
WP3 (GRADIENT)

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Objectives of our work in WP3

1. Evaluate the performance and the usefulness of existing UV-spectrophotometric sensor (with domestic wastewater that may contain model toxic compounds or an organic overload dairy effluents)
2. Develop an adapted low-cost on-line UV-spectrophotometric sensor to monitor pilot and industrial pilot SBRs reactors

Description of work

1st Year

- Evaluate the performance of a lab-scale commercial UV-spectrophotometric sensor to estimate the COT, COD, Nt and nitrate content in the SBRs influent and effluent

2nd Year

- Develop the UV-databases for several wwt
- Validate the UV-databases with the on-line pilot-scale sensor

- Simplify the existing on-line pilot-scale sensor to obtain an affordable sensor to be used with different wwt

3rd Year

Implement the low-cost, adapted on-line sensor, on the SBRs reactors

Tested wastewaters

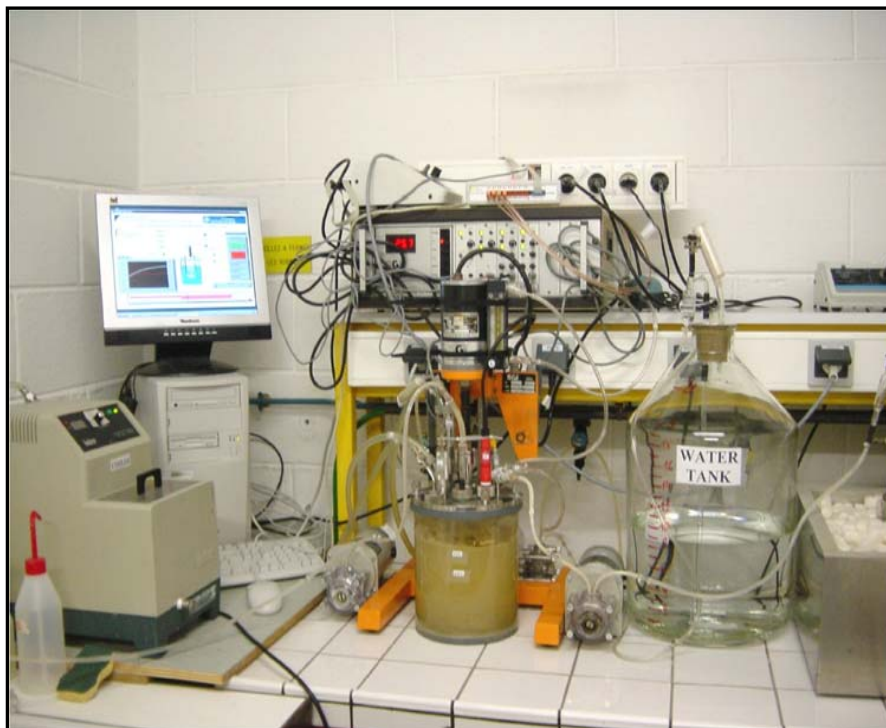
- Estimation of compounds
 - OECD-wastewater with POLIMI
 - UNAM-wastewater
 - UU-wastewater
 - LBE-wastewater
- Estimation of suspended solids

Nov 2003 – Nov 2004

1. Run of SBR reactor with OECD, UNAM and UU wastewater
2. Develop and test models to estimate nitrate, nitrite, carbon compounds during SBR cycles
3. Develop strategy for on-line measurement

OECD Wastewater

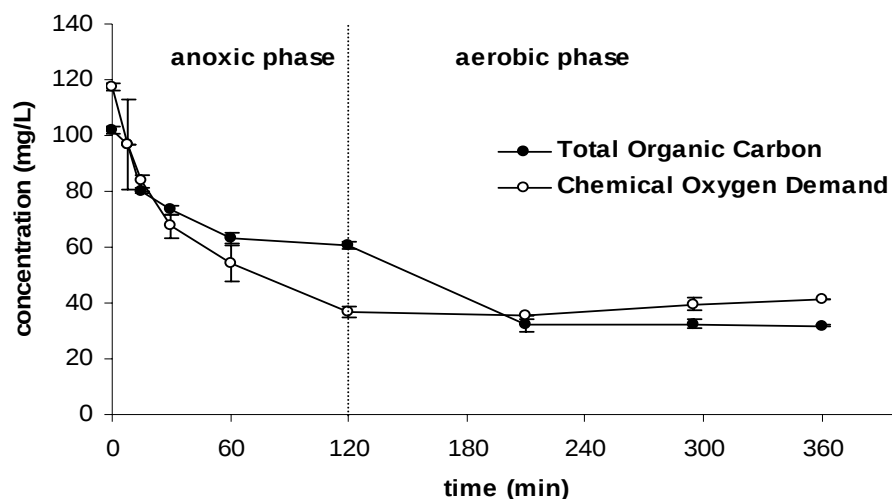
Lab-scale SBR (...Gaston!!)



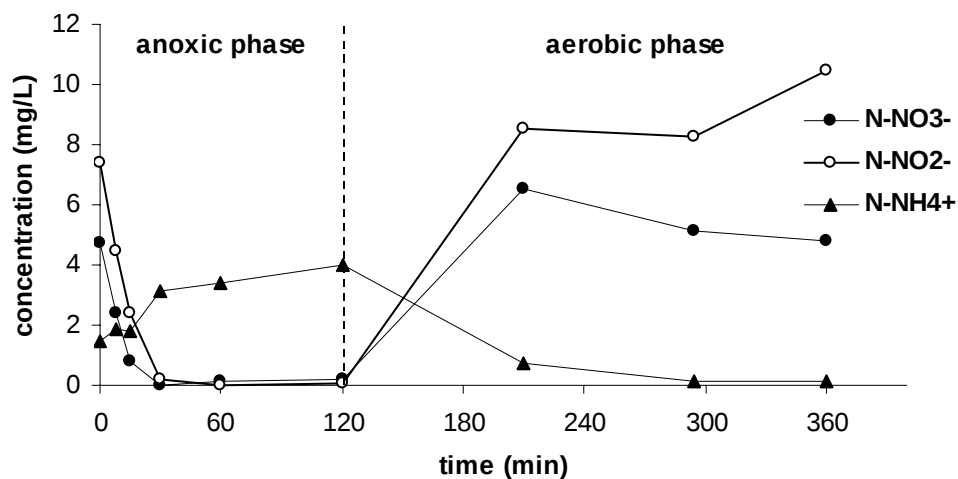
Standard conditions

Feeding	6 min
Anoxic phase	120 min
Aerobic phase	175 min
Sedimentation	50 min
Total time	360 min

Nov 2003 – May 2004



Redox potential = $f(\text{NO}_2^-)$?



New operating conditions / June 15th, 2004

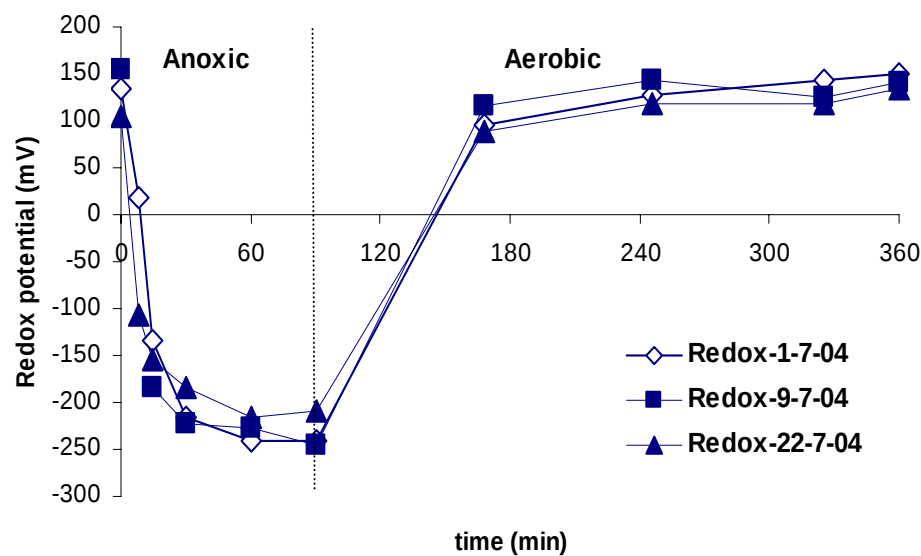
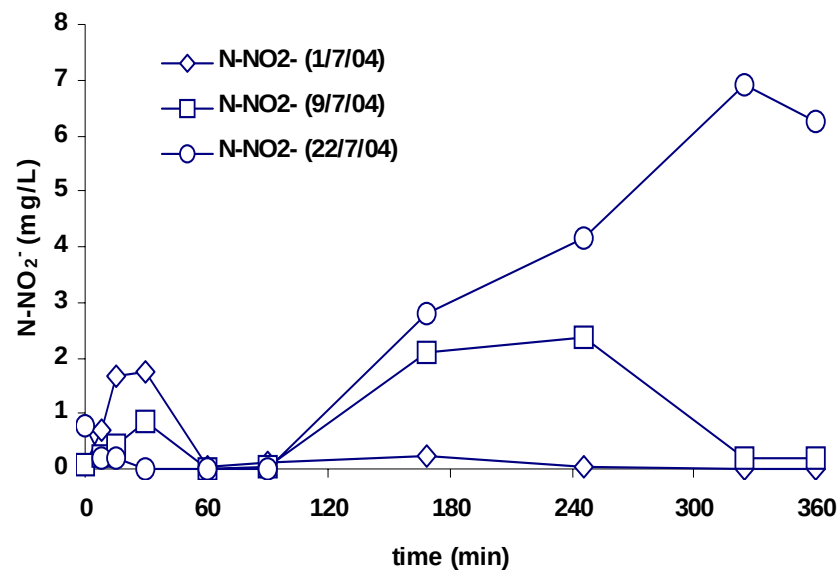
Standard conditions	
Feeding	6 min
Anoxic phase	120 min
Aerobic phase	175 min
Sedimentation	50 min
Total time	360 min

Current conditions
6 min
90 min
235 min
30 min
360 min

COD = 675 mg/L

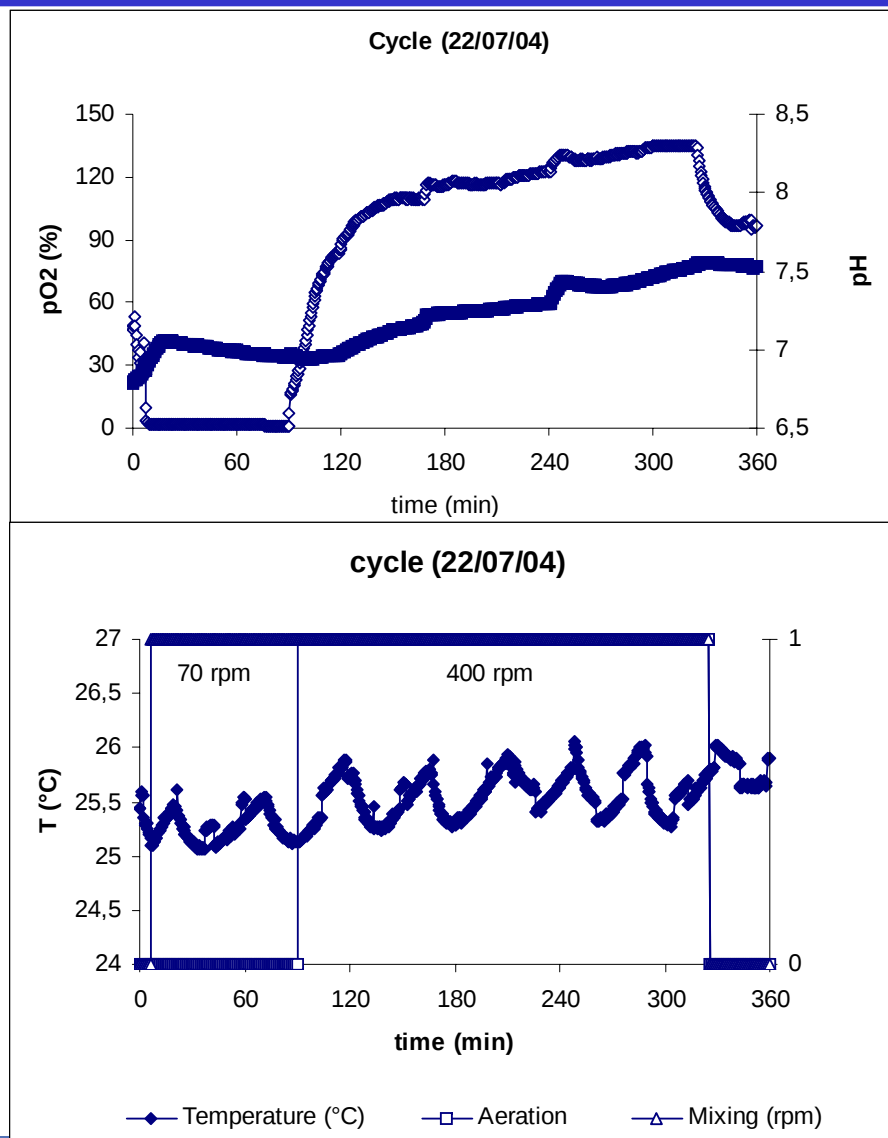
Acetate (NaCOOCH₃)

New conditions / Results



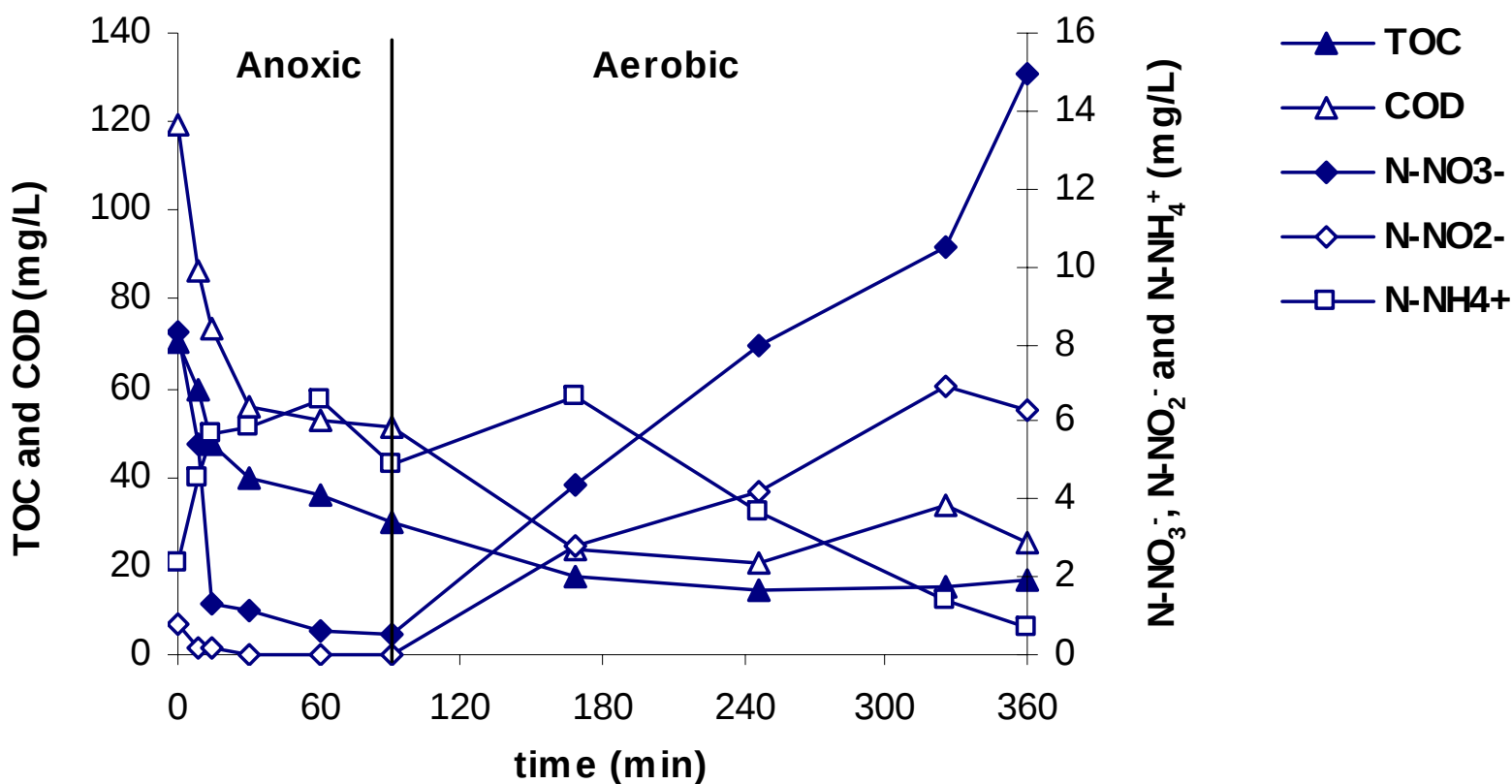
Evolution of on-line parameters

(Cycle 22/7/04)



Evolution of TOC, COD and N-forms

(Cycle 22/7/04)



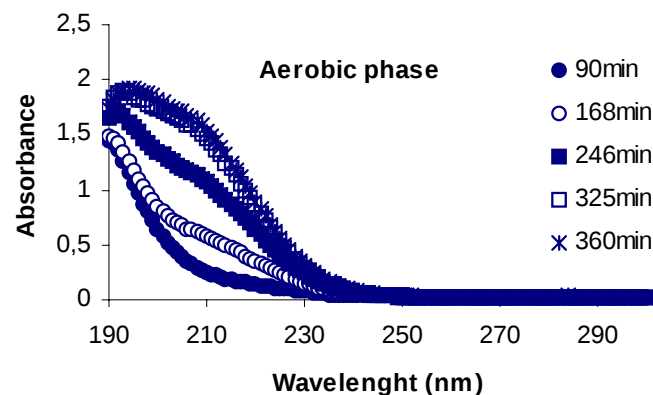
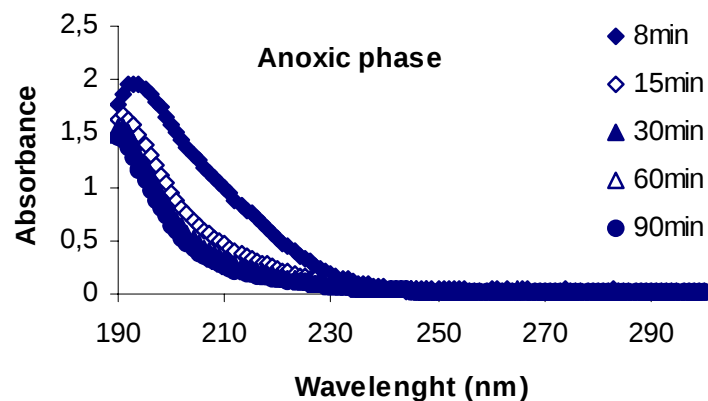
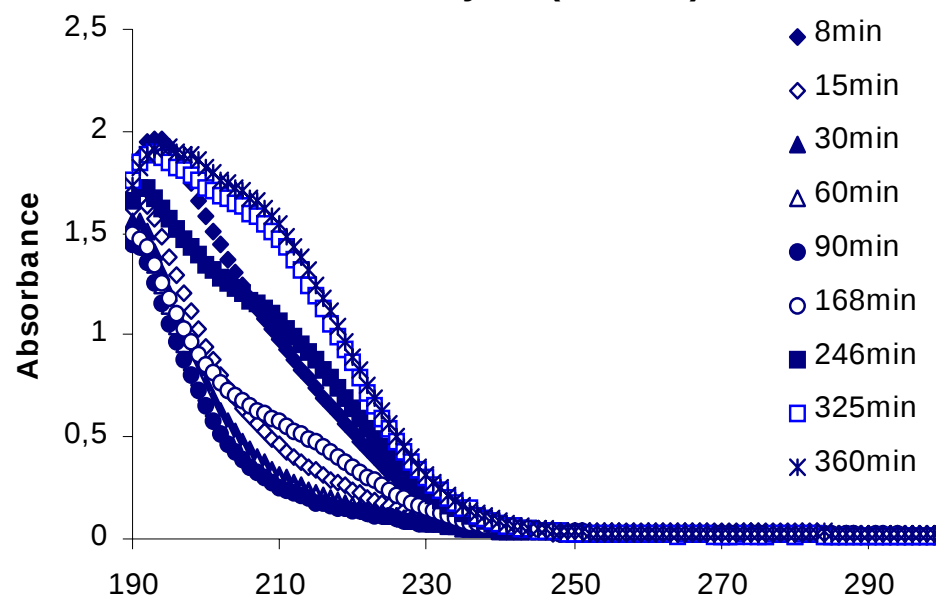
Evolution of UV-spectra

Dilution: 1/3

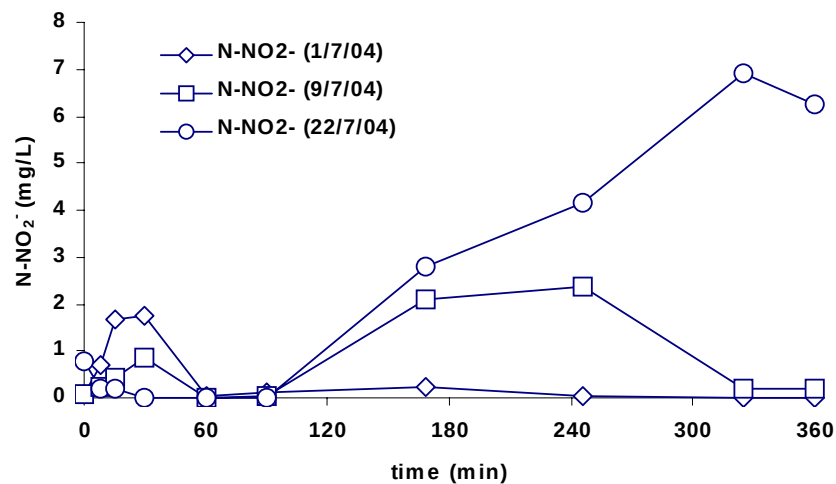
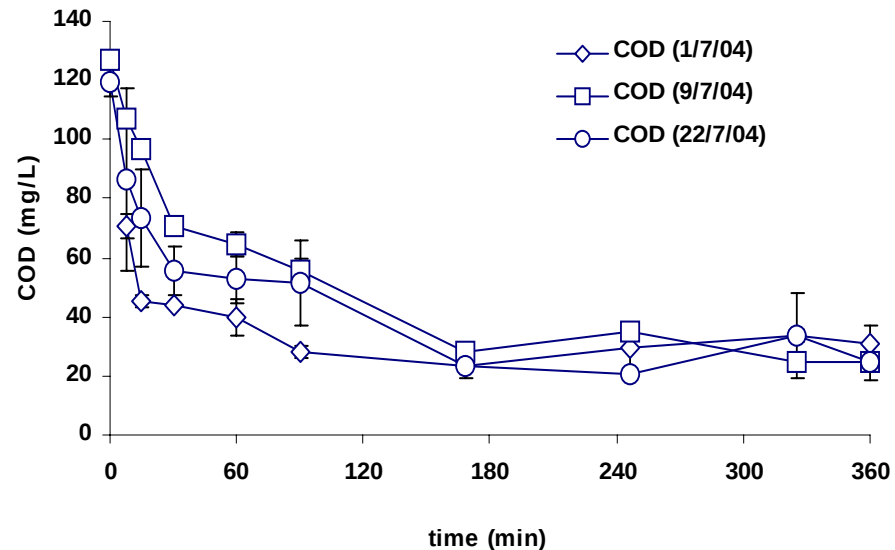
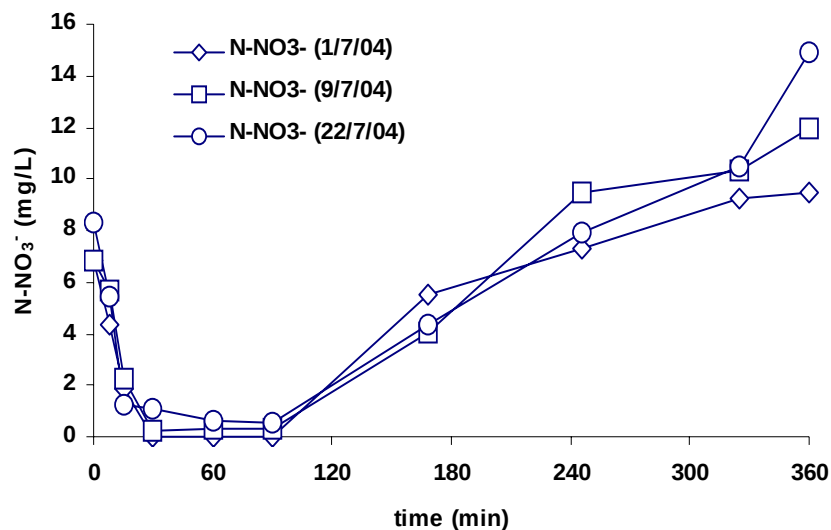
Filtration: 0.22 μm

Cycle (22/7/04)

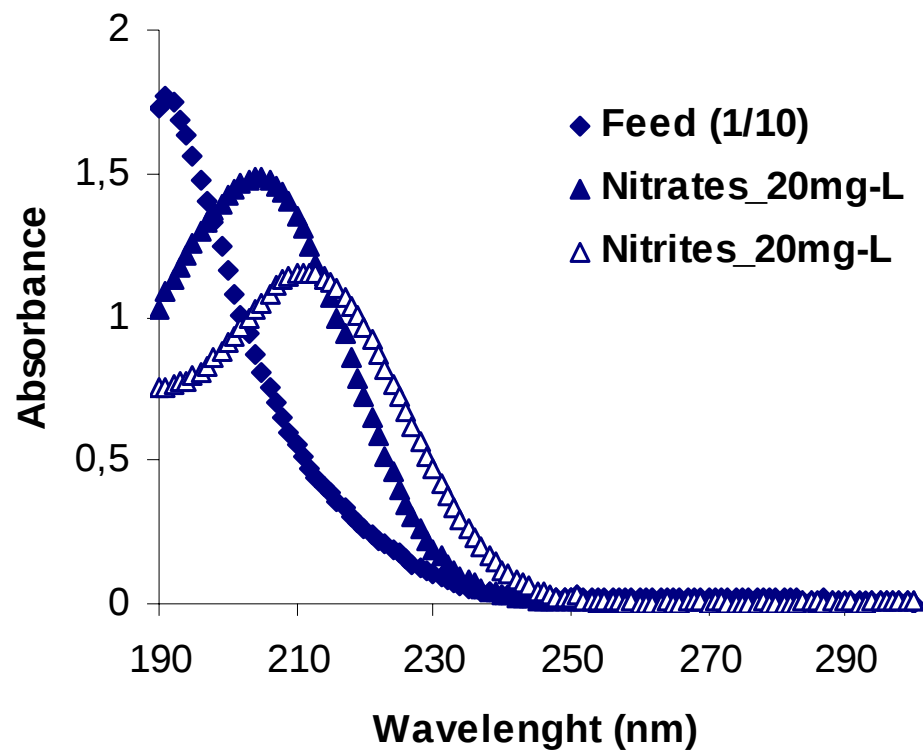
(Cycle 22/7/04)



Reproducibility of SBR cycles



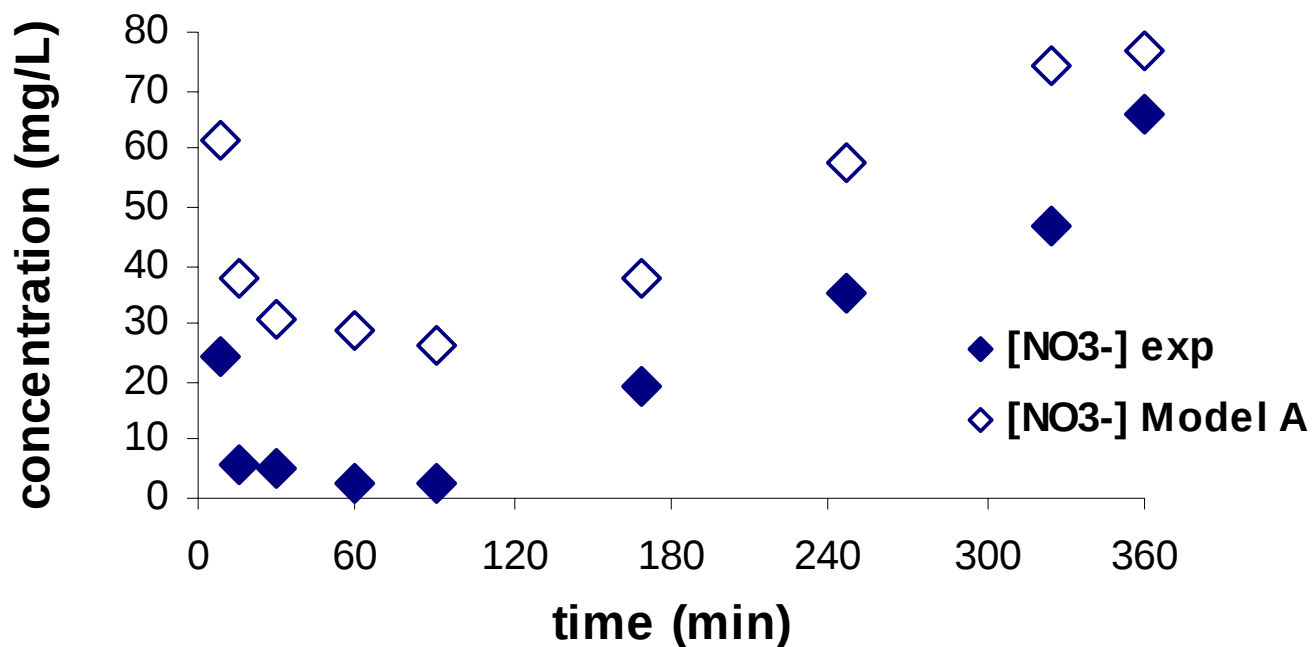
Deconvolution



Compound	$\lambda_{\max}$	ϵ (L mg ⁻¹ m ⁻¹)
Feed	191	12.33
Nitrates_ 20 mg/L	205	14.88
Nitrites_ 20 mg/L	211	11.57

Model A: NO₃⁻ alone

Deconvolution with model A (nitrates.MOD)

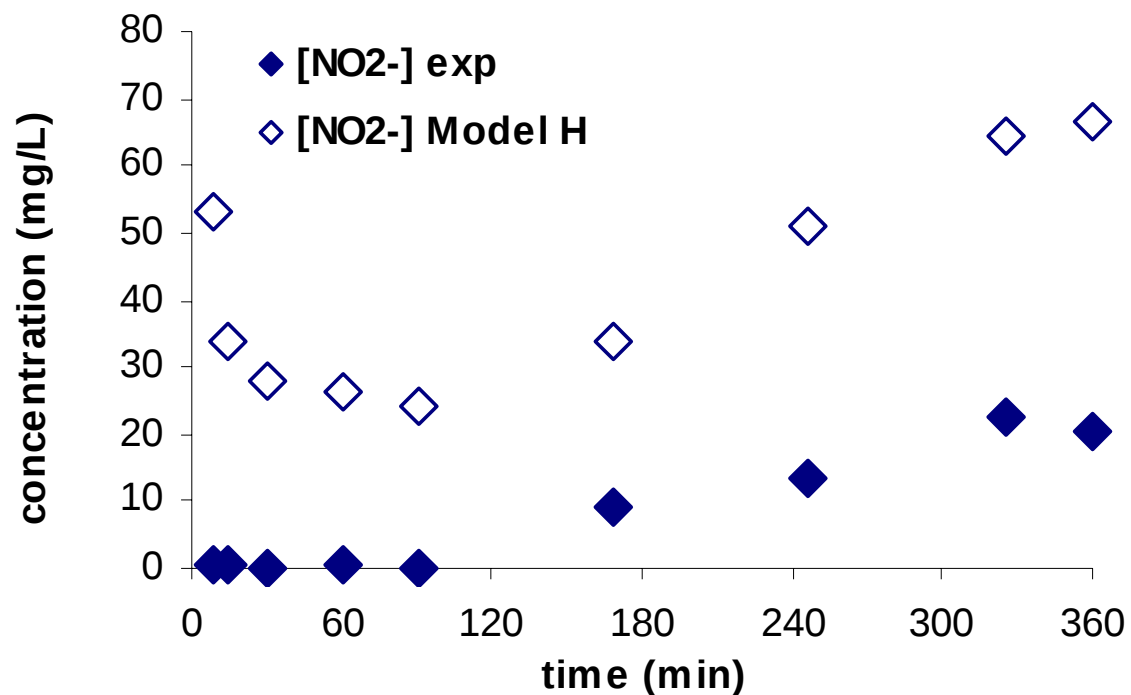


Dynamic evolution: well described

Concentration: systematically overestimated

Model B: NO_2^- alone

Deconvolution with model B (nitrites.MOD)

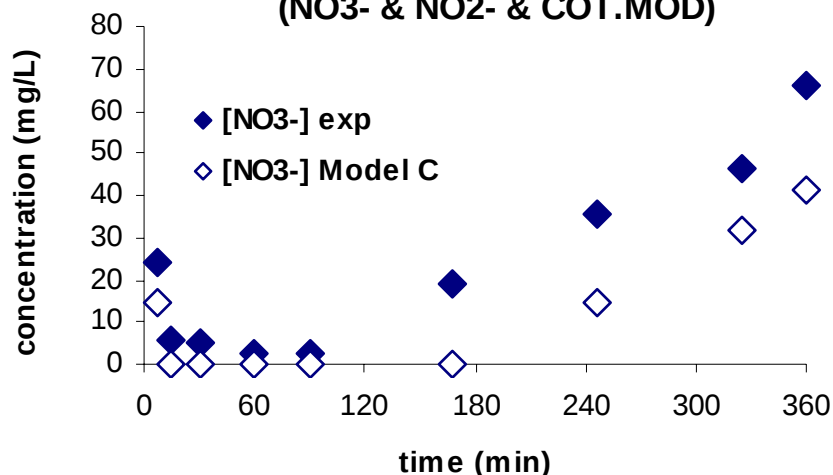


Dynamic evolution: well described in the aerobic phase

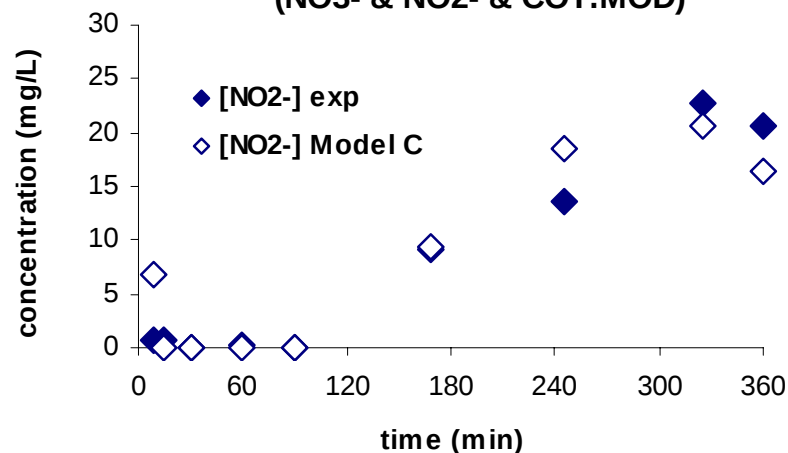
Concentration: systematically overestimated

Model C: (Feeding + NO_3^- + NO_2^-)

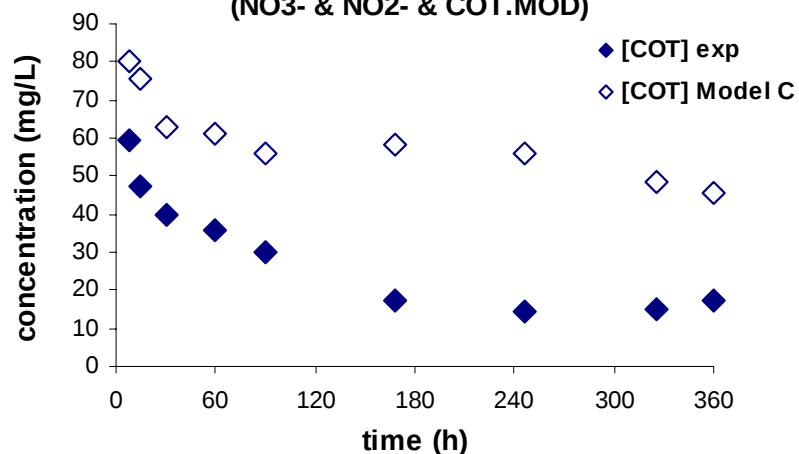
Deconvolution with model C
(NO_3^- & NO_2^- & COT.MOD)



Deconvolution with model C
(NO_3^- & NO_2^- & COT.MOD)



Deconvolution with model C
(NO_3^- & NO_2^- & COT.MOD)



NO_3^- : well estimated in the anaerobic phase

NO_2^- : well estimated in the aerobic phase

TOC: overestimation

Quantitative use of UV-spectra by deconvolution

Let us considering that the experimental UV-spectrum is a linear combination of elementar spectra, developed by O. Thomas and co-workers (Ecole des Mines d'Alès, France)

$$S = \sum_{i=1}^p a_i \text{REF}_i \pm r$$

where:

S is the sample spectrum

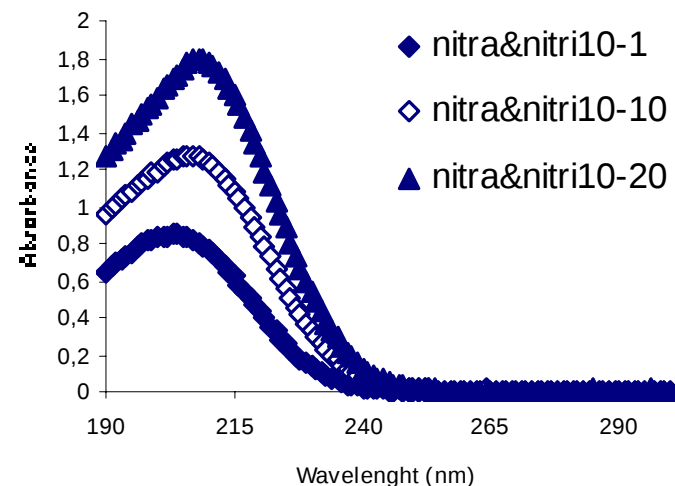
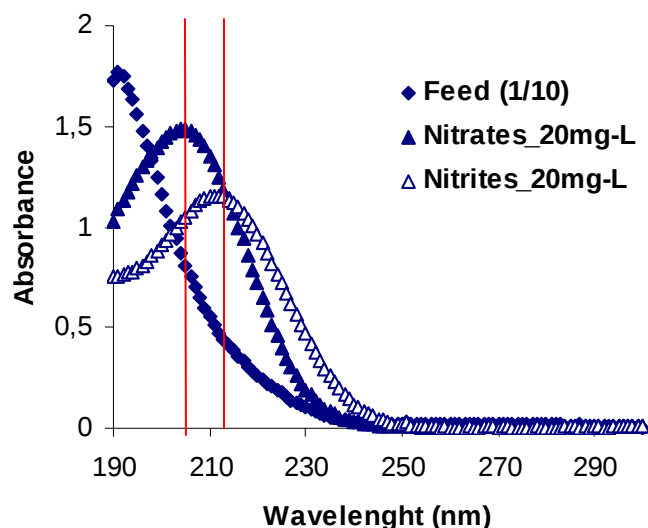
a_i is the contribution coefficient of the i th reference spectrum REF_i

p is the number of reference spectra

r is the quadratic error

Conclusions

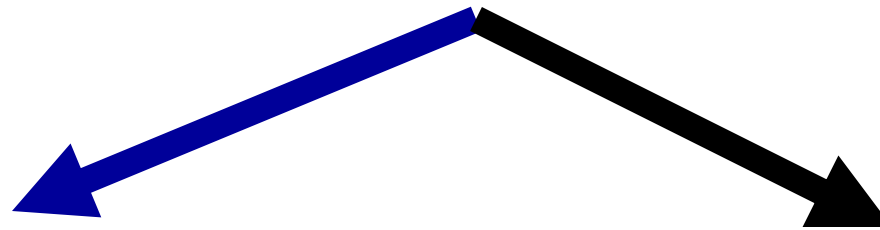
1. Commercial UV-Pro software is not enough sensitive to discriminate TOC, nitrite and nitrate during a SRB cycle, even if the dynamics are correctly estimated



2. Time evolution of TOC composition is not taken into account by the software

Investigations

Improvement of the deconvolution models



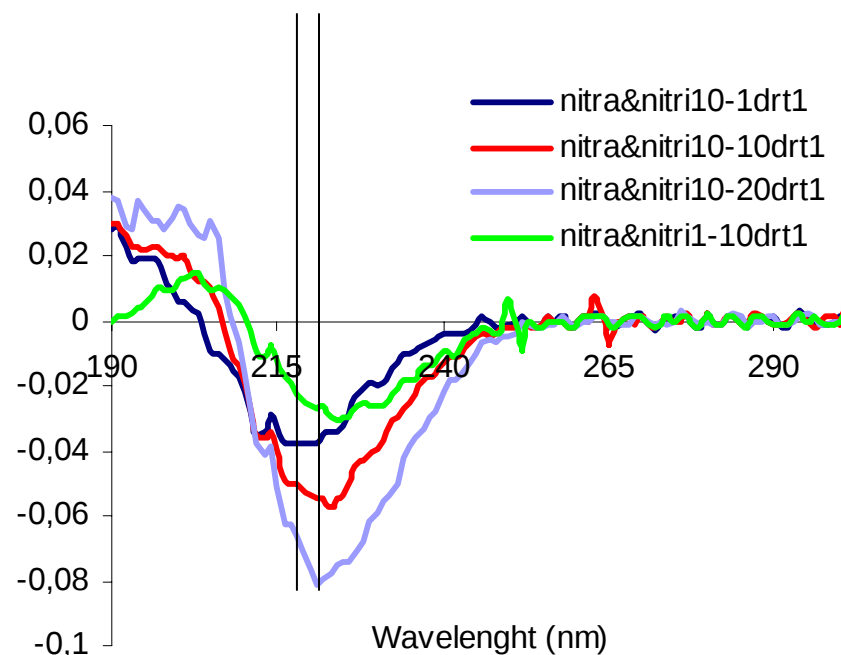
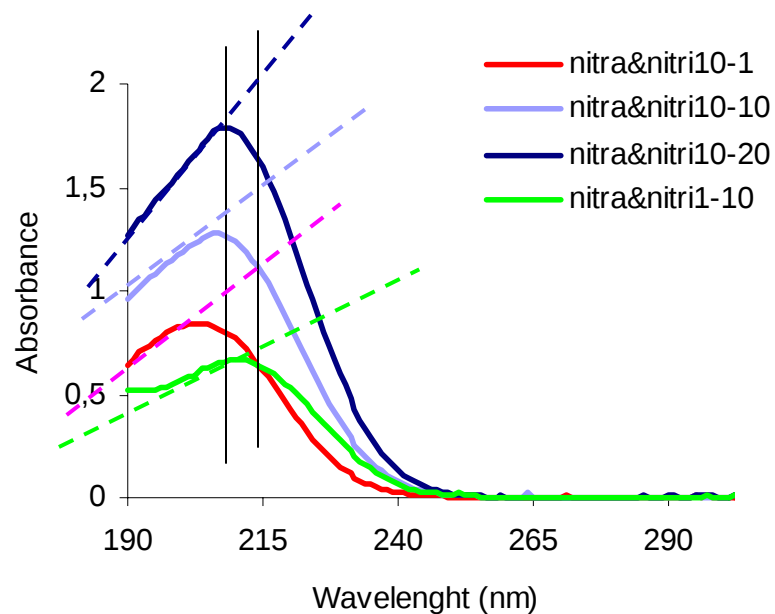
**1. Spectrum
derivates**

**2. INRA-LBE
investigation**

Improvement of the deconvolution models

Spectrum derivatives

Shift of $\lambda_{\max}$ and
slope variation



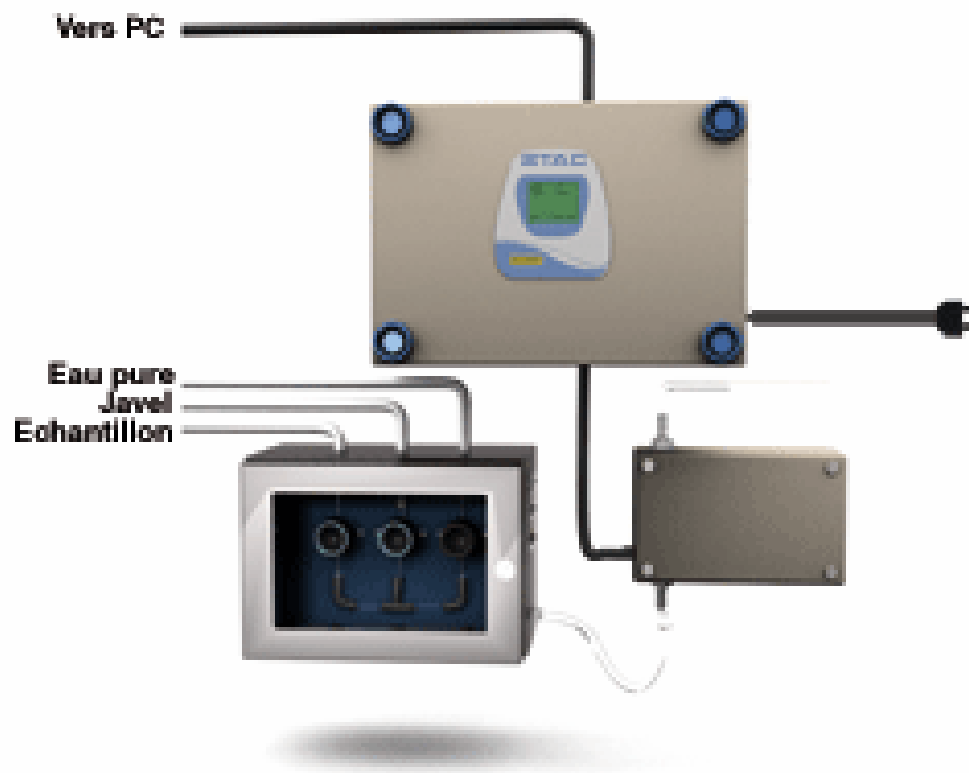
Improvement of the deconvolution models

INRA-LBE investigations

Next year

- 1. Development and application of others deconvolution methods to enhance the reliability of the UV-models**
- 2. With different wastewaters, application of the commercial on-line spectrophotometer, based on off-line obtained UV-models**

Implementation of the on-line spectrophotometric sensor



STAC (SECOMAM)