CARBON DIOXIDE CAPTURE FROM AIR AND ENHANCEMENT OF BIOGAS USING A DGC REACTOR

SUMMARY & CONCLUSION

A Project, funded by the Technology Strategy Board, was undertaken to capture of Carbon dioxide from Air and upgrading of Biogas in a DGC reactor unit.

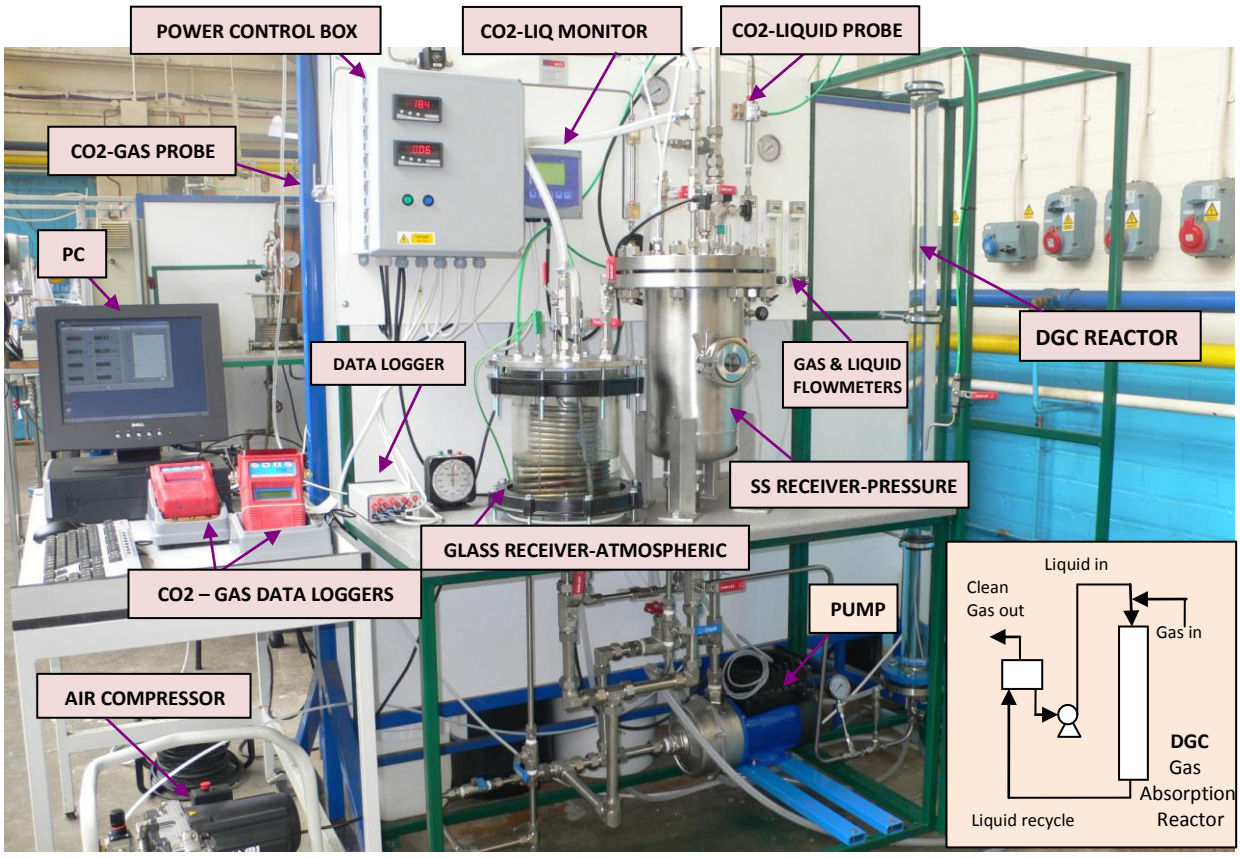
It was concluded from the trials that the DGC unit is a very efficient system for selective capture and sequestration of Carbon dioxide from Air [reduction from 360 ppm to 10 ppm or less] thereby effecting a reduction of environmental pollution and effects of global warming of CO2. The captured CO2 can be recovered and used as required.

The DGC reactor could also be used very effectively for enhancement of Methane concentration in Biogas [simulated biogas used] by selectively absorbing and removing the CO2 and H2S content in it - thereby improving the quality of Biogas and increasing the calorific value, resulting in reduction of costs of energy production, with high cost benefits.

The absorption of individual gases like CO2 or H2S or Siloxanes can be undertaken in the DGC by use of specific absorbent solutions using much lower concentrations than normally used in existing systems. Even though trials have not been undertaken for removal of Siloxanes (in Biogas) or other Mixed gases, the same system can be used very effectively for selective removal of these gases by using a suitable absorbent solution.

An application for a Patent is currently being made to protect the Intellectual Property

Use of the DGC Reactor will allow shorter operating and contact times, lower energy requirements, reduced capital and lower operating costs and a smaller footprint - than systems currently used like a Scrubber. It can be easily scaled-up and retrofitted in existing systems and be located at the point of CO2 or Mixed emission like AD plants, Power Plants etc.

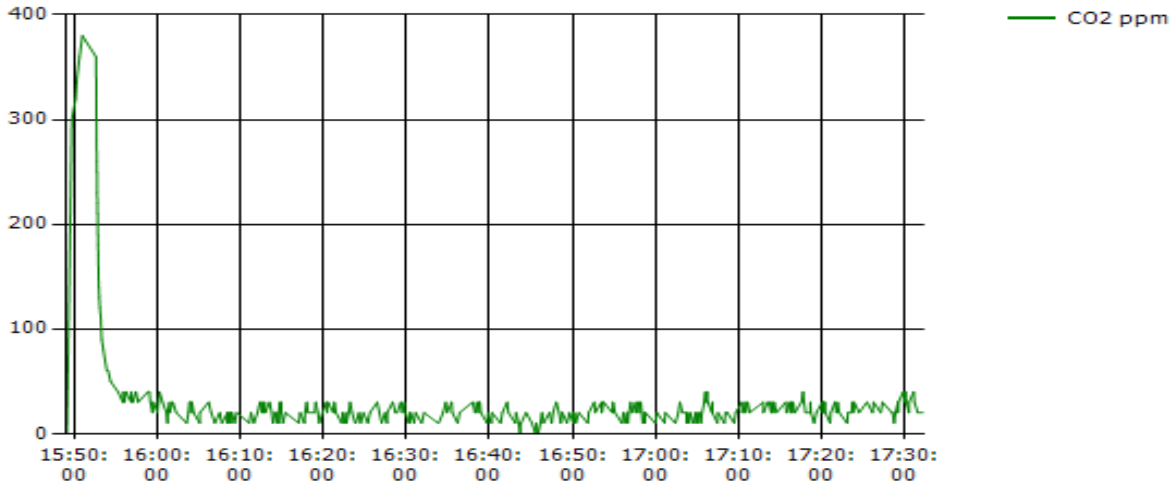


CO2 ABSORPTION DGC REACTOR UNIT

TRIALS WITH AIR

A typical example of the CO2 absorptions is shown below:

SEA SALT WITH WATER

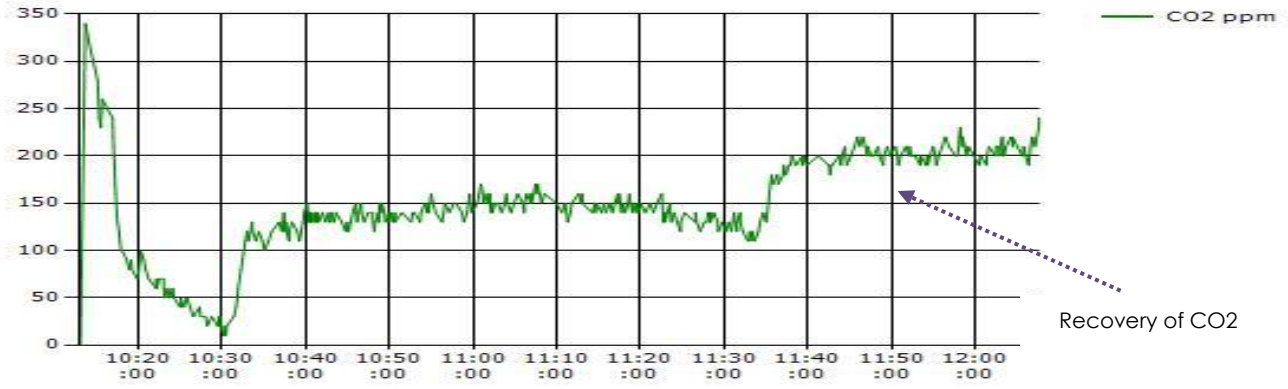


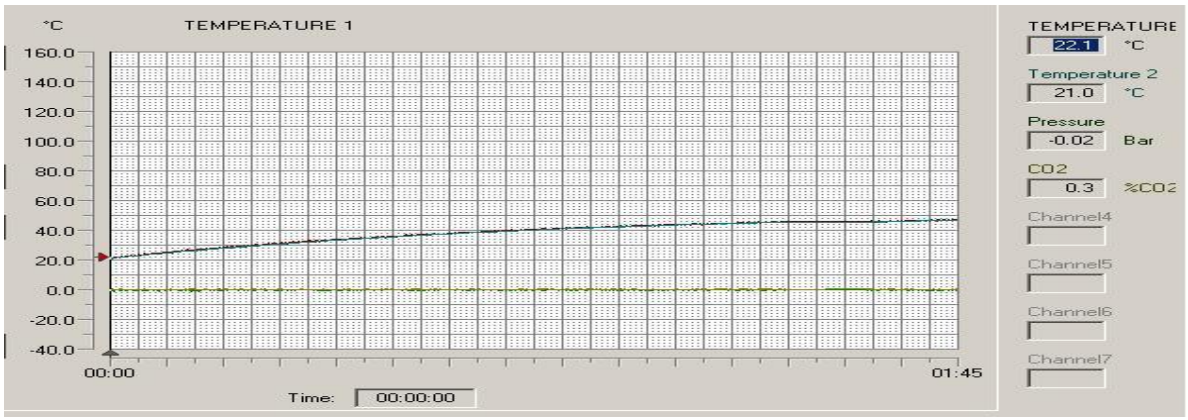
RECOVERY OF ABSORBED CO2

The absorbed CO2 was able to be recovered by increase of temperature. A typical graph is shown below.

The recovered CO2 can be used for other processes as required as in Algae growth and Biodiesel production, production of chemicals and even for energy production.

Graph V – EFFECT OF HEATING AND RECOVERY OF ABSORBED CO2

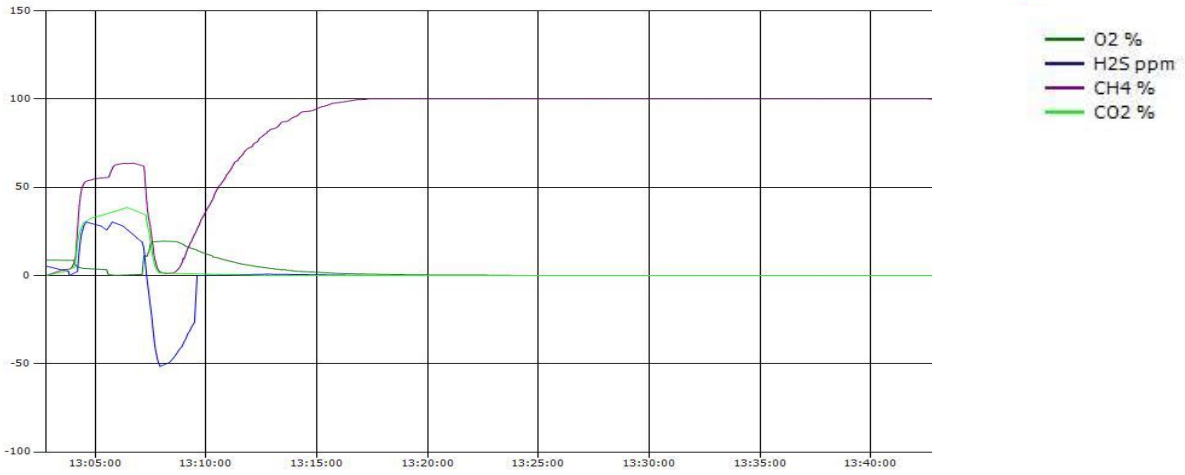




TRAILS WITH SIMULATED BIOGAS - RESULTS

Trials were done with simulated Biogas and a typical example is shown below

SIMULATED BIOGAS [60% CH4-38% CO2-2% H2S]



CONCLUSIONS FROM TRIALS WITH SIMUATED BIOGAS

The trials show that the DGC can be used very effectively to absorb all the CO2 and H2S content in Biogas. This results in obtaining a Biogas of improved quality, with very high Methane concentration and enhancement of the Calorific value of the Biogas, resulting in significant cost savings for power generation. Removal of the H2S allows increased longevity of the CHP engines which are used for Power and Heat generation with the Biogas.

COMPARISION OF EXISITING CO2 ABSORPTION/BIOGAS ENHANCEMENT UNITS WITH DGC.

- Much bigger Scrubber units than a required DGC reactor unit – higher Capital costs
- Contacting efficiency of Scrubbers or Packed tower, approximately 55-65 %, compared to 100% obtained with a DGC
- Higher concentration of Absorbent chemicals usually used than in the current trials with DGC unit. Absorbent concentrations used in the DGC about 0.5-1.0 M - compared to 3.0-7.0 M used in Scrubbers. Due to the higher gas-liquid mass transfer rates, higher efficiencies and greater gas absorption capabilities of a DGC reactor, use of low concentrations are more effective than possible in Scrubbers. Higher concentrations of absorbent can be used in the DGC, if required, to get much higher gas absorption rates
- Higher operating costs in present systems
- CO2 can be recovered if required by simpler methods.
- The DGC can also be operated at higher pressures if required, with greater benefits.

Criteria: DGC REACTOR

Adsorption process: Physical/chemical
Pre-cleaning necessary? No
Required pressure (bar): Any pressure – from atmospheric
Methane loss: Not measured, but only seen at the start of the process; estimate max 0.5-1.0 %
Methane content of the gas product: > 98% [100% as seen from the Biogas Analyser]
Required power consumption [kWh/Nm³]: 0.05-0.07 kWh/Nm3
Required temperature range [°C]: Atmospheric
Range of controllability as percentages of total load: 100%

For further details please contact – enquiries@wrkdesign.co.uk