Crecimiento de bacterias electrogénicas en humedales artificiales

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Juan P. Busalmen

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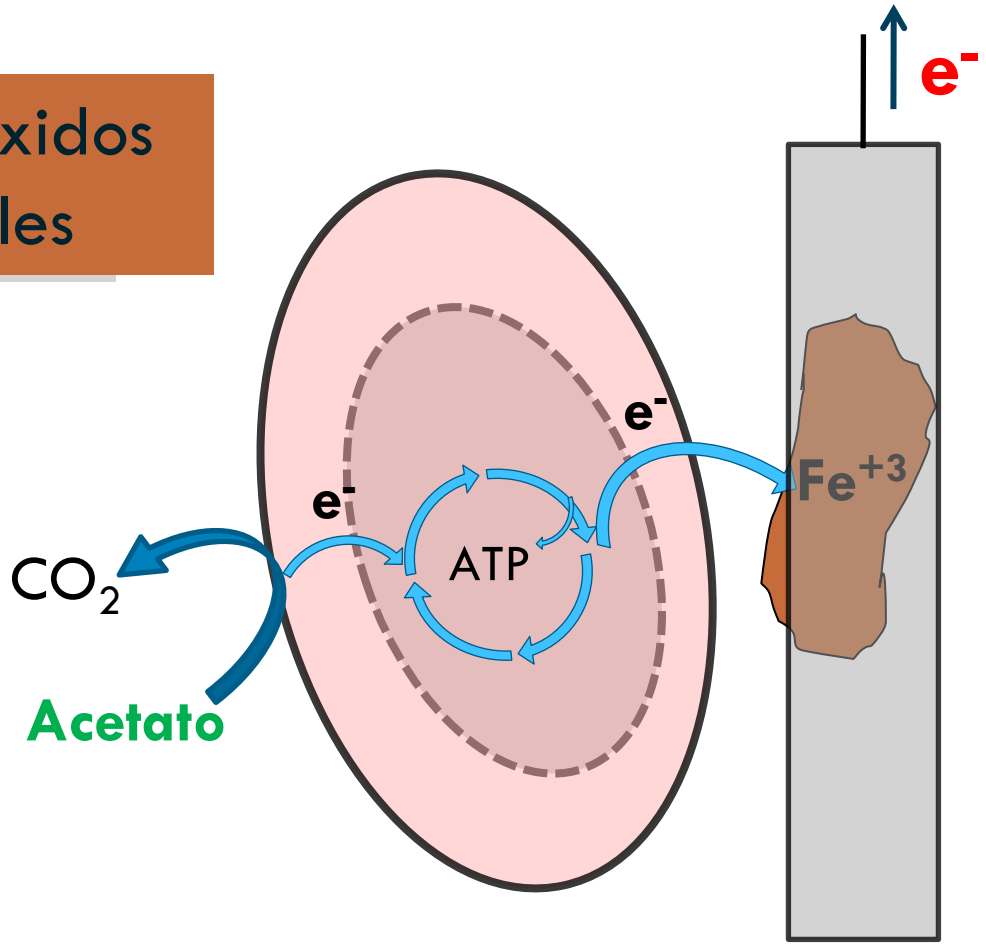
¿Bacterias electrogénicas?

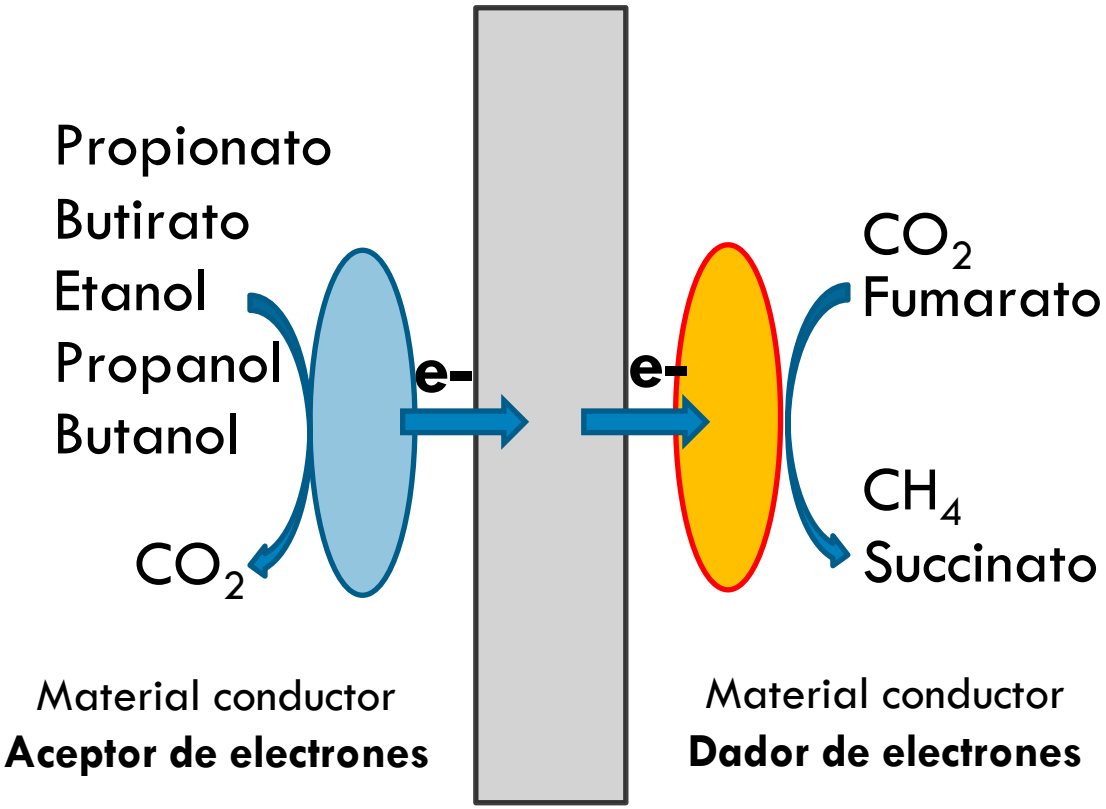
Respira óxidos insolubles



- ✓Metabolismo rápido
- ✓ Baja DQO
- ✓ Baja temperaturas
- ✓ Presentes en aguas residuales

$$\text{Acetato} + Fe^{+3}_{app} \rightarrow CO_2 + e^- + Fe^{+2}$$

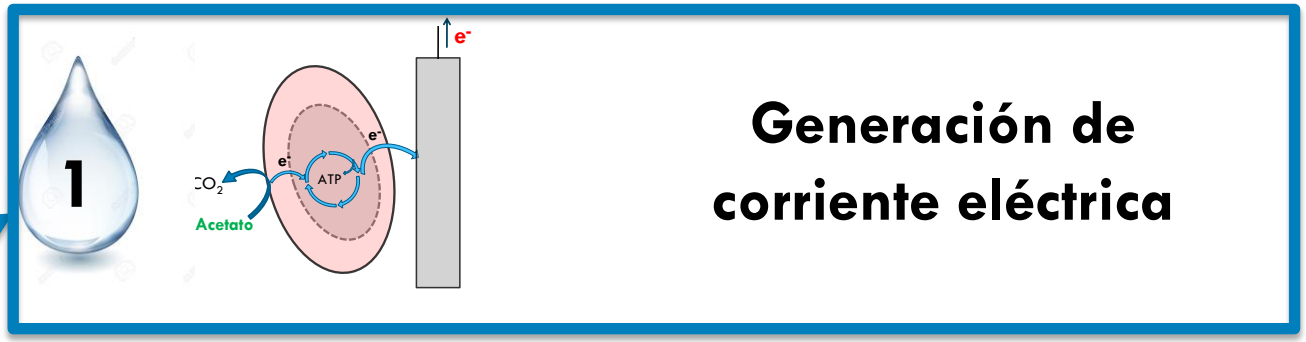
DIET (Direct interespecies electron transfer)



¡Se amplía la diversidad metabólica!

Direct Exchange of Electrons Within Aggregates of an Evolved Syntrophic Coculture of Anaerobic Bacteria
Zarath M. Summers, *et al.*
Science **330**, 1413 (2010);

Líneas de trabajo con humedales

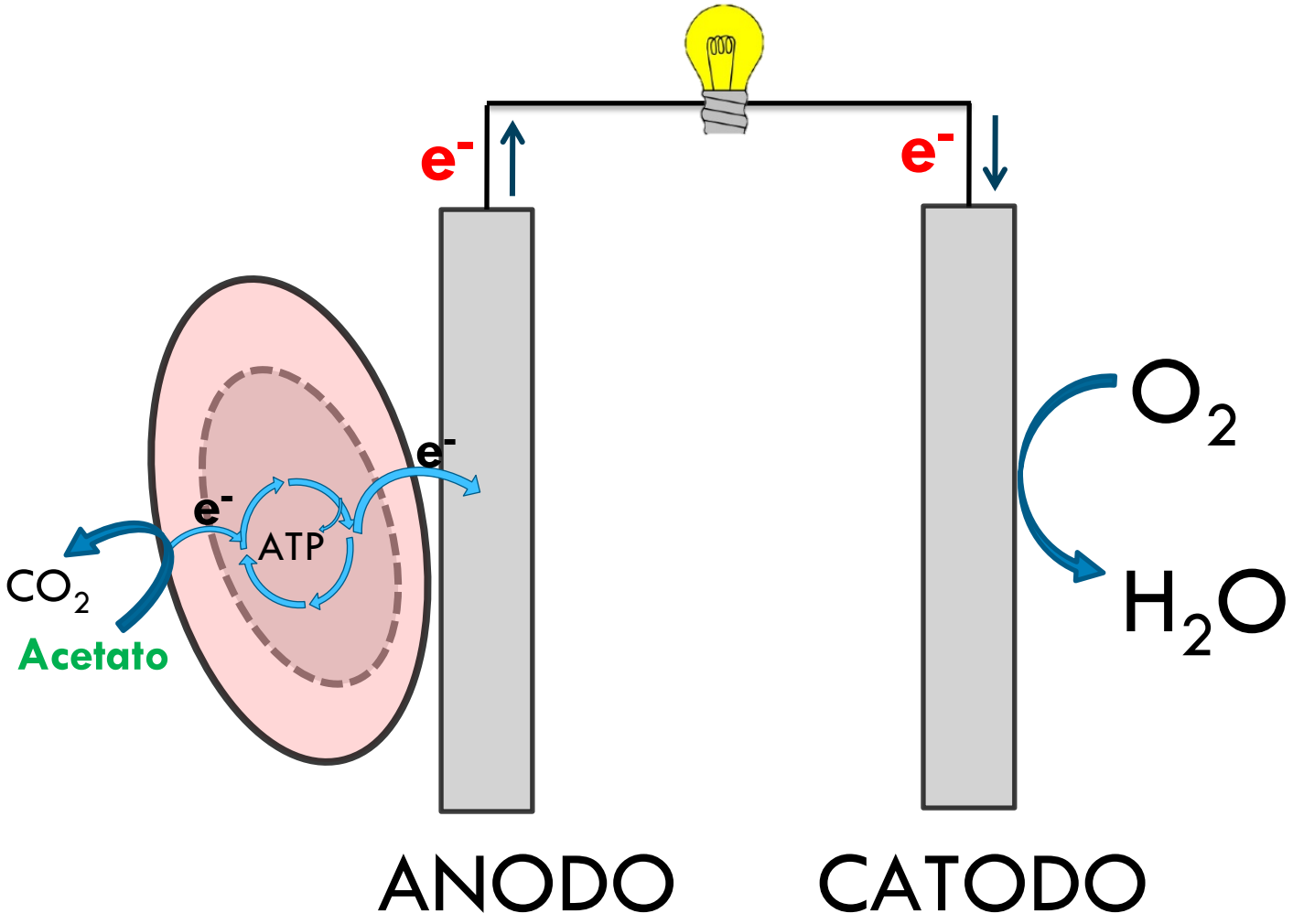


INTEMA / CONICET

Aprovechamiento de DIET

iMETland

1 Generación de corriente eléctrica



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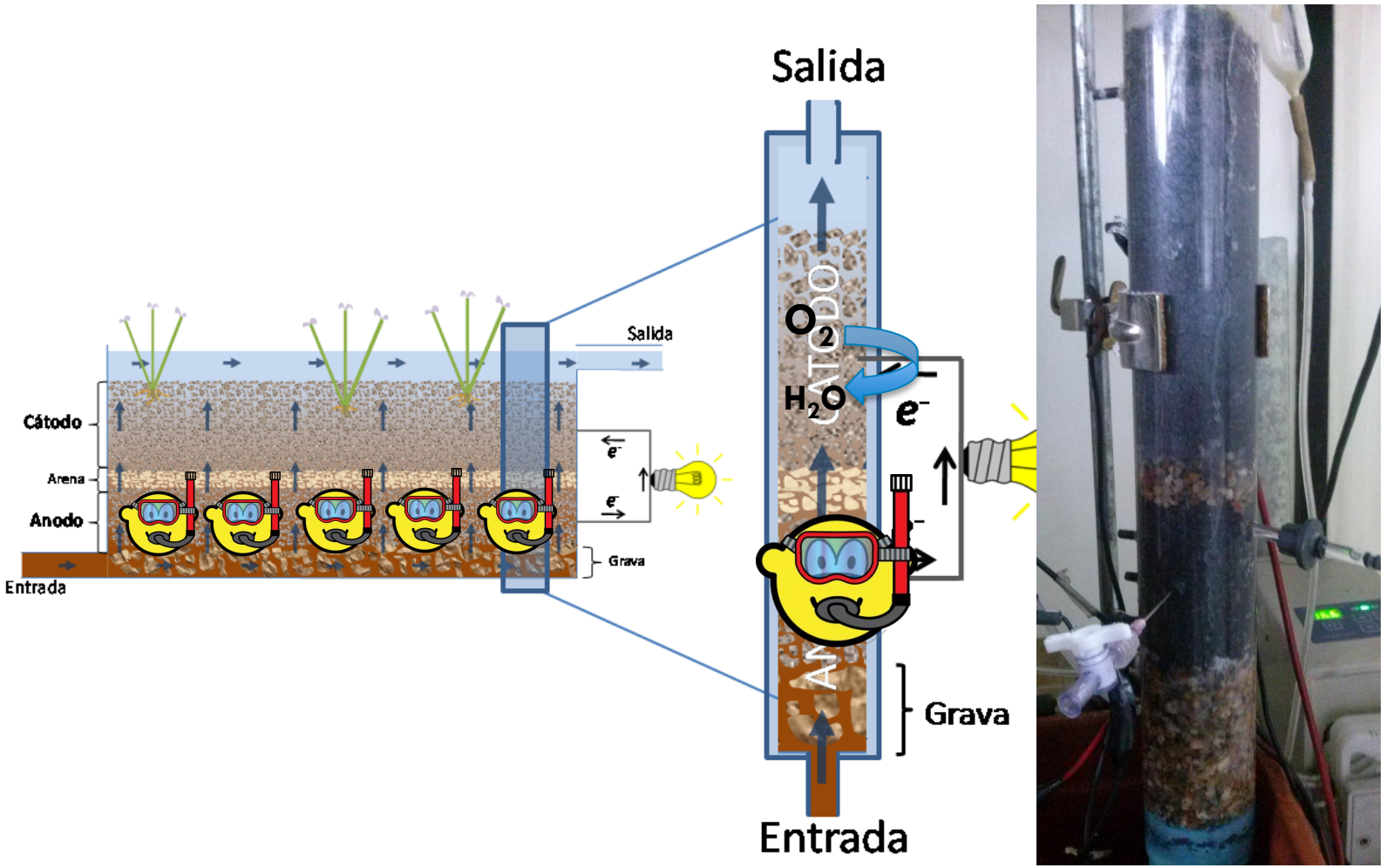

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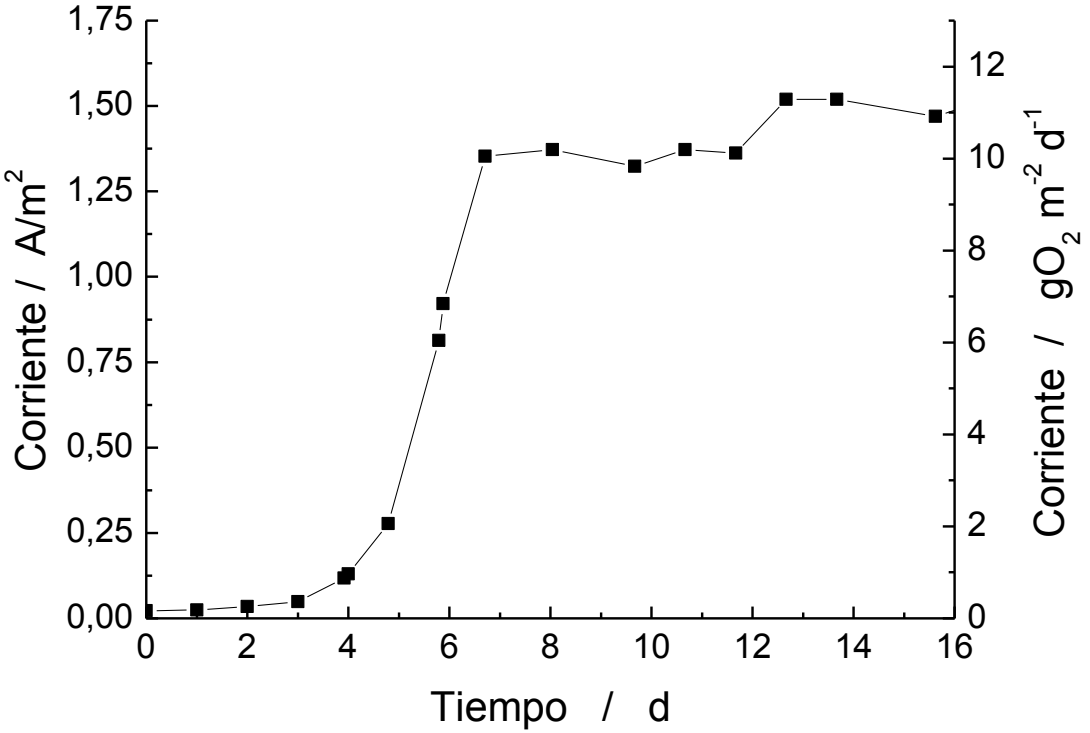
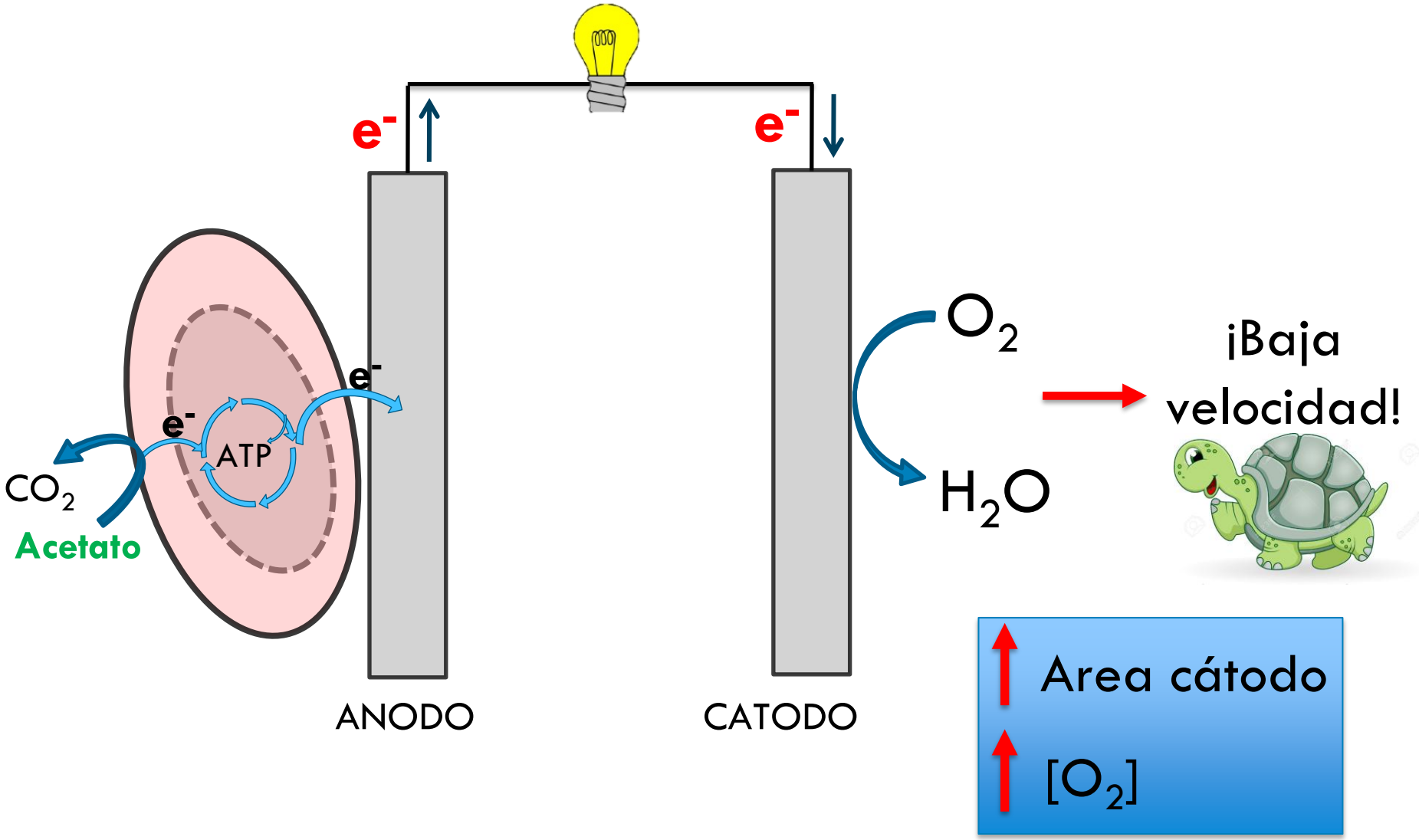


Cultivo puro *G. sulfurreducens*

h Altura ánodo = 1,5 cm

$E_{ánodo}$ = 0,05 V *(vs Ag/AgCl)*

1 Generación de corriente eléctrica



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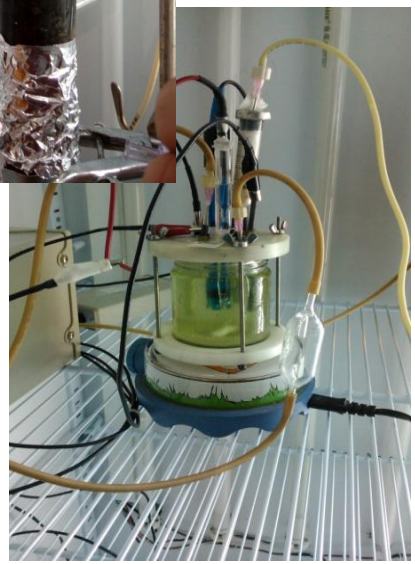
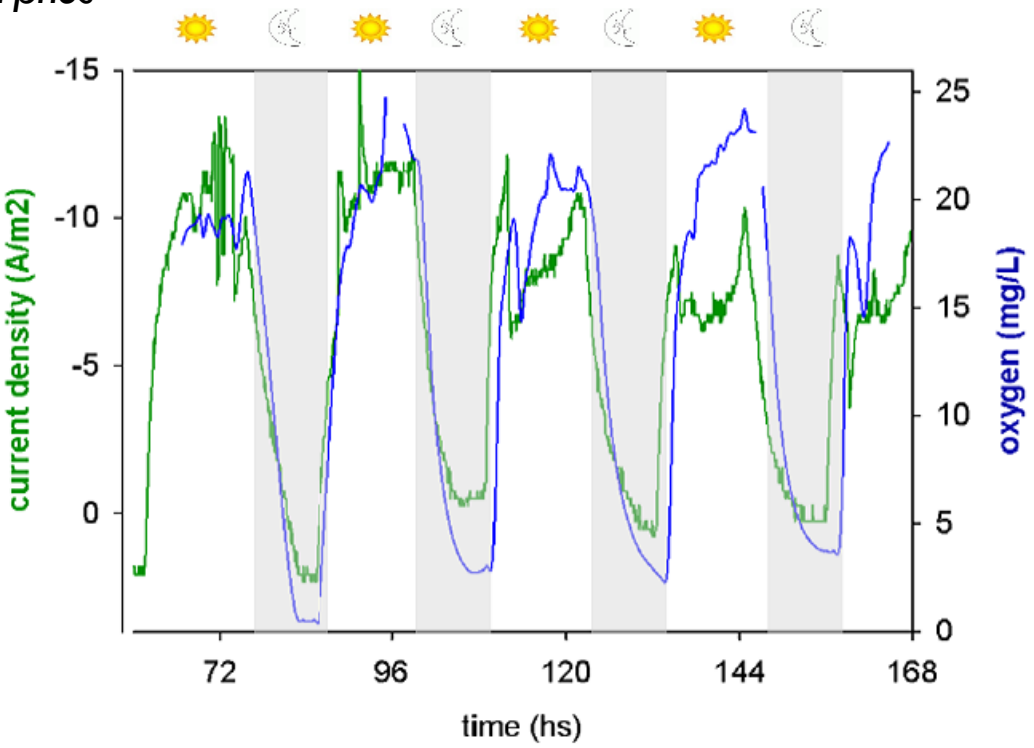


Scenedesmus dimorphus
En grafito/Coque

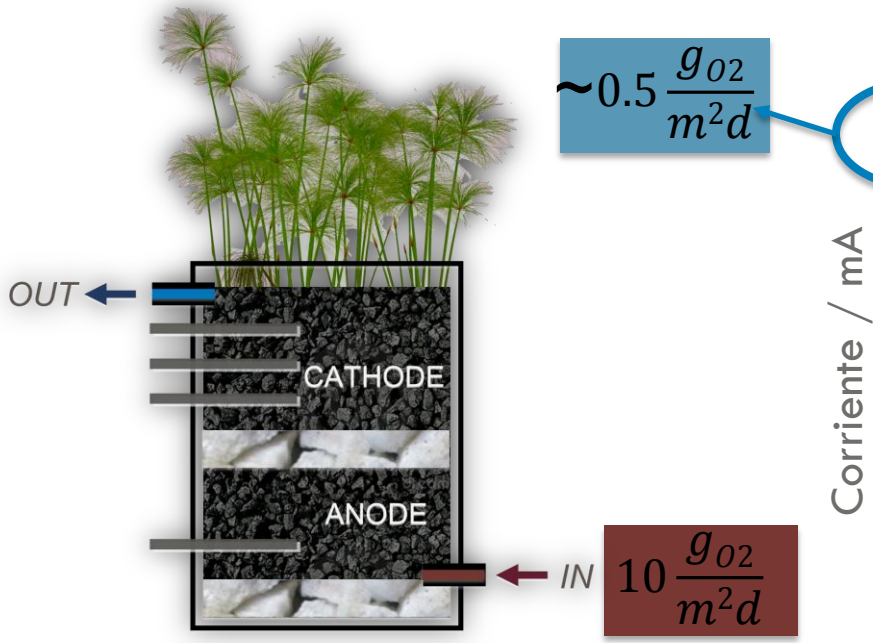


[O_2]

14 -22 mgO_2/litro
(Saturación con aire 5-7 mgO_2/litro)

10 cm dan **20 gO_2 m^{-2} d^{-1}**

1 Generación de corriente eléctrica

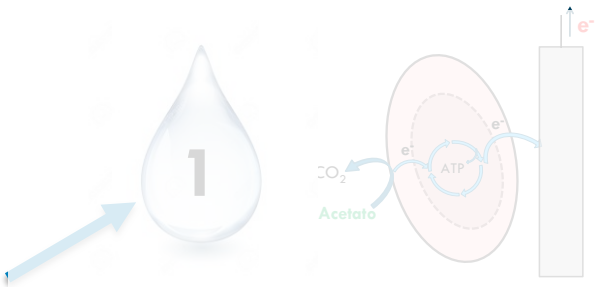


$\sim 0.5 \frac{g_{O2}}{m^2 d}$

$10 \frac{g_{O2}}{m^2 d}$

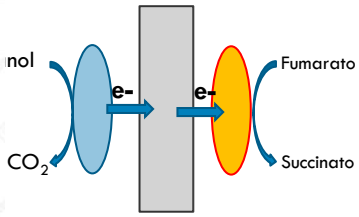
Eficiencia = **5%**
vs **10-15%**
en sistemas bioelectroquímicos estabilizados

Líneas de trabajo con humedales



Generación de corriente eléctrica

INTEMA / CONICET



Aprovechamiento de DIET

iMETland

2 Aprovechamiento de DIET

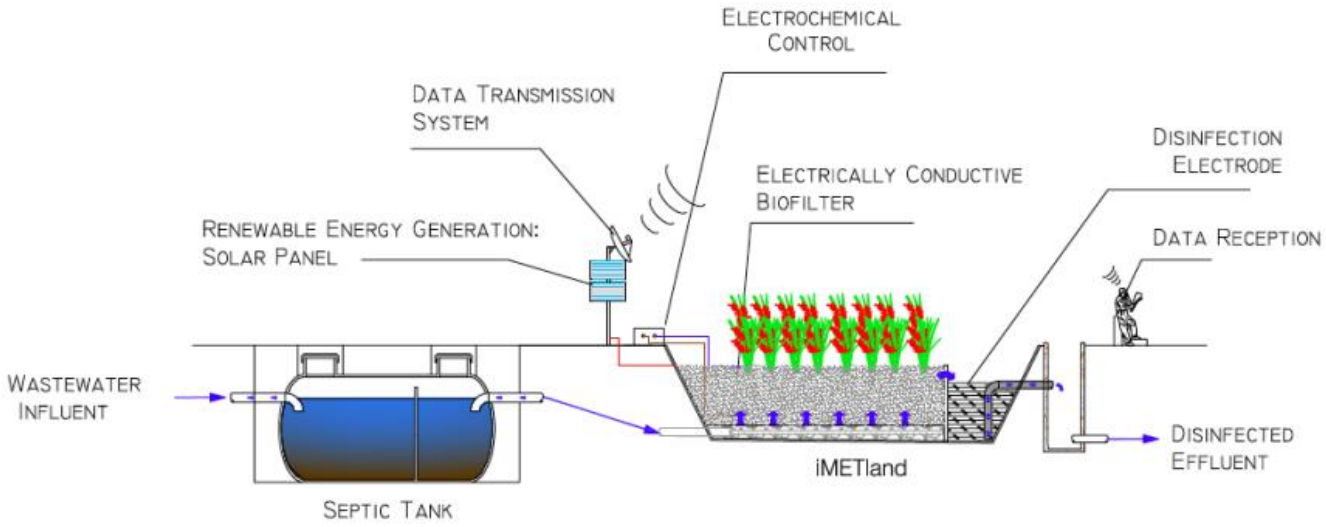
2 Aprovechamiento de DIET

iMETland

Tratamiento de aguas sin coste energético

Hasta 200 personas

Poblaciones/barrios/hogares sin acceso a la red



2 Aprovechamiento de DIET

iMETland

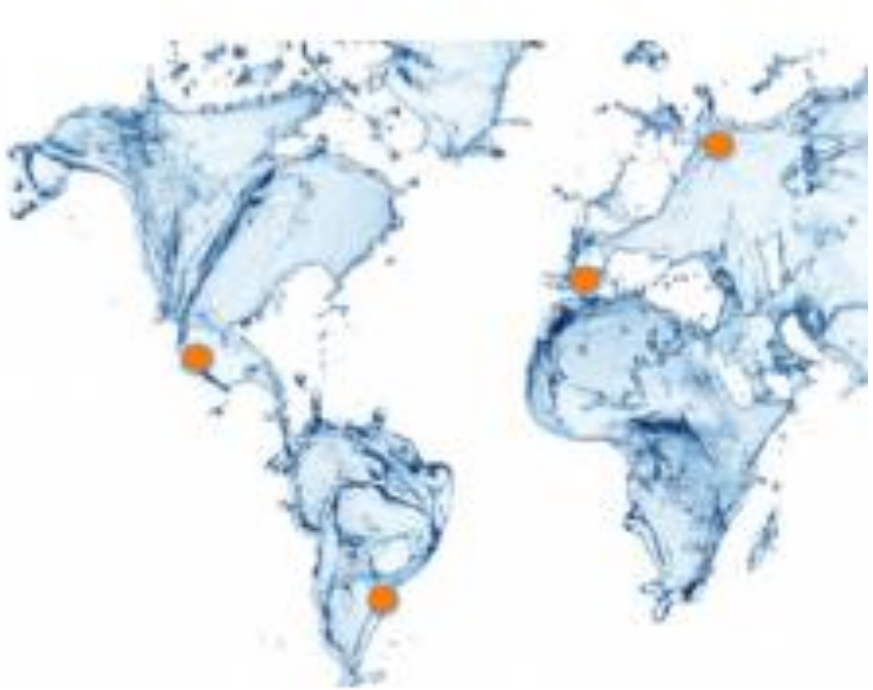
	iMETland (200PE)	Standard wetland[1] (200PE)
DESIGN PARAMETERS		
Total area (m^2)	80	600
Area (m^2/PE)	0.3	3
Depuration capacity ($gDBO_5$/day m^2)	125	6
TSS removal (% removal)	99%	90%
Disinfection treatment	YES	NO
On line monitoring of operation quality	YES	NO
Bed clogging	NO	YES
	iMETland (200PE)	**Standard wetland[1] (200PE)**
COST ANALYSIS		
Construction Cost (euros/PE)	45	300
Bed material cost (euro/PE)	120	50
Construction cost (for 200 PE)	9000	60000
cost associated to operation (euros/year)	3000	7000

institute imdea water

centa
FUNDACIÓN CENTRO DE LAS NUEVAS TECNOLOGÍAS DEL AGUA

2 Aprovechamiento de DIET

iMETland



A) Validación global:

- Sevilla, España
- Jiutepec, Méjico
- Orby, Dinamarca
- MdP, Argentina

B) Plan de negocios

C) Comercialización

CONICET

UNIVERSIDAD NACIONAL de MAR DEL PLATA

I N T E M A

iMETland

Preguntas?

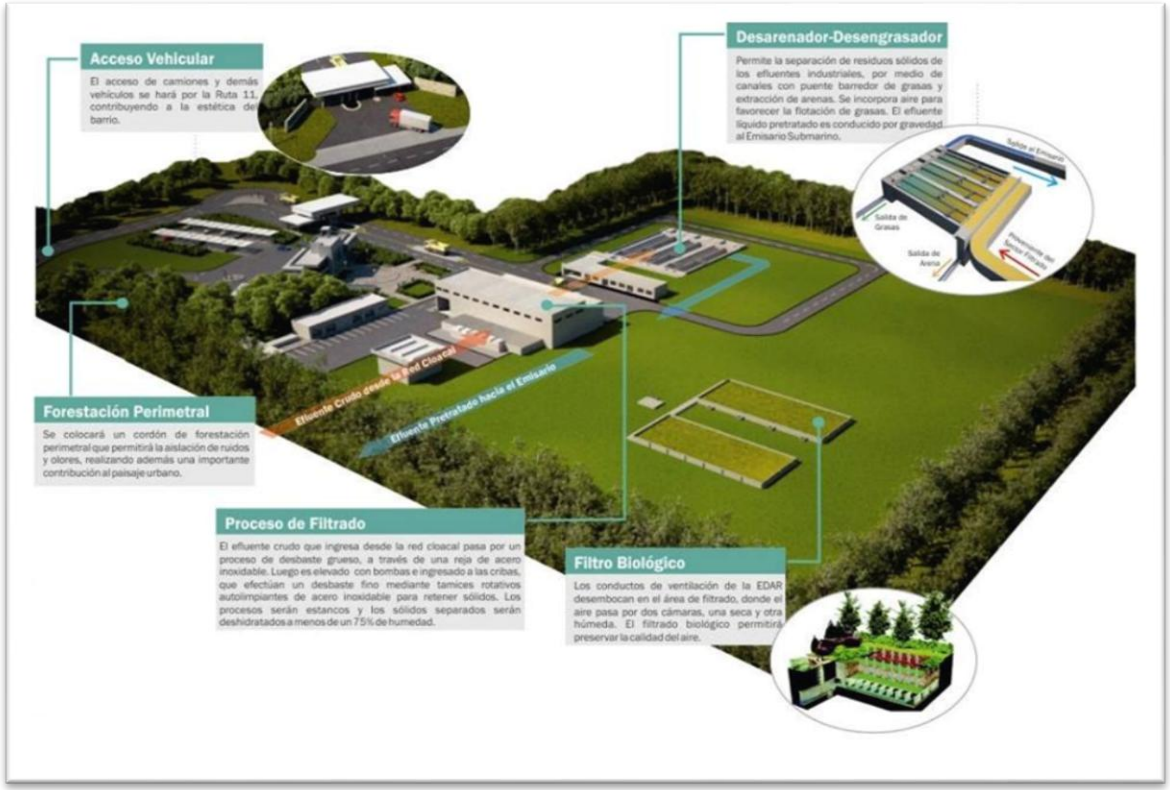
www.imetland.eu

www.electromicrobio.org

Sebastian.bonanni@fi.mdp.edu.ar

Final location

New wastewater treatment plant in Mar del plata



1.800.000 inhab.

September 2017

Grids, screens

+

Degritting and degreasing (small solids, sand, grease)

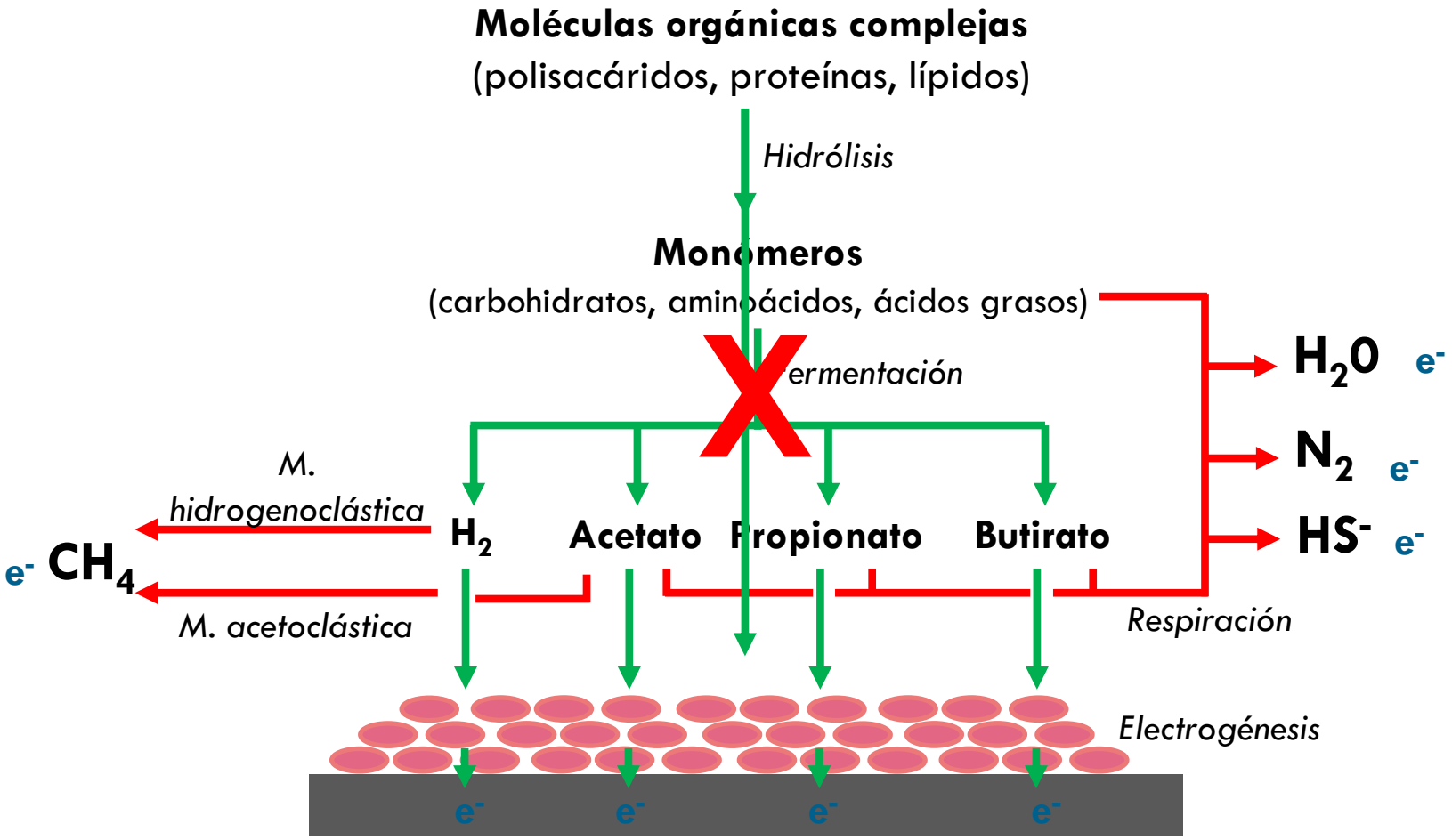
+

Biological Filter (gases)

+

Submarine outfall

Cadena trófica



$$\text{Eficiencia coulombimétrica (EC)} = \frac{\text{e- colectados como corriente}}{\text{e- totales removidos del agua residual}}$$

Metanogénicas vs Electrogénicas

Electrogénicas vs Metanogénicas

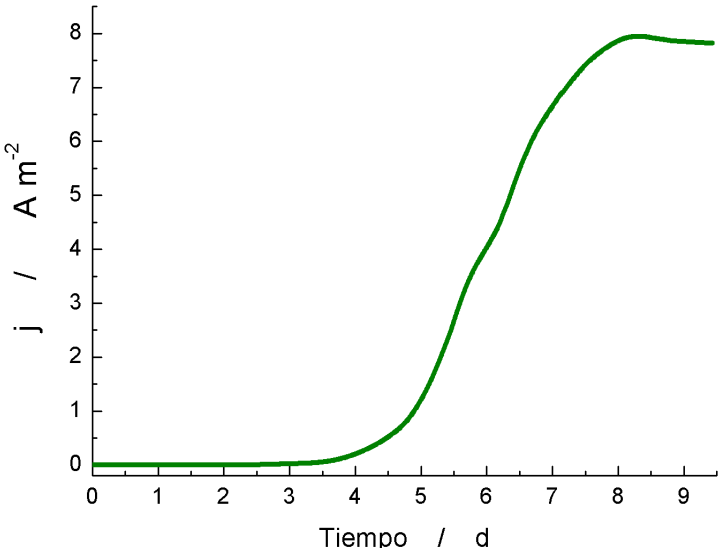
	Geobacter S.	Metanog.	Acetogénicas
K_s Acetato (mM)	1-2	1-7	-
q_{max} ($gC_{OD}\ g_{VS}^{-1}\ d^{-1}$)	19 *(Lee et. al)*	3 *(Lier et al)*	13 *(Lier et al)*
μ (h^{-1})	0.04-0.09	0.03-0.3	-

✓Crece y degradan más rápido que metanogénicas

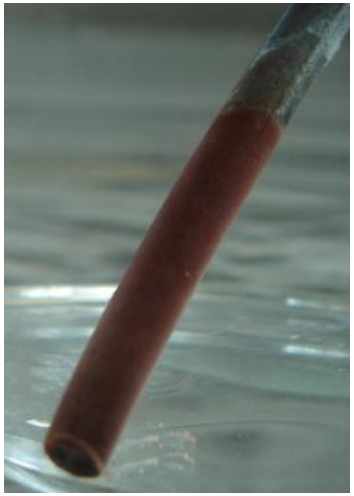
✓ Trabaja mejor a bajas DQO (mayor afinidad por el acetato)

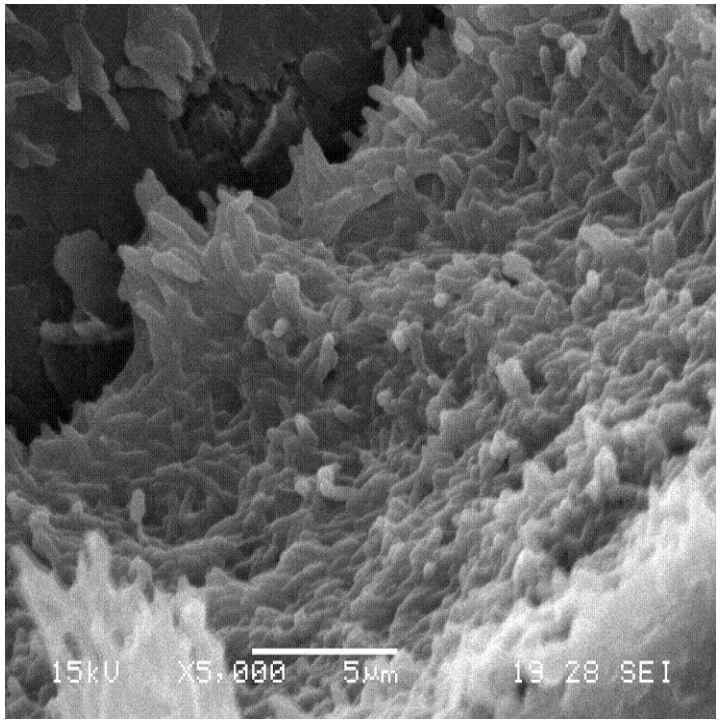
✓ Trabaja mejor a bajas temperaturas

Crecimiento en biofilms



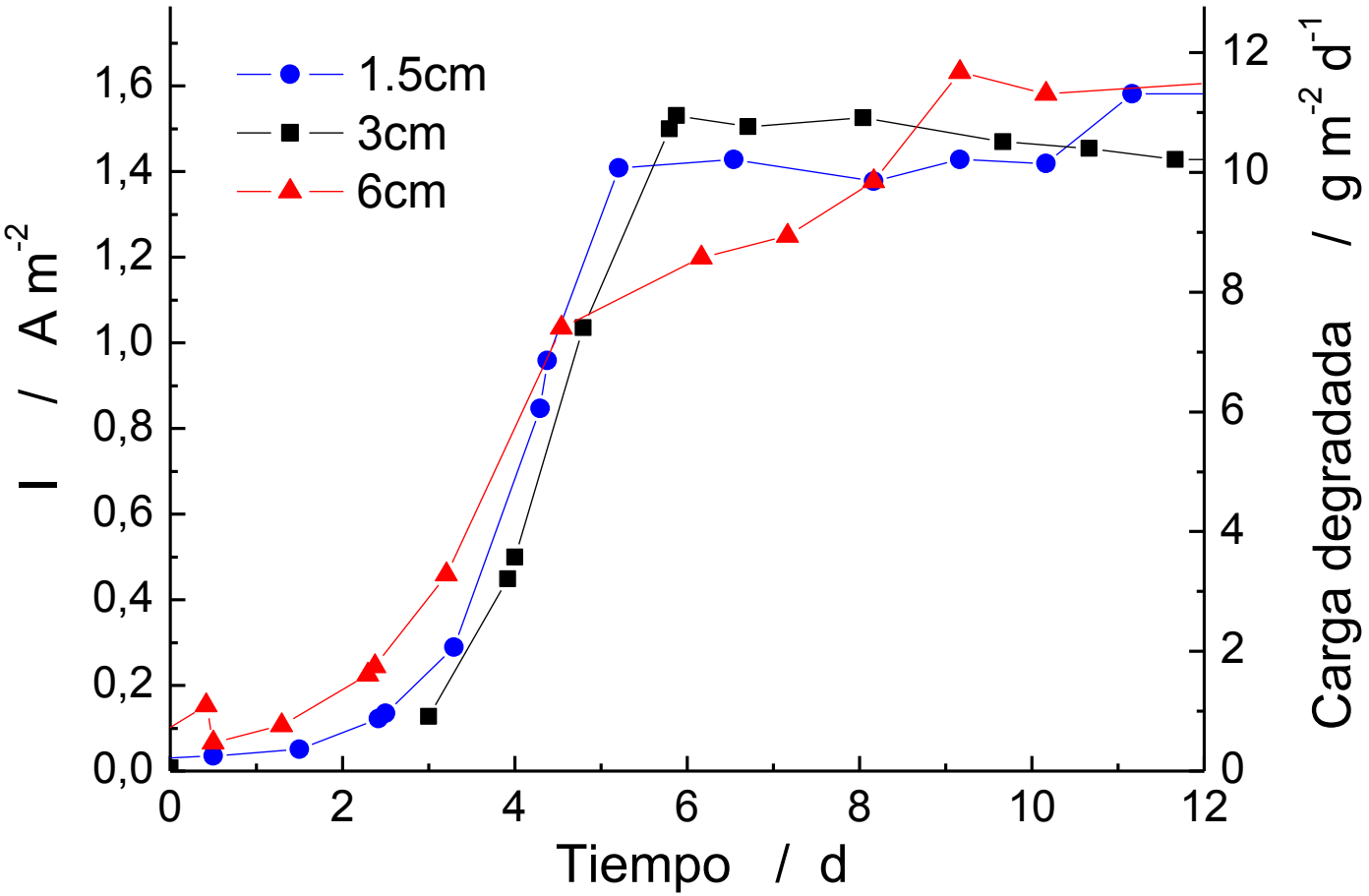
Curva de crecimiento





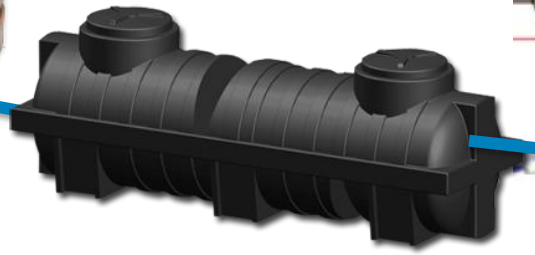
Altura requerida de material conductor

E_{app} = -0,05 V vs Ag/AgCl

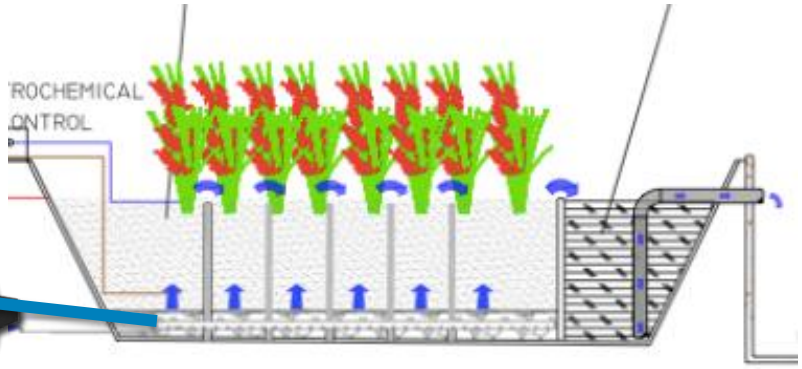


Final location

Storage Tank
(25 m^3)



Plastic septic tank
(10+5 m^3)

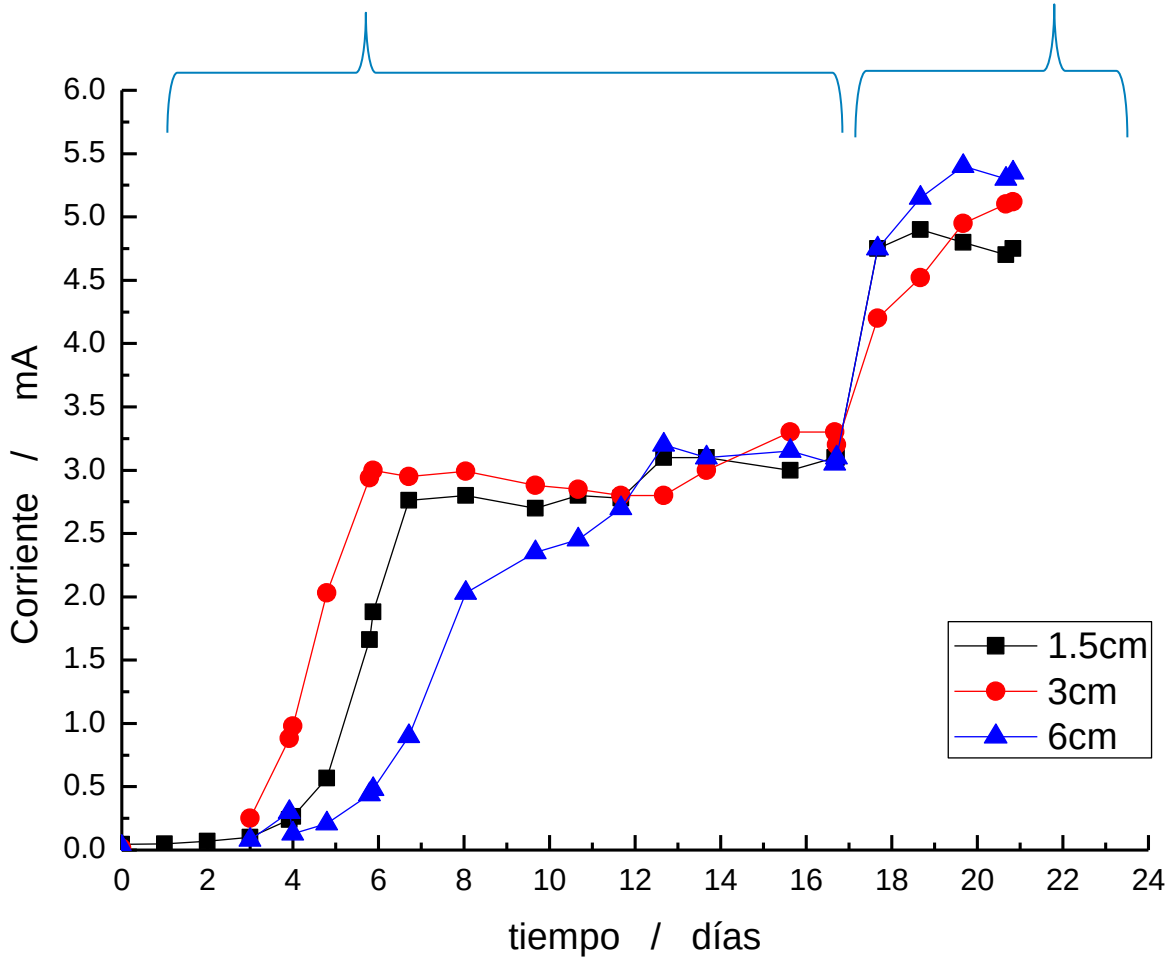


iMETland unit
(40m^2)

¿Carga orgánica?

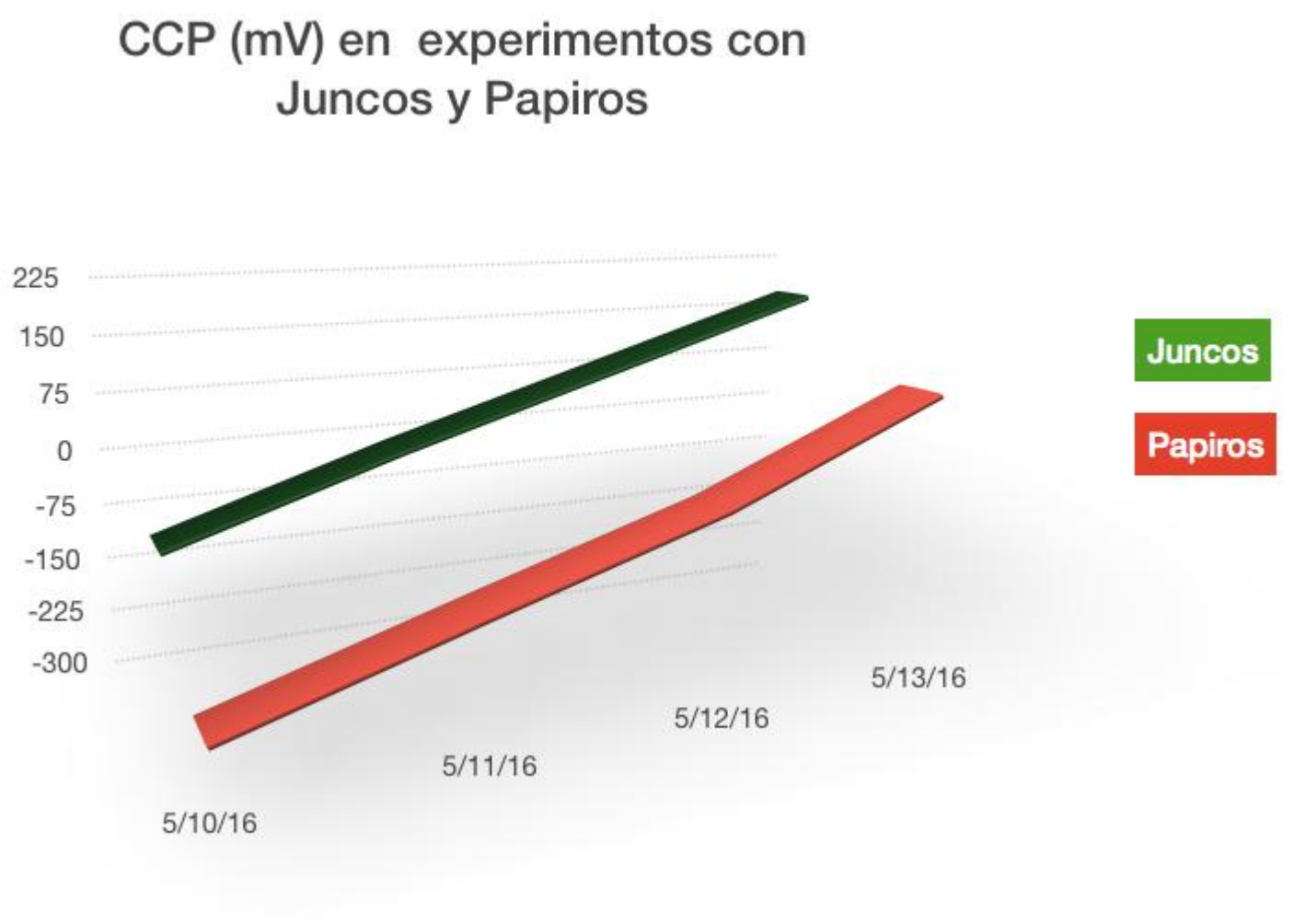
0.036 $cm^3\ min^{-1}$ 0.08 $cm^3\ min^{-1}$

17 gCOD $m^2\ d^{-1}$ → 4.7 mA 38 gCOD $m^2\ d^{-1}$ → 10.5 mA



Carga (gCOD $m^2\ d^{-1}$)	1.5	3	6
10			93%
17	67%	72%	66%
38	44%	49%	51%

Potencial plantas



Tratamiento de aguas industriales

Humedales 1 m^2

1) Conductor (A+C)
2) Conductor
3) Control (granza)

Prueba piloto de degradación de agua residual de la industria del café