

Gas standard generation from a liquid

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The Laboratory of Civil and Environmental Engineering (LGCIE) combines research in chemistry, biology, processes, and civil engineering to improve the consideration of environmental issues in the management of waste treatment and waste recycling. Their LiqMix™ application is the generation of a gas standard from a high molecular weight liquid.

Biogas valorization

Because of its high composition in methane, biogas, which is naturally produced in non hazardous waste landfill and forced in anaerobic digester (sludge treatment plants, agricultural waste, ...), is an excellent renewable energy source for electricity and heat production.

However, the energy recovery (in internal combustion engines, turbines, fuel cells ...) is often problematic because biogas contains trace elements such as sulfur compounds, halogen compounds and volatile organic compounds of silicon (especially siloxane) which can create, in these conditions of pressure, temperature and humidity, corrosive compounds and especially silica.

If laboratories and industries have long worked on the treatment of sulfur compounds, siloxanes are subjects of more recent research. Characterized by their structure Si-O-Si linked to organic groups (eg methyls), siloxanes are used in a large number of products (cosmetics, additives for paints and resins, emulsifiers, waxes, toys ...). The growing consumption of siloxanes and silicones in industrial processes is thus increasing their presence in the waste.

As such compounds are detrimental in many applications using biogas as a fuel (fouled spark plugs, abraded surfaces due silica oxides), it is necessary to provide methods of treatment, technically efficient and economically viable.

Use of LiqMix™

In order to obtain a biogas quality compatible with the tolerance criteria of a Solid Oxide Fuel Cell (SOFC), the LGCIE focuses its research on a gas treatment by adsorption process (Picture 1).

Different kinds of adsorbents were evaluated to assess their capability to remove siloxanes and hydrogen sulfide from biogas. The LGCIE used a GC (PR2100 – AlphaMos) equipped with FID and FPD.

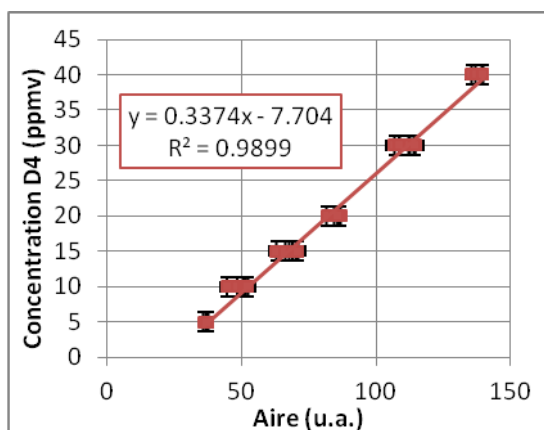


Picture 1 : Experimental setup

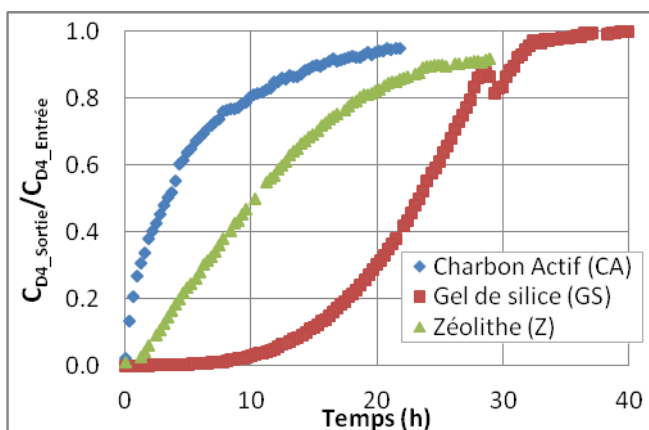
This instrument needs to be calibrated and commercial gas standards of siloxanes are not available because they would be very unstable. FID was calibrated for siloxane D4 (octamethylcyclotetrasiloxane) with LiqMix. Different concentration levels were generated and helped to build a linear regression (Picture 2).

LiqMix is also used to "continuously" generate a polluted gas where the concentration is known and controlled. Thus, a gas mixture (30 ppm) is generated from a liquid standard of D4. This gas mixture might be mixed with a H₂S standard. The efficiency of the removal process is evaluated with the chromatographic analysis of the gas downstream of the charcoal (Picture 3). An experiment can last several days.

LGCIE LiqMix is equipped with a liquid Mass Flow Controller of 0,28 g/h full scale, a gas MFC of 4000 NmL/min and a vaporizer. A third channel (a gas MFC of 4000 NmL/min) is dedicated to the dilution of H₂S. Each MFC has been calibrated on air.



Picture 2 : FID calibration for D4



Picture 3 : Breakthrough curves of D4 for 3 types of adsorbent

Conclusion

This application is a typical case of a study that could not have been led without using this standard preparation system. The LiqMix allows the generation of gaseous standards at multiple concentrations and dilutions which are not commercially available.

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