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

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INTRODUCTION

METHODOLOGY

RESULTS

CONCLUSIONS

Introduction

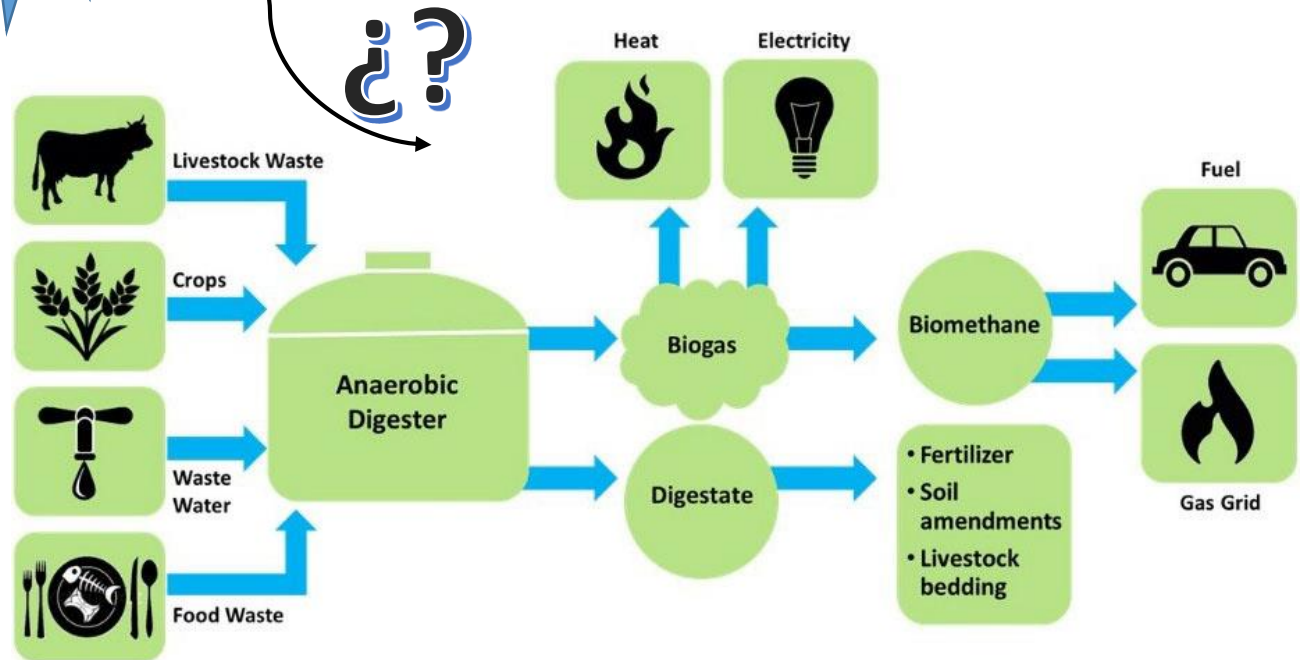
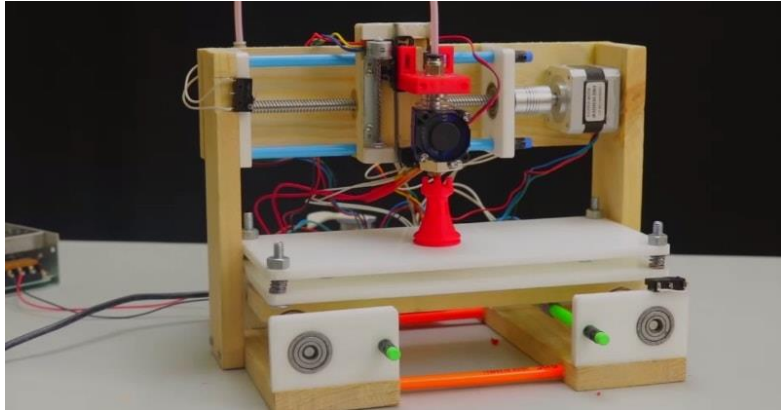
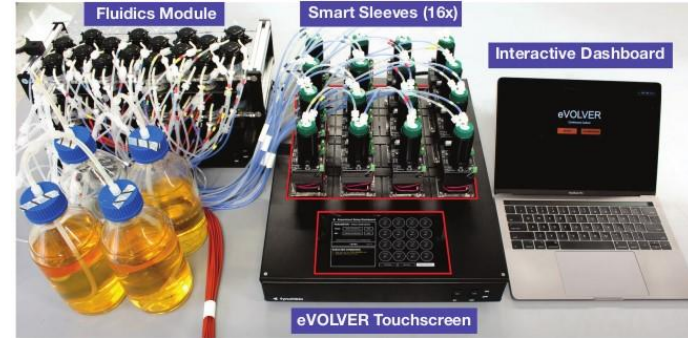
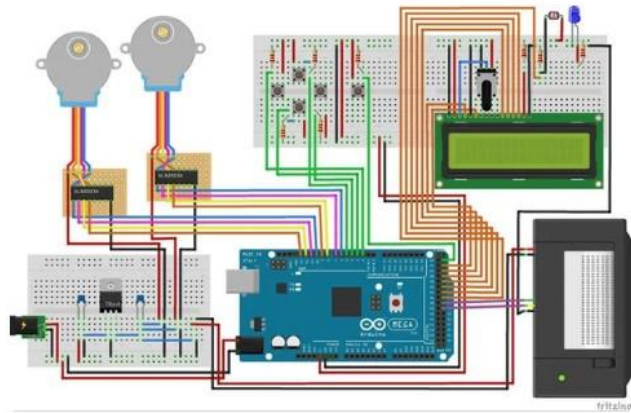
DO IT YOURSELF



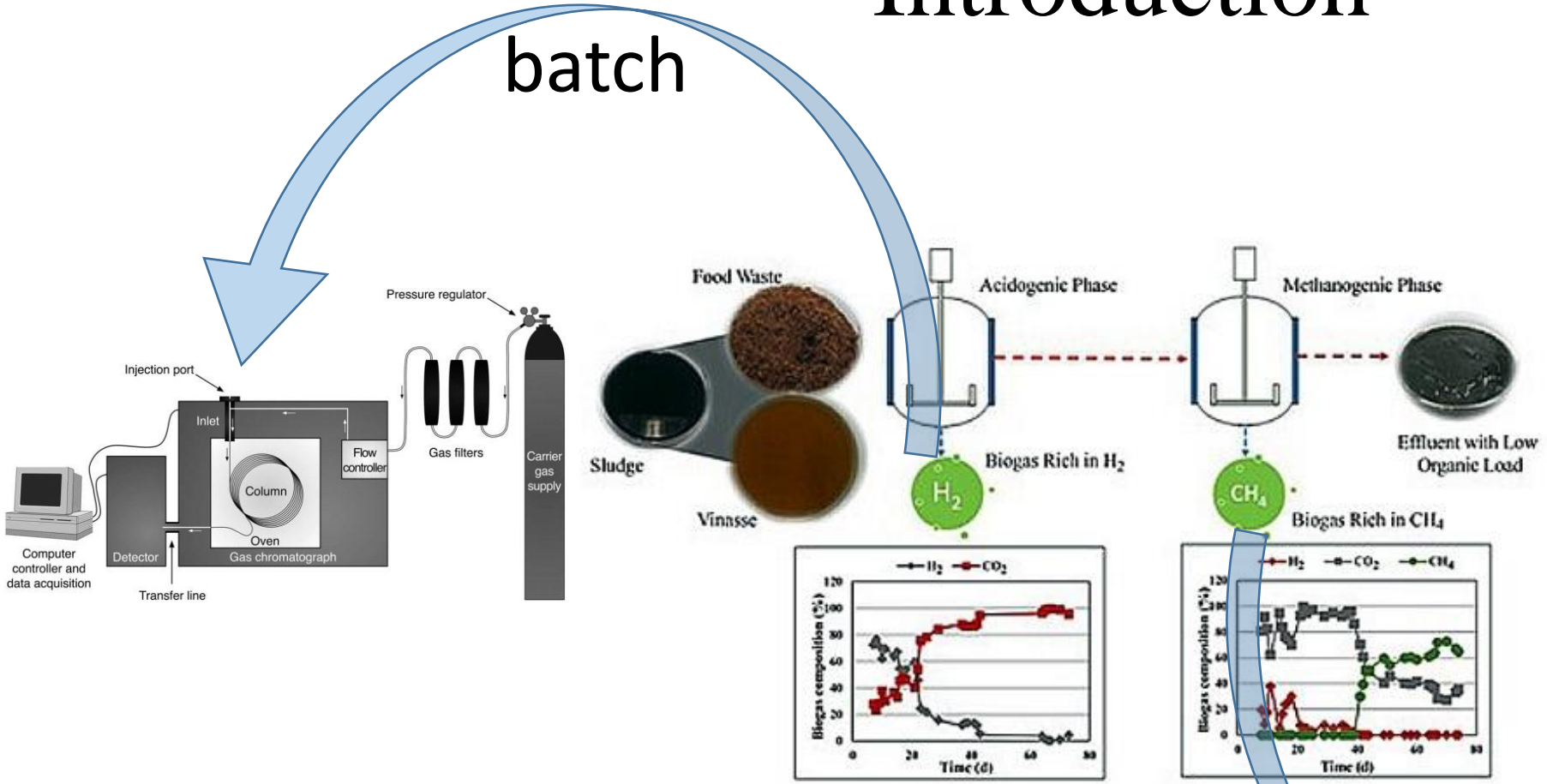
DIY (Do It Yourself)

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



Introduction

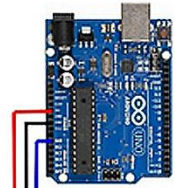


continuous?

Methodology



(a)



(b)

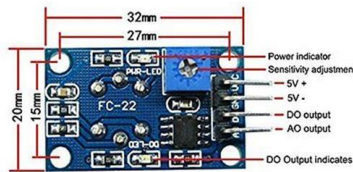
Arduino with
microcontroller ATmega328P



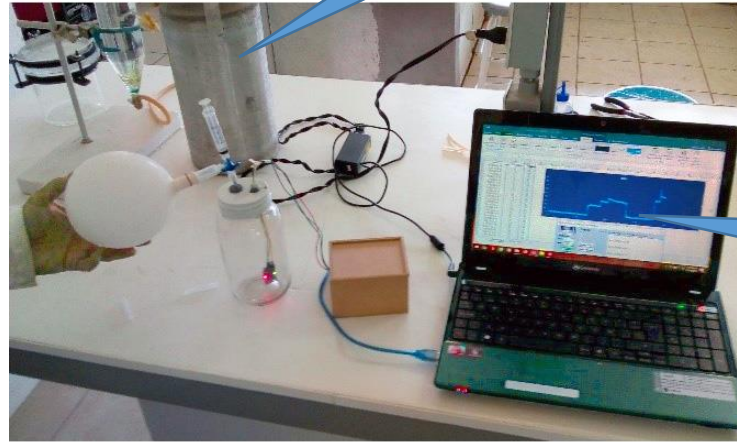
MQ-4
methane



MQ-8
hydrogen

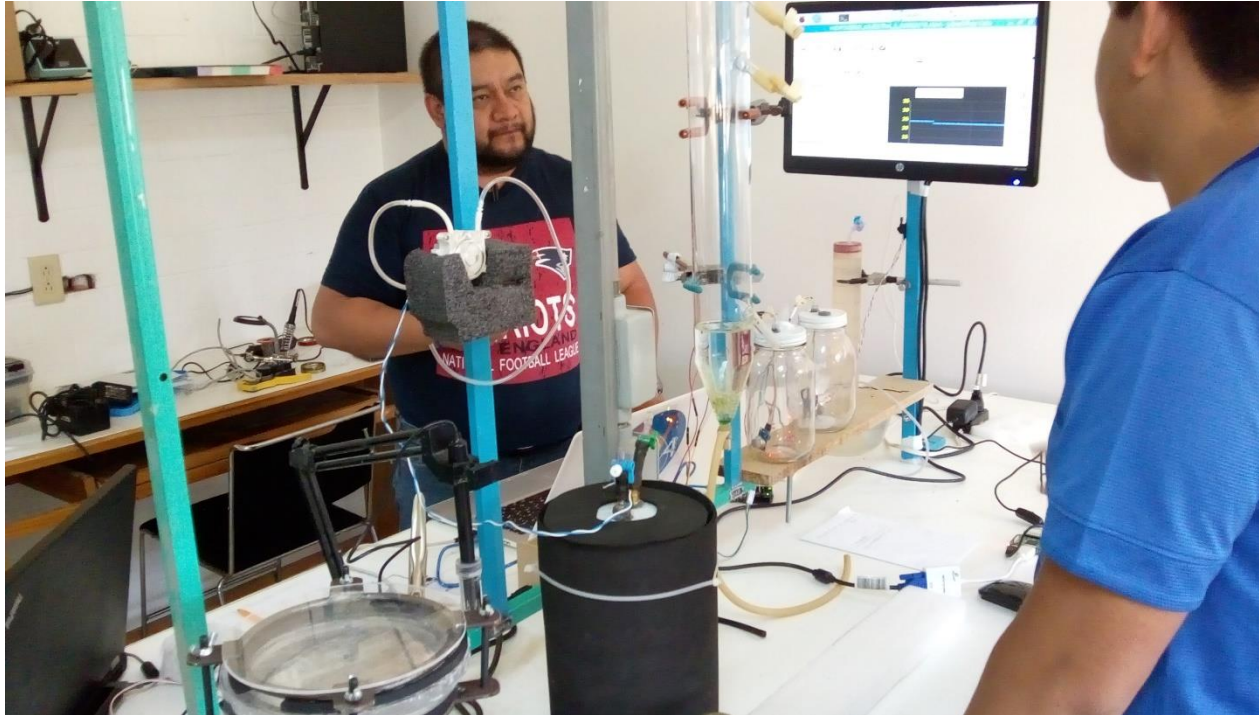


Cylinder with 3-component mixture:
50% hydrogen / 40% methane / CO2
balance; with Gravimetric Analysis
traceable to the weight frame of
CENAM. INFRA brand. 1 m3, 2015 Psig.



Excel interface
PLX-DAQ V2

Methodology

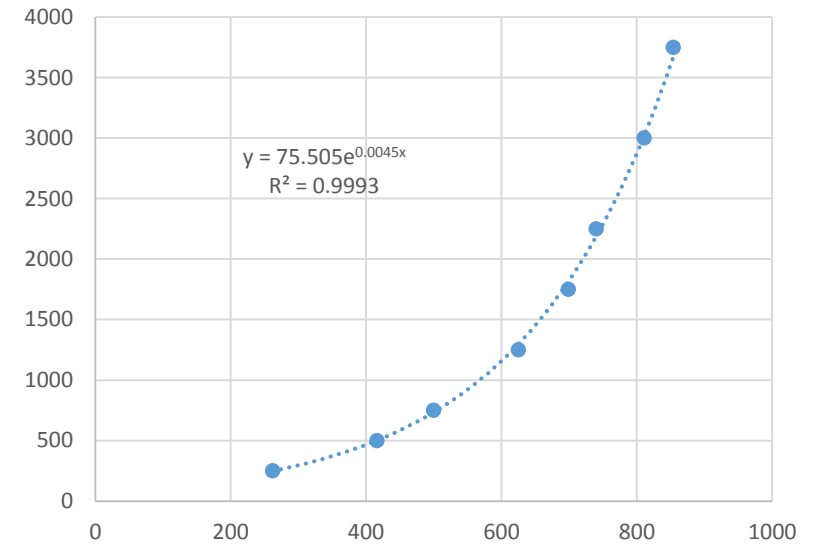
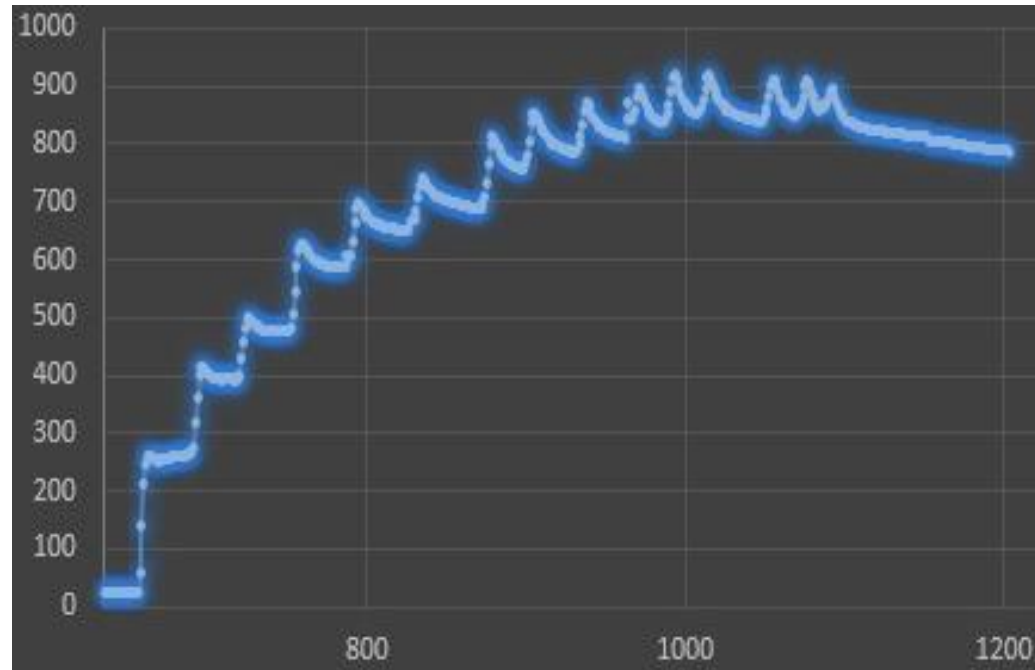


	SENSOR	
	MQ4	MQ8
Detecting concentration scope	200-10000 ppm CH ₄ , natural gas	100-10000 ppm Hydrogen (H ₂)
Sensing Resistance	10KΩ- 60KΩ (1000 pm CH ₄)	10KΩ- 60KΩ (1000 ppm H ₂)
Using Tem	-10°C-50°C	-10°C-50°C
Circuit voltage	5V±0.1 AC OR DC	5V±0.1 AC OR DC
Heating voltage	5V±0.1 AC OR DC	5V±0.1 AC OR DC



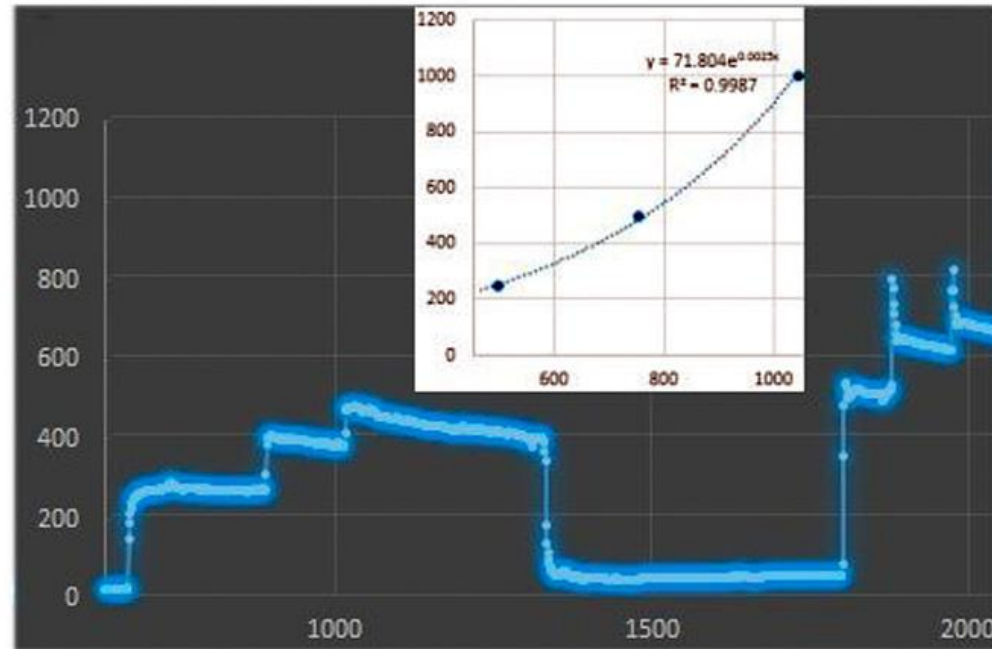
Results

MQ-8 Behavior



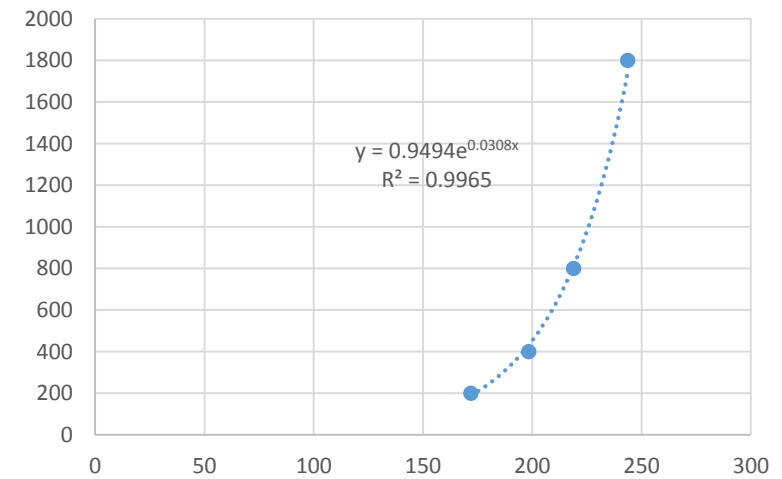
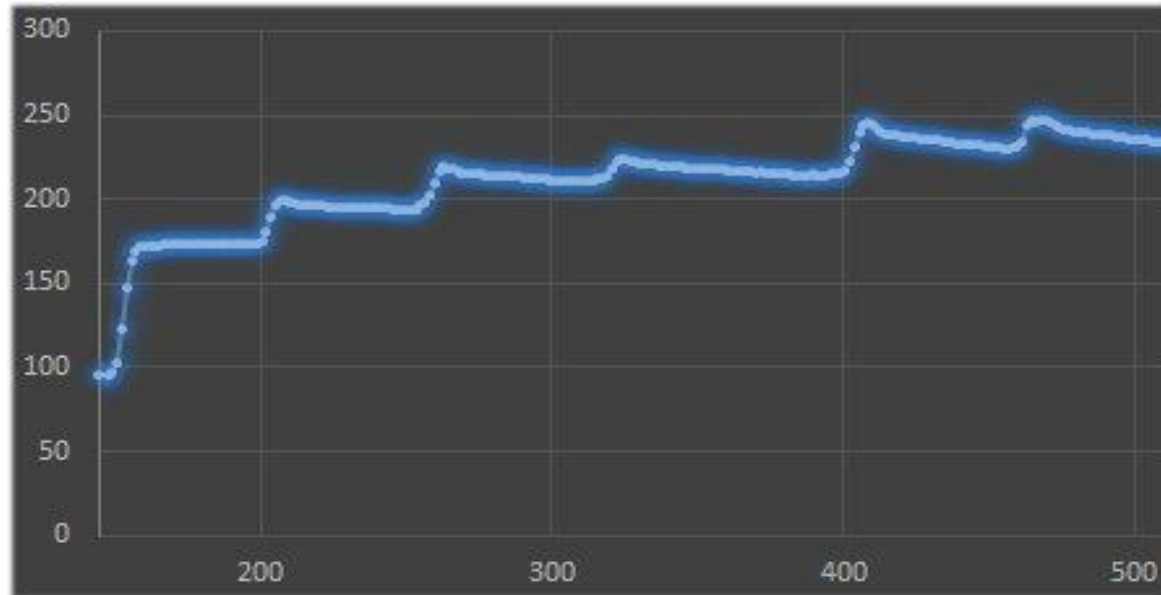
Results

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

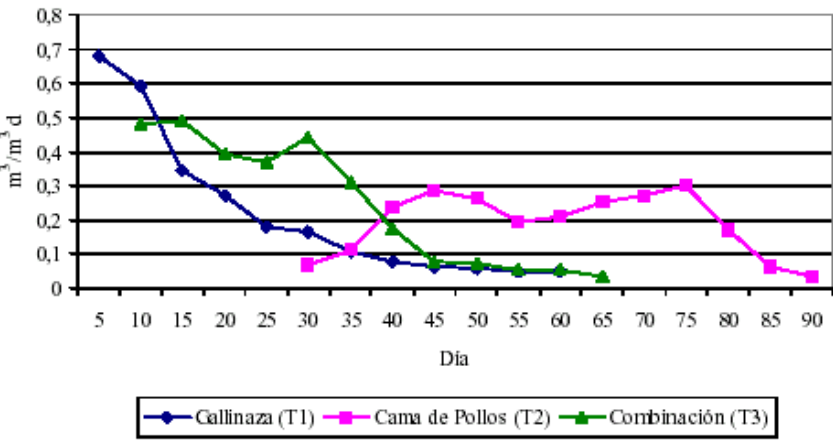


Figura 2. Producción diaria de Biogas

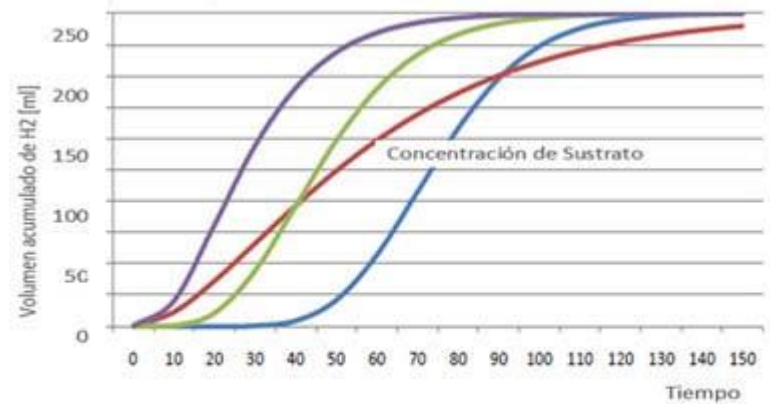
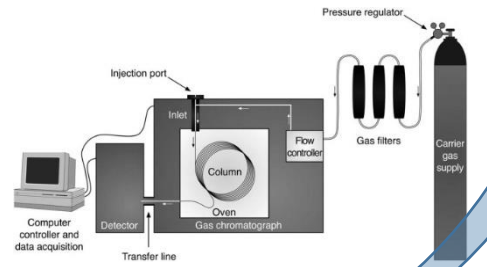
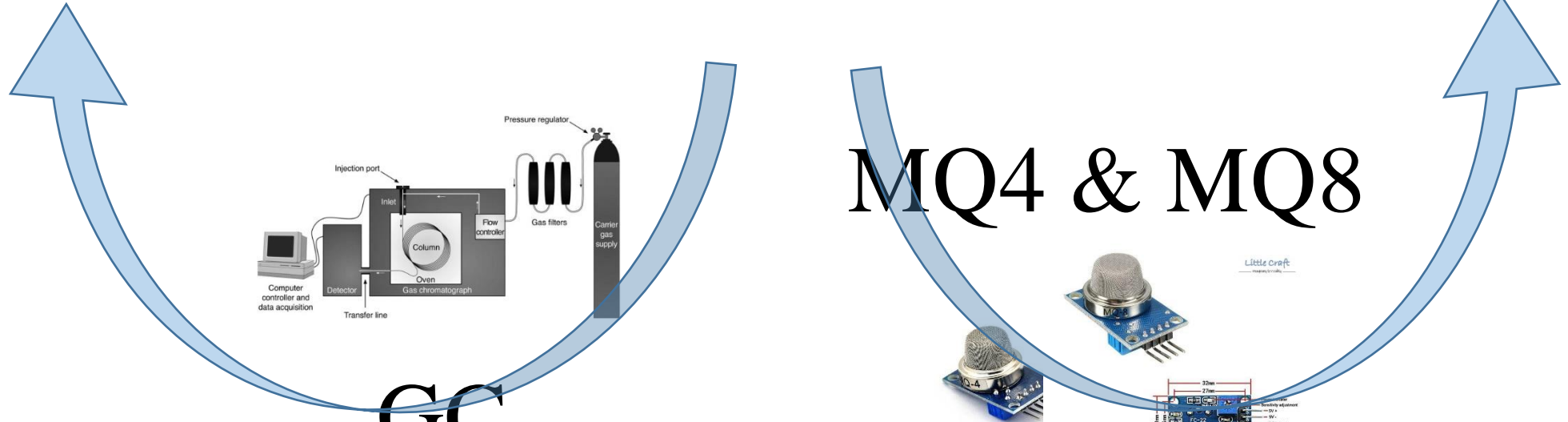
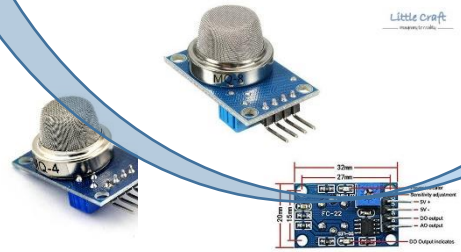


Figura 7. Representación de la cinética de la fermentación oscura por Gompertz



GC

MQ4 & MQ8



Conclusions

- ❑ HydrogenMQ8 and methane MQ4 sensors are adequate for the determination of the composition of these gases in line and semi-continuous biogas reactors.
- ❑ A differential response to concentration was observed, with exponential 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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