DEMOWARE

Water reuse in Sabadell Demoware site for testing

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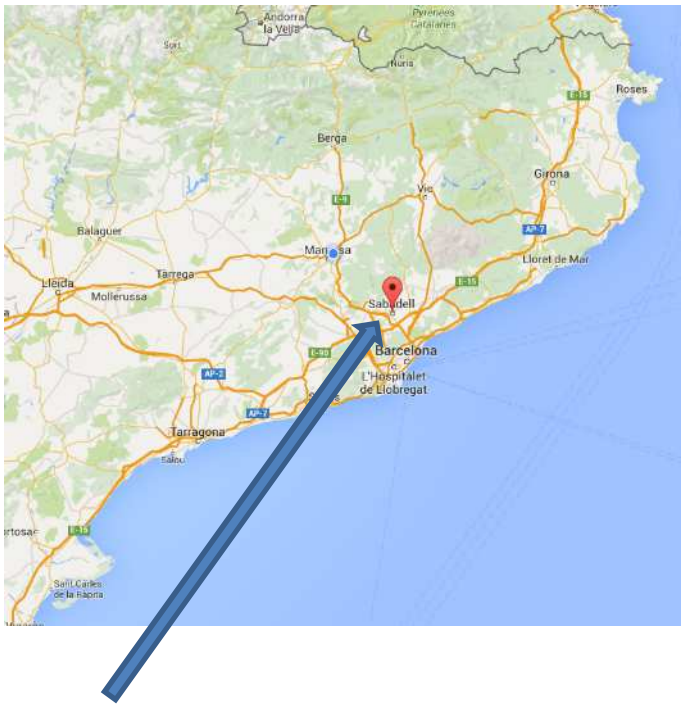
OVERVIEW

- The city of Sabadell and the water management
- Riu Sec WWTP: production of reclaimed water
  - Life Cycle Assessment
  - Human Health Risk Analysis
- Maintenance strategies in distribution networks for urban applications

THE CITY OF SABADELL AND THE WATER MANAGEMENT



The City:

- Vallès Occidental (30 km north-west of Barcelona)
- 200.000 inhabitants

Water management (CASSA):

- Drinking water:
  - 85 % surface water from Llobregat River
  - 15 % groundwater
- Water treatment:
  - Two WWTPs
- Non-drinkable water management
  - Network of 25 km
- Reclaimed water management

Ajuntament de Sabadell

AIGÜES Sabadell

THE CITY OF SABADELL AND THE WATER MANAGEMENT

Water management in Sabadell:

- 2003. Study of reclaimed water uses opportunities in the city.
- 2005. Approval of the Water Masterplan of Sabadell which includes:

  External water resources used in Sabadell for non-drinkable uses
- 2010. Municipal Ordinance regulating uses of water and promoting water saving in new buildings.
- 2013. Update of the Municipality Domestic Water Supply regulations: including non-drikable water public services
- 2015. Update of Water Masterplan of Sabadell.

Ajuntament de Sabadell

AIGÜES Sabadell

THE CITY OF SABADELL AND THE WATER MANAGEMENT

Recovery of **hydric resources** (25 supply points):

- 2002. Ribatallada Mine in operation for urban uses.
- 2003. Construction of a pipe to use treated wastewater to restore the ecologic flow of Ripoll River
- 2003. Ripoll River Mine in operation for urban uses.
- 2007. Severe drought period. Implementation of advanced treatments for the use of groundwater for swimming pools.
- 2008. Martí-Vinyals Mine in operation for agricultural and urban use.

Urban uses for non-drinking water:

Irrigation of green areas, street cleaning, drilling machine for the underground construction.

Urban uses of groundwater (after treatment) in drought periods:

Swimming pools

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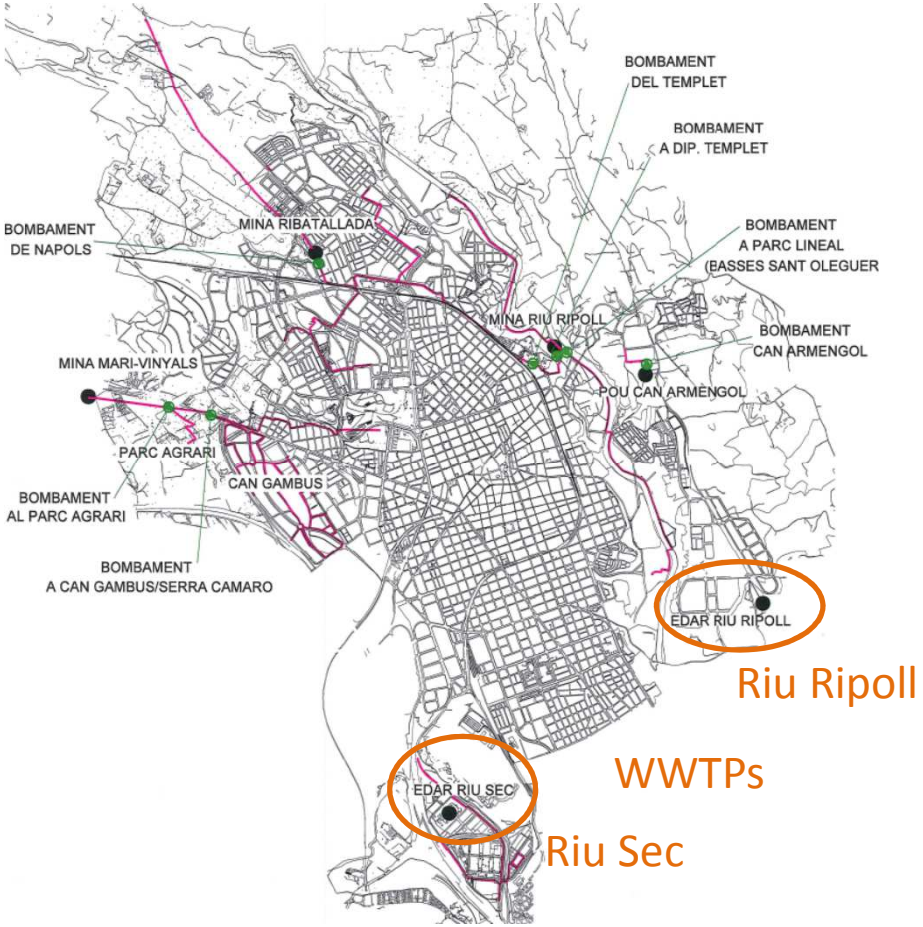
THE CITY OF SABADELL AND THE WATER MANAGEMENT



Reclaimed water management

- 2008-2009. Upgrading Riu Sec WWTP with MBR technology. Possibility to reclaim water.
- 2015. Use of reclaimed water at commercial and industrial area of Sant Pau Riu Sec.

Reclaimed water uses (24 supply points):

- Toilet flushing
- Street cleaning
- Irrigation of green areas

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RIU SEC WASTE WATER TREATMENT PLANT

- Treatment capacity:
  - 35,000 m^3/day
- Wastewater from:
  - Sabadell
  - Sant Quirze del Vallès

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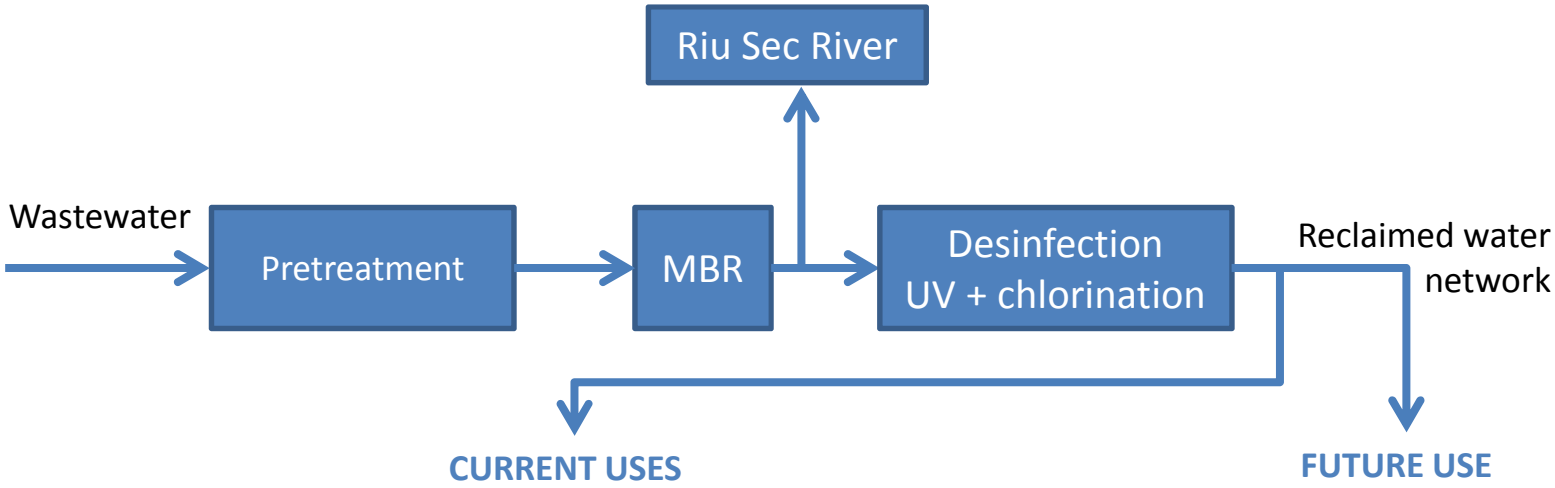
RIU SEC WASTEWATER TREATMENT PLANT



Green areas irrigation

Street cleaning

Toilet flushing

Golf course irrigation

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IMPACT: LCA and WATER FOOTPRINT

Objective

- Evaluate the environmental implications of current reuse schemes of Riu Sec WWTP.
- Determine the viability (in terms of impact) of increasing water reuse ratio in Sabadell

System Boundaries:

- Sabadell WWTP (Pretreatment, MBR, disinfection, biogas production, sludge treatment plant, plant construction and direct air emissions)
- Energy for distribution, reagents use and infrastructure for different reuse schemes

Reuse Scheme	Water reused (m^3/day)	Reuse rate from WWTP capacity
Street Cleaning	4,77	0,42%
WC Flushing	20,97	1,86%
Irrigation	11,33	1,01%

IMPACT: LCA and WATER FOOTPRINT

Impact categories for LCA:

- Climate change
- Freshwater eutrophication
- Marine eutrophication
- Cumulative energy demand

Water footpring:

- Considers water scarcity index of the site

IMPACT: LCA and WATER FOOTPRINT

Preliminary results:

- Energy used for the MBR seems to be the main source of impact
- Pollution abatement rate is the greatest source of avoided impact

- Water reclamation and reuse is an excellent option for the adaptation to climate change but not for mitigation of climate change

RISK ASSESSMENT

Objective

Determine the chemical and microbiological risk for human health of the use of reclaimed water

Scenarios for risk assessment

CURRENT USES :	FUTURE USE:
1. Green areas irrigation 2. Toilet flushing 3. Street cleaning	4. Irrigation golf course

Pathways of exposure

	Water				Air	
	Dermic absorption		Oral Ingestion		Inhalation	
	adult	child	adult	child	adult	child
Irrigation of public gardens	x	x		x	x	x
Street cleaning	x	x	x	x	x	x
Toilet flushing	x	x		x	x	x
Irrigation of golf courses	x				x	

RISK ASSESSMENT

Pretreatment → MBR → Desinfection UV + chlorination → **Reclaimed water** → Sprinkler

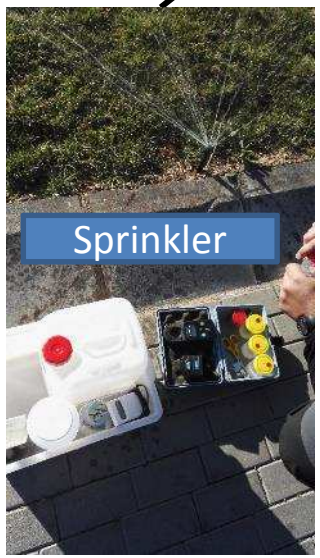
WWTP influent

MBR effluent

MBR effluent

WWTP effluent

Regenerated effluent



Sprinkler

Monitoring campaings:

September 2015
December 2015
February 2016
May 2016

RISK ASSESSMENT

Chemicals:

Metals
Halogenated solvents (chlorination by-products)
Polychlorinated Biphenyls (PCB)
Polycyclic Aromatic Hydrocarbons (PAH'S)
Volatile hydrocarbon fractions (BTEX)
Chlorinated Pesticides
Pesticides and Pharmaceuticals

Microorganisms:

Protozoa:
•Cryptosporidium spp.
•Giardia spp.

(only 1st and 2nd sampling campaing)

Bacteria:
E.Coli
Clostriudium Perfrigens
Coliforms totals
(4 sampling campaigns)

Campylobacter jejeuni
(only 1st and 2nd sampling campaing)

Virus:
•Adenoviruses
• Rotaviruses
•Noroviruses I and II
•Enterovirus
(4 sampling campaigns)

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RISK ASSESSMENT

Preliminary results:

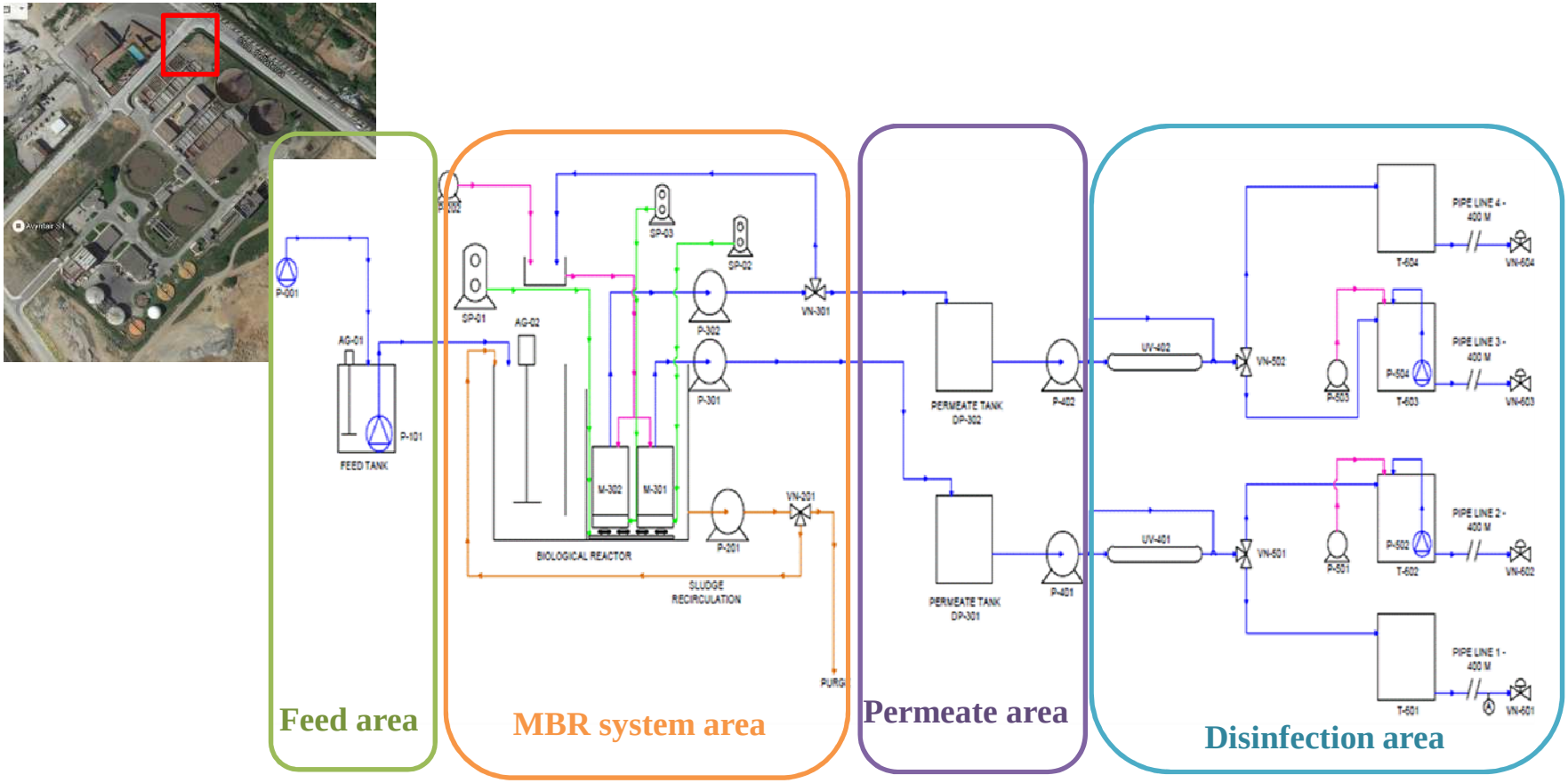
- Chemical risk assessment: the most influencing compounds are the chlorination by-products.

- Microbial risk assessment:
  - The microorganism removal of the water treatment system is very high and in accordance with the values in the literature
  - In general, the microorganisms content in the effluent is below the detection limit of the techniques.
  - The risk probability is being calculated.
  - The uncertainty on the available data has a strong effect on the final result.

Objectives:

- Derive a correlation between reclaimed water quality and observed biofilm formation
- Evaluate a biofilm online sensor for its use in maintenance strategies in water distribution networks
- Evaluate biofilm mitigation adopting different disinfection strategies

MBR pilot plant with 4 disinfection strategies



MAINTENANCE STRATEGIES IN DISTRIBUTION NETWORKS FOR URBAN APPLICATIONS

UV

Chlorination

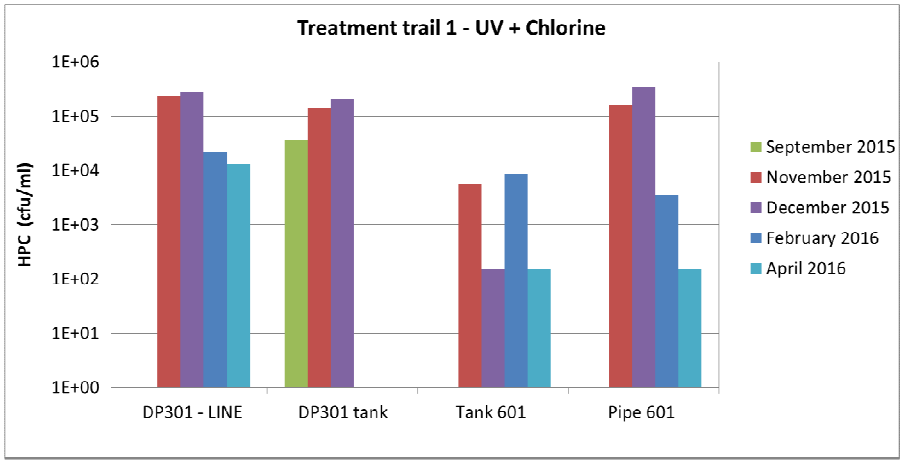
UV + Chlorination

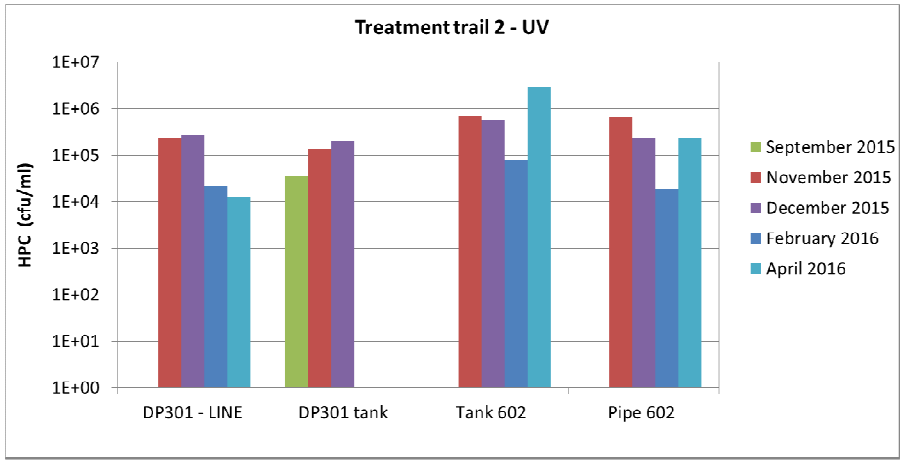
No disinfection

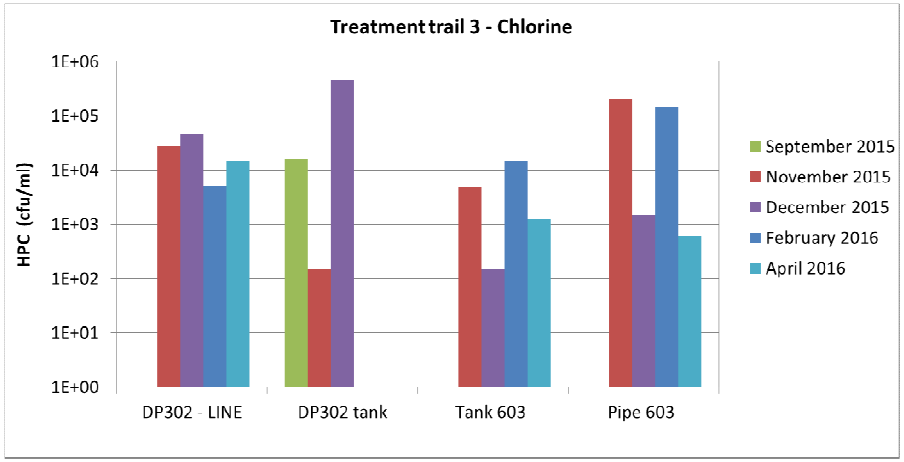
Reclaimed water tanks

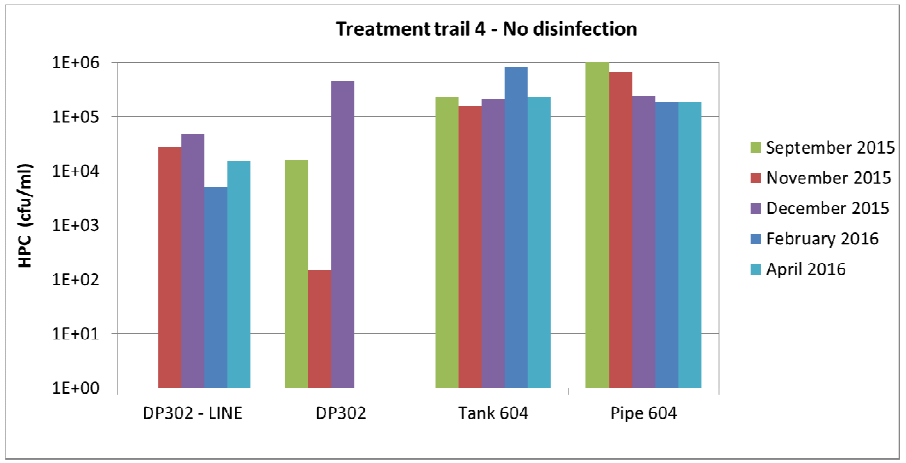
400 m of pipe
simulating irrigation system
4h discharge/day

Effect of disinfection strategy on microbial water quality

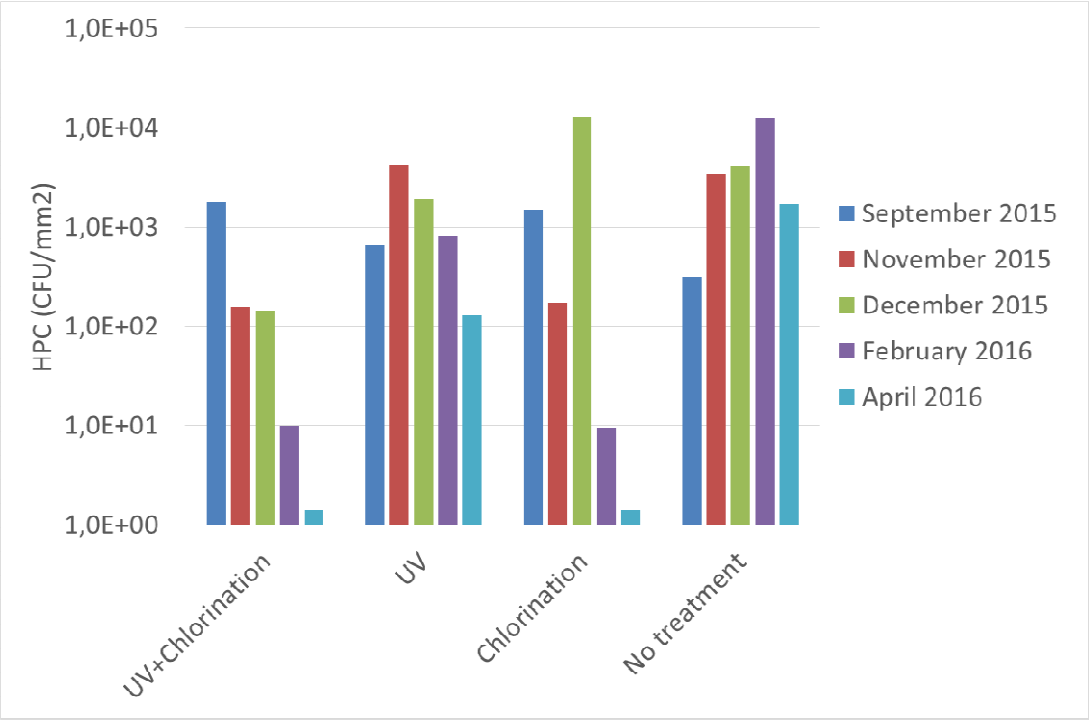








Effect of disinfection strategy on biofilm formation on the pipe



Assessment of an on-line biofilm sensor (ALVIM)

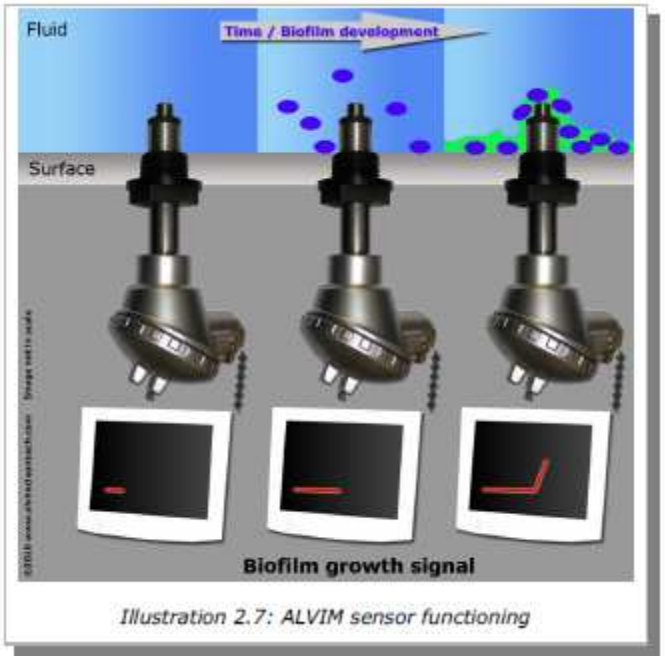
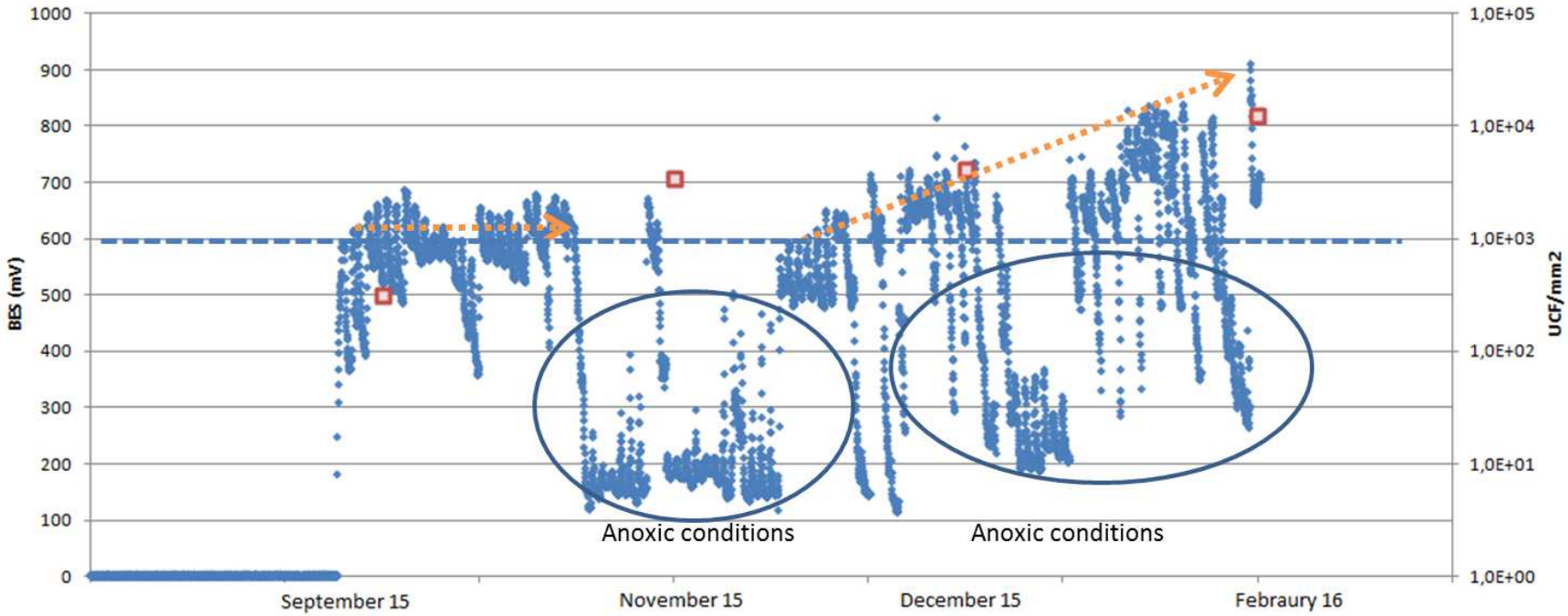


Illustration 2.7: ALVIM sensor functioning

Assessment of an on-line biofilm sensor (ALVIM)



Pipe maintenance strategies

Disinfectant	Before	After
NaOCl (4h) at 25 ppm	1,3E+02 cfu/mm^2	< 7,5E-01 cfu/mm^2
HClO (4h) at 25 ppm	1,7E+03 cfu/mm^2	1,2E+01 cfu/mm^2

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THANKS FOR YOUR ATTENTION !

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