Comparison of several olive oil mill wastewaters as electron donor in a bioelectrical system

Fernando G. Fermoso, Maria Espinosa, Barbara Rincón and Rafael Borja

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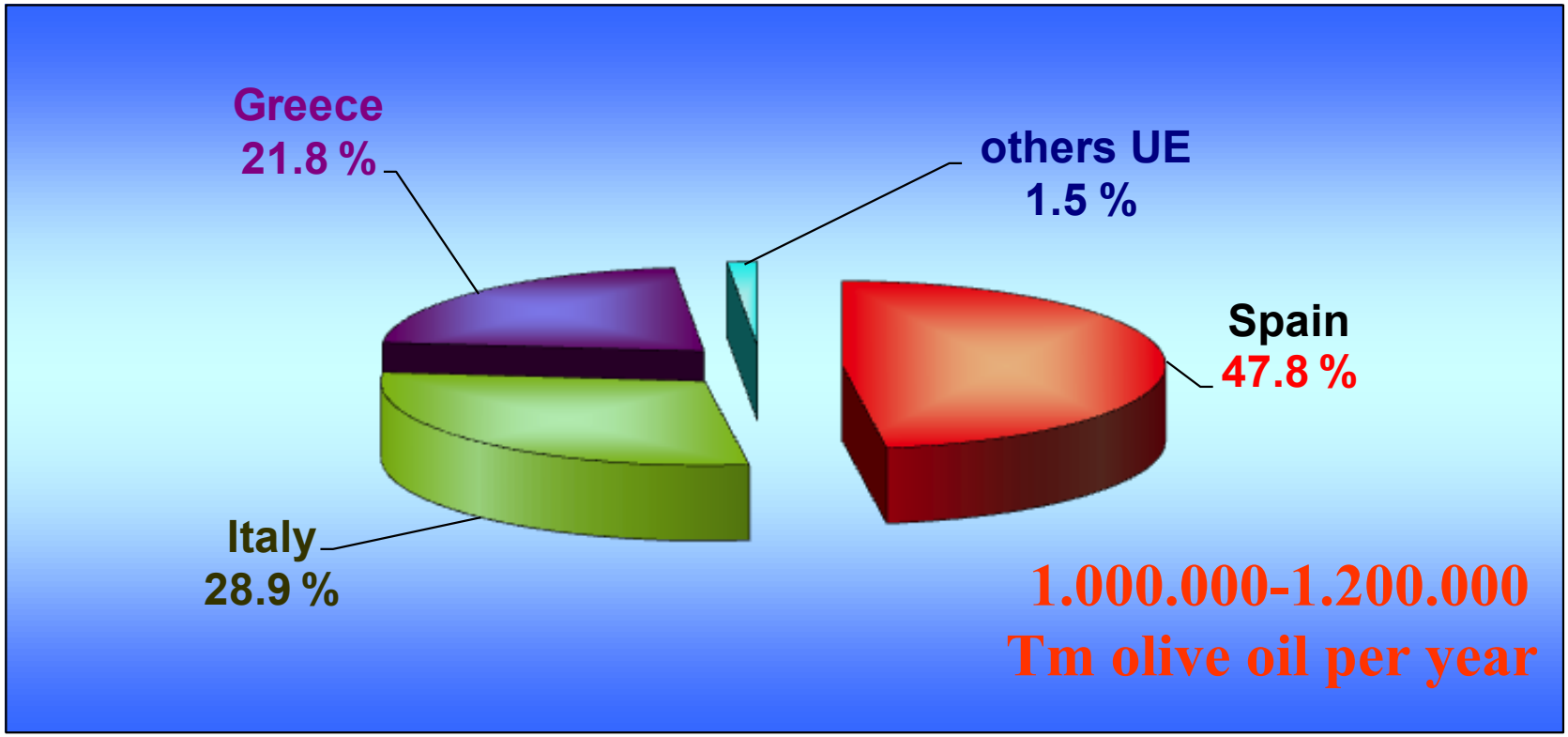
1. Olive mill wastewaters

EU is the main olive oil poducer in the world:
80-84 % world production.

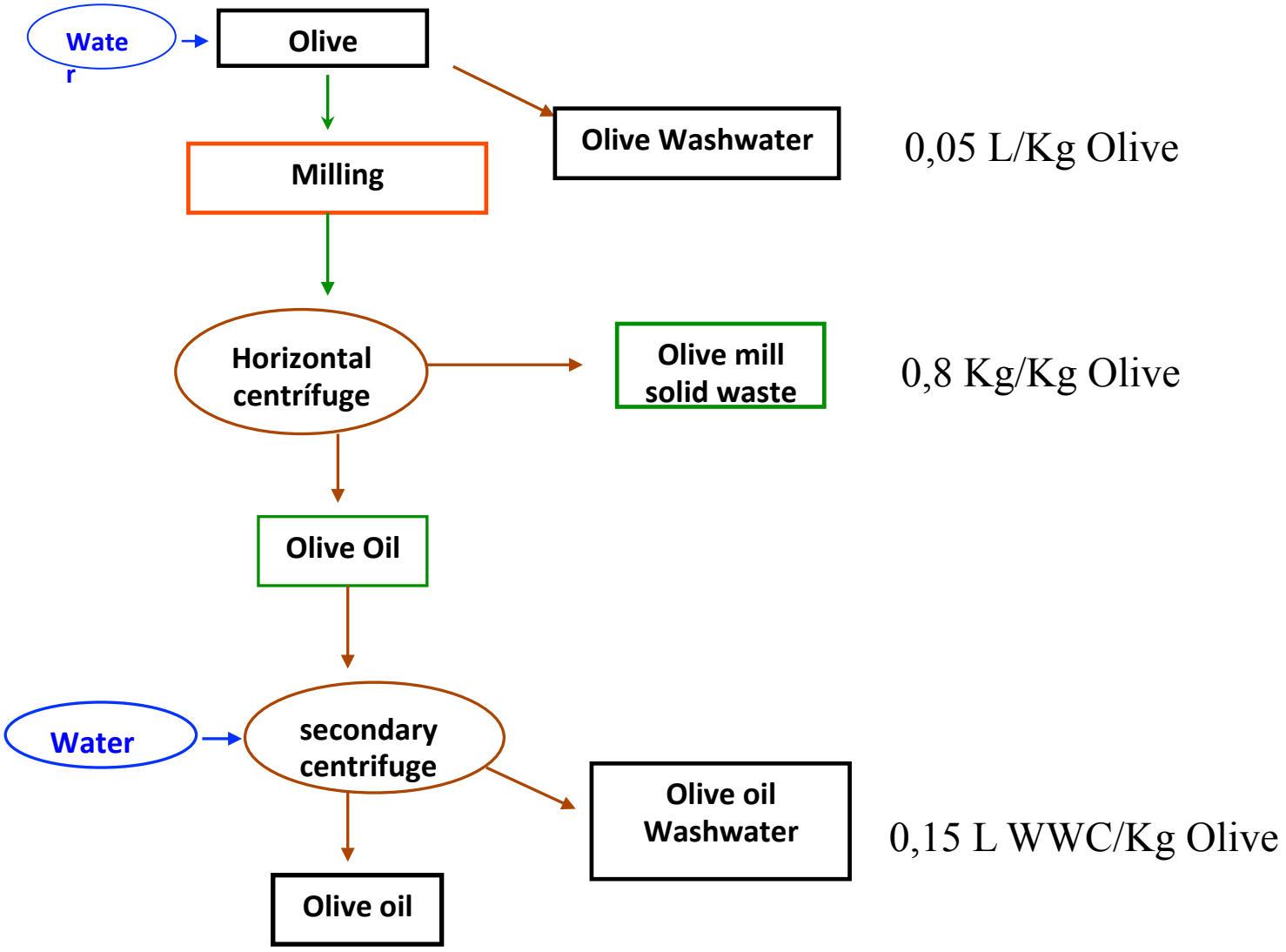


Olive oil production in the European Union

Source: IOOC, 2009

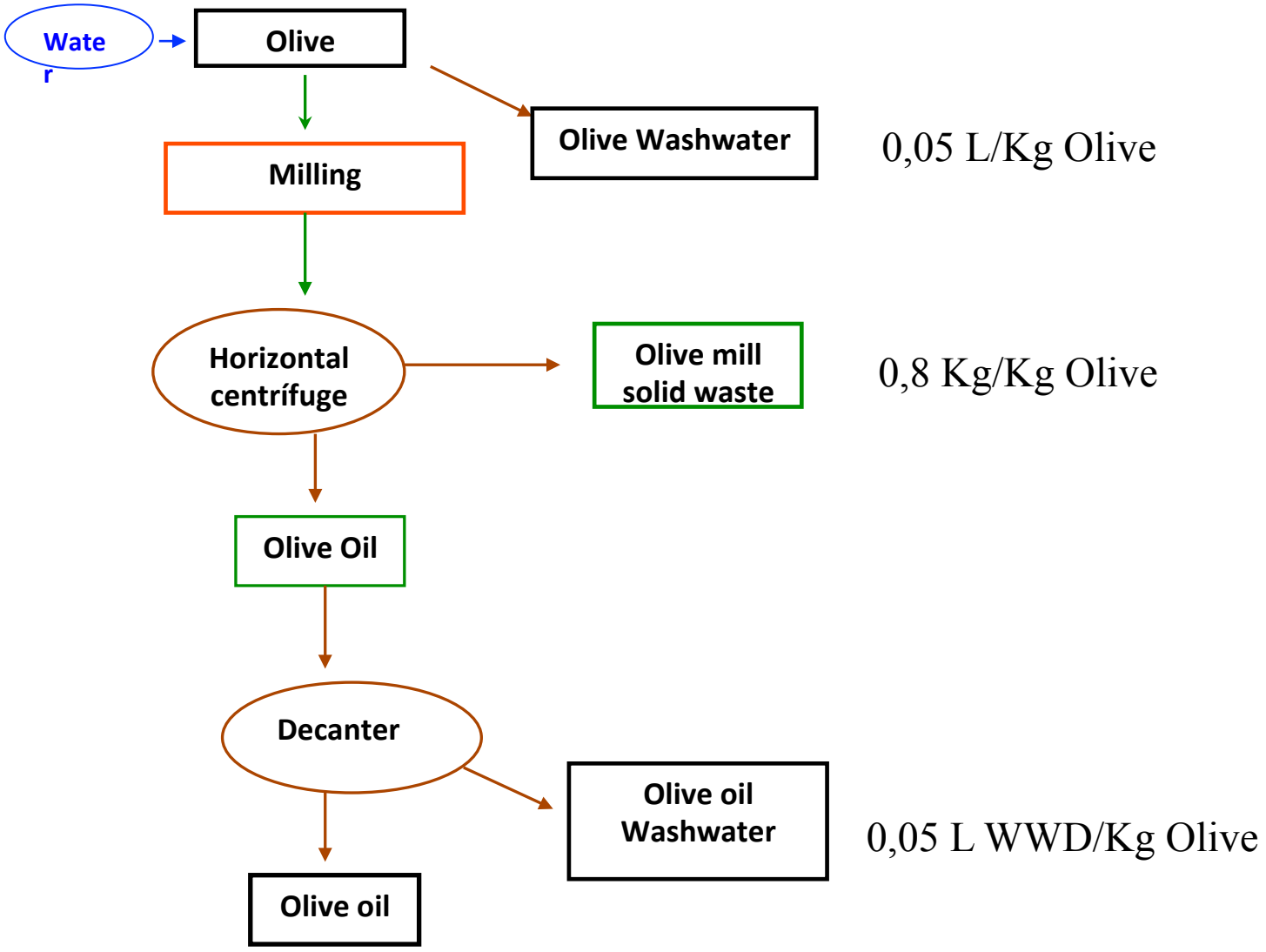
1. Olive mill wastewaters

Olive oil production process



1. Olive mill wastewaters

Olive oil production process



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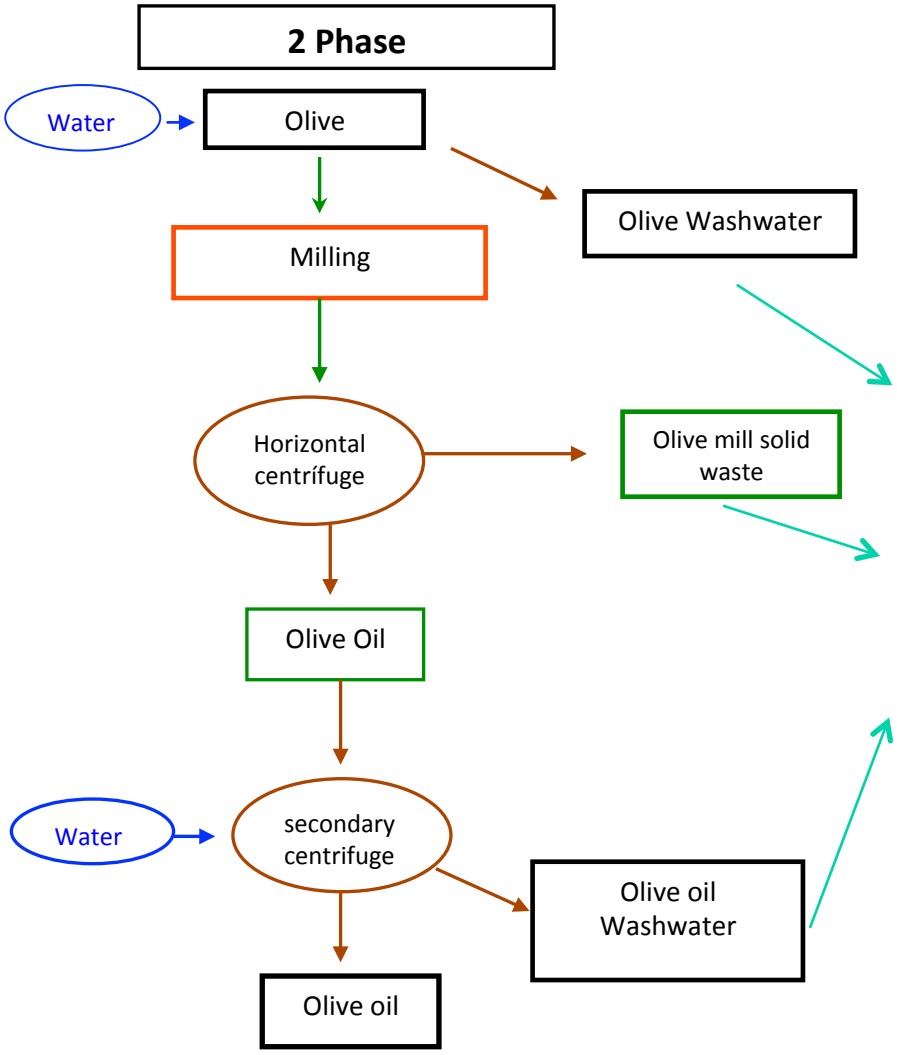
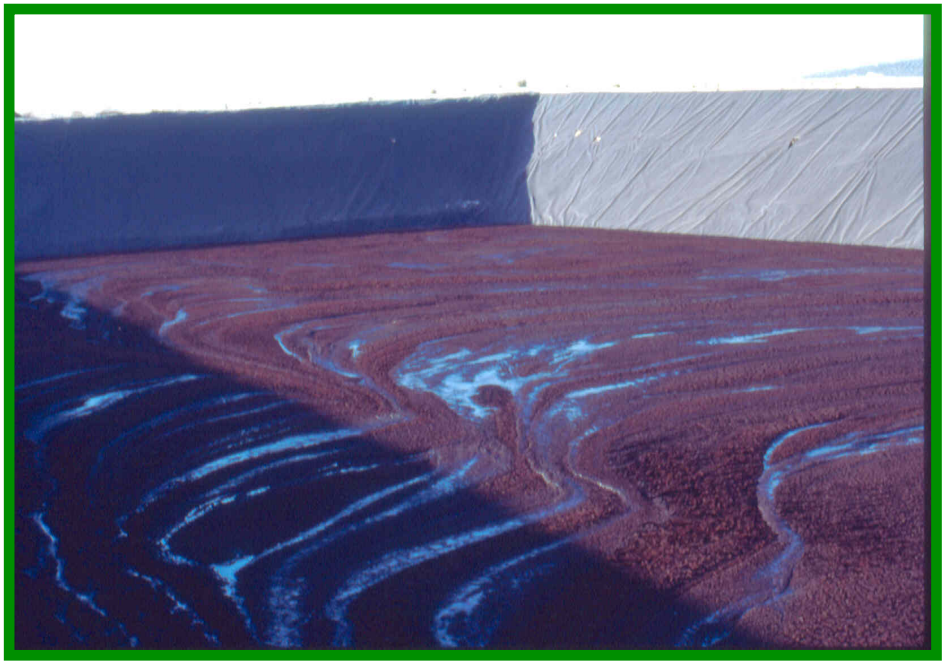
1. Olive mill wastewaters



Evaporation pond



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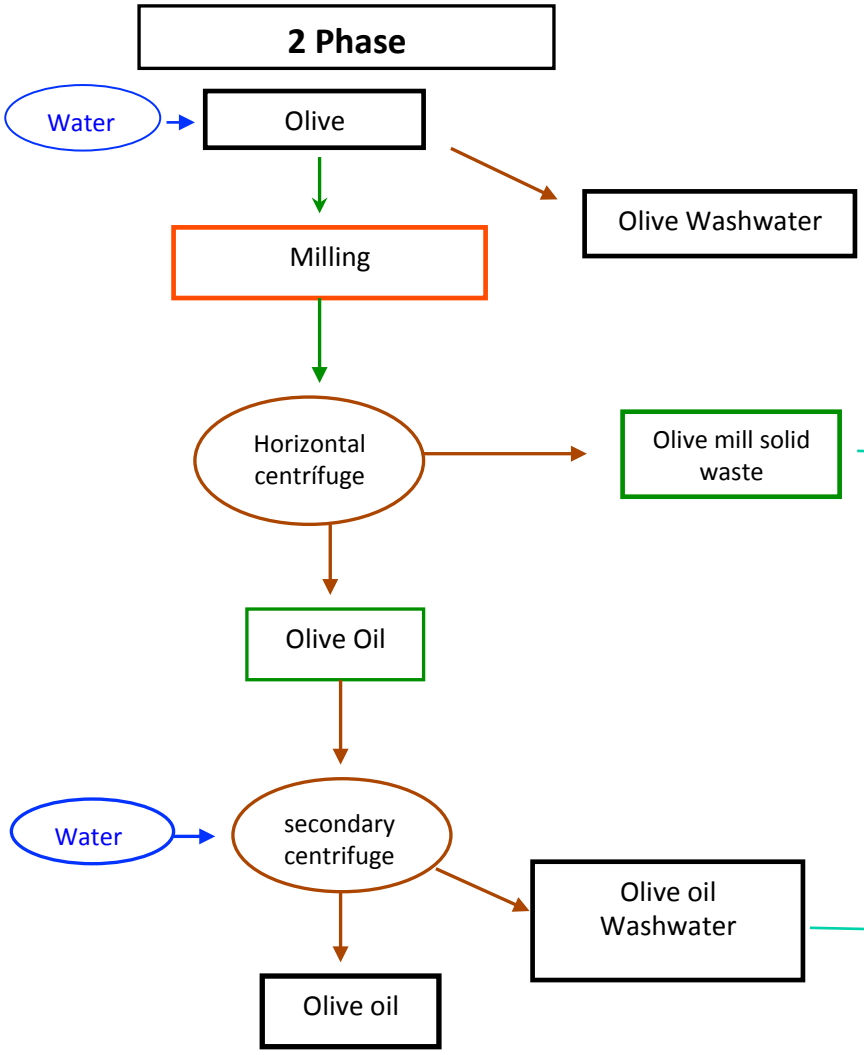
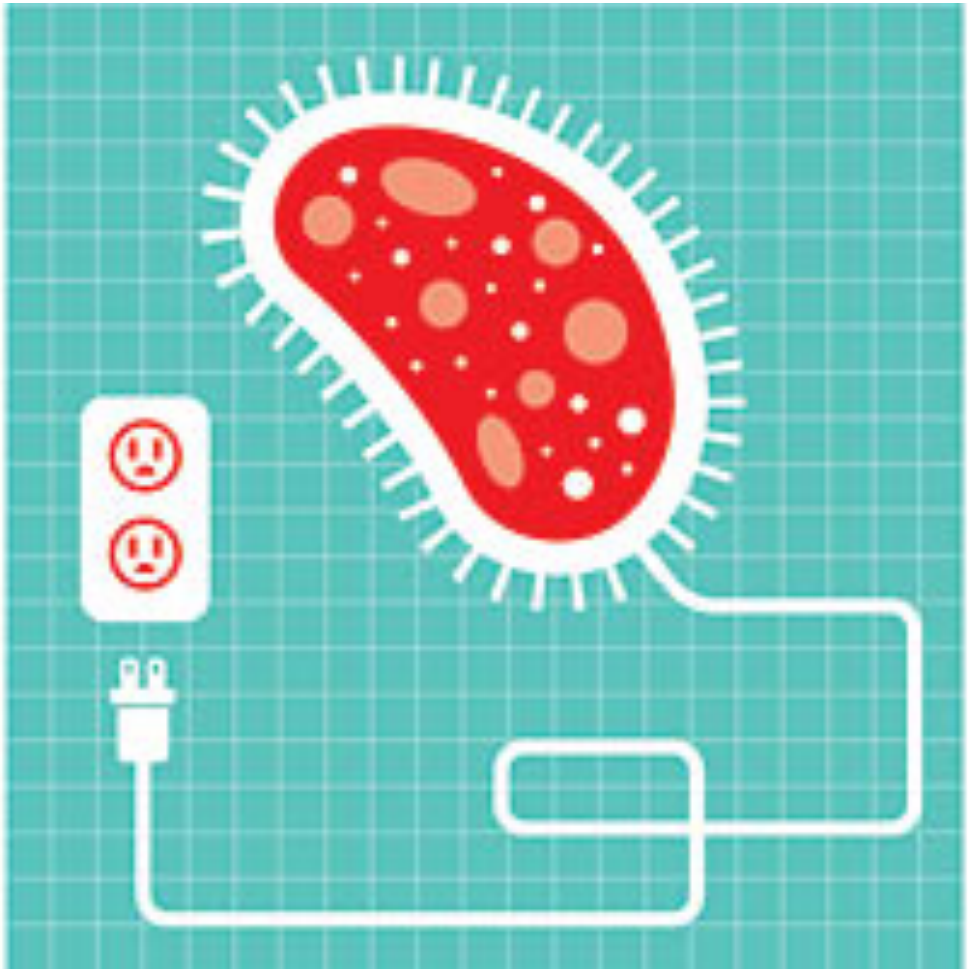


Irrigation

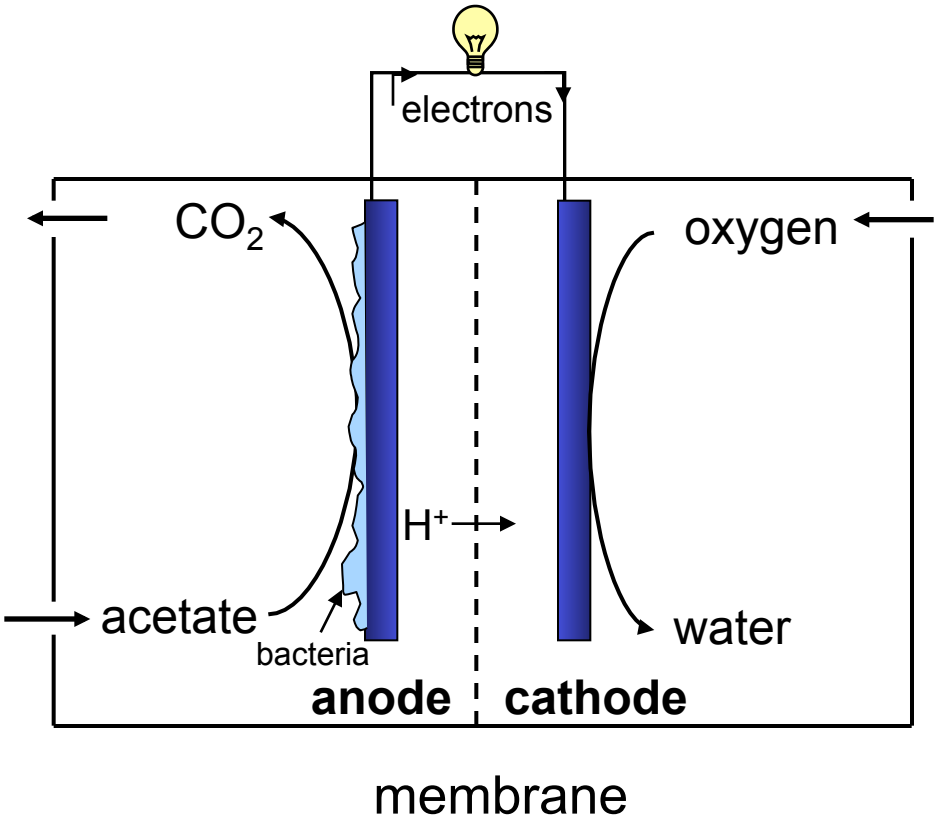
- Compost
- AD (Rincon et al. 2007)
- High value products

WWC	WWD
•10 g COD/L	•80 g COD/L
•300 mg total phenolic /L	•2000 mg total phenolic /L
•0.5% Oil	•1-2 % Oil

Bioelectrochemical systems



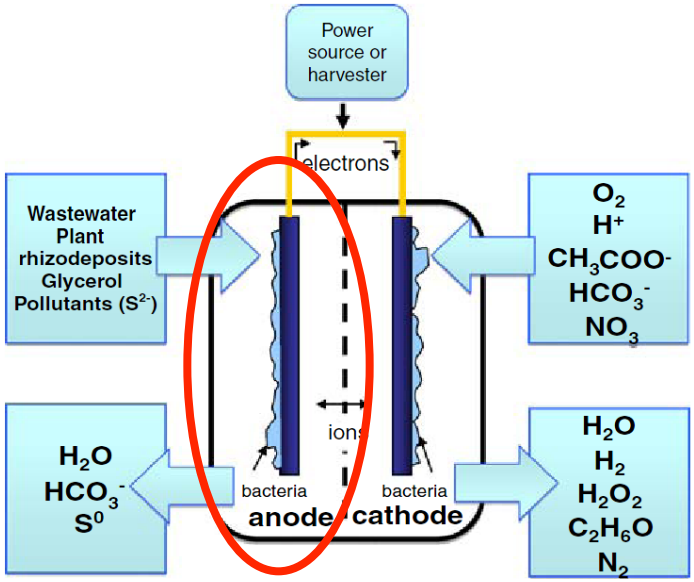
Bioelectrochemical system
Electron harvesting from organic matter oxidation



2. Bioelectrochemical systems

Bioanode: electrons from waste

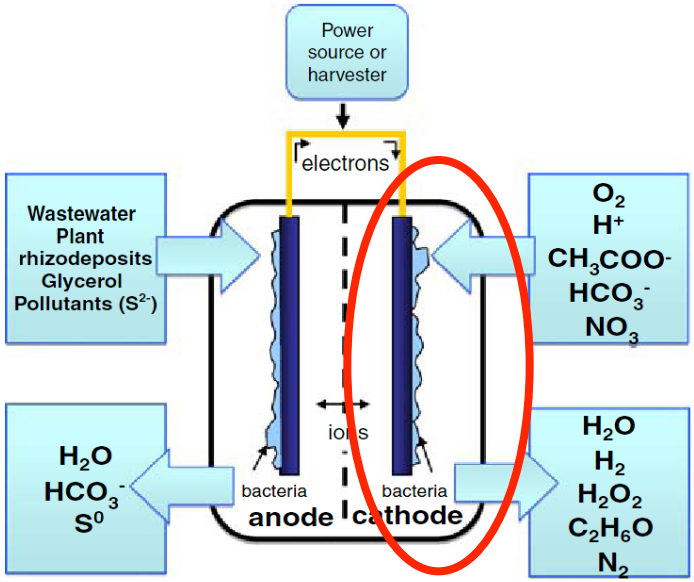
- **Glucose:**
  - $C_6H_{12}O_6 + 6\ H_2O \rightarrow 6\ CO_2 + 24\ H^+ + 24\ e^-$
- **Acetic Acid:**
  - $CH_3COOH + 2\ H_2O \rightarrow 2\ CO_2 + 8\ H^+ + 8\ e^-$
- **COD:**
  - 1 g COD → $0.125\ mol\ e^- + 0.125\ H^+$



2. Bioelectrochemical systems

Cathode determines Application

- **Microbial Fuel Cells:**
  - $2\ O_2 + 8\ H^+ + 8\ e^- \rightarrow 4\ H_2O$
  - **Electricity Production**
- **Biocatalysed Electrolysis:**
  - $8\ H^+ + 8\ e^- \rightarrow 4\ H_2$
  - **Hydrogen Production**
- **Others**



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Objective

2 Phase

Water → Olive

Olive → Olive Washwater → Irrigation

Olive → Milling → Horizontal centrífuge → Olive mill solid waste → AD (shown by Rincon et al. 2007)

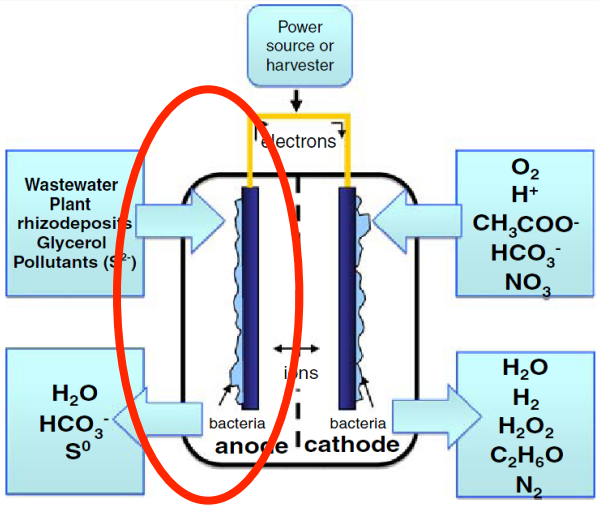
Horizontal centrífuge → Olive Oil → secondary centrifuge

Water → secondary centrifuge

secondary centrifuge → Olive oil Washwater

secondary centrifuge → Olive oil

Olive oil Washwater →



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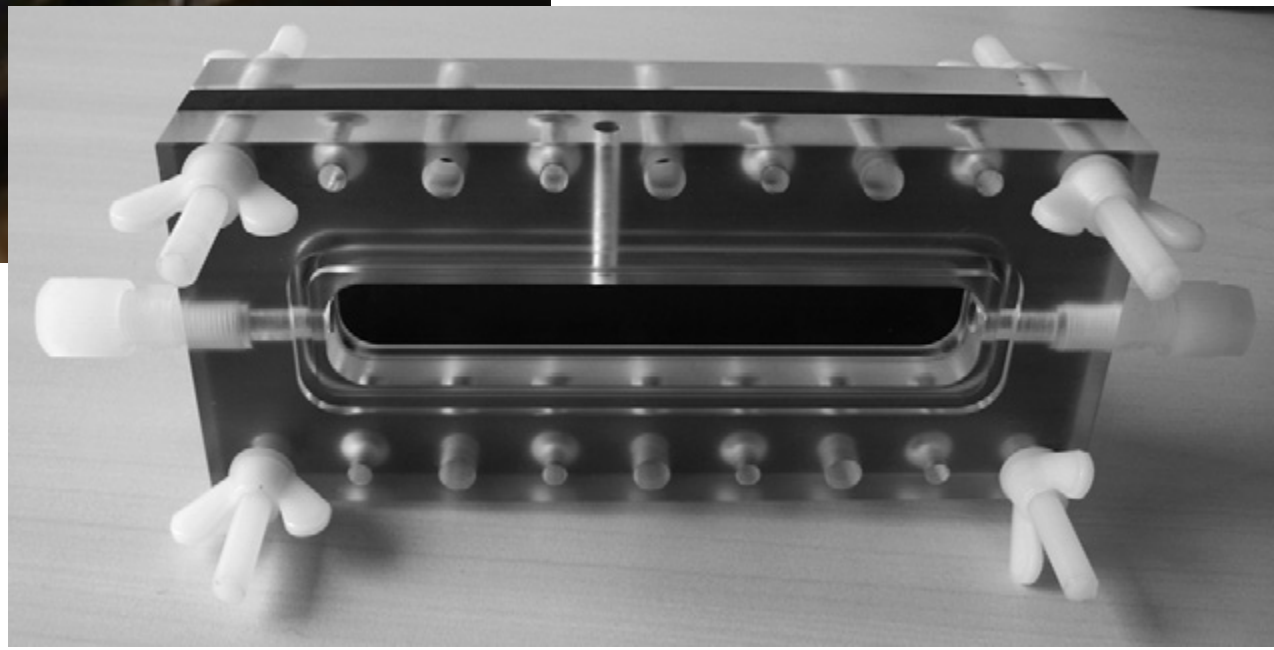
3. Material and methods



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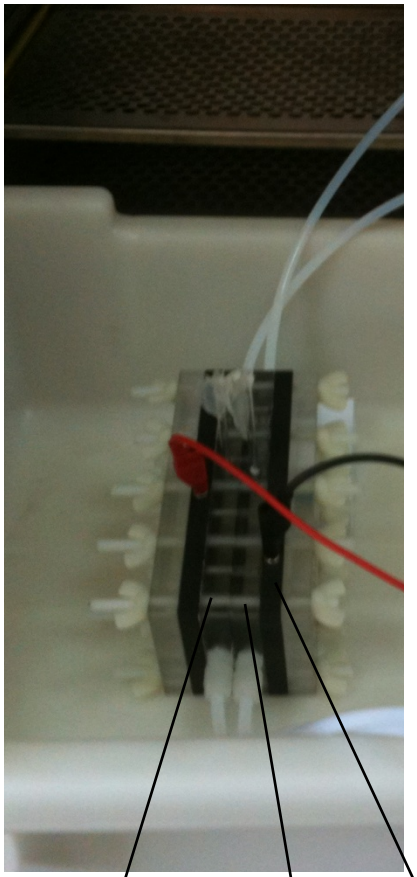
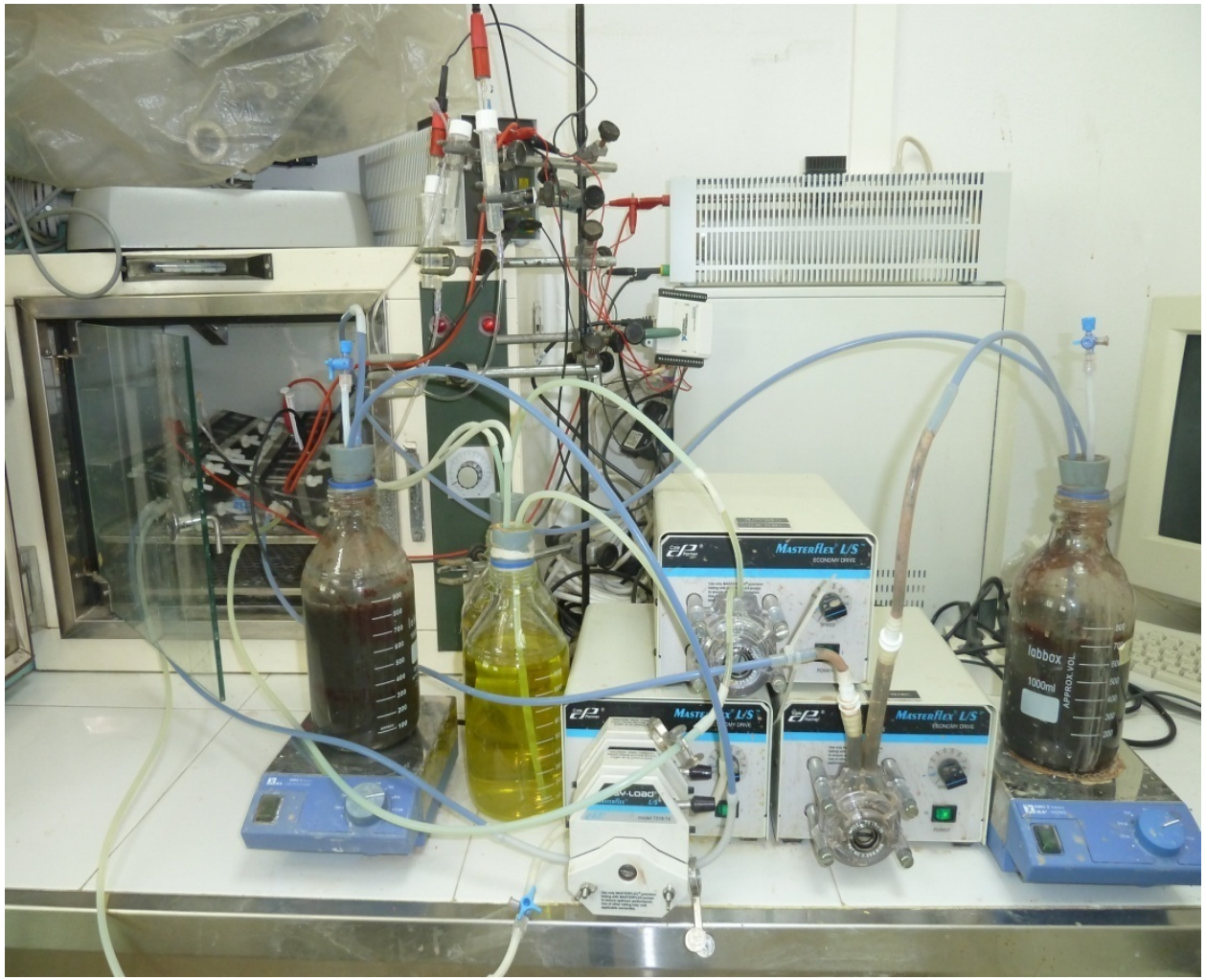
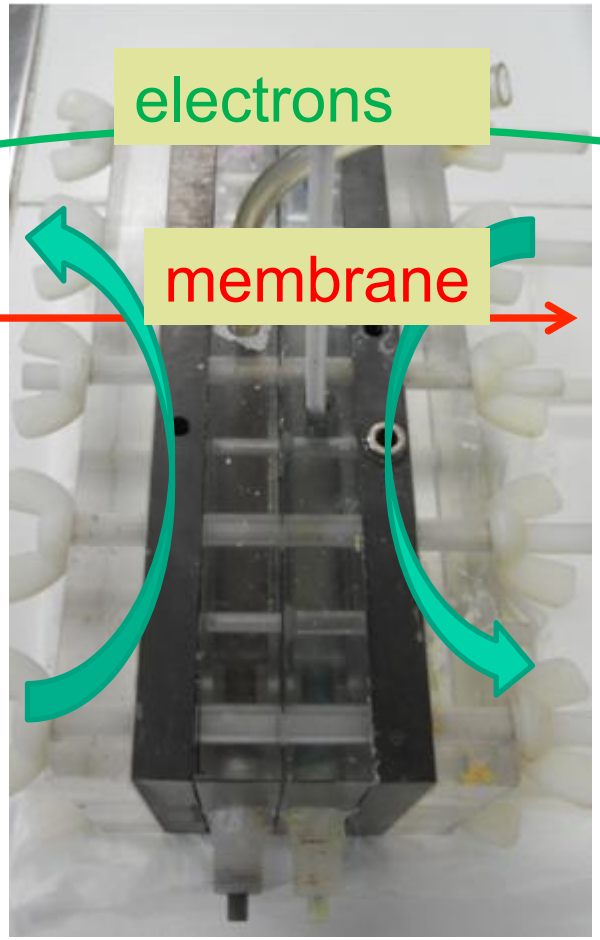




anode cathode Electrode

3. Material and methods

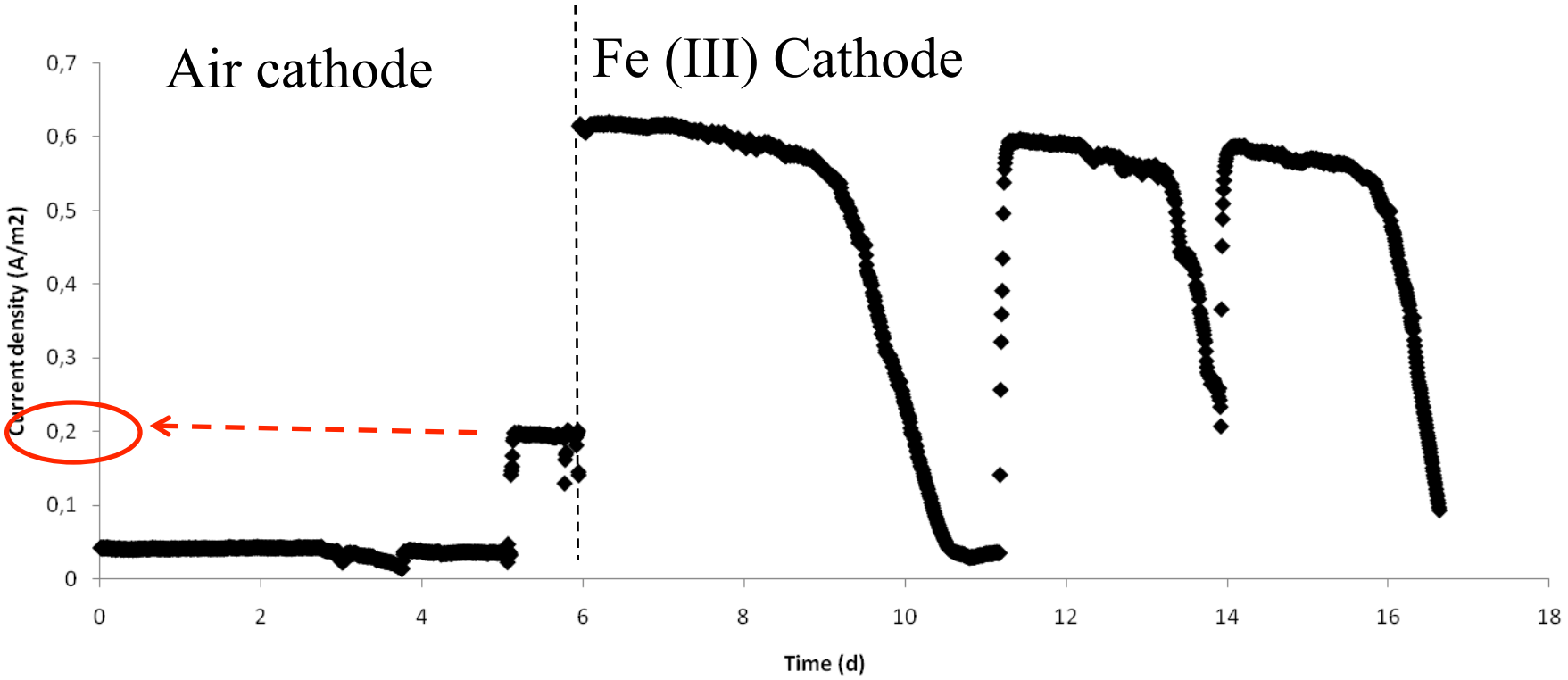


4. Results

Start-up

1.Inoculation with anaerobic granular sludge from Brewery wastewater plant

2. Acetate fed Anode



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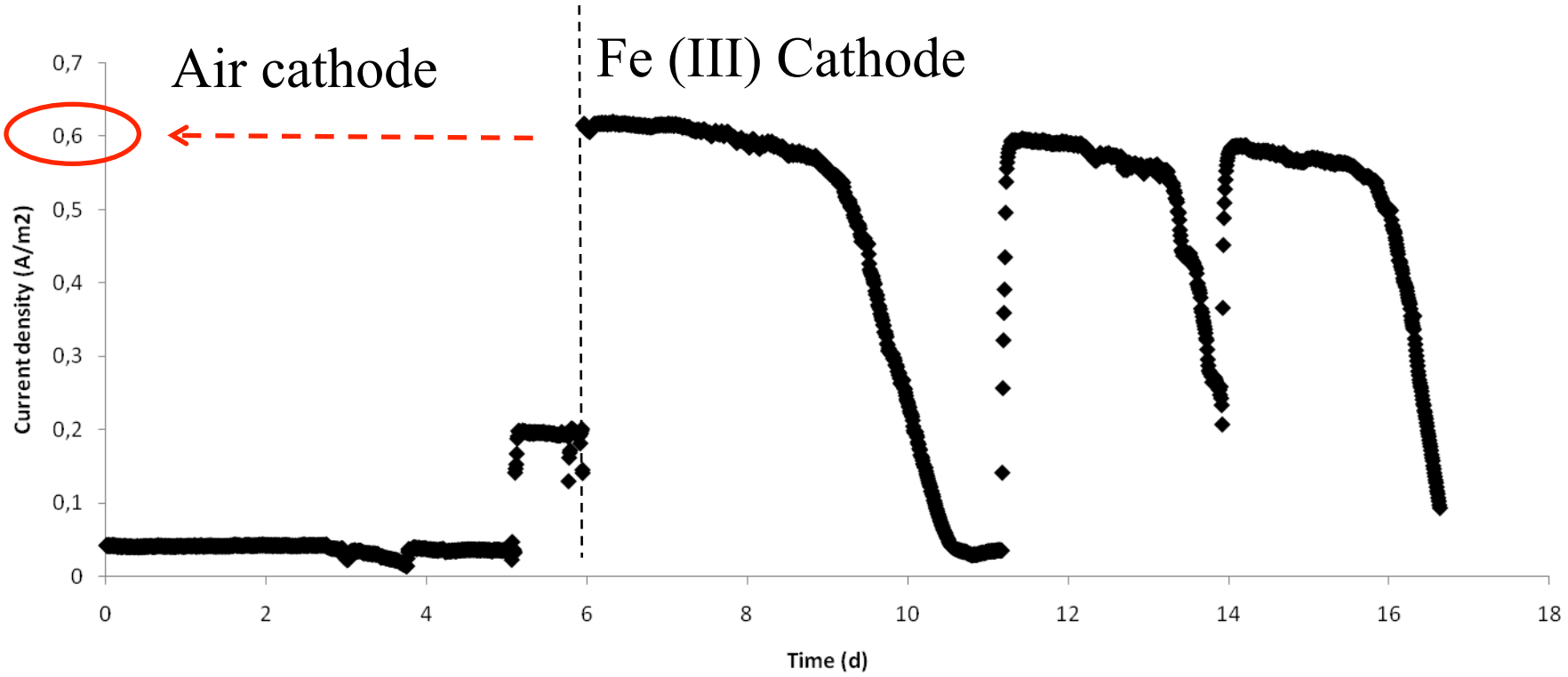

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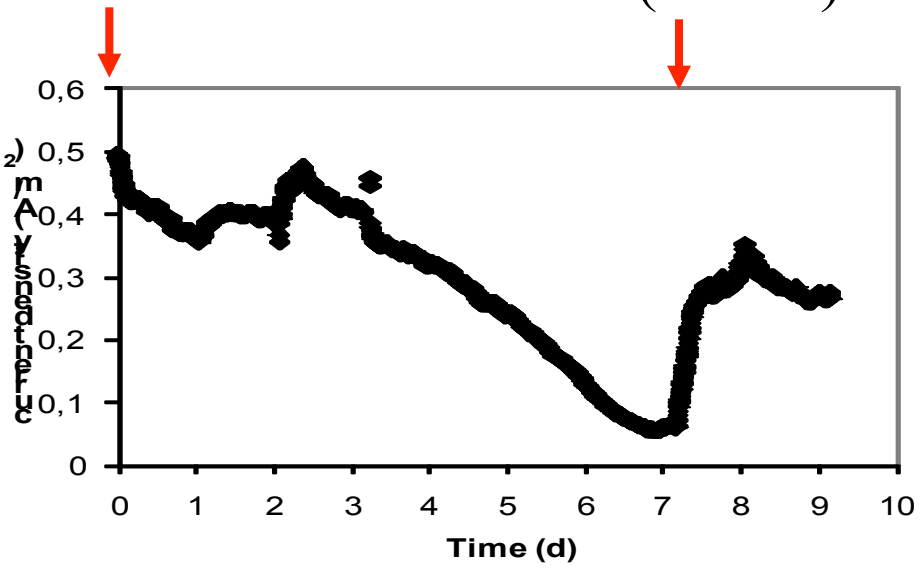
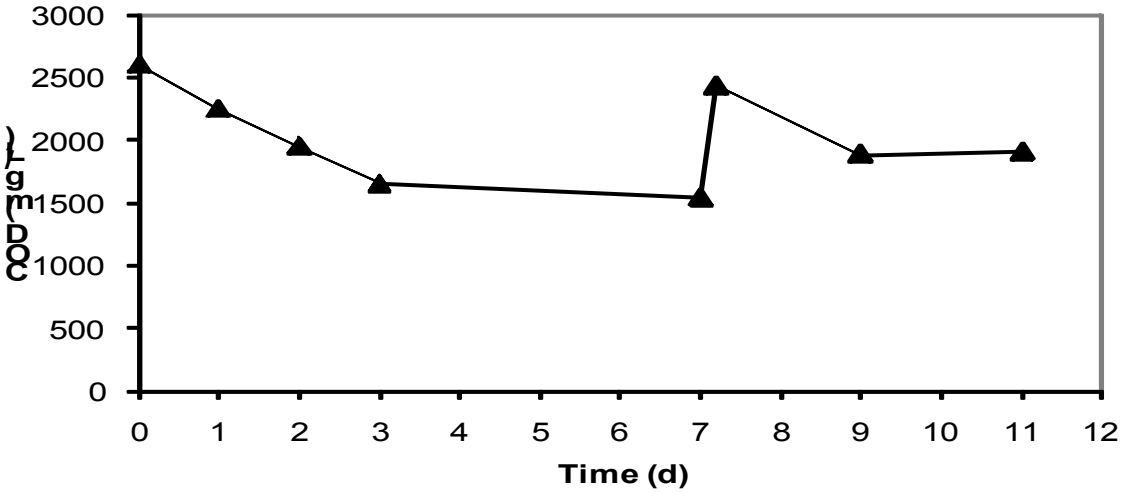
Olive oil washwater (WWC)





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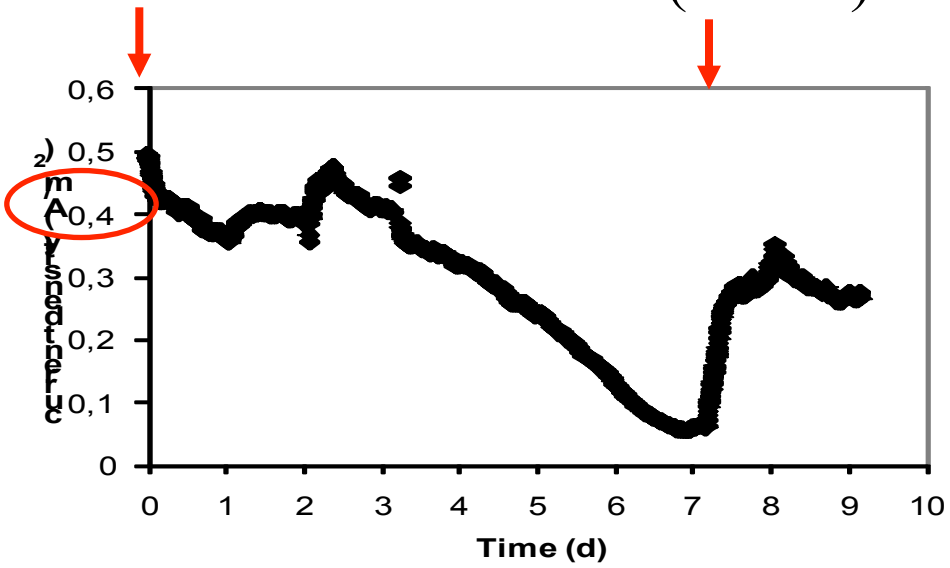

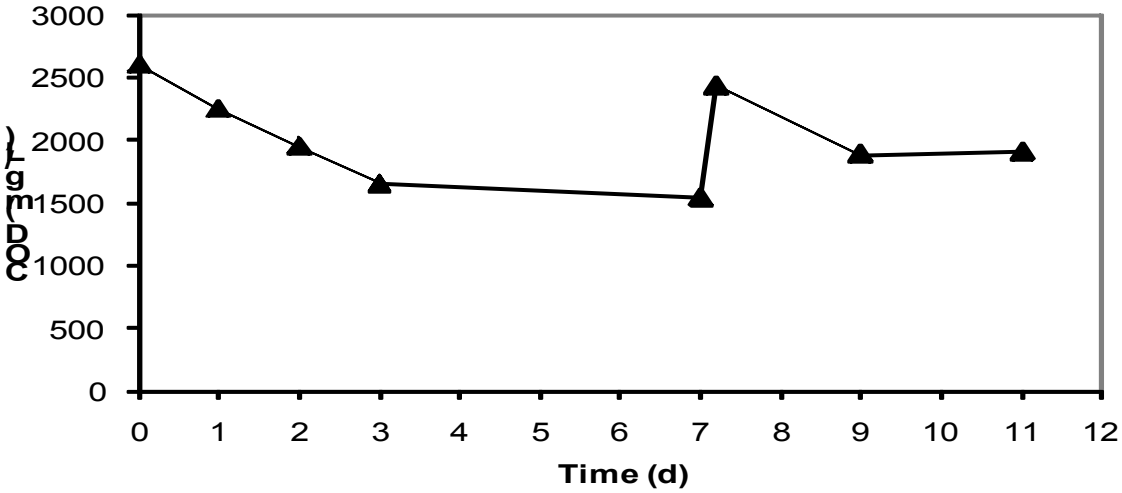

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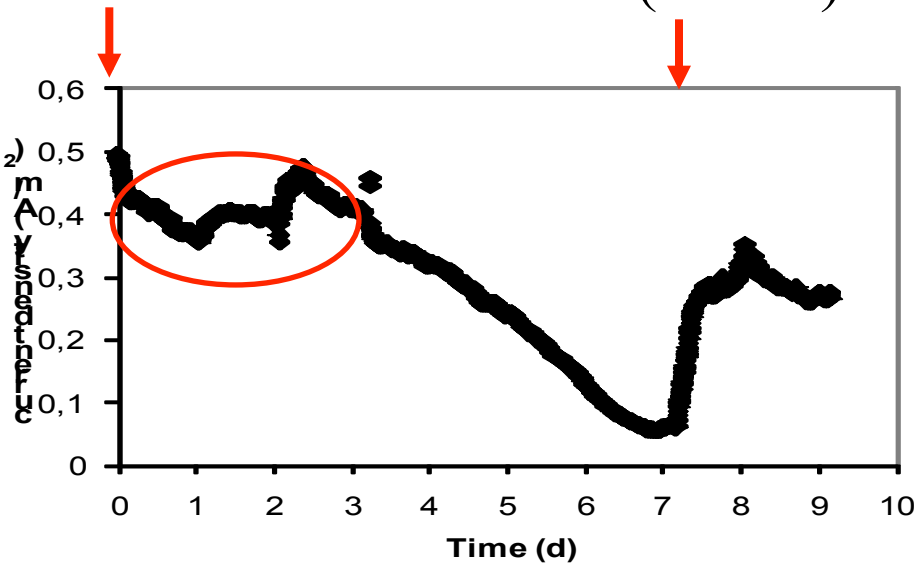

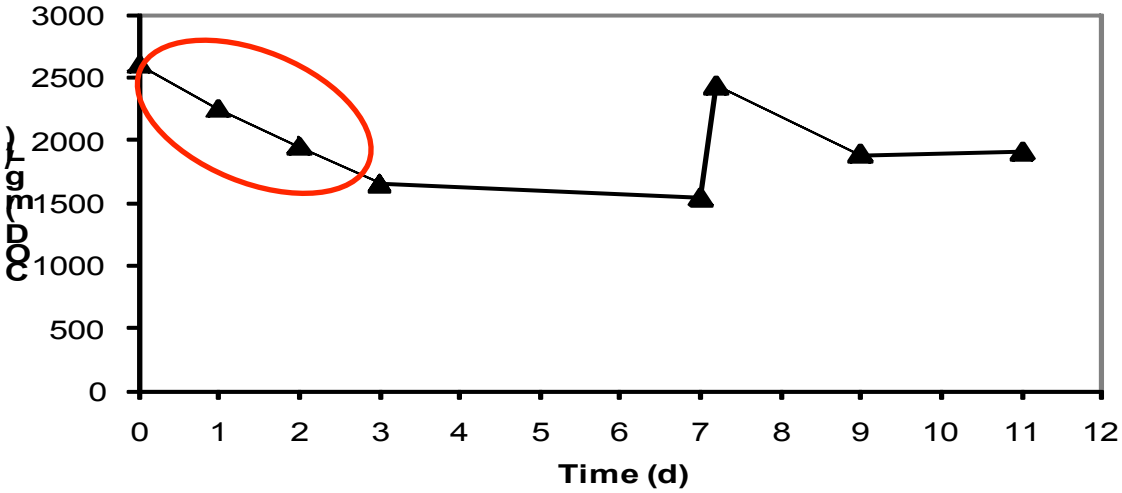

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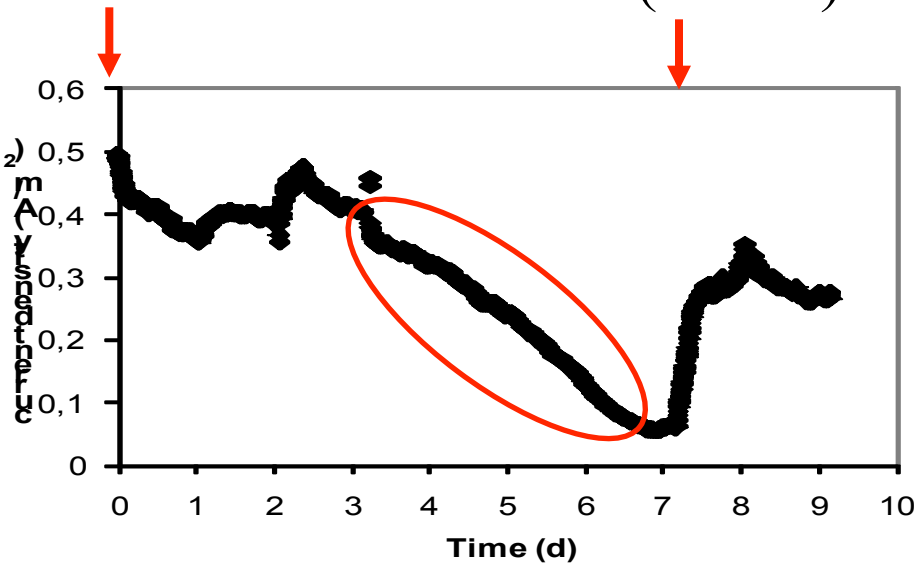
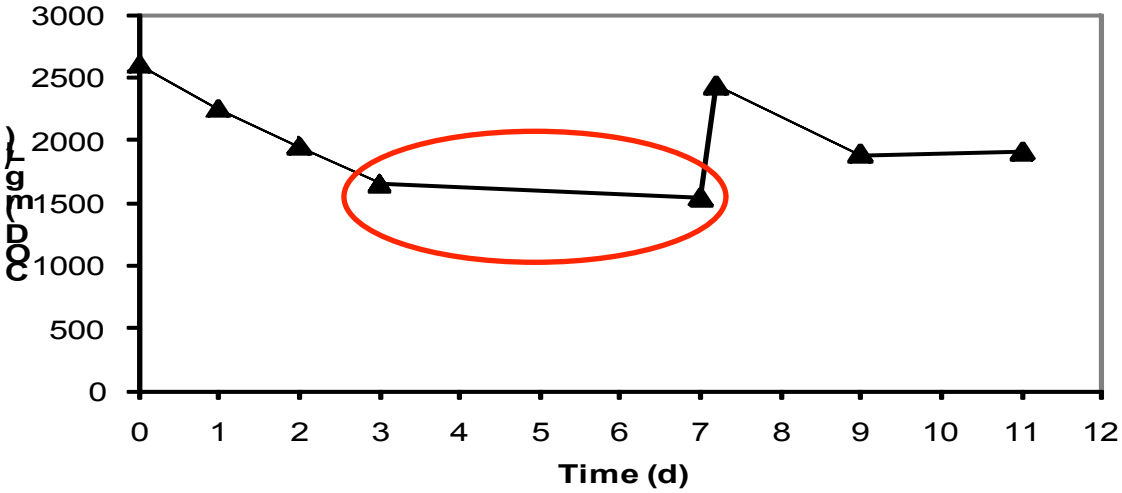
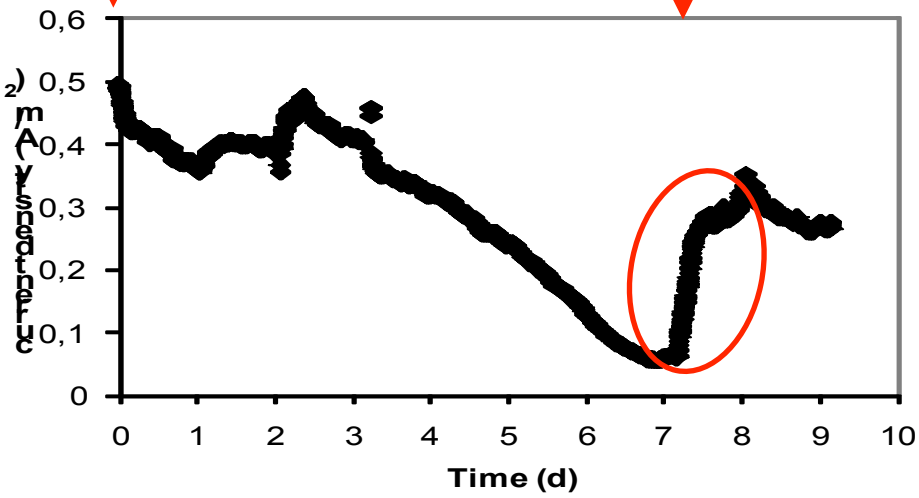
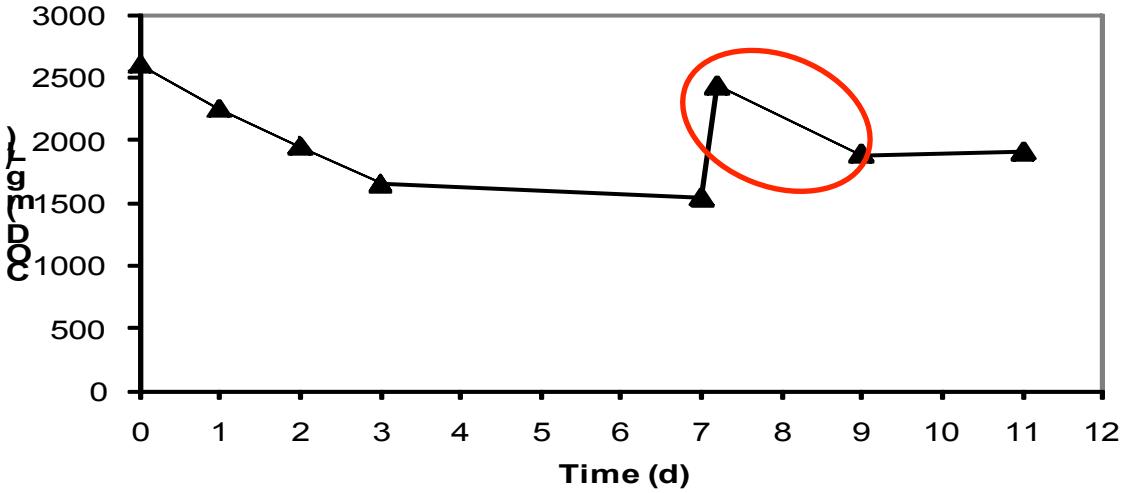




4. Results

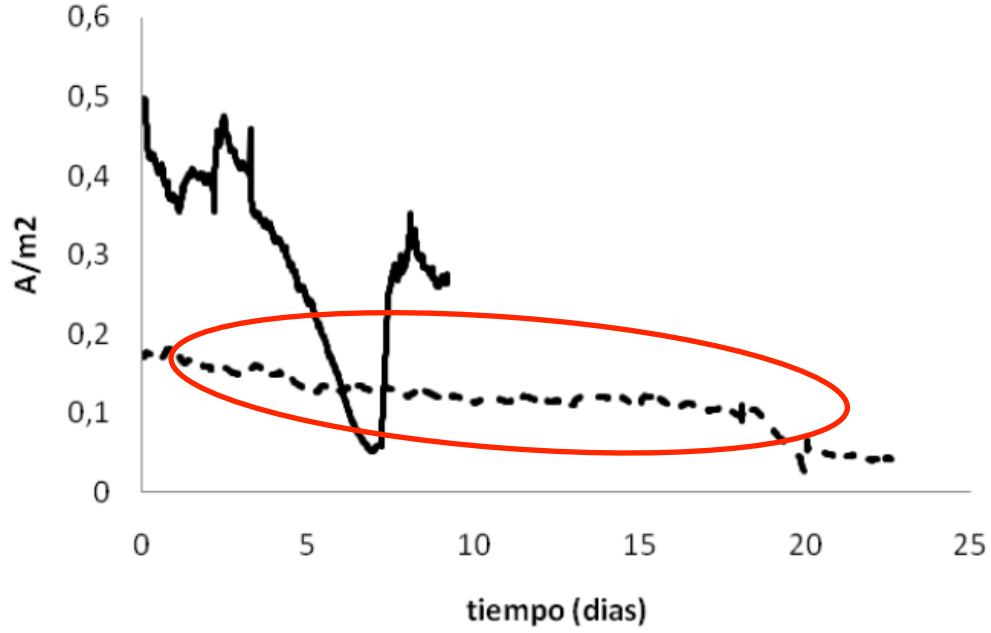
Olive oil washwater (WWC)

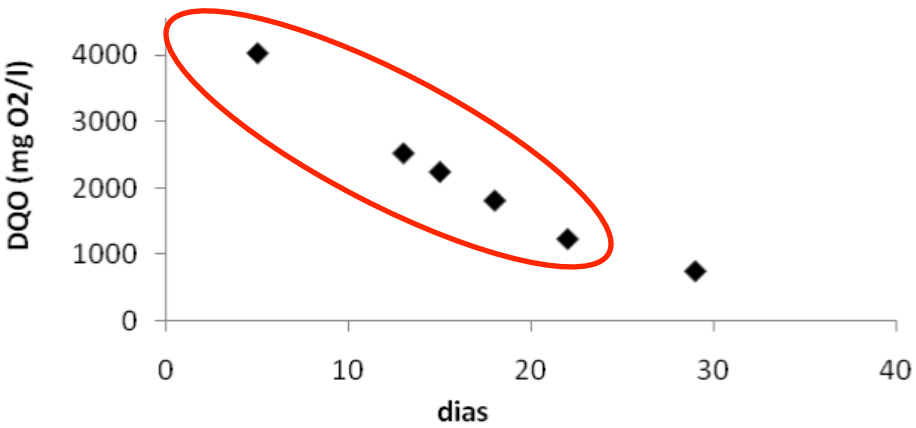




4. Results

Olive oil washwater (WWD)





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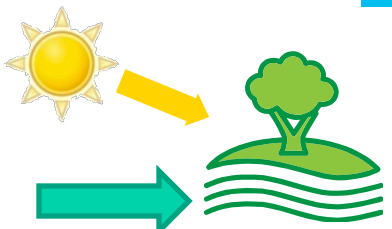
5. Conclusions

- Olive oil washwater is a feasible (not promising) electron donor for bioelectrochemical systems

- Recalcitrant organic matter degradation has to be further investigated in order to make it more suitable for real application

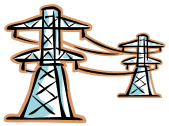
- Real application? ⟶ Biorefinary

5. Conclusions

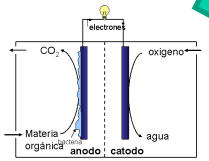


Agua tratada

Extracción de aceite de oliva



Electricidad



Celda microbiana de combustible

Decantación aceite

Agua decantación de aceite

Aceite de Oliva

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