the combined tasks of cooking, heating space and heating water. Obviously, individuals can trim this amount considerably by using efficient appliances, such as flow-on-demand water heaters, and high-efficiency space heaters.

The best way to get a handle on this information is to look at the amount of consumption listed on the utility bill of some family you know and then observe their lifestyle.



Key Questions

How much gas do I need? That will determine how much gas must be produced. Next is, how much material do I need to produce this amount of gas? The third question is, how large must the equipment be to produce and store this amount of gas?

Gas is thought of in terms of cubic feet. We can all visualize a cubic foot–12 inches square in each direction. The amount of gas within such a space of 12 inches square is determined by the compression of the gas. Fortunately, when we are working with methane, we are talking about only ounces of pressure–just enough pressure to push the gas to the burner, whether it might be a stove, water heater, or refrigerator.

Processes of Gas

We say that the liquid provides transport. That transport is two-fold. Obviously, we must transport the material to the tank. Equally important, yet not so obvious, is the transport of the micro organisms to the material or vice-versa, so that the material can be digested by the life forms. Within the digestive tract of a warm blooded animal, this action takes place by peristalsis. We imitate this transport by very gently moving the contents within the tank from time to time.

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Concerning The Tank

A simple paddle mechanism works the best. Some systems re-circulate some of the gas to provide movement, but this has proven to be less than satisfactory. Often inorganic material is stirred from the bottom of the tank–material such as sand and small rocks if they are present–and the living organisms are injured in the process. The best method is a slow mixing action with a paddle of some sort. The paddle may be on a horizontal axis or a vertical axis. It merely has to move the material very gently a few times each day.

The exclusion of air is essential to have the process work. While we know that even water contains some air–otherwise how could fish breathe–once the activity of gas producing bacteria becomes established, even the air is mostly excluded.

The tank must be closed so that new air is not able to enter. This is done effectively by having both the fill pipe and the exit pipe extend below the water line. So, air exposure to the tank is limited to the surface of the water level in both the fill and exit pipes.

In the past much discussion focused on whether the tank should be horizontal or vertical. It is the consensus that when the tank is horizontal rather than vertical, it can work more effectively. (Note the illustration on pg. 25.) The reason is that the fill and exit pipes need to be spaced as far apart as possible. Then the material entering the tank has greater exposure to the activity within the tank before being moved near the exit pipe.

The gentle stirring action needed, of course, mixes up everything. Yet if the new material is forced to "migrate" some distance before reaching the exit pipe, then the micro-organisms will have more time to feed upon it before it is replaced by incoming material.

How big should the tank be? This is determined by how much material is available to the tank on a daily basis, and ultimately how much gas one wants to generate.

Production Mixture

The input for the tank needs to be a mixture of manure and carbon material. Carbon material is ordinarily understood as waste vegetation, but it can't be just anything. It needs to be something that when soaked in water for a few days becomes very soft. The bacteria don't have any teeth. They have to "gum" it.

Hardness can be misleading. A carrot seems hard, but if soaked long enough it turns to mush. Grass clippings, on the other hand, contain a quantity of lignin, that cellulose fiber that makes wood very "woody." Anything with a high content of lignin will not work well in a methane tank. Straw for the most part is acceptable. Hay is not.

Even such things as ordinary newspaper work well. Although newspaper at one point was wood, the lignin has been broken down so that when the newspaper is soaked for a day or so, it turns to mush–good stuff for our purposes. The bacteria want a mixture of 30 parts carbon to 1 part nitrogen. Manure is nitrogen rich–about 15 parts carbon to 1 part nitrogen, so manure needs to be balanced with more straight carbon material. This ratio isn't a critical proportion and the process still functions, but 30 to 1 is the ideal.

Potency

The ability of manure to produce gas varies from animal to animal. Chicken manure can be especially potent. I have observed as high a yield as 10 cubic feet of gas from each pound of naturally moist chicken manure which was mixed with some finely ground spilled feed.

Hog manure usually yields about 4 cubic feet per wet pound. Cow manure usually yields about 1 cubic foot of gas for each pound of fresh manure. The reason there is such a difference is that much of the methane potential has already been released when the waste goes through the digestive system of a ruminant. There is usually so much of this kind of manure, using it is still worthwhile. Another good feature of the process is that raw manure is changed into something which is aged and totally acceptable to be placed on growing things. With any quantity of raw, green manure, this is not the case.

Sizing the System

Having established that we need around 200 cubic feet of gas a day, we need to set about designing a system that will provide this. How much is 200 cubic feet? Visualize an inflatable bag that is six feet wide, six feet long and six feet high, and you're seeing a space of 200 cubic feet.

If we say that a mixture of manures will give us 4 to 5 cubic feet of gas per pound of naturally wet manure we are going to need about 40 to 50 pounds of manure a day. We would

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need even less manure if we use chicken waste. These forty pounds are going to be mixed with some type of additional carbon material, to which water, preferably warm water, will be added to give us a "slurry." This will most likely be about 15 gallons of bulk. Visualize the content in three five gallon buckets.

Size of the Tank

It is generally a rule of thumb that the size of the tank needs to be 40 times the size of daily input. This means that when 1/40th of the volume of the tank is introduced at the input end then 1/40th of the volume will exit the overflow end simply by being displaced. Allowing some space at the top of the liquid for the gas to collect, the tank should be about 50 times the size of daily input.

Sewage plants that employ the methane process–and many do–like to have a holding time of 90 days. In other words the preference is to have the tank 90 times the size of the daily input. The purpose of this is to totally destroy any potential pathogens. That length of time within the tank does exactly that. Periodic inspections by the various health departments around the country keep a check on such activity and find consistently that the 90 day holding time accomplishes this goal.

Within a 40 day holding period most of the pathogens are eliminated. Because we are not dealing primarily with human feces (although this material may be used with animal waste) the longer holding time is not as imperative. Within a 40 day time span the greatest amount of gas is produced. In a period longer than 40 days, the gas production begins to slow down considerably.

We need a tank that is 50 times the volume of the daily input of 15 gallons, or a 750 gallon tank. Obviously, a 1,000 gallon tank would be ideal to take care of extra demand for production or additional material input.

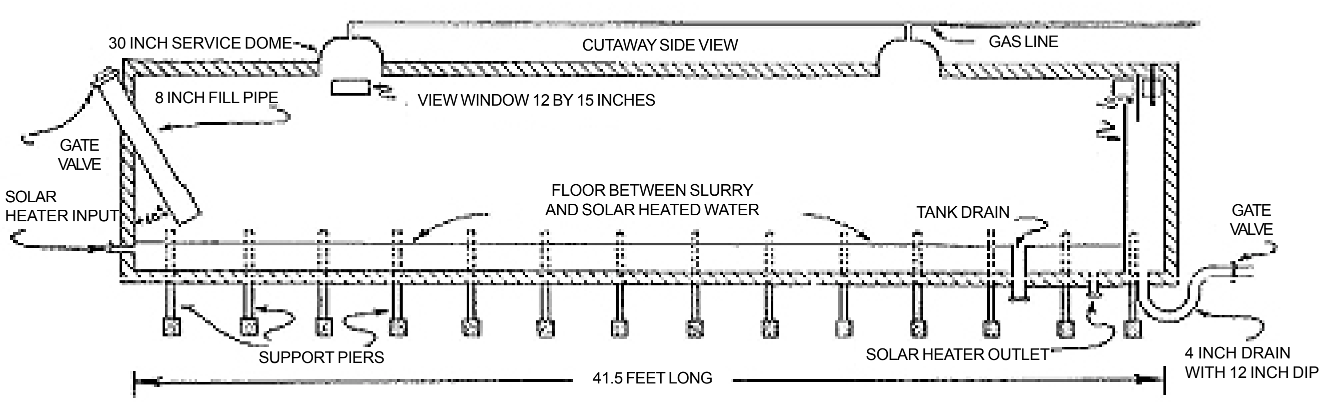
Tank Choice

A 1,000 gallon discarded milk bulk tank would be ideal. Because bulk tanks already have a system for cooling the tank, this system could be easily adapted for holding the temperature of the tank at 100°F. rather than cooling it. One type has the "radiator" already built-in.

The fact that the tank is stainless steel is also an advantage because it would extend the life of the tank considerably over ordinary sheet metal. The acids within the mixture do not work rapidly on the tank, but they will deteriorate it over an extended period of time.

Originally, I had an ordinary 250 gallon fuel-oil tank that I used for demonstration purposes. It lasted for several years. It finally rusted through, but considering the fact the metal was relatively light gauge to begin with, the tank served well. Because oxygen is excluded in the process and the pH must be kept at neutral, the deterioration of the tank was not rapid.

Another great feature of a milk bulk tank is the fact it already has a mixing paddle as part of the tank's design. All access ports above the water line would have to be sealed air tight for effective gas production and, more importantly, just common sense safety.



Al Rutan's Methane Digester Design

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The Gas Holder

Regarding a gas holder, one may use a solid vessel open at the top filled with liquid into which another solid vessel open at the bottom is placed. The gas pushes the top unit up out of the liquid as the gas is produced.

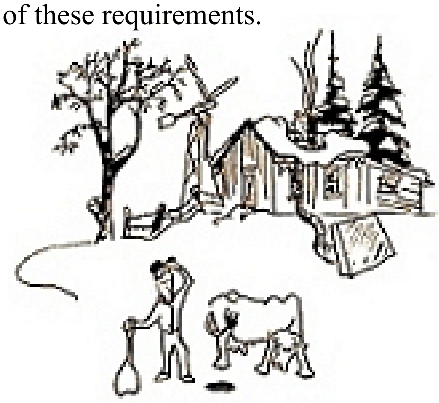
The simplest type of gas holder is an expandable bag. It can be something like a waterbed mattress upon which a weight is placed to produce enough pressure to send the gas to the point where it is used–a burner of some type.

One may use simply a vinyl of some type, but the best type of material is a nylon fabric that is impregnated with vinyl–not laminated, but impregnated–which becomes exceedingly durable. If this inflatable bag is placed inside a "silo" of some type, then there is a measure of assurance that the bag is not going to be punctured. The people who work with the nylon impregnated vinyl–one of the trade names is Herculite–seal it by a process of electro-statically welding it. Using an ordinary adhesive may not work because methane has a tendency to dissolve a number of adhesives

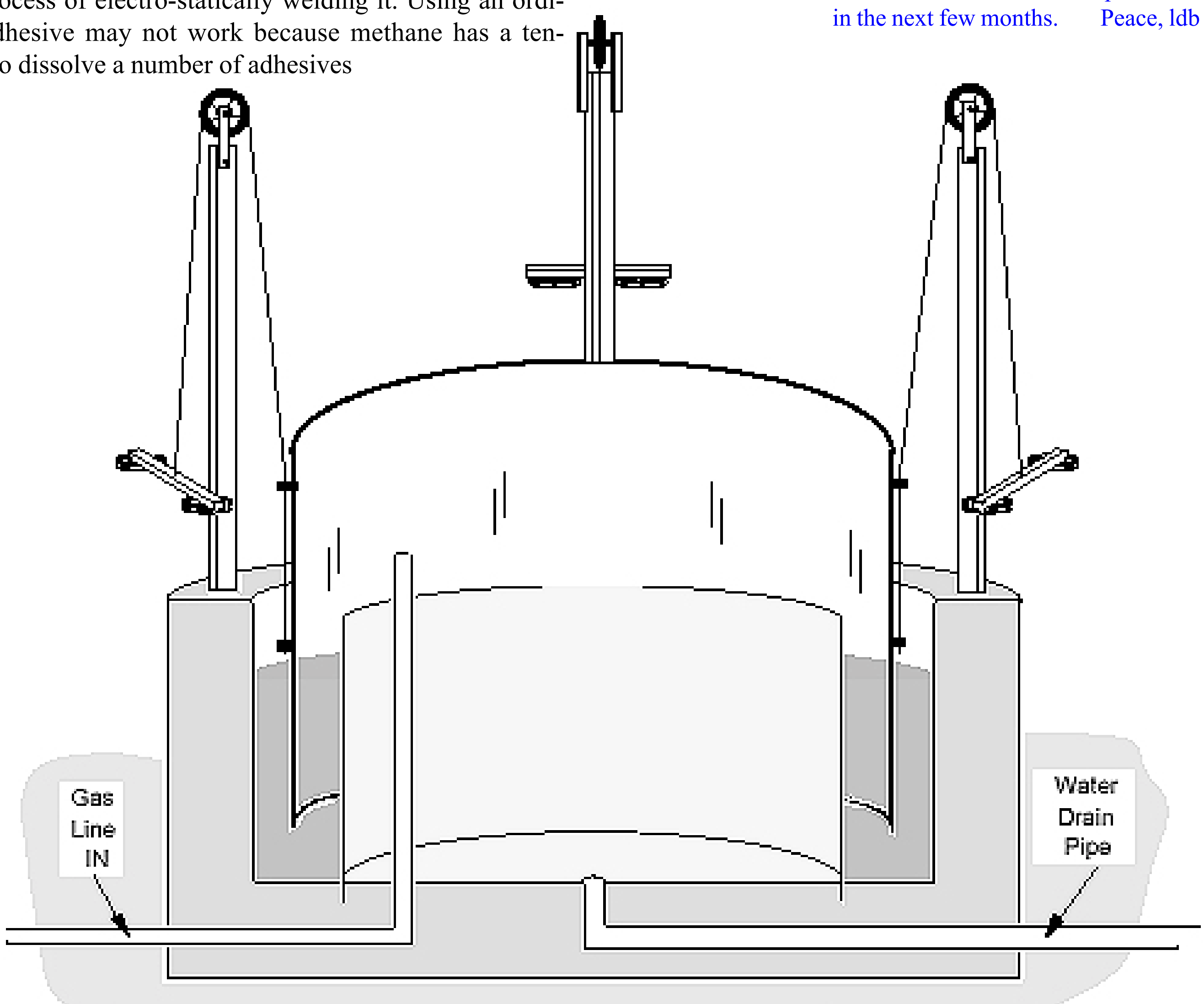
For Now

The process of making methane gas is relatively simple if one is attuned to the basic needs of the process. They are: the right balance of material, the right temperature, and the exclusion of air. Given these three conditions, the methane process is virtually unavoidable. The trick is to be sensitive to the fine-tuning of each of these requirements.

Al Rutan



More of Al's articles will be published in the next few months. Peace, ldb



Gas Storage Tank