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BOOKLET

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Title: Low cost method for quantification of hydrogen and methane in continuous flow bioreactors

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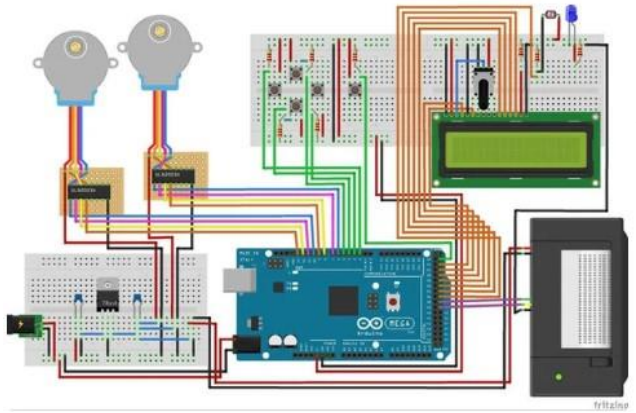
Introduction

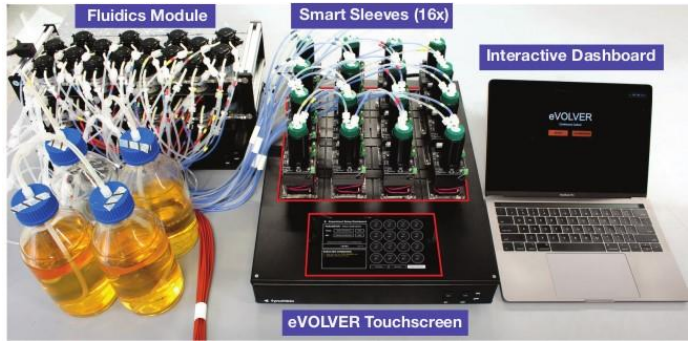
DIY (Do It Yourself)

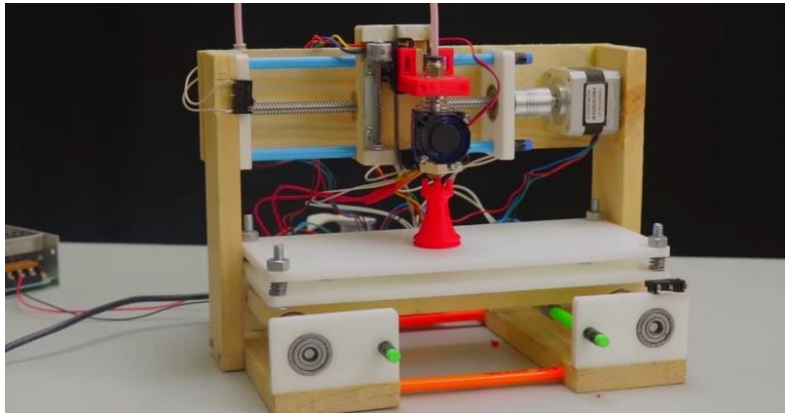
Provides at least two great benefits: 1) Flexibility: whereby scientists can build just what they need to automate their particular laboratory processes, rather than buying a standard configuration; 2) Economic advantage: commercial equipment that can cost USD $ 100,000 or more, scientists can build it for USD $ 5,000 or less, depending on the desired performance, controls and sensors

Introduction



DIY





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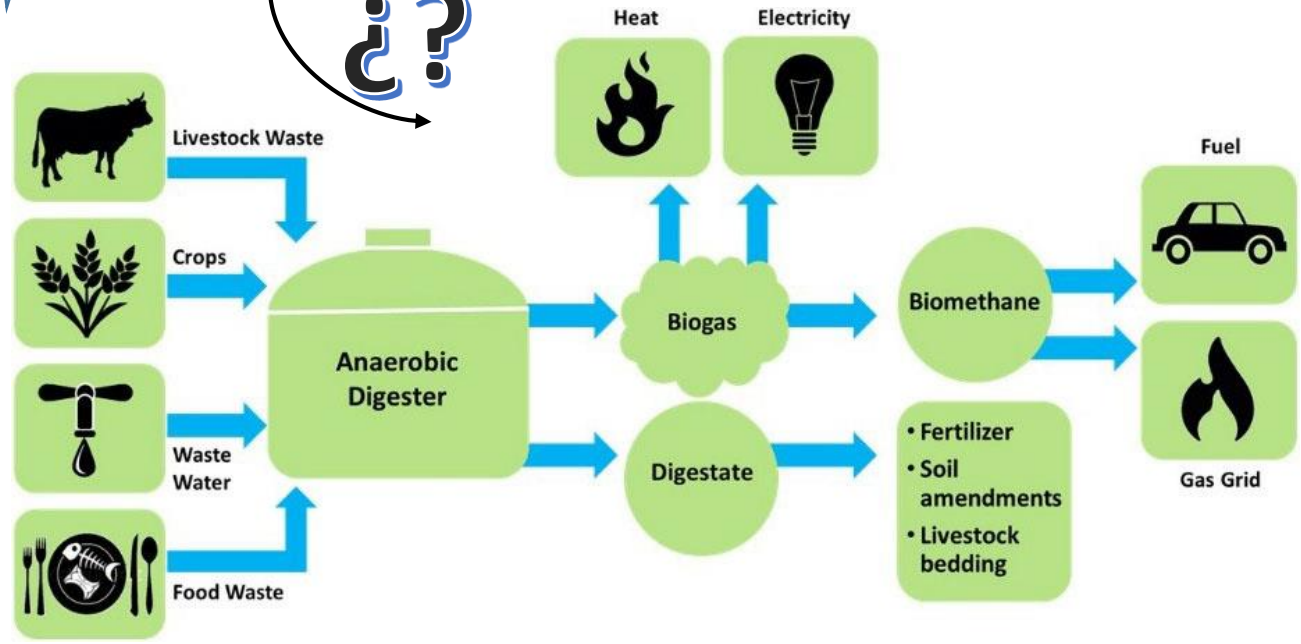
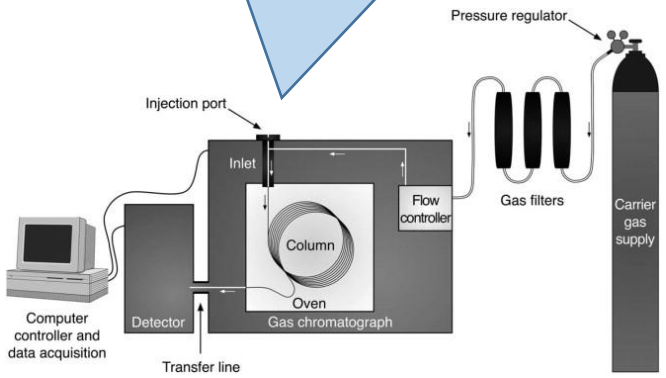
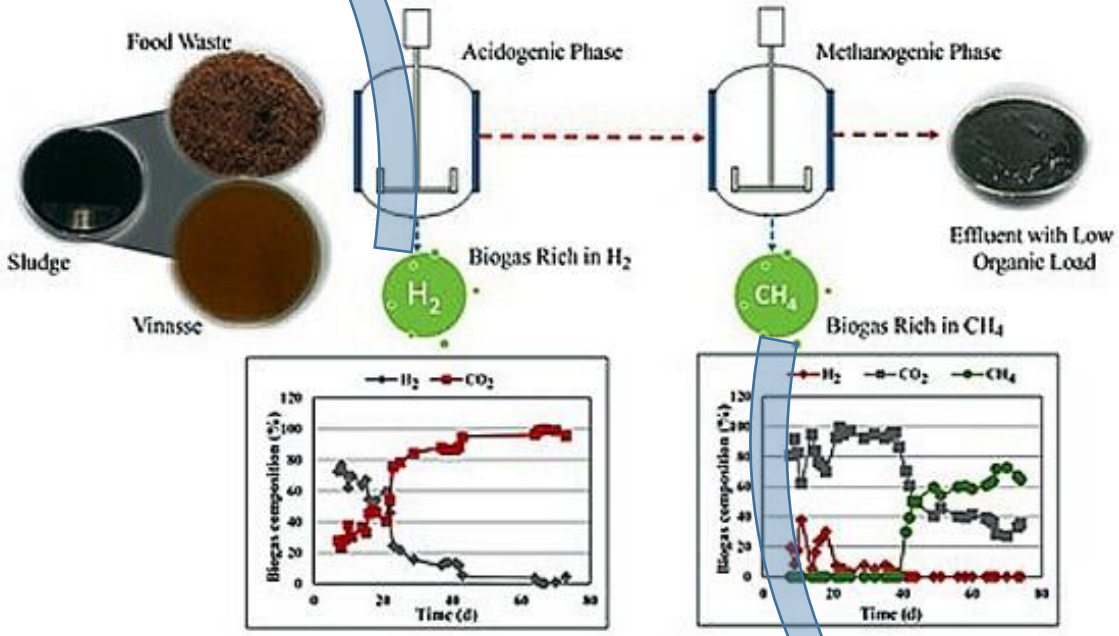


Introduction

batch

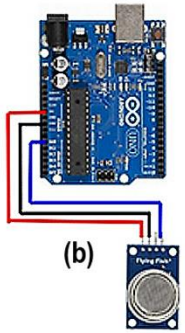




continuous?

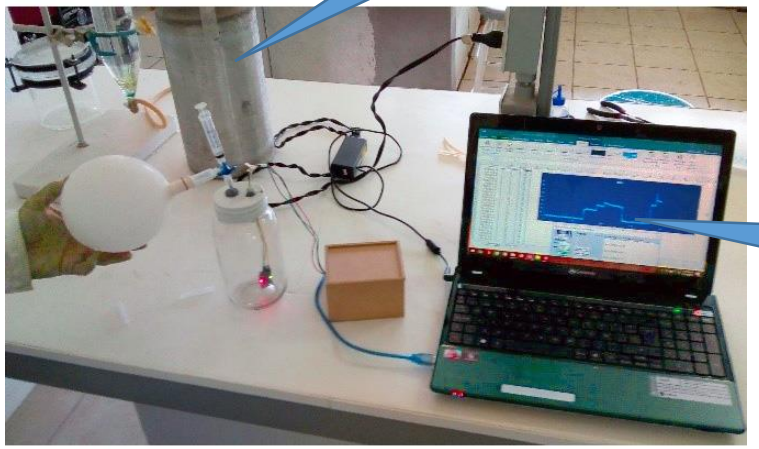
Methodology

(a)



(b)

Arduino with microcontroler ATmega328P

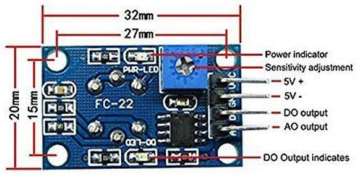


Cylinder with 3-component mixture: 50% hydrogen / 40% methane / CO2 balance; with Gravimetric Analysis traceable to the weight frame of CENAM. INFRA brand. 1 m3, 2015 Psig.

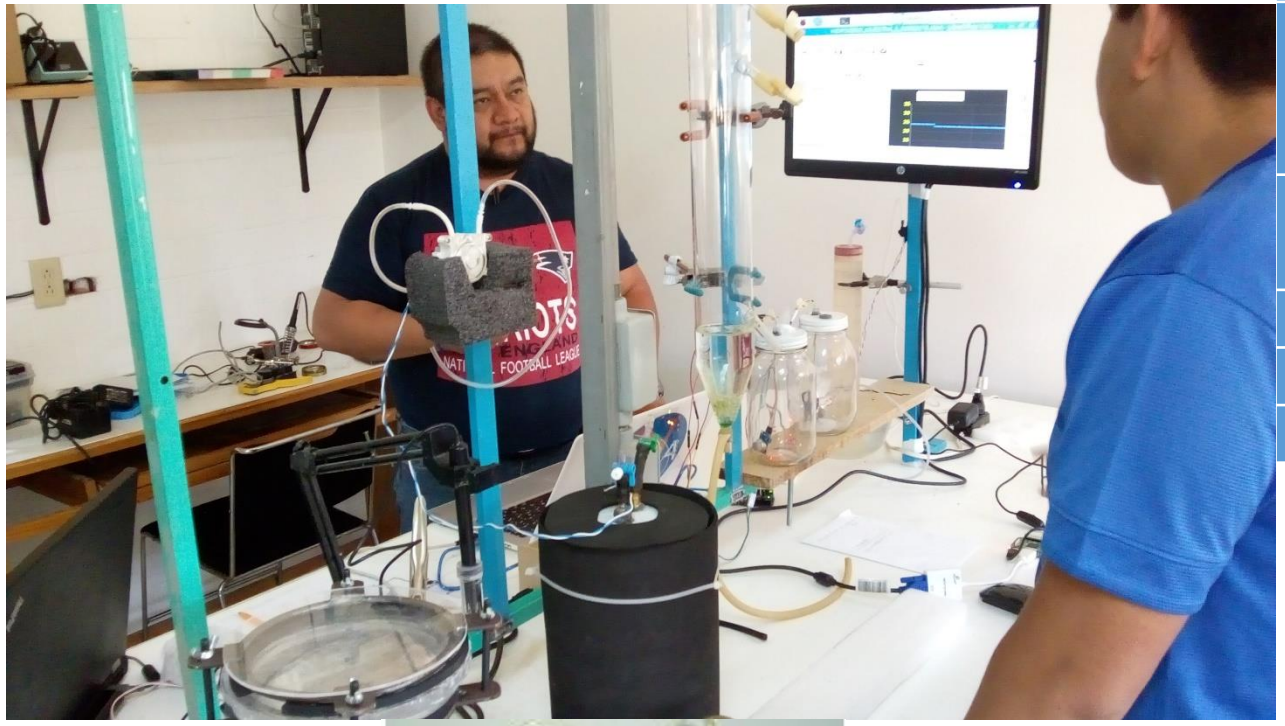
Excel interface PLX-DAQ V2

MQ-4 methane

MQ-8 hydrogen

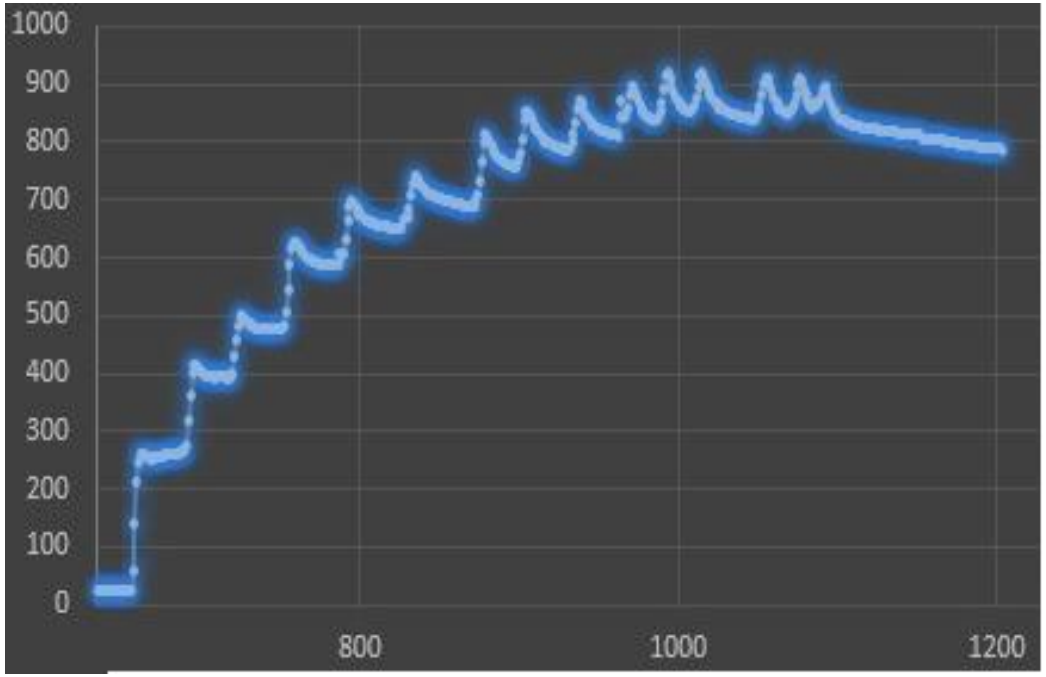


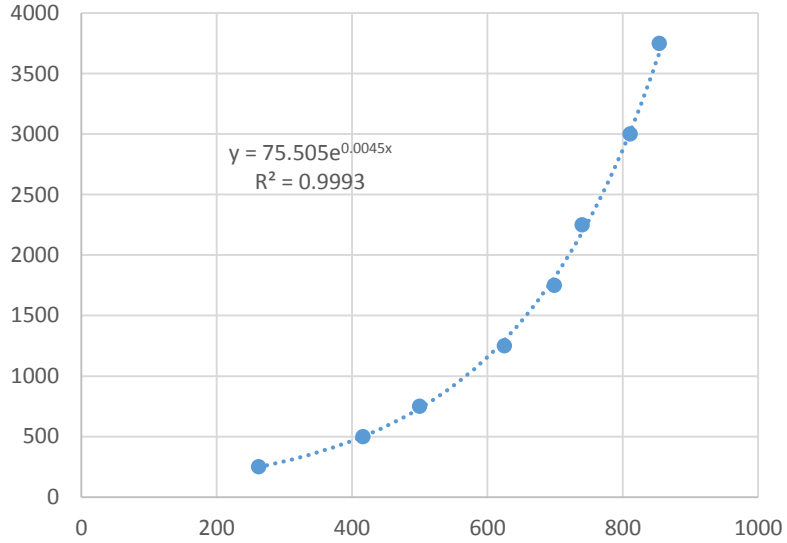
Methodology



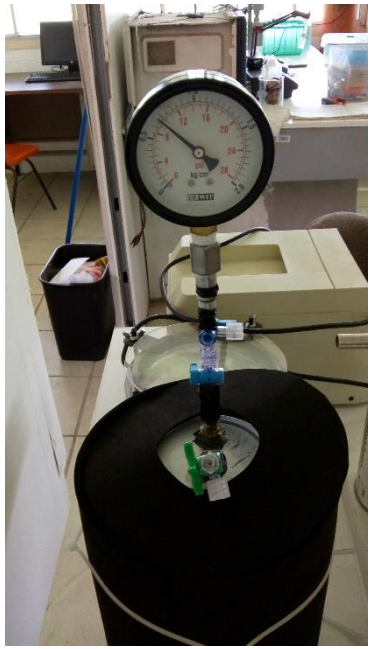
	SENSOR	
	MQ4	MQ8
Detecting concentration scope	200-10000 ppm CH_4, natural gas	100-10000 ppm Hydrogen (H_2)
Sensing Resistance	10KΩ- 60KΩ (1000 pm CH_4)	10KΩ- 60KΩ (1000 ppm H_2)
Using Tem	-10℃-50℃	-10℃-50℃
Circuit voltage	5V±0.1 AC OR DC	5V±0.1 AC OR DC
Heating voltage	5V±0.1 AC OR DC	5V±0.1 AC OR DC

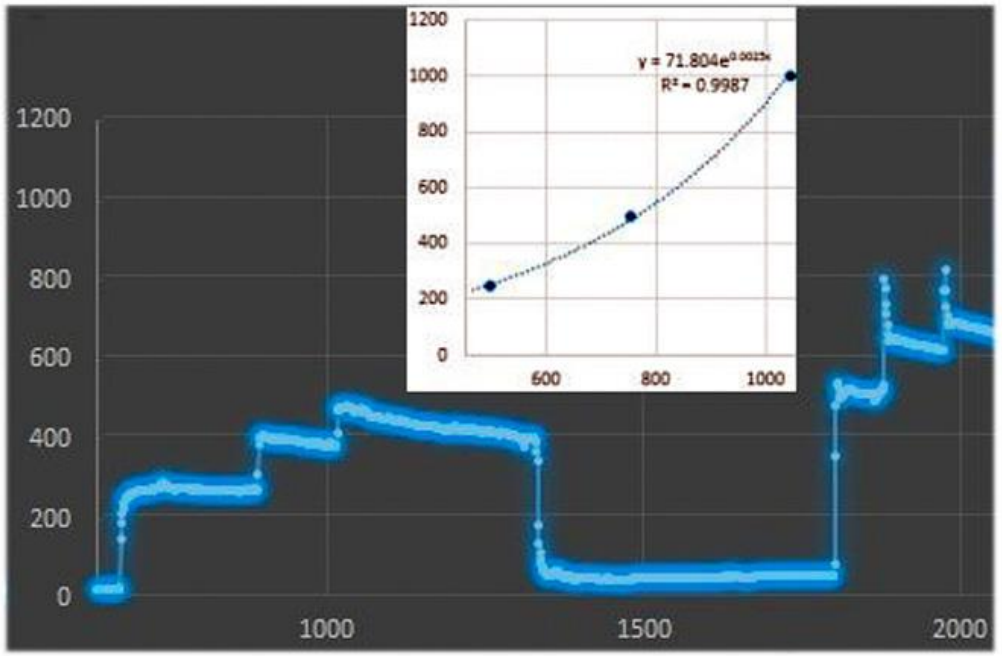
Results
MQ-8 Behavior



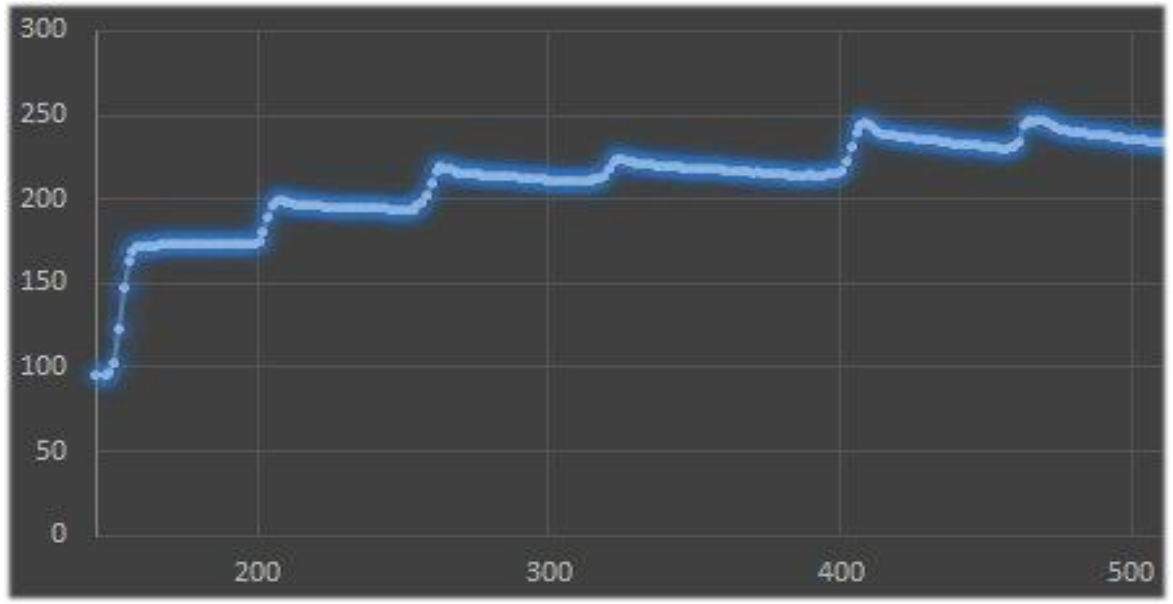


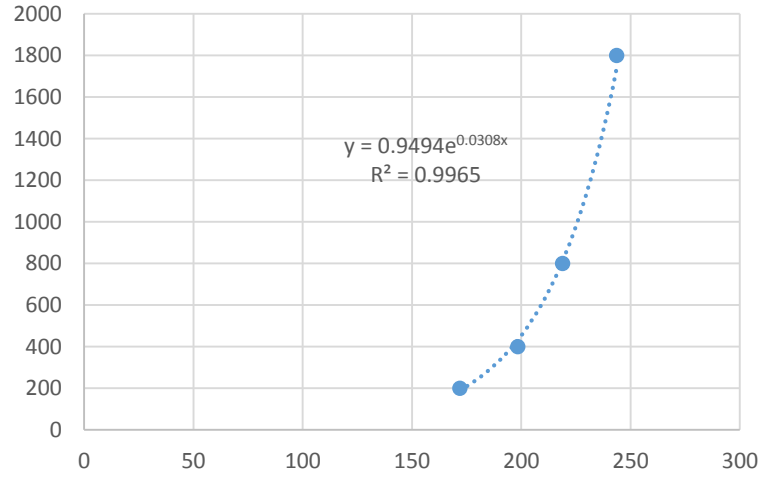
Results
MQ-8 Behavior





Results
MQ-4 Behavior





Results

The reactor is producing 52% methane gas & 23% hydrogen. Therefore, methanogenic bacteria predominate over hydrogenic ones; it will be necessary to apply an extra thermal shock to eliminate methanogenic bacteria. A result obtained in less than an hour, which previously would have been obtained after several days, after sending the corresponding samples to a laboratory with a CG team.

Results

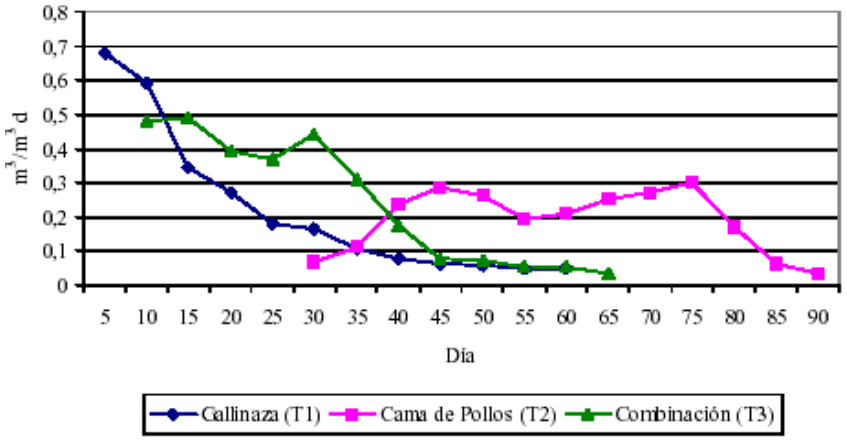


Figura 2. Producción diaria de Biogas

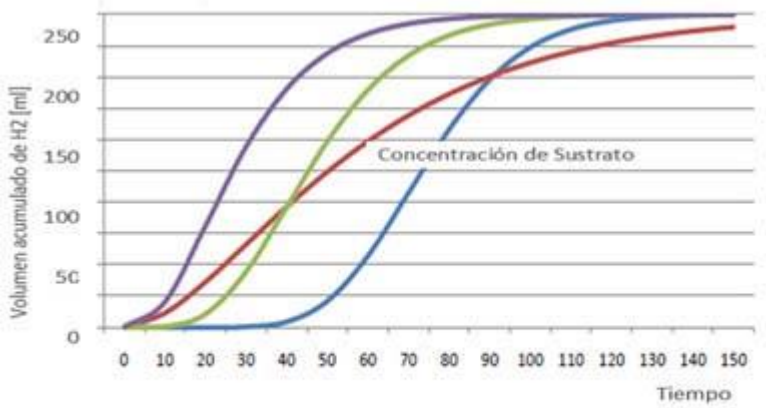
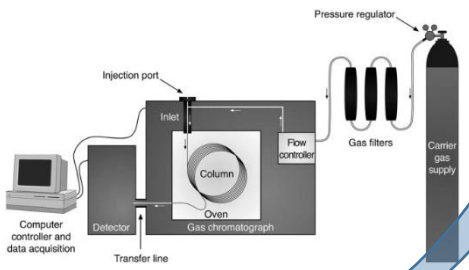
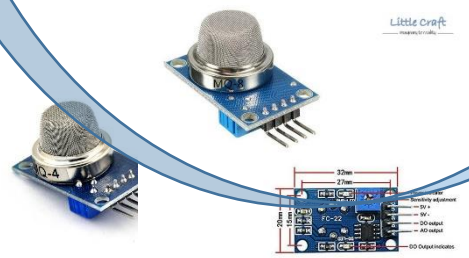


Figura 7. Representación de la cinética de la fermentación oscura por Gompertz



GC

MQ4 & MQ8



Conclusions

- **HydrogenMQ8 and methane MQ4 sensors are adequated for the determination of the composition of these gases in line and semi-continuous biogas reactors.**
- **A differential response to concentration was observed, with exponentially behavior, with R2 of up to 0.9993, before saturation of the sensor.**
- **MQ8, the frequency of the biogas pulses should be >= 10 minutes, to return to the baseline.**
- **MQ8 & MQ4 could be key technology to the growing community infrastructure of open source hardware oriented to biotechnology, for use together with prototyping, low-cost electronics, optoelectronics and microcomputers.**

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