# Production of Biogas from Amenity Grasses

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The process of anaerobic digestion causes organic matter to be broken down by bacteria, in the absence of oxygen, giving off biogas in the process, which is usually rich in methane.

The idea of this project was to carry out some experiments using the process of anaerobic digestion to obtain biogas from the grass. It was decided that 2 grass types could be tested, with the possibility of adding extra experiments in future. Plans were drawn up as to how the experiment could be set up, and how many experiments would be run. It was decided that there would be two tests of each grass type, with a control digester which contained no grass.

The equipment required was sought out from the chemistry catalogues, which was surprisingly challenging due to the vast amounts of variations on each item (for a mechanical engineer). Once the first batch of equipment arrived, it was found that the rubber stoppers were too large, so more had to be ordered. There were a number of delays, which surrounded the ordering of parts, and by the time they arrived, finding a fume cupboard in which to do the experiment was difficult. Also the large number of holidays in the middle of the project were problematic, as the process of anaerobic digestion was expected to take around 30 days.

Towards the end of the allotted time it was possible to start the experiments, which are likely to run on into the summer.

With the arrivals of the grass for the experiments it was possible to carry out some tests on the grass samples. They were tested for total solids content, by heating at 105C until the weight of the sample did not change, giving the dry weight. These samples were also tested for volatile solids content, by placing a small sample inside a crucible and heating in a furnace at 950C for one hour, and the weighing the remains of the samples, with only the inert material left. The results are in table 1 below.

| | Golf | Football |
|---|---|---|
| Total Solids Content | 64.07 | 68.05 |
| Volatile Solids Content | 93.62 | 90.01 |

Table 1

It was also possible at this point to set up the experiment. Half a litre of sewage sludge was added to each digester, along with 200g of grass. There were two digesters with golf grass, and only one with football grass, due to the size of the samples provided. The digesters were then topped up with water to minimize the amount of air within the digesters. A control digester was set up containing just sewage sludge and water. One of the problems encountered in setting up the digesters was getting a good mix within the digester, with the grass and most of the sewage sludge being lighter than the water, causing separation to occur. This is clearly illustrated in figure 1 below. This is something to think about in future, possibly adding a stirring mechanism, though that adds complication, and may not be very effective.


Figure 1

A fish tank was used to contain the water which the gas was bubbled through before collection in upturned measuring cylinders. One other issue which occurred was that not enough head space was left in the digesters, causing some leakage through the pipe and into the fish tank.

Some of the early results can be seen in figure 2 below.

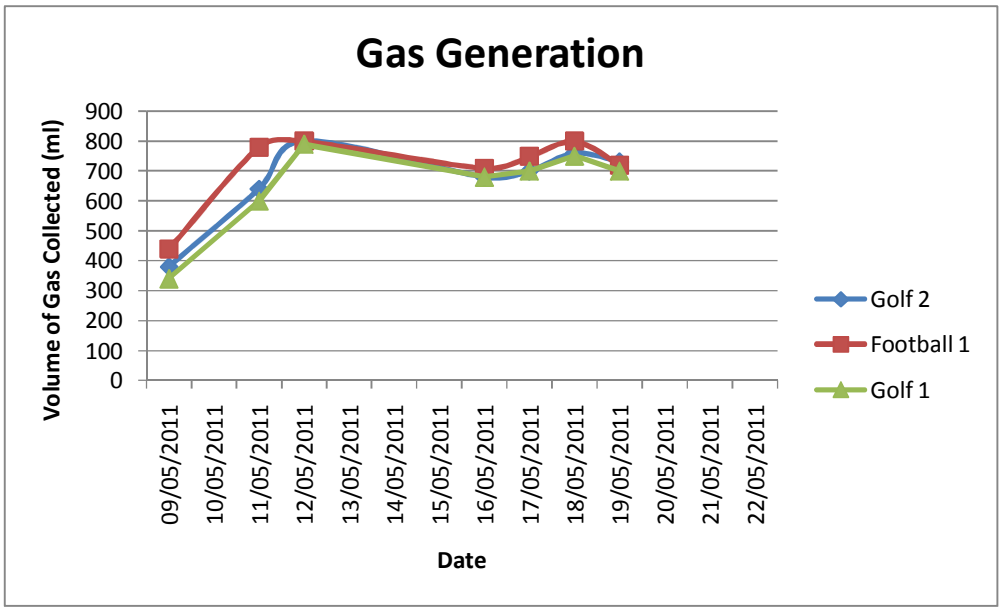


Figure 2

From figure 2 it can be seen that initially there was a strong generation of gas, which then dropped off before climbing more gently. This may have been due to the water absorbing the carbon dioxide, as in the early stages the gas is expected to consist of mainly carbon dioxide, but it has not yet been possible to test the gas. It was expected that the gas generation would climb steadily before

reaching a plateau and then dropping off. It may be that the initial gas generation was caused by the sewage sludge, with it taking a little longer for the grass to have an effect. Another factor in the experiment is temperature. This is not controlled in the experiment, and it is known that the optimum temperature for anaerobic digestion is around 35C.

Further work;

- Continue the experiments; with more batches of grass digested the bacteria will become more optimised for digesting grass.
- Store the grass for a period of time to see what effect this has.
- Mix the samples and test, also combine the grass with other potential feedstock to optimise gas production.
- Measure the content of the gas produced, and also take samples from inside the digester for analysis, to better understand what is going on.