



POLITECNICO DI MILANO

DIIAR - Environmental Engineering Section

HETEROTROPHIC DENITRIFICATION OF DRINKING WATER:

OPTIMIZATION OF A CASE-STUDY PROCESS AND EVALUATION OF AUTOTROPHIC ALTERNATIVES

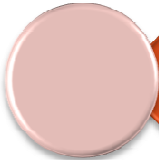
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Ph.D. Supervisor: Manuela ANTONELLI

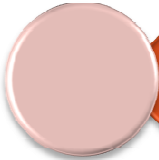
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INTRODUCTION AND CASE-STUDY DESCRIPTION



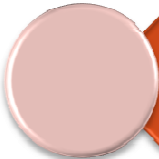
PROCESS OPTIMISATION OBJECTIVES



PRELIMINARY EVALUATIONS



HETEROTROPHIC PROCESS: FIRST RESULTS



AUTOTROPHIC ALTERNATIVES

INTRODUCTION AND CASE-STUDY DESCRIPTION

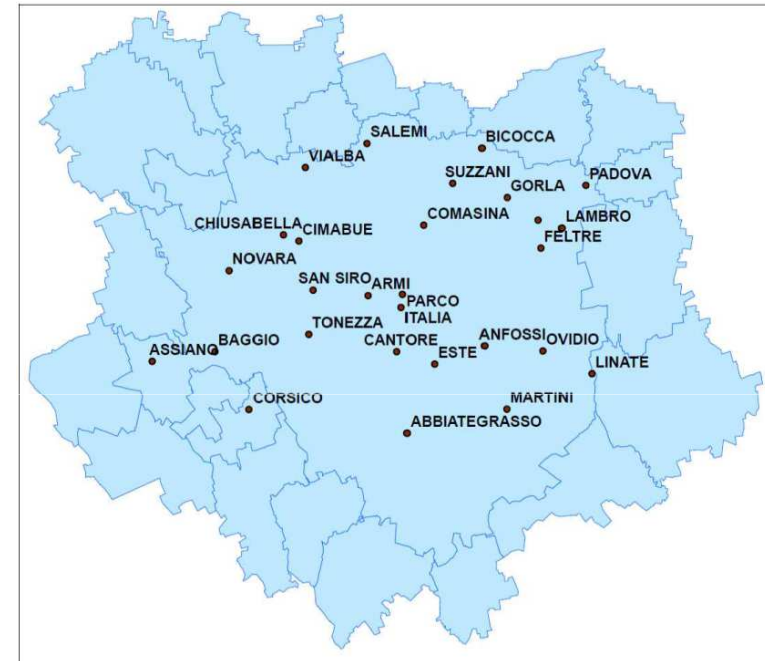
MILAN'S WATER SUPPLY SYSTEM :

GROUNDWATER SUPPLY

33 DRINKING WATER TREATMENT PLANTS

MORE THAN 500 WELLS AT 40 ÷ 200 mt

3 WATER TABLES



MAIN POLLUTANTS:

- Pesticides,
- Cd, Pb, Cr (VI),
- Trichloroethylene,
- Tetrachloroethylene,
- Nitrates



- GAC adsorption filters
- Aeration columns



Evaluation of biological
denitrification processes

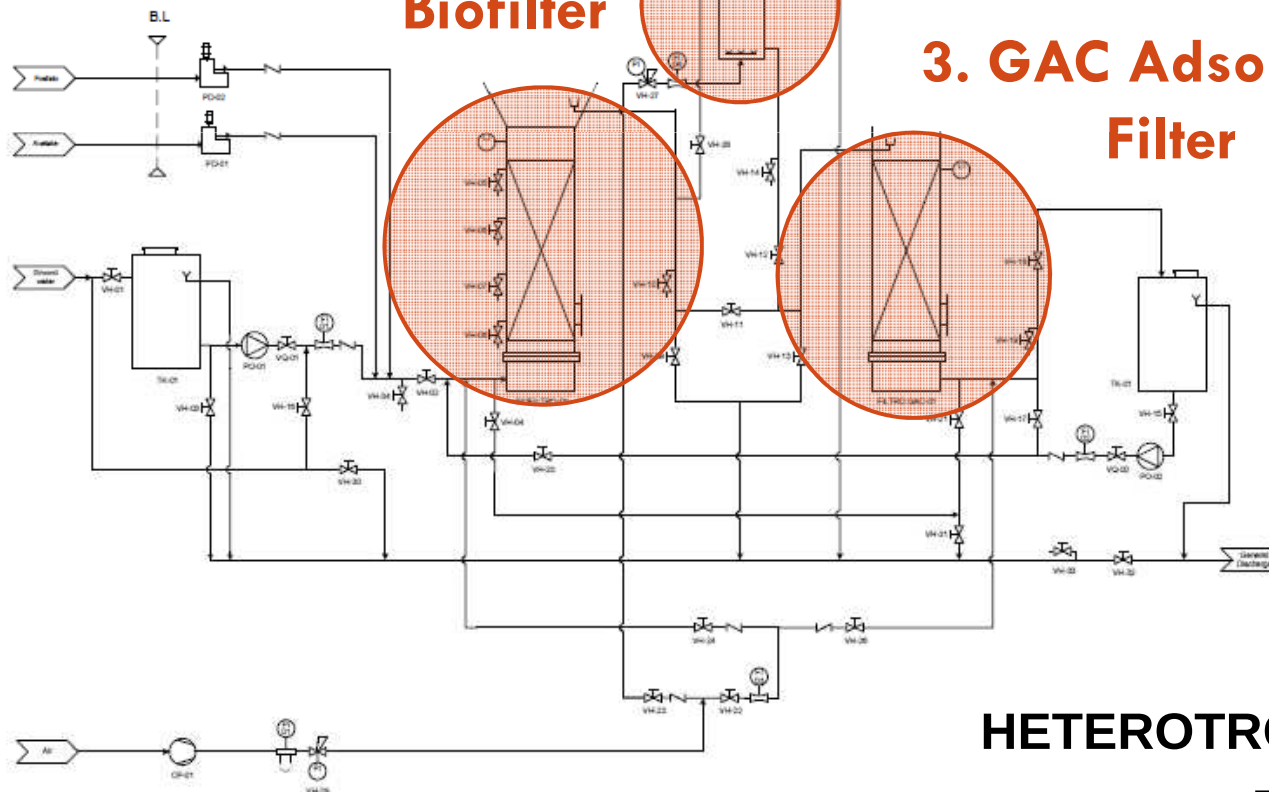
INTRODUCTION AND CASE-STUDY DESCRIPTION

1. Heterotrophic Denitrification Biofilter

2. Aeration

3. GAC Adsorption Filter

	Biofilter	Aeration	GAC Filter
C_i [m/h]	8,49	34,0	8,49
EBCT [min]	17,0	3,2	7,1
C_v [kgN/m ³ d]	0,77	-	-



**PILOT PLANT FOR
HETEROTROPHIC DENITRIFICATION
PROCESS OPTIMISATION**



PROCESS OPTIMISATION OBJECTIVES

PRELIMINARY EVALUATIONS

Nitrate loading, pilot plant hydraulic characterisation

HETEROTROPHIC DENITRIFICATION FILTER EVALUATION

Denitrification efficiency,
kinetic limitations/inibitions, nitrite accumulation,
design parameters check

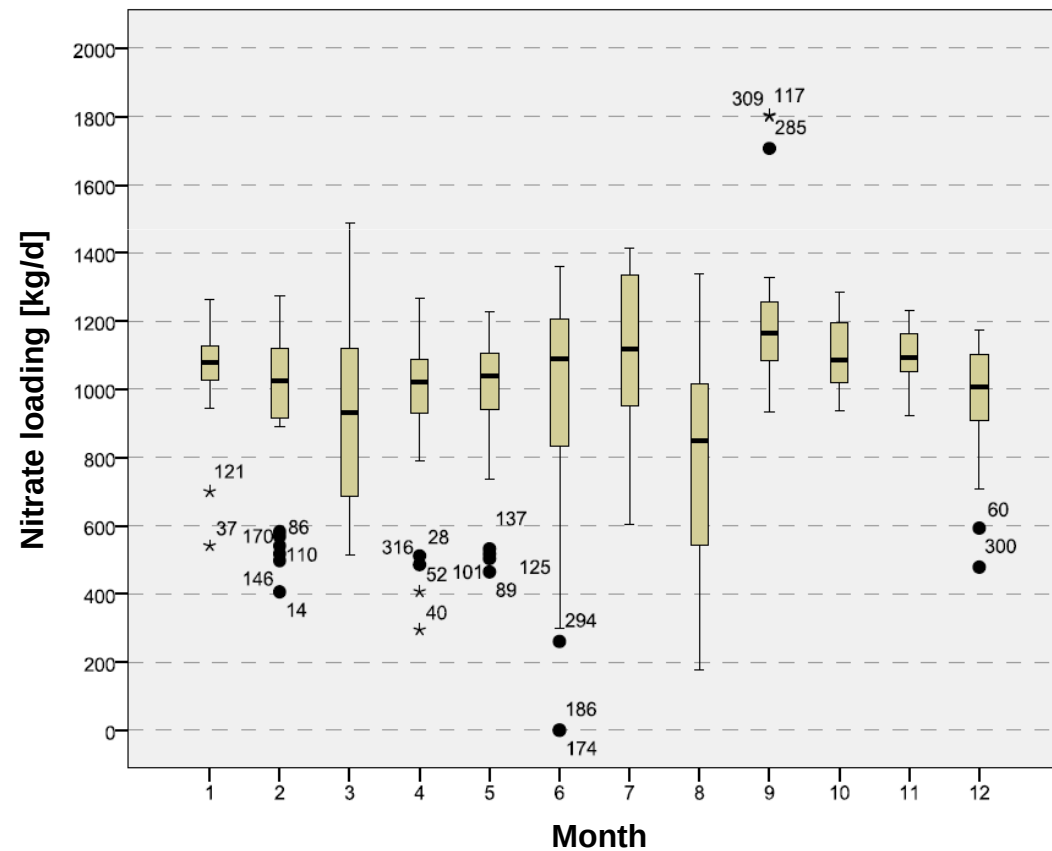
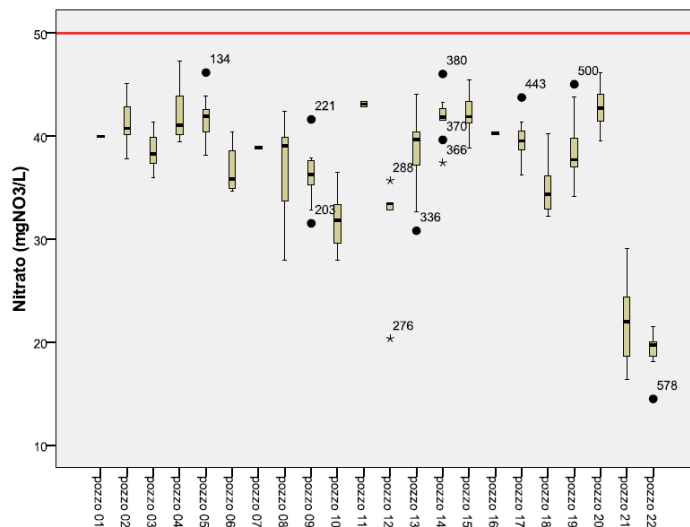
PROCESS OPTIMISATION

Substrate and nutrients feeding procedure,
C/N ratio, backwashing frequency and
procedures, recirculations

PRELIMINARY TESTS

NITRATE LOADING EVALUATION

- Nitrate concentration at each well (year 2010)
- Wells flow (year 2010)





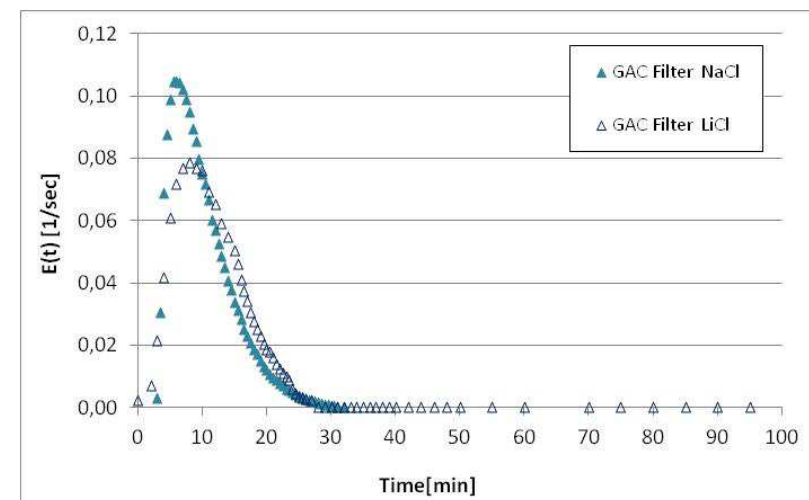
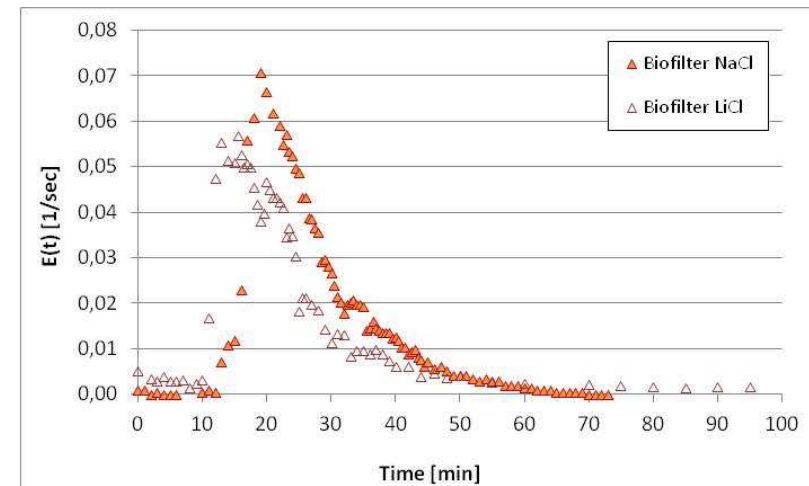
PRELIMINARY TESTS

PILOT PLANT HYDRAULIC CHARACTERISATION:

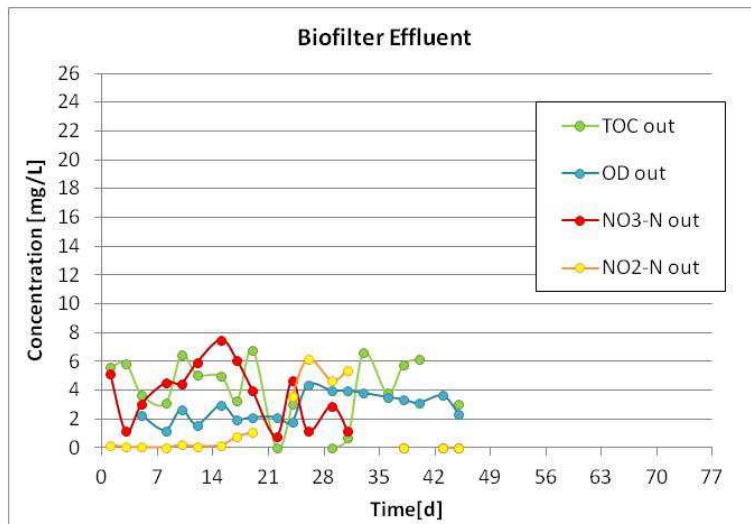
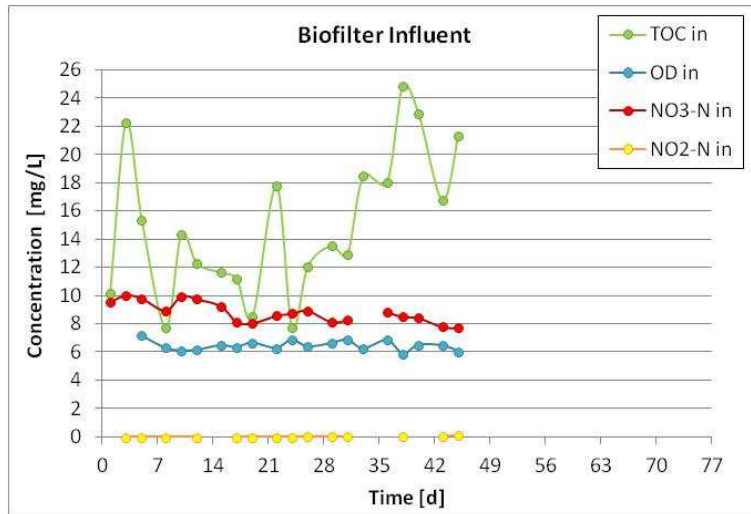
Tracer tests:

- o Before biofilter colonisation,
- o After start-up phase,
- o End of sperimentation.

Reactor		Biofilter	Biofilter	GAC Filter	GAC Filter
Tracer		NaCl	LiCl	NaCl	LiCl
HRT _{mean}	min	22,8	26,4	9,5	13,1
HRT _{theoretical}	min	26		20	

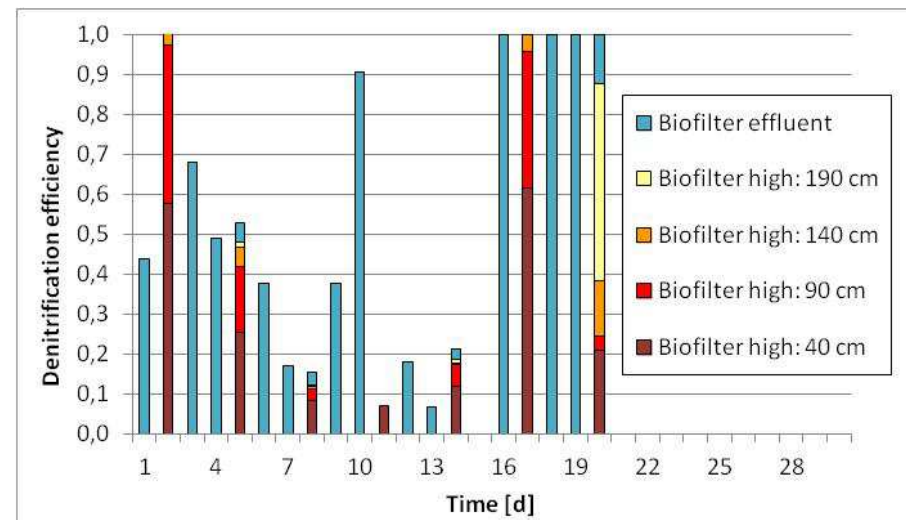


HETEROTROPHIC PROCESS: FIRSTS RESULTS

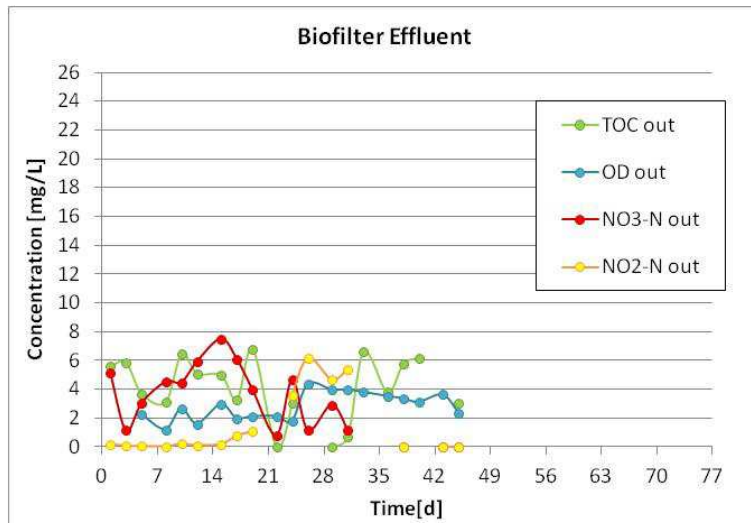
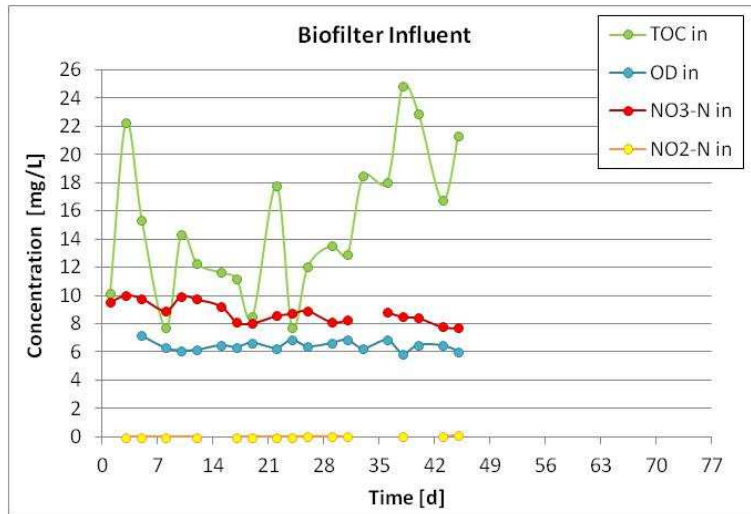


SUBSTRATE FEEDING EFFECTS ON:

- Denitrification Efficiency
- Nitrite Accumulation

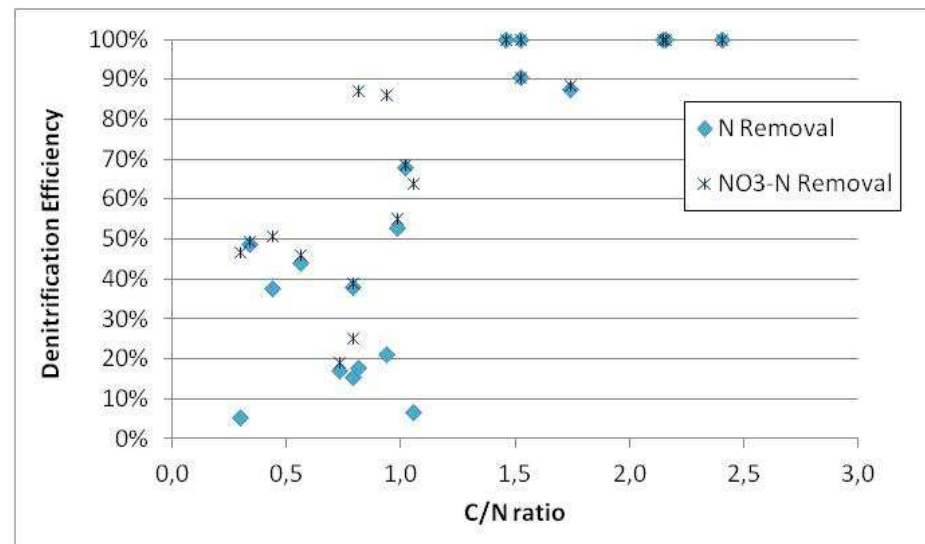


HETEROTROPHIC PROCESS: FIRSTS RESULTS

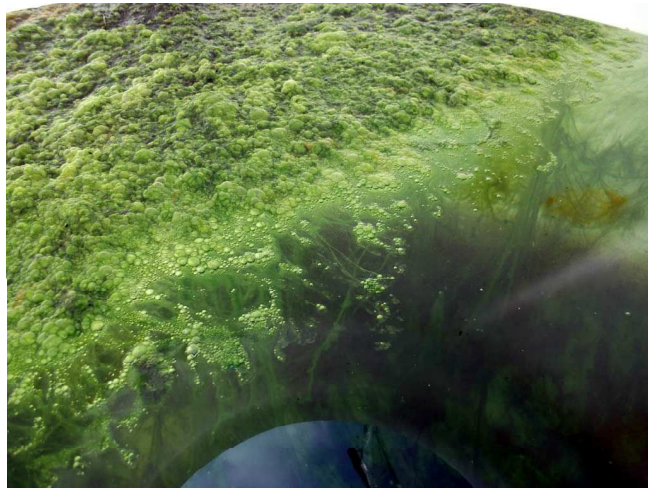


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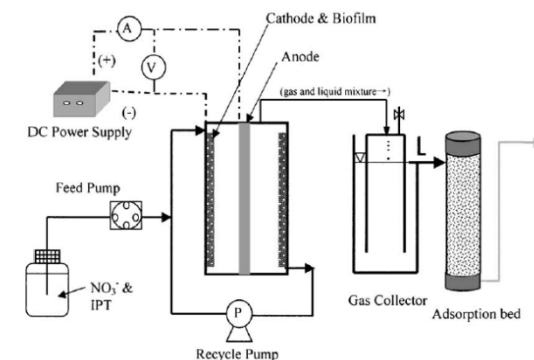
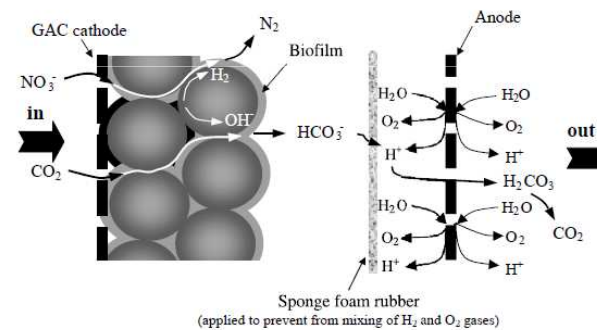


AUTOTROPHIC ALTERNATIVES: NEXT STEPS



**SPONTANEOUS AND
INOCULATED ALGAE:**
Nitrate assimilation
evaluation

**HYDROGENOTROPHIC
DENITRIFICATION:**
Innovative processes
evaluation





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