Smallwat11 WFD4 MDG4

POTENTIAL OF SULPHATE-REDUCING BACTERIA FOR DEGRADATION OF CARBON POLLUTION

APPLICATION TO HORIZONTAL SUBSURFACE FLOW SAND FILTERS

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Introduction

Introduction

- **Horizontal subsurface flow sand filters (HSF)**
  - Rustic biologic reactors
  - Intense development for several years

  (Molle, 2003; Groupe Macrophyte et Traitement des Eaux, 2005; Matamoros & Bayona, 2008, etc…)

- **Sulphate-reducing bacteria**
  - Reduce sulphates
  - AND oxidize organic matter for their growth

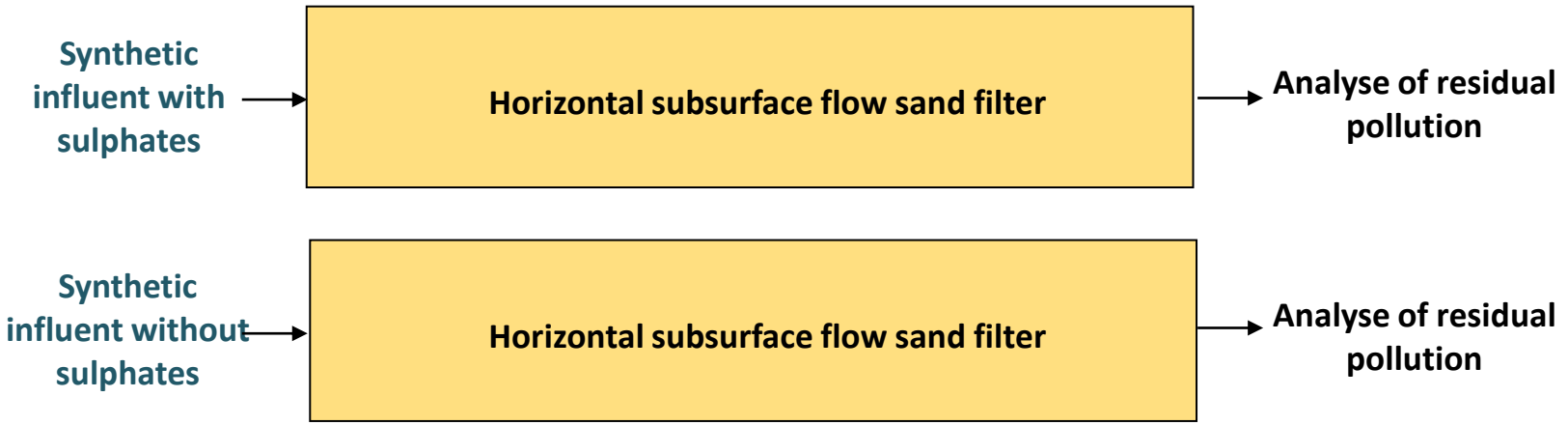
  (Pelmont, 1993; Sadowski, 2005; Liamleam & Annachhatre, 2007; Reddy & De Laune, 2008)

Do SRB play a role in the degradation of carbon pollution contained in a mixing of domestic wastewater and acid mine drainage in horizontal subsurface flow sand filters?

Methods

METHODS

- **HORIZONTAL SUBSURFACE FLOW SAND FILTER**
  - Feeding flow : 4 L/hour → 30 gCOD/m²/day
  - Slope : 1 cm/m
  - Continuous feeding



2 Horizontal subsurface flow sand filters

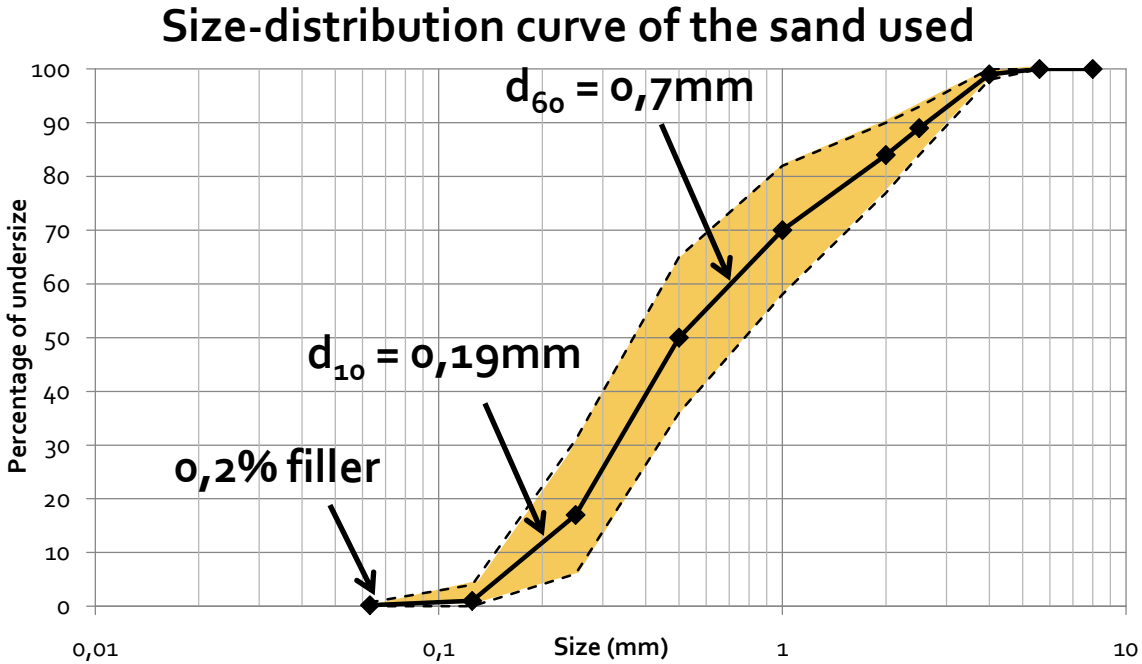
METHODS

- HORIZONTAL SUBSURFACE FLOW SAND FILTER

Experimental device

METHODS

- **HORIZONTAL SUBSURFACE FLOW SAND FILTER**
  - Alluvial sand
  - d_{10} = 0,2mm
  - 3 < UC < 6
  - $K_{sat} \approx 5.10^{-4}$m/s
  - % filler : poor



  - UC = 3,68
  - Ksat = $4,2.10^{-4}$m/s (Hazen – theorical)
  - Ksat = $4,7.10^{-4}$m/s (Grant – experimental)

METHODS

- **THE INFLUENTS**
  - [COD] = 450 mg/L
  - Source of carbon : acetic acid

Influent with SO_4^{2-}	Influent without SO_4^{2-}
CH_3COOH : 478 mg/L	CH_3COOH : 478 mg/L
$FeSO_4$: 2500 mg/L	-
$MgSO_4$: 229 mg/L	$MgCl_2$: 55 mg/L
NH_4Cl : 16 mg/L	NH_4Cl : 16 mg/L
NaH_2PO_4 : 7 mg/L	NaH_2PO_4 : 7 mg/L

Composition of the two influents

METHODS

- **PARAMETERS MONITORED**

Carbon pollution	Sulphur compounds	Bacterial development
COD	Sulphates	pH
BOD	H_2S	Redox. Pot.
TOC		Temperature

BOD analyse

COD analyse

TOC analyse

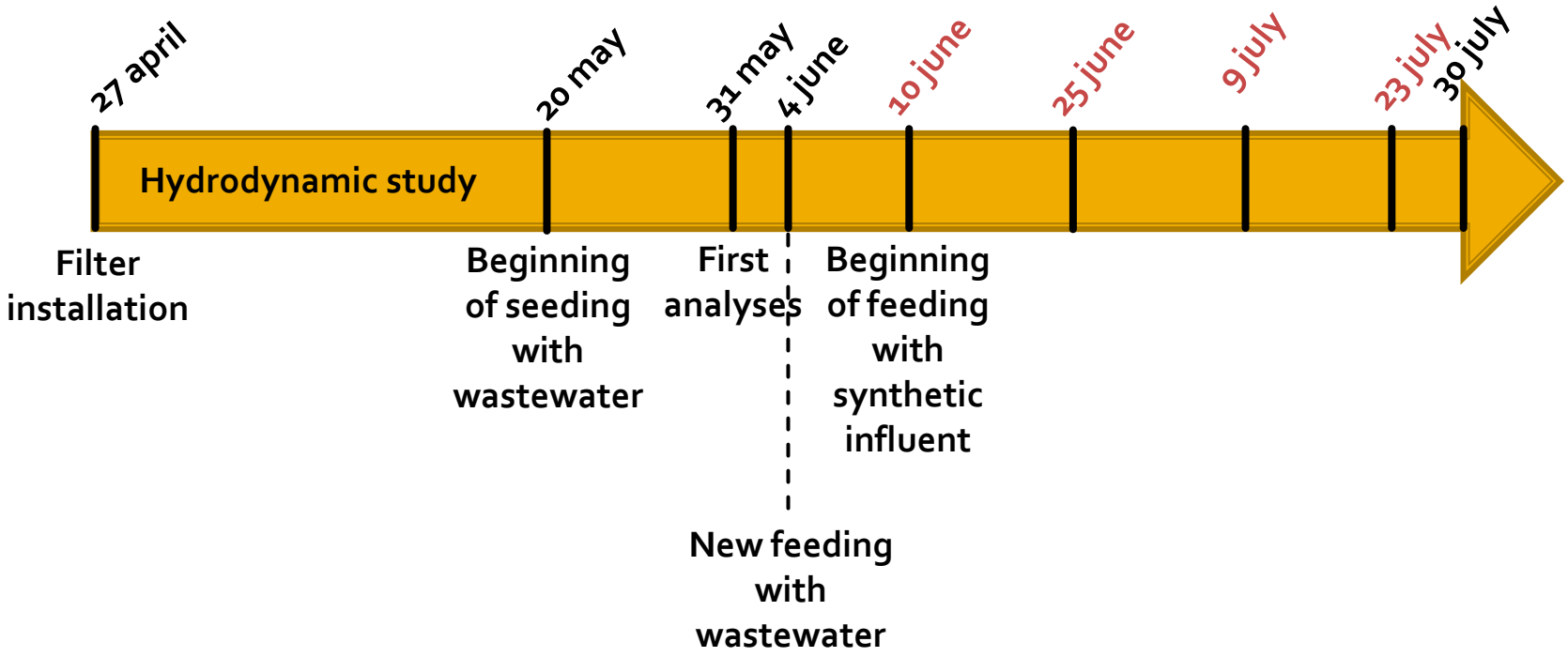
Sulphates analyse

TSS/VSS analyse

Results

RESULTS

- **MACROSCOPIC OBSERVATIONS**



The different steps of the experiment

RESULTS

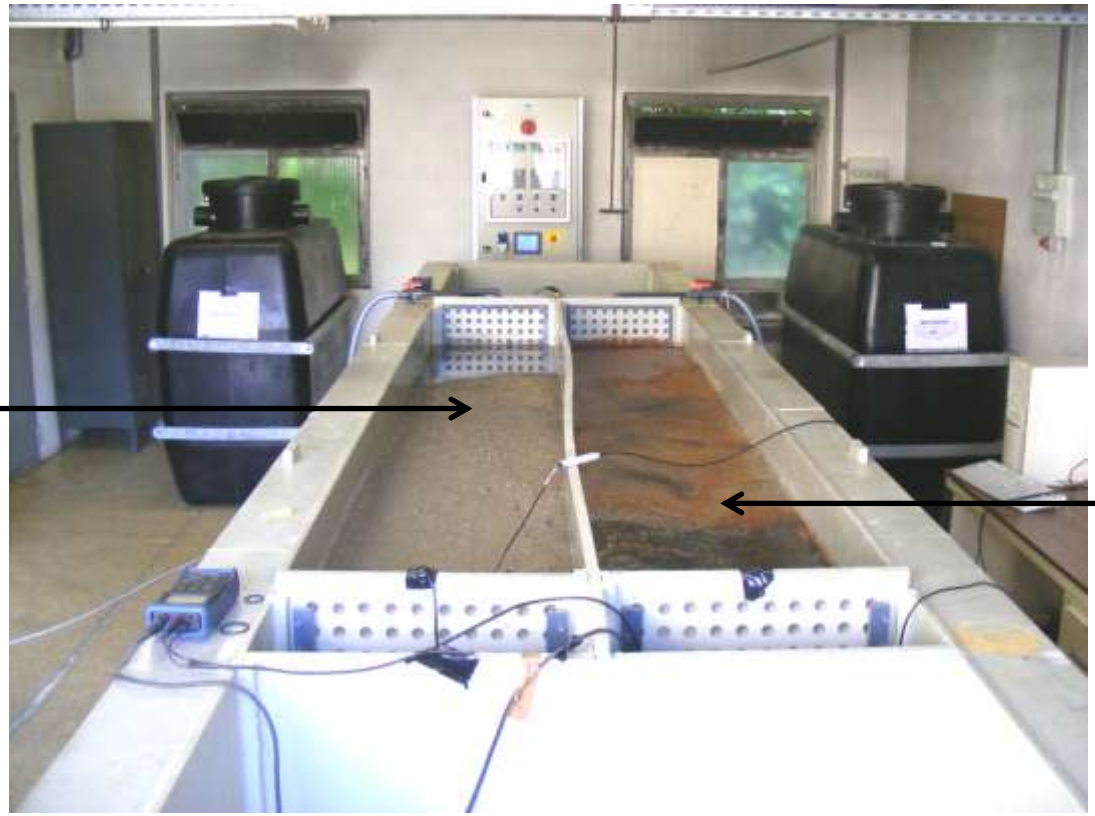
- **MACROSCOPIC OBSERVATIONS**

The two HSFs on the 8th June

RESULTS

- **MACROSCOPIC OBSERVATIONS**

Sand filter fed without sulphates

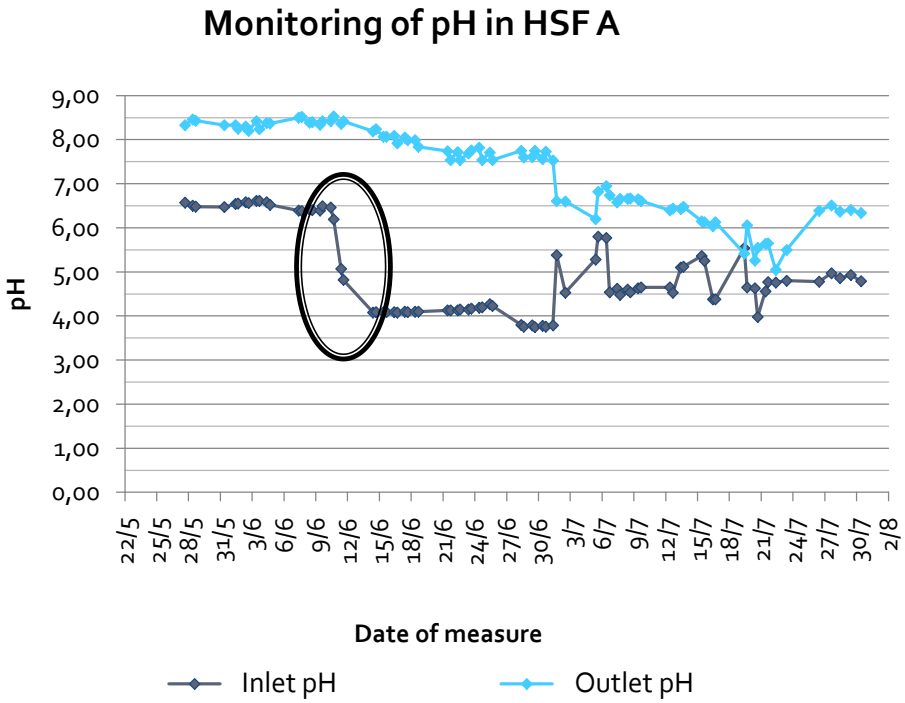


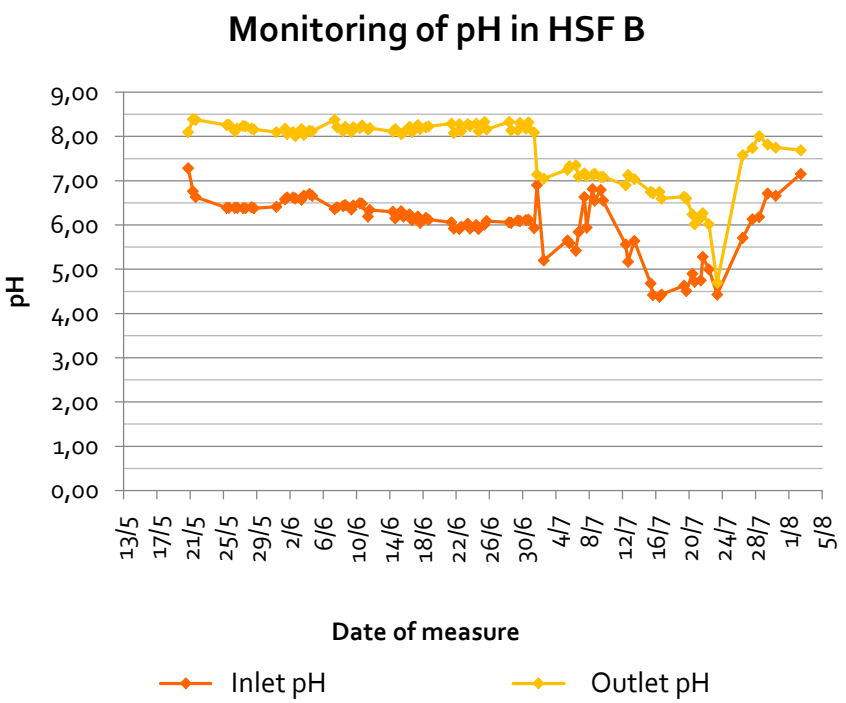
Sand filter fed with sulphates

The two HSFs on the 21th June

RESULTS

DEGRADATION OF CARBON

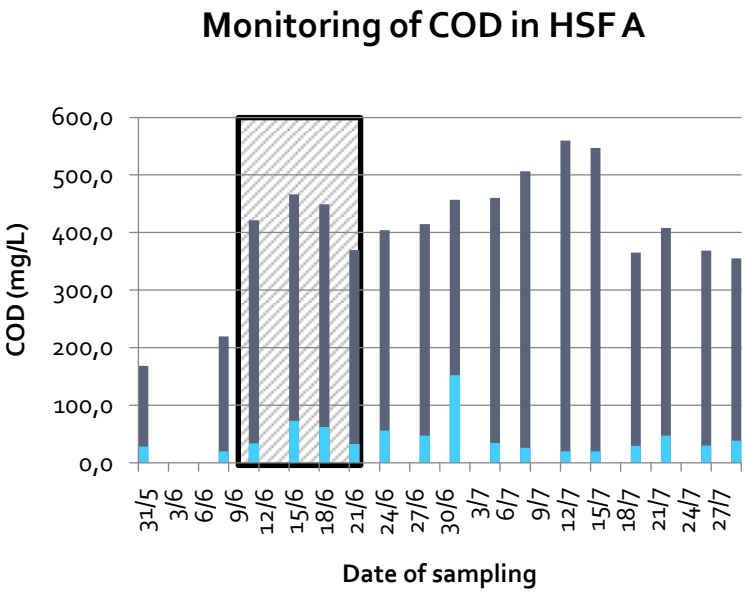




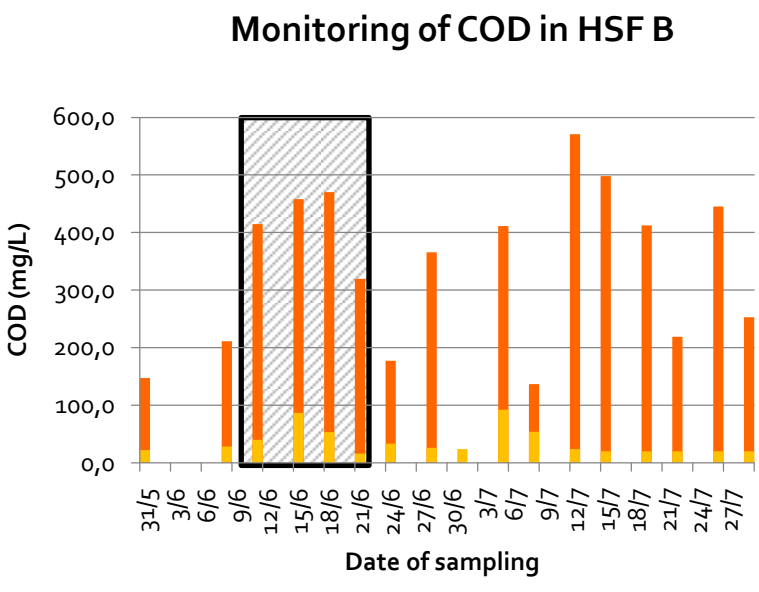
HSF A : With sulphates **HSF B : Without sulphates**

RESULTS

DEGRADATION OF CARBON



Mean treatment yield : 88,8%

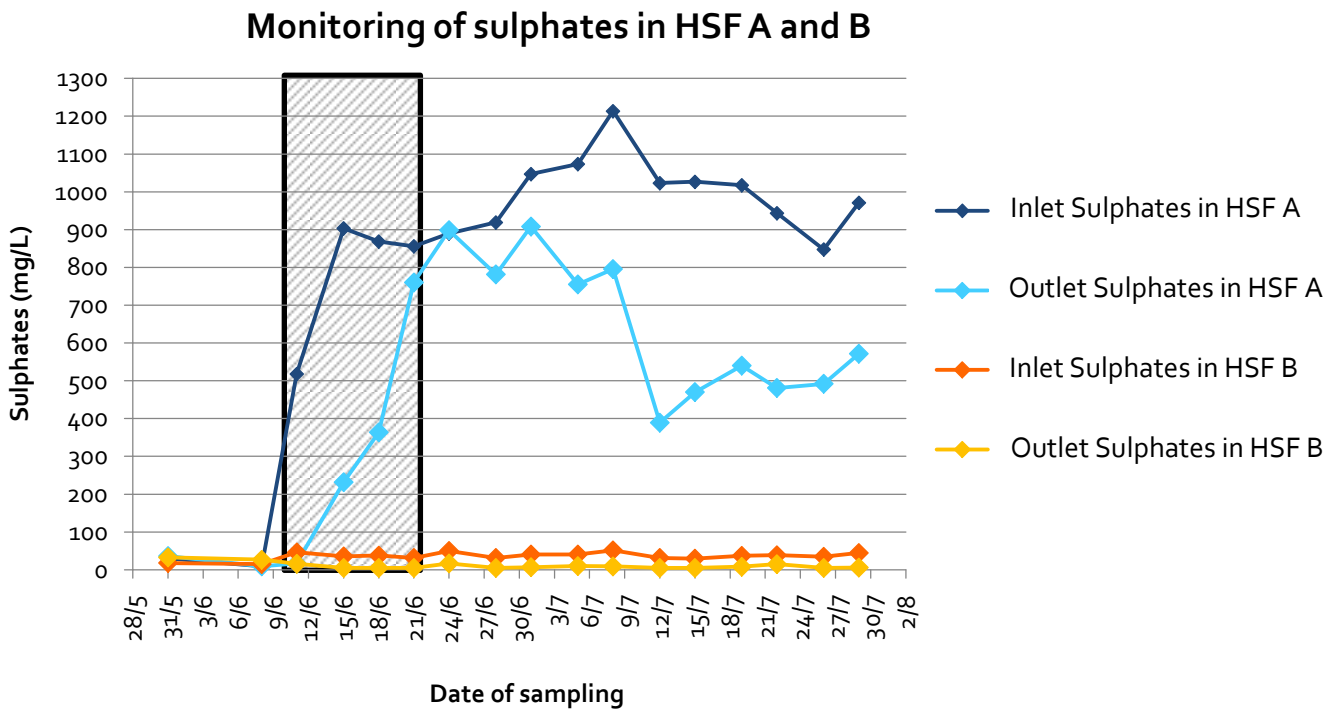


Mean treatment yield : 87,7%

HSF A : With sulphates **HSF B : Without sulphates**

RESULTS

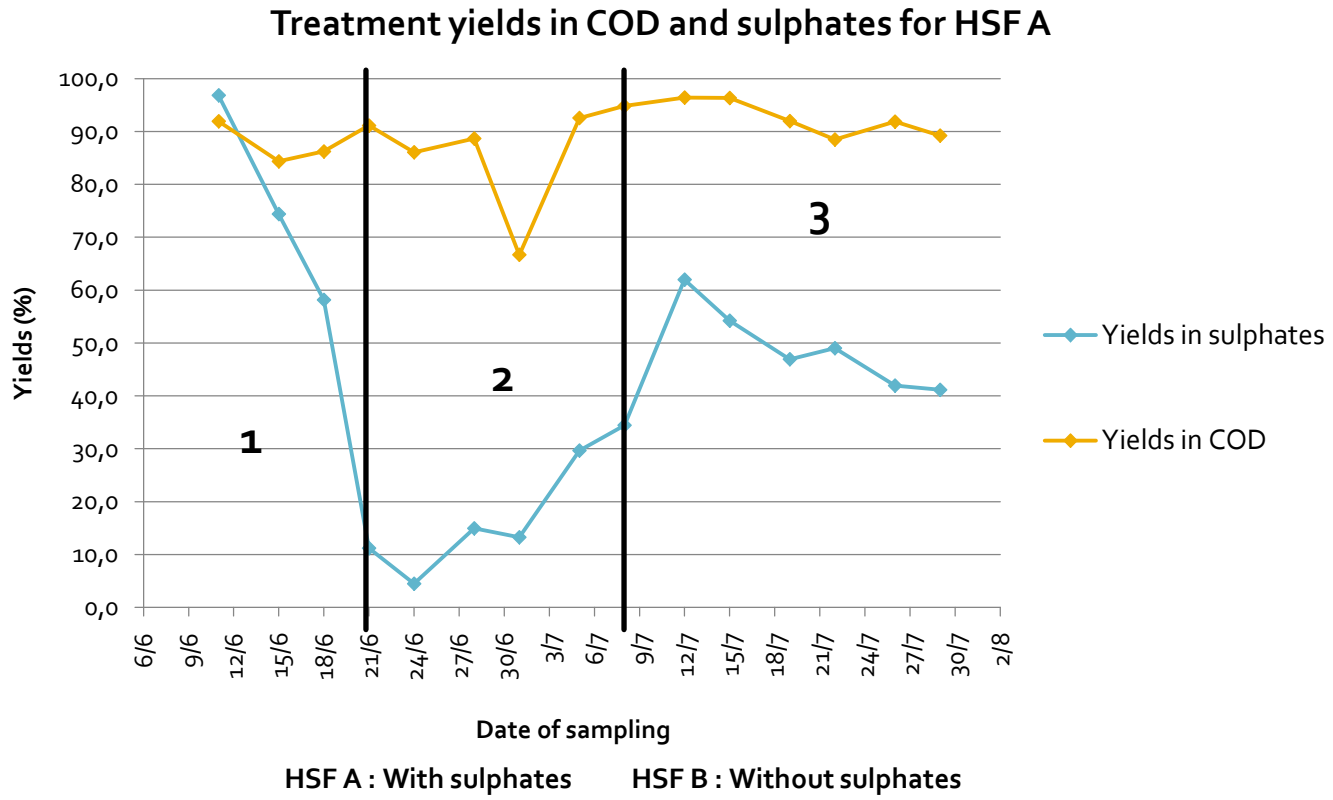
DEGRADATION OF SULPHATES



HSFA : With sulphates **HSF B : Without sulphates**

RESULTS

- ## DEGRADATION OF SULPHATES



HSF A : With sulphates HSF B : Without sulphates

Discussion

Mechanisms of degradation

Discussion

- **Mechanisms of degradation**

Date	Yields in Fe(II)
22 July	66,2%
26 July	60,9%
29 July	54,7%

Treatment yields in iron at the end of the experiment

FeS precipitation ???

Iron bacteria ???

Discussion

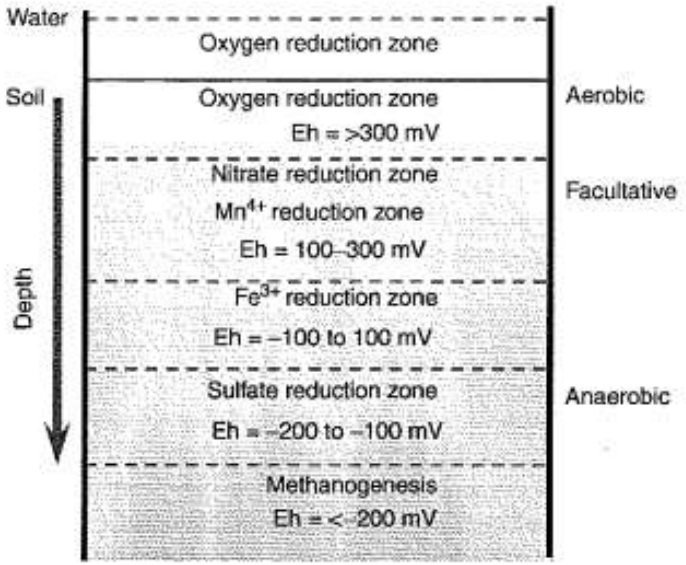
- **Mechanisms of degradation**

Sample of soil of surface of HSFA – 2nd September

Sample of soil of bottom of HSFA – 2nd September

Discussion

- ## Mechanisms of degradation



Vertical distribution of reductions according to redox potential – Reddy and De Laune, 2008

Iron oxides at the surface of HSF A

Conclusions and perspectives

Conclusions

- **Hydrodynamic study : 2 identical HSFs**
- **Sand filter fed with sulphates :**
  - Influent similar to acid mine drainage BUT effective treatment of COD
  - Equivalent yields to sand filter fed without sulphates

PERSPECTIVES

- **BACTERIA**
  - Full microbial monitoring
  - Identify the different populations
    - Sulphate reducing bacteria
    - Iron oxidizing bacteria???
    - Molecular tools (PCR, DGGE, etc…)

THANK YOU FOR YOUR ATTENTION

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