Aplicació de noves tecnologies en les ampliacions d'EDAR

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Acciona Agua

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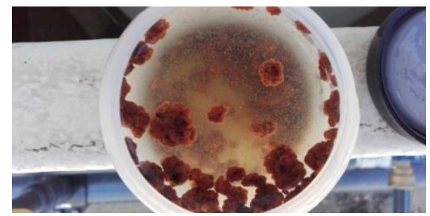

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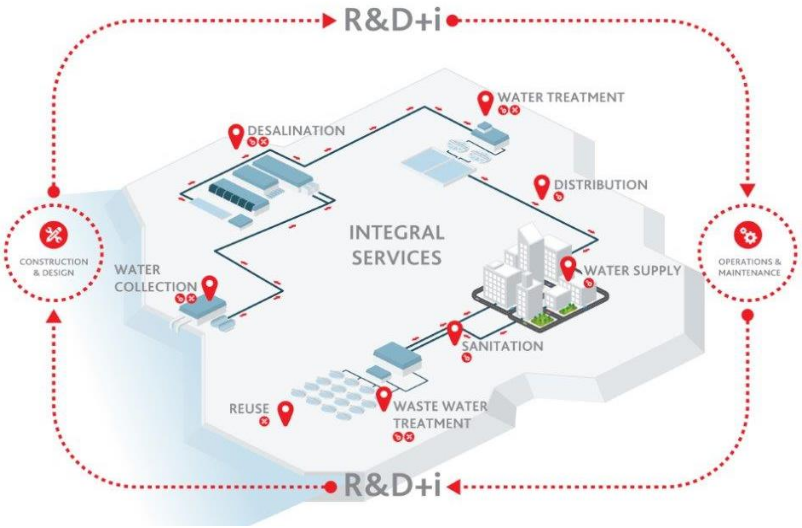
Introduction ACCIONA Agua



Atotonilco WWTP. Mexico.

- **More than 75 desal plants**
  4 of them, among the world's largest
- **400 water treatment plants**
  100 drinking water plants
  300 purification plants
- **Comprehensive services offering**
  engineering & design, financing, procurement, Building and Operation & Maintenance
- **Focus on R&D**
  Committed to environmental protection, R&D, innovation and technology
- **Global Water Intelligence Awards**
  World's Best Water Company (2010, 2013)
  Best Desalination Company (2007)

Introduction ACCIONA Agua R&D

- **Water Technology Center:**
  Barcelona, Spain.
- **Patents developed**
  More than 25.
- **Team:**
  More than 30 multidisciplinary team of highly qualified scientific researchers.
- **Experience:**
  More than 30 years of experience, more than anyone else in the sector.
  - **Desalination and drinking water treatment.**
  - **Wastewater treatment.**
  - **Water reuse.**
  - **Industrial water treatment.**
  - **Advanced control systems.**
- **Pilot plants located in full-scale plants, real water.**

Pilot Plant in Archena (Murcia, Spain)

R&D laboratory

Pilot Plant in Almuñécar (Andalusia, Spain)

Sureste Pilot Plant (Canary Islands, Spain)

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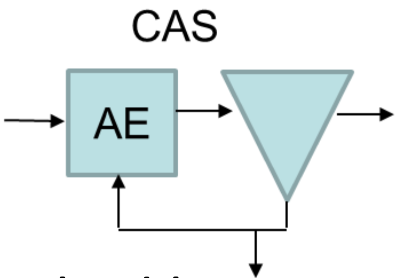
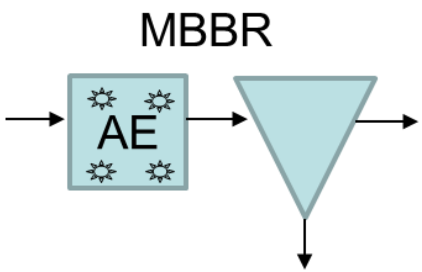
Conventional technologies

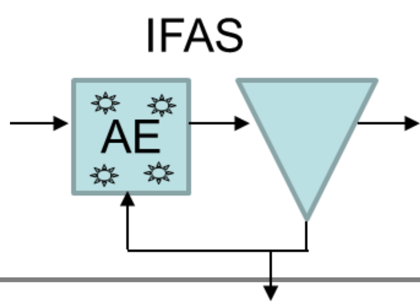
- Activated sludge systems



- MBBR =Moving bed bioreactor



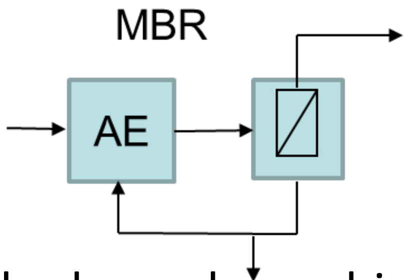
- IFAS =Integrated Fixed-film activated sludge



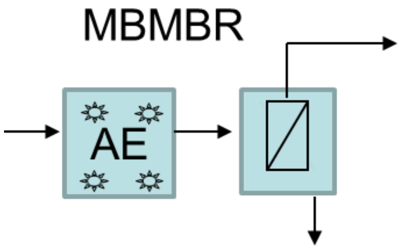
x2 plant capacity

Innovative biofilm technologies

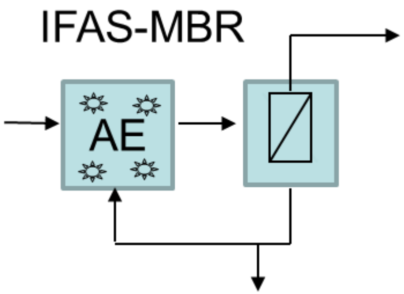
- MBR= Membrane bioreactor



- MBMBR =Moving bed membrane bioreactor



- IFAS-MBR =Integrated Fixed-film membrane bioreactor



capacity
N removal (and MP)
fouling
→ Only recommended when severe footprint limitations

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Control systems: LIFE-BRAINYMEM project

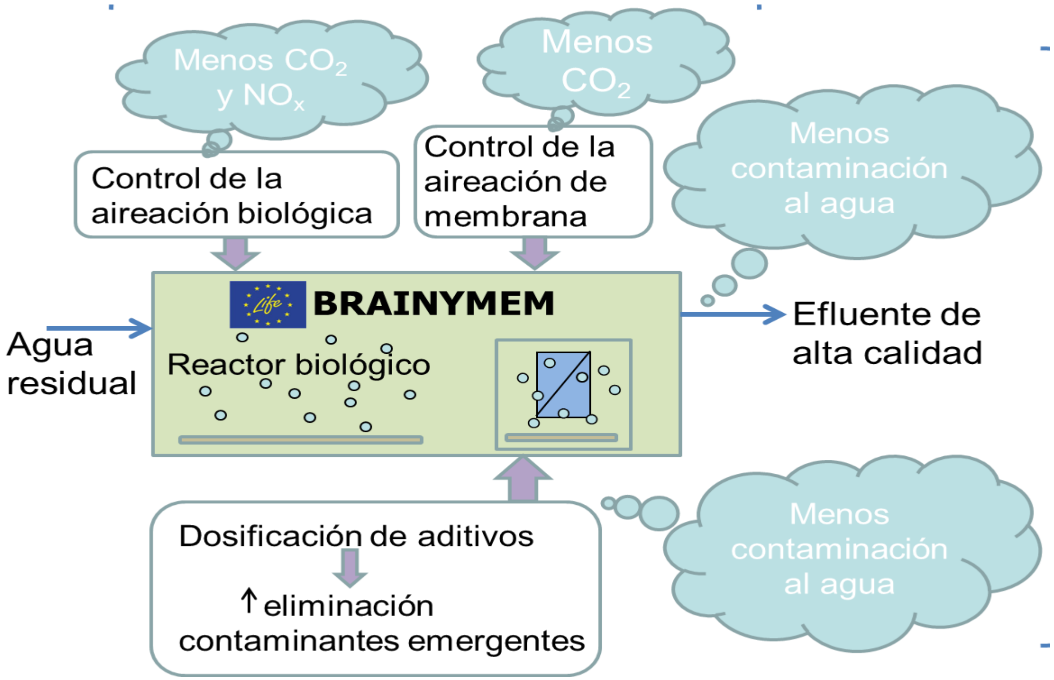
Advanced-control MBR for wastewater reclamation (BRAINYMEM):

Membrane aeration control:

- Based on fouling velocity
- Chemical cleaning frequency selected

Biological aeration control:

- Based on N2O, ammonium and DO

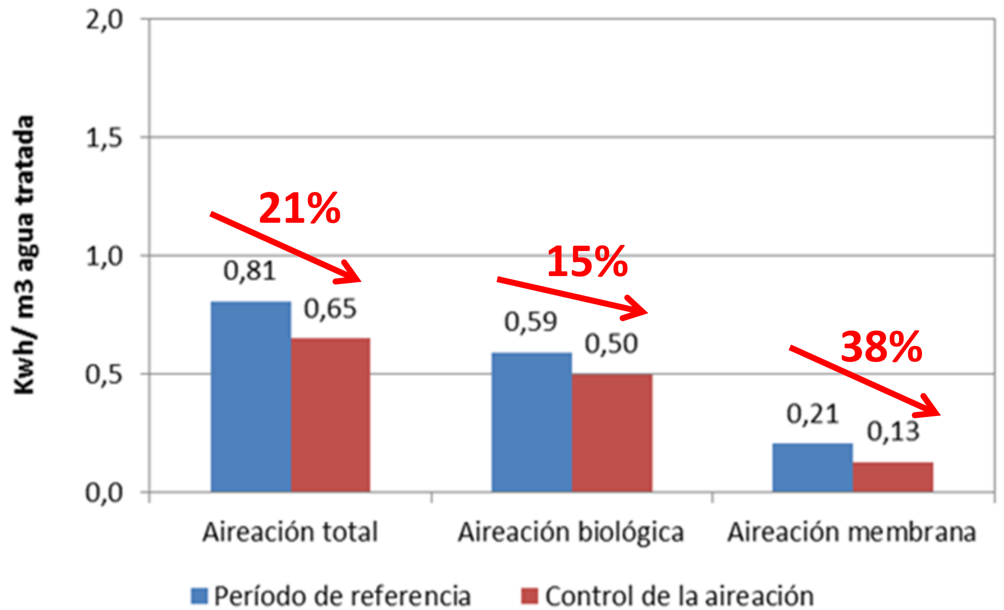


- MBR: 5m3/h municipal WW
- LeapMBR Hollow fiber (UF)

Control systems: LIFE-BRAINYMEM project

Results

- 2 years experimentation
- Reduction of energy consumption:
    - **Membrane aeration (38%)**
    - **Biological aeration (15%)**
    - **Total aeration energy (21%)**
- Chemical cleaning frequency increased
- www.life-brainymem.com

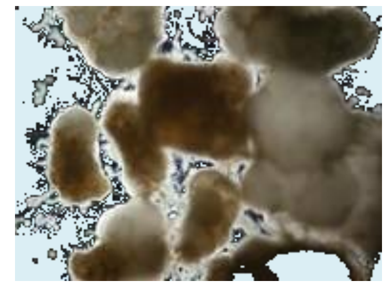


Nereda®: Aerobic Granular Biomass Technology

Flocs		Granules
4 g/l	→	8 g/l or more
$SVI_5 > SVI_{30}$		$SVI_5 \approx SVI_{30}$

Activated Sludge

Aerobic Granules

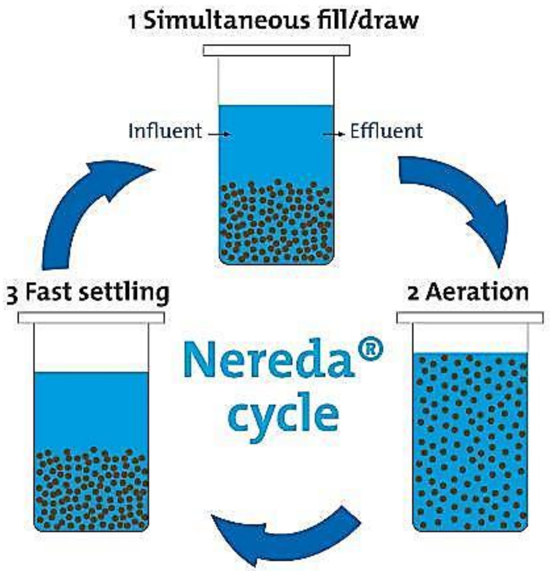


- Excellent settling properties
- Pure biomass
- No support media
- High MLSS levels (up to 15 g/L)
- Reliable and stable operation
- No bulking sludge
- Lisenced technology from DHV

Royal HaskoningDHV
Enhancing Society Together

Nereda®: Aerobic Granular Biomass Technology

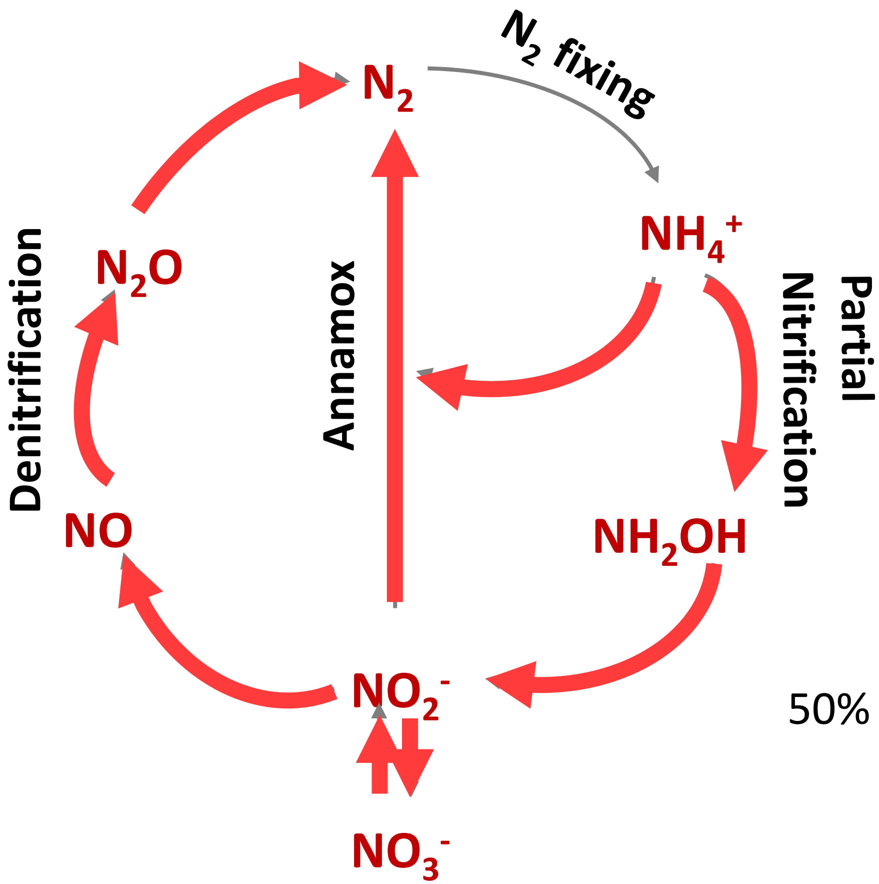
- Simple one-tank concept
- No clarifiers
- No mixers
- Extensive biological COD, N- and P-removal



Parameter	Conventional Activated Sludge	Nereda®
effluent quality	good	similar or better
process stability	good	better
N-removal	good via intermittent aeration or separate compartments	extensive & simultaneously during aeration
P-removal	biological/chemical	biological (mainly)
footprint	100%	25%
energy demand	100%	< 65-75%
sludge production	100%	similar or lower
MLSS in reactor	3-5 kg/m3	10-15 kg/m3
CAPEX and OPEX	100%	significantly lower

Anammox technology

Nitrogen cycle



CONVENTIONAL NITRIFICATION

$NH_4^+ + 2O_2 \rightarrow NO_3^- + H_2O + 2H^+$

Partial Reactions

$NH_4^+ + 1.5O_2 \rightarrow NO_2^- + H_2O + 2H^+$ **(AOB)**

$NO_2^- + 0.5O_2 \rightarrow NO_3^-$ **(NOB)**

CONVENTIONAL DENITRIFICATION

$6NO_3^- + 5CH_3OH \rightarrow 3N_2 + 5CO_2 + 7H_2O + 6OH^-$

Oxygen & Energy savings (60%)

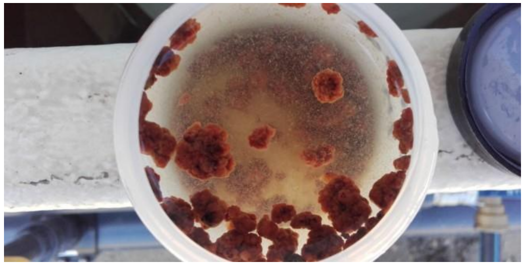
PARTIAL NITRIFICATION/ANAMMOX DENITRIFICATION

$NH_4^+ + 1.5O_2 \rightarrow NO_2^- + H_2O + 2H^+$ **(AOB)**

50%

$NH_4^+ + 1.32NO_2^- + 0.066HCO_3^- + 0.13H^+ \rightarrow 1.02N_2 + 0.26NO_3^- + 2.03H_2O + 0.066CH_2O_{0.5}N_{0.15}$

Mainstream Anammox: LIFE-CELSIUS

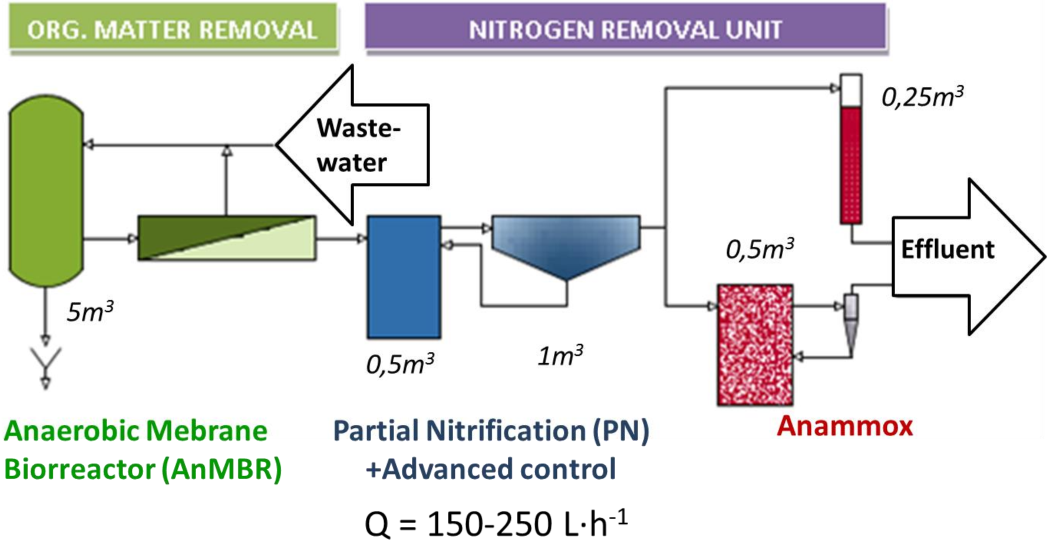


Pilot plant in Archena, Murcia

Duration: 01/10/2015 – 30/09/2018

Results:

- In process of obtaining a stable partial nitritation process
- Anammox: High N removal rate in the Anammox biofilter.

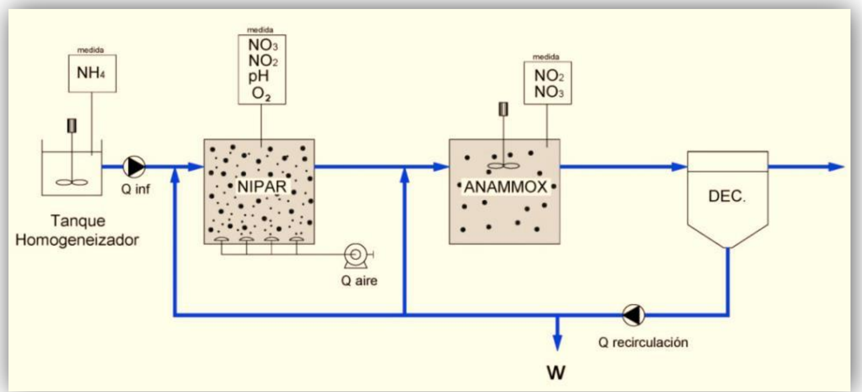


Anammox Centrate treatment: Niparmox®

- N centrate content represents 25% of N load of the biological reactor
- Key core technology of NIPARMOX® relies in an **Advanced Control Algorythm** based on NOB inhibition vs. AOB.
- In construction in Kuthaya, Turquía

Advantages:

- ❑ Requires less aeration, 40% oxygen savings.
- ❑ Energy savings on aeration and internal recycling, 60% energy savings.
- ❑ Does not require external organic matter source.
- ❑ Lower sludge production.
- ❑ Robustness and reliability thanks to separate processes and supported growth.
- ❑ Smaller blueprint than conventional systems.



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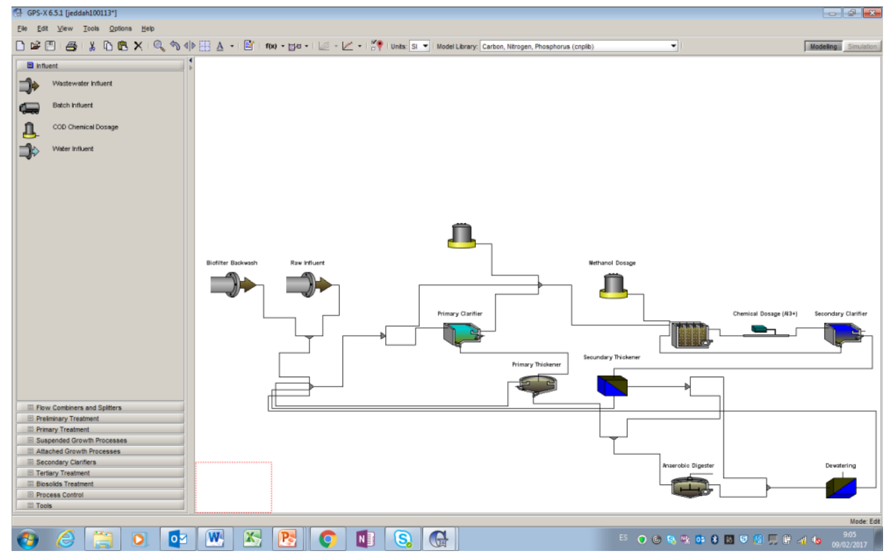
Design and O&M optimization through modelling

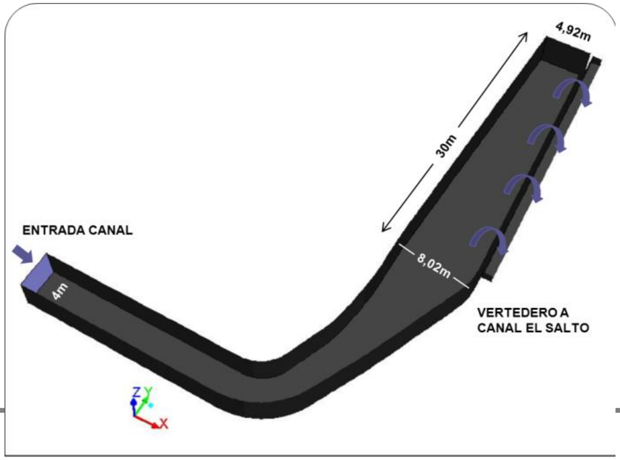
- **Integrated WWTP modelling and simulation:**
  - GPS-X and Biowin
  - Introduction of new models
  - Design optimization:
    - Cost calculation
    - Control systems simulation
    - Sensitivity analysis
  - Evaluation of alternatives

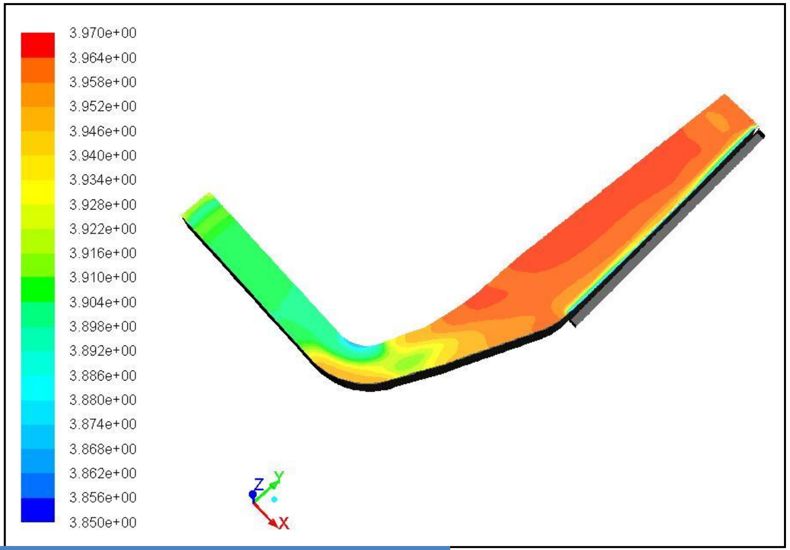


- **Examples of WWTP upgrade:**
  - WWTP Alcalá de Henares: upgrade to IFAS

Design and O&M optimization through modelling

- **CFD:** Computer Fluid Dynamics with Fluent:
- Design optimization examples:
  - Calculate flow distribution in waste water and drinking water treatment plants.
  - Verify chemical mixing at injection points
  - Evaluate vortex generation in open channels (for instance, seawater intake systems).
  - Calculate real residence time, detect dead zones and preferential pathlines.
  - Verify and improve micro-bubble behaviour within air flotation devicest.
- Examples:
  - Gabal el Asfar (Egypt)
  - Atotonilco (Mexico)

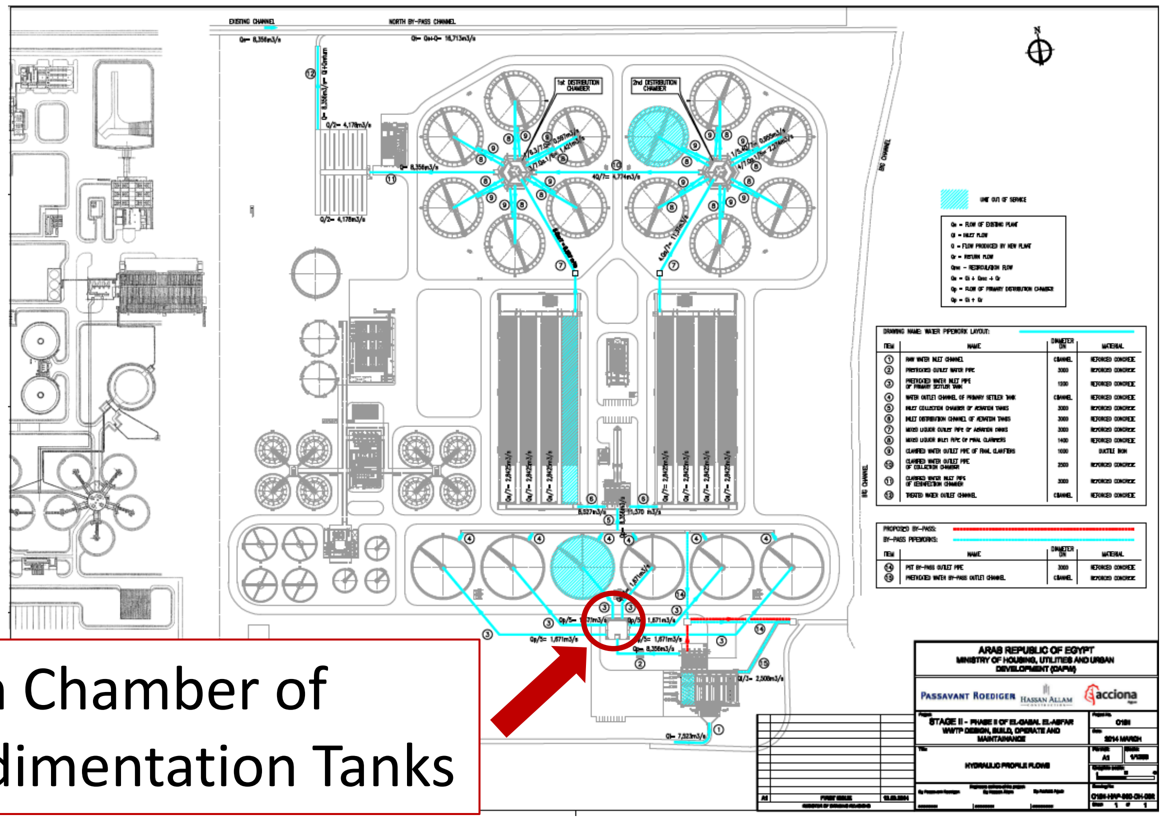




25m less constructed

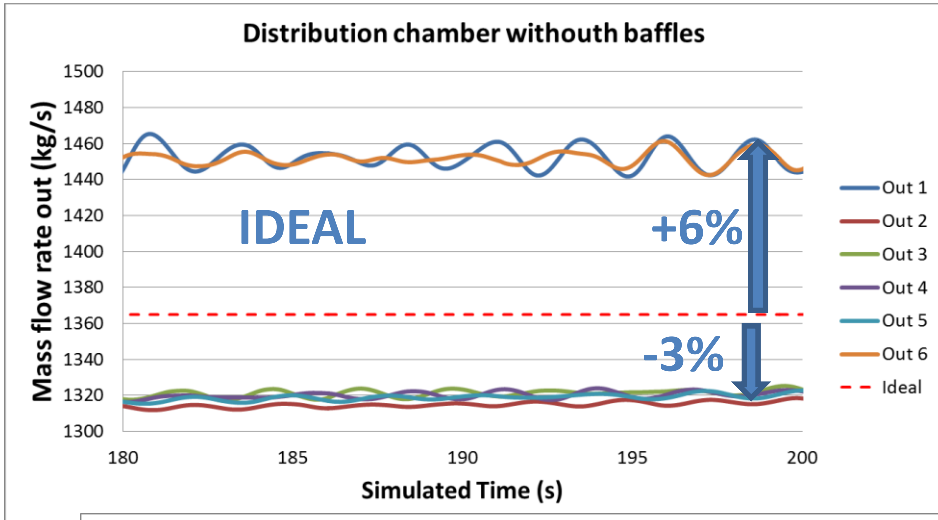
Design and O&M optimization through modelling

Phase II of Gabal El Asfar WWTP

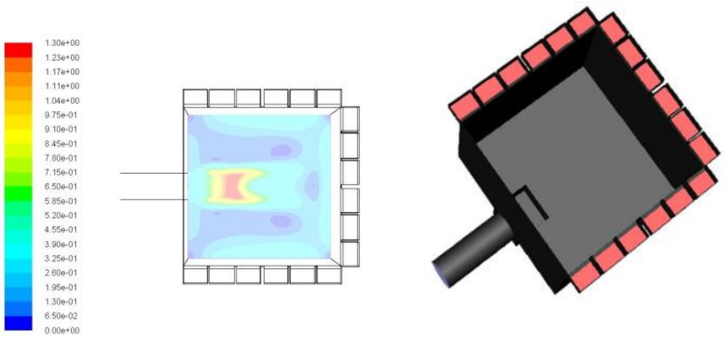


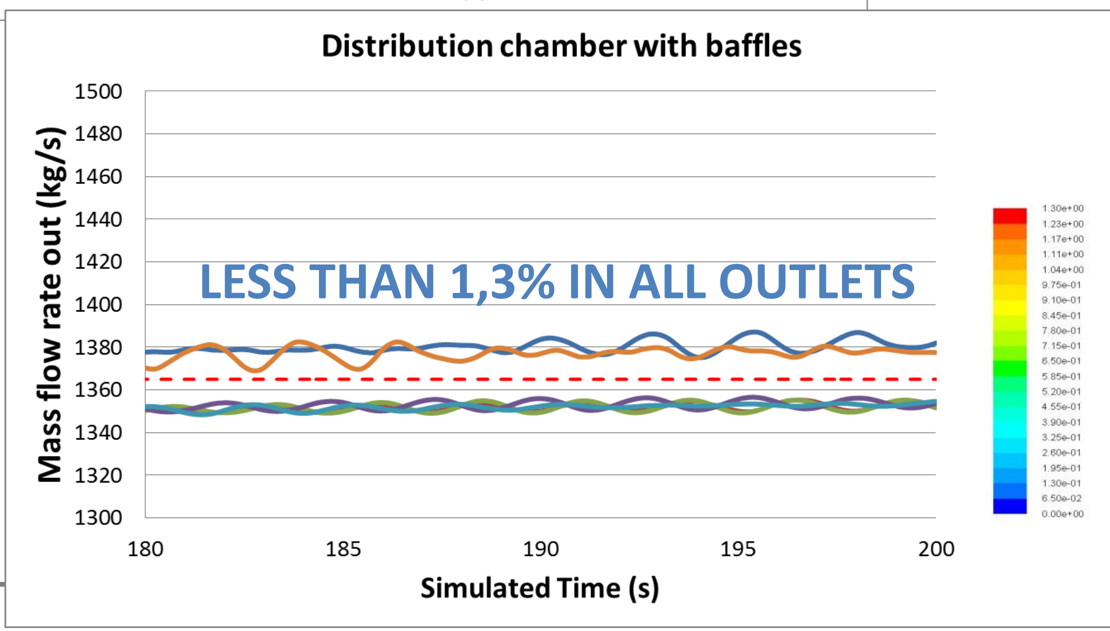
Distribution Chamber of Primary Sedimentation Tanks

Design and O&M optimization through modelling

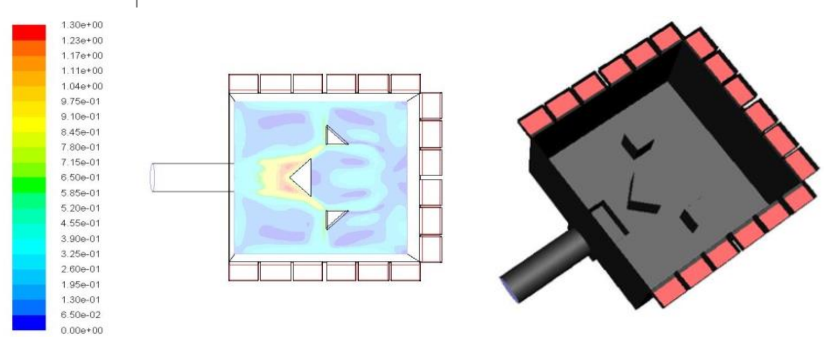


BASE CASE: NO BAFFLES





MODIFIED CASE: BAFFLES



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Conclusions

- WWTP remodelling and extensions are good opportunities for implementing new technologies that can reduce energy consumption and improve effluent quality:
  - Anammox
  - Advanced control
- Compact technologies are available for footprint limitations:
  - Nereda
  - Advanced MBR and biofilm technologies
- Simulation softwares are helpful tools for verifying design and compare alternatives

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  - LIFE13/ENV/ES/000160 LIFE BRAINYMEM www.life-brainymem.com
  - LIFE 14 ENV/ES/000203 LIFE CELSIUS www.lifecelsius.com

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