Newcastle University

Civil Engineering and Geosciences

Understanding bioelectricity generation and biodiversity in Microbial Fuel Cells

Sharon B. Velasquez Orta

Krishna Katuri, Ian Head, Keith Scott, Tom Curtis

Future Energy: Chemical Solutions

12-14 September, 2007

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- Aim and objectives
- Methodology and experimental set-up
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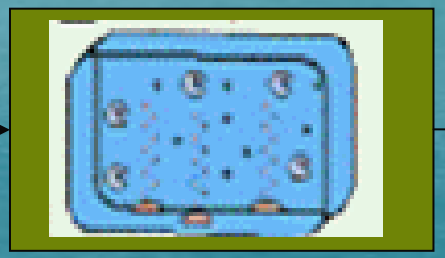
- Future Work

Wastewater Treatment Systems

Physical **Biological**

Wastewater Inlet

High **C**hemical **O**xygen **D**emand



Energy

MFC

COD≈40%

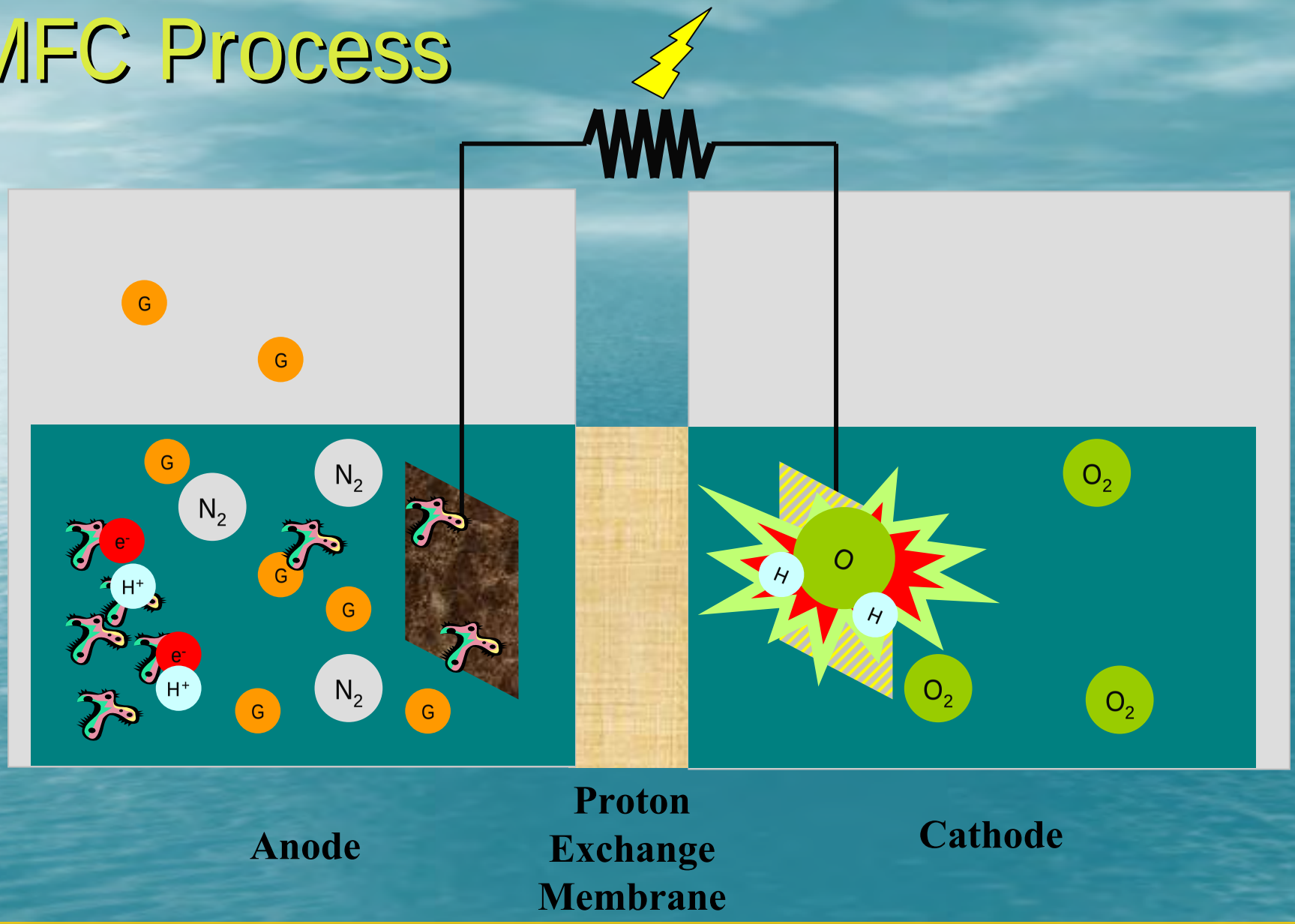
T Tr nt

UV

Chemical

Images taken from www.rdn.bc.ca

MFC Process


G
G
G
N2
N2
e-
H+
G
G
e-
H+
N2
G
G
O2
O
H
H
O2
O2
Anode
Proton Exchange Membrane
Cathode

MFC Reactions

CO_2

$C_6H_{12}O_6 + 6\ H_2O \rightarrow 6\ CO_2 + 24\ H^+ + 24e^-$

H+

$6\ O_2 + 24H^+ + 24\ e^- \rightarrow 12\ H_2O$

H_2O

e^- → Electrode (Anode)

Electrical Circuit

e^- ← Electrode (Cathode)

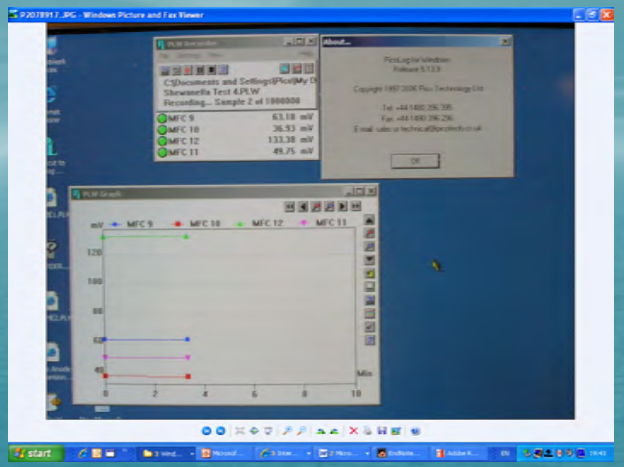
MFC development areas

- To determine the relationship among bacterial density, substrate and power output (Rabaey et al, 2004)
- To study the impact of the bacterial metabolic losses in power output (Logan et al, 2006)
- To clarify bacterial metabolism (Park et al, 2001)

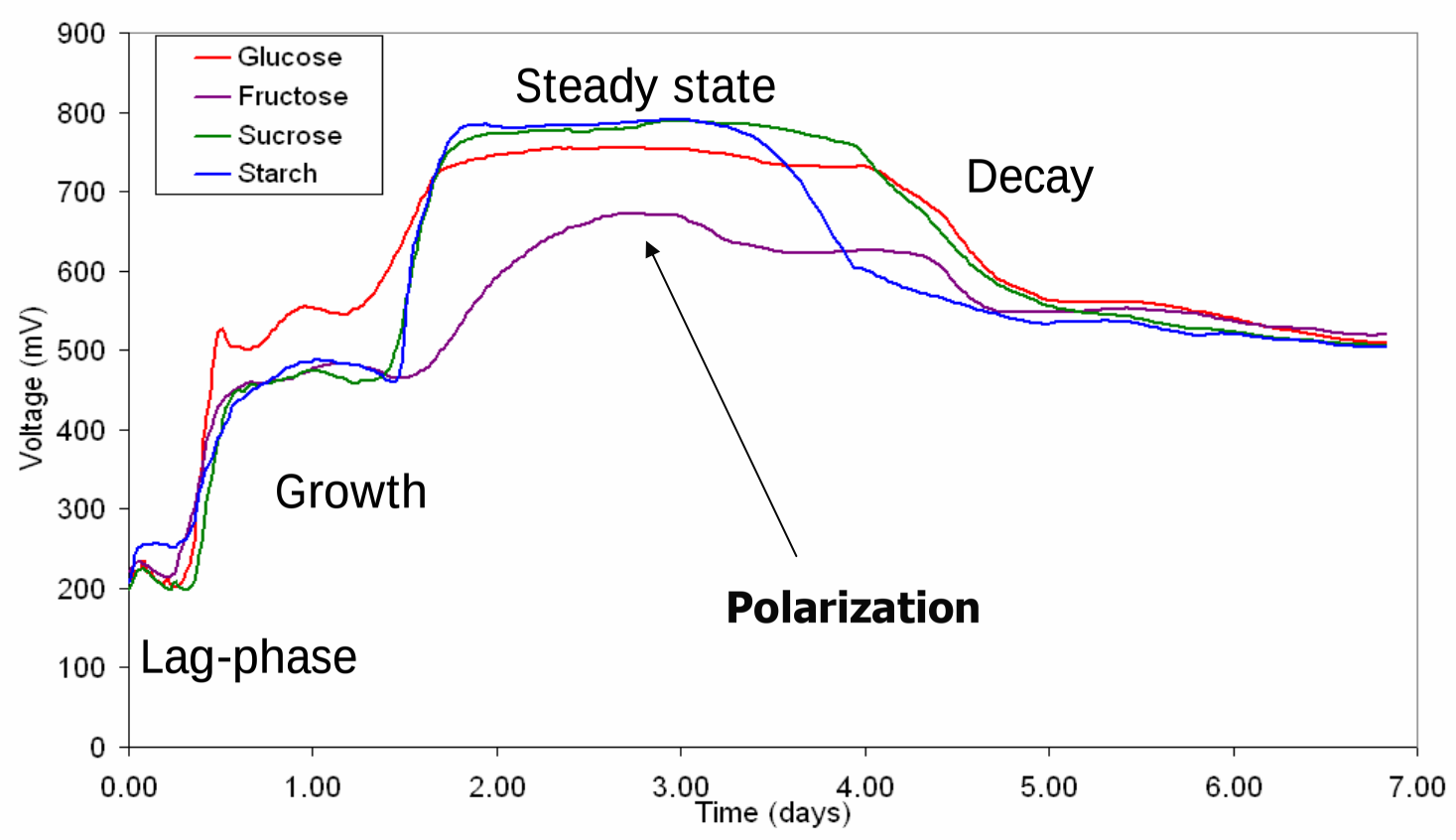
Aim

To evaluate the effect of different organic compounds on bioelectricity production and microbial diversity in Microbial Fuel Cell Technology

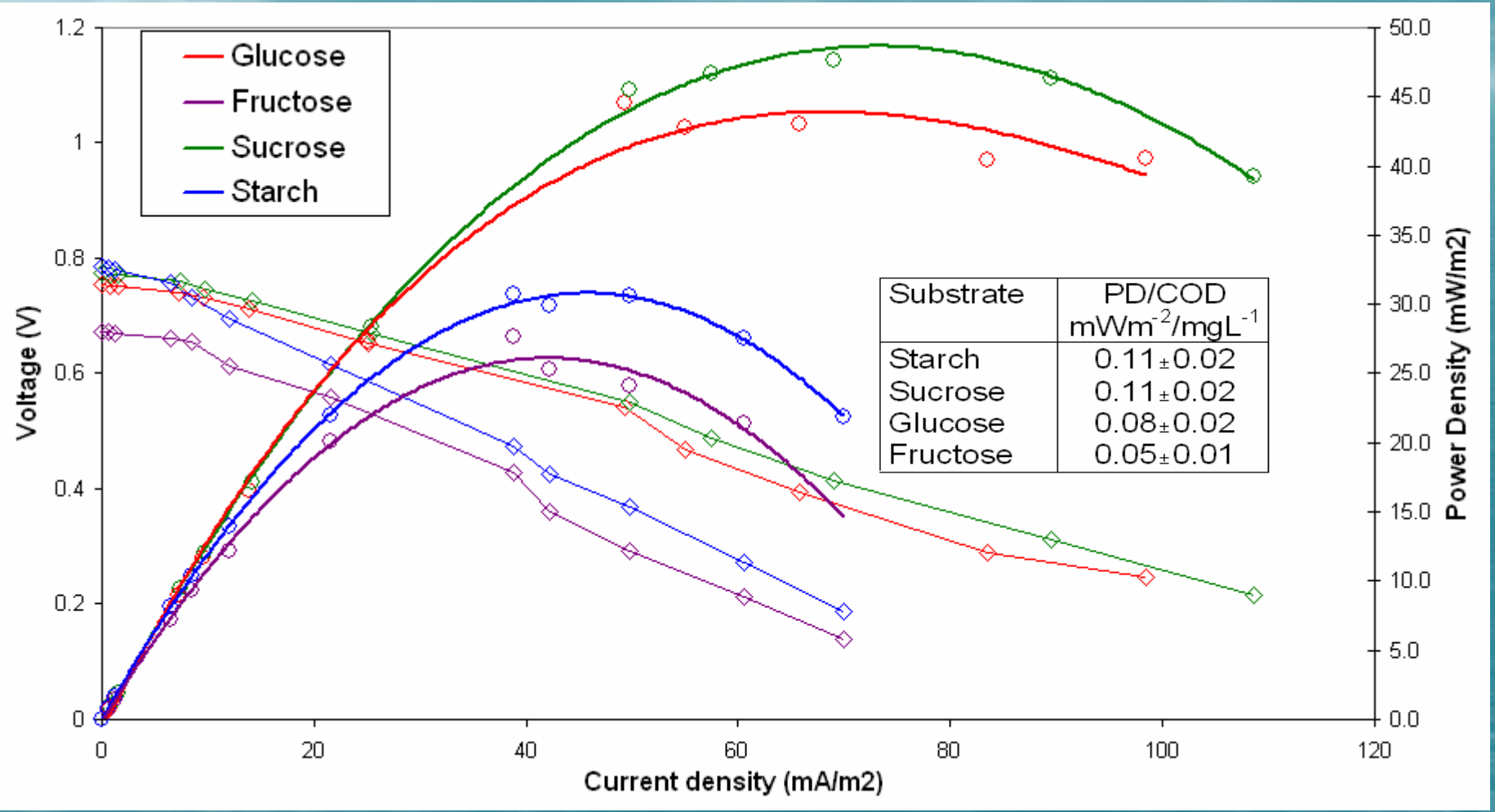
Experimental Set-up



Voltage Production

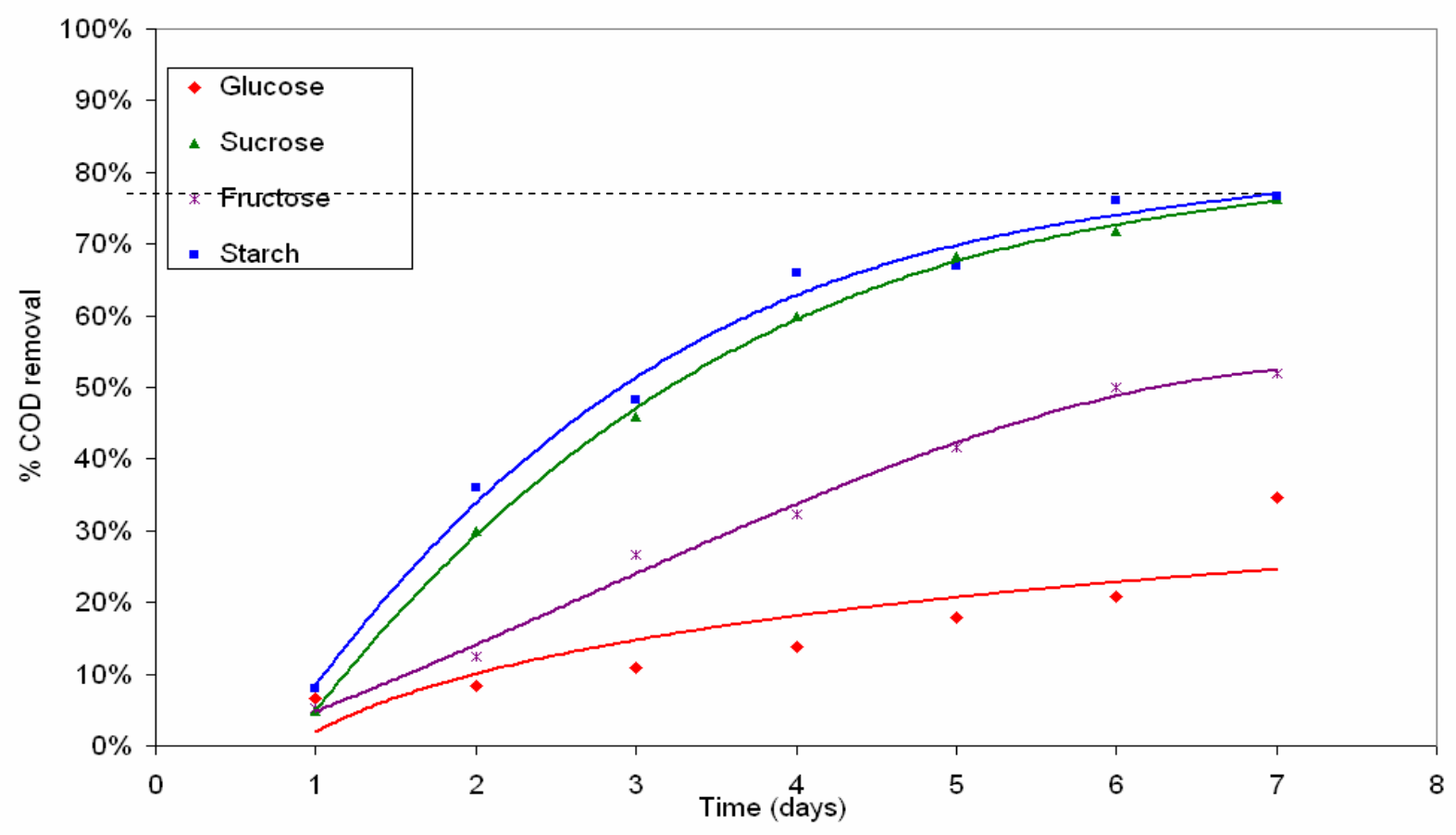


Power Densities & Voltage Losses



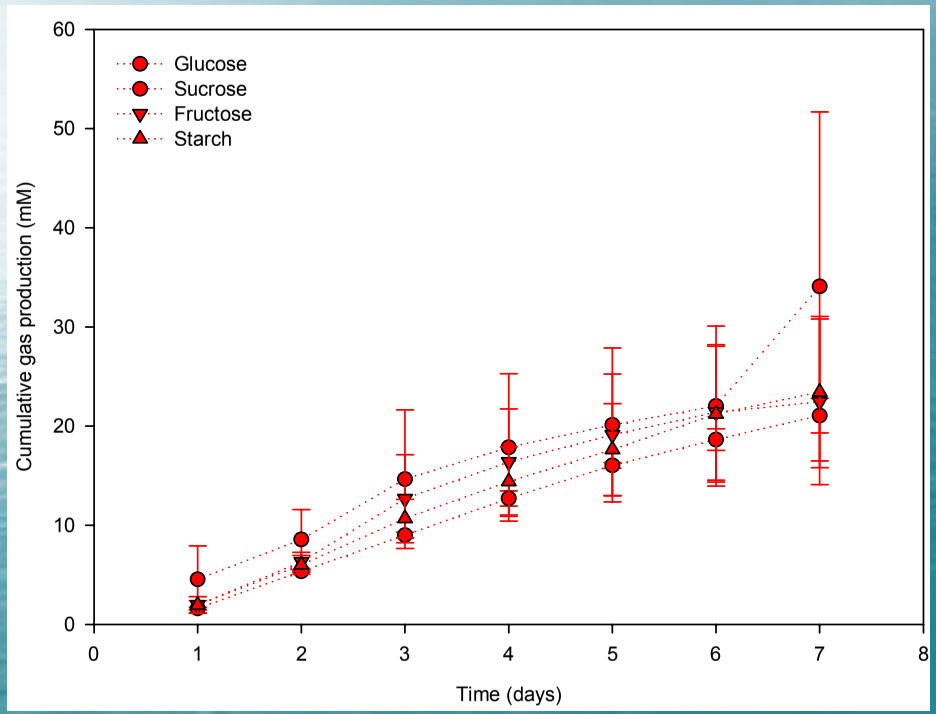
Substrate	PD/COD mWm^{-2}/mgL^{-1}
Starch	0.11±0.02
Sucrose	0.11±0.02
Glucose	0.08±0.02
Fructose	0.05±0.01

COD Removal

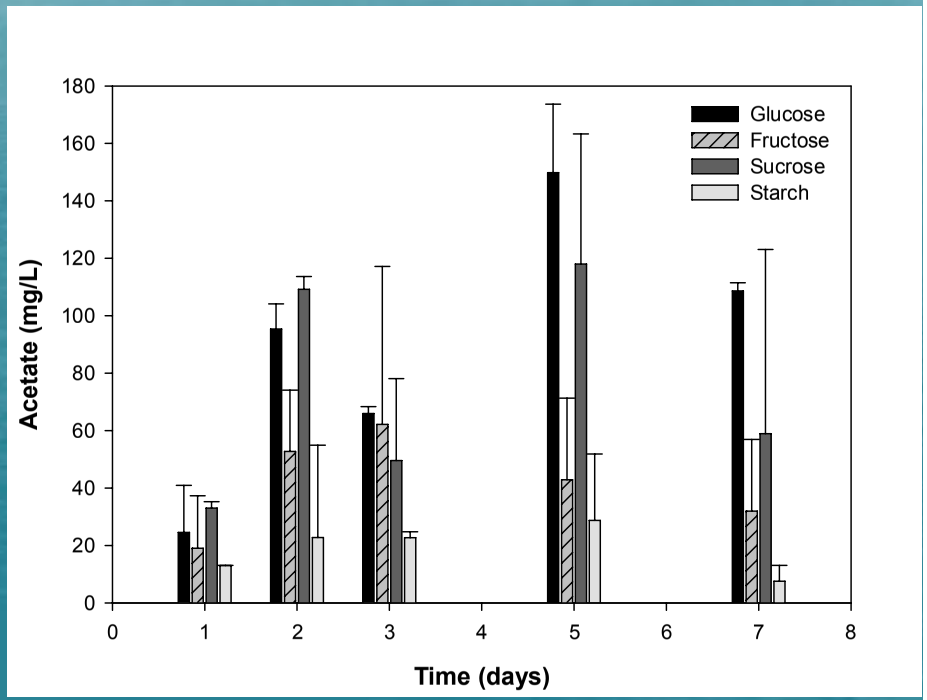

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% COD removal
Glucose
Sucrose
Fructose
Starch
0
1
2
3
4
5
6
7
8
Time (days)

By-products: VFA and Biogas

CO_2



Acetic, propionic & butyric acids



Conclusions

- ✓ Substrate complexity influences microbial fuel cell performance and bacterial enrichment
- ✓ Polysaccharides produced greater PD/COD than monosaccharides and had higher COD removals
- ✓ MFC microorganisms in the biofilm and bulk liquid had significant differences according to the substrate used and location
- ✓ There is an bacterial enrichment were pseudomonas predominate and act as the catalyst

Acknowledgements

- CONACyT, México (Grant 196298)
- European Union for Transfer of Knowledge award on biological fuel cells (contract MTKD-CT-2004-517215)

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THANK YOU