

Removal of priority and emerging pollutants by biological and tertiary treatments

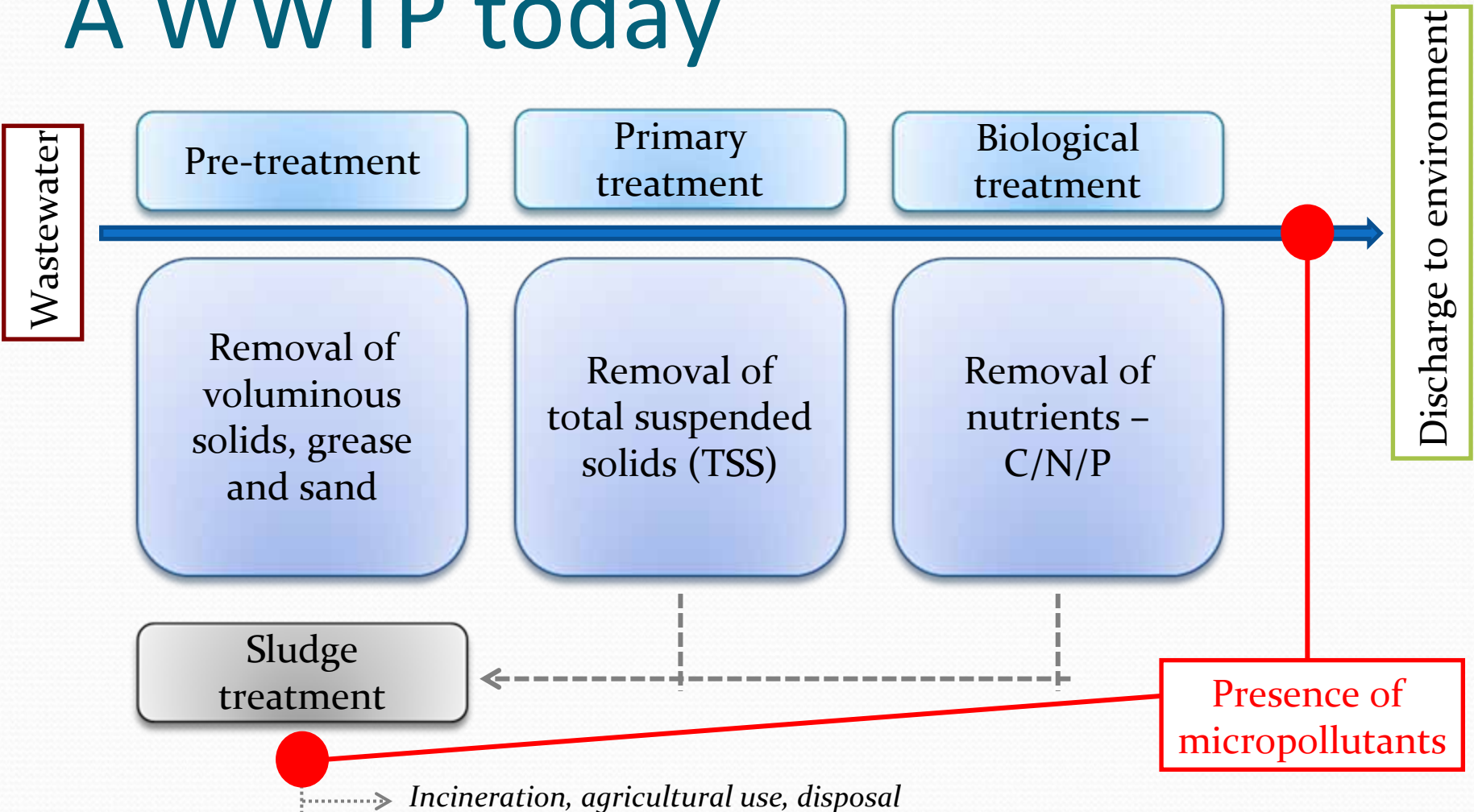
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Plan

1. Scientific context
 - A WWTP today
 - Conventional and tertiary treatment
2. Issues and goals
3. Focus on tertiary treatment
 - Methodology
 - CarboPlus[®]
 - Sampling strategy
 - Primary results
4. Significance and limitations for developing countries ?
5. Planning

A WWTP today



Context

- General
 - Presence of micropollutants in WWTPs discharges ([Heberer 2002](#))
 - European regulation: WFD ([2000/60/EC](#))
- Conventional treatments
 - Fate of some compounds not well documented in WWTPs
 - Conventional primary and biological (conventional activated sludge) treatments quite well studied ([Clara et al. 2005](#); [Ruel et al. 2010](#))
 - Lack of knowledge on enhanced primary treatment (coagulation/flocculation), biofiltration and MBR at industrial scale
- Tertiary treatments
 - Hardening of regulations, anticipation of water operators and insufficient efficiency of conventional WWTPs → *development of tertiary treatments*
 - Efficiency of activated carbon for micropollutants removal was highlighted in literature ([Delgado et al. 2012](#); [Margot et al. 2011](#); [Nowotny et al. 2007](#))

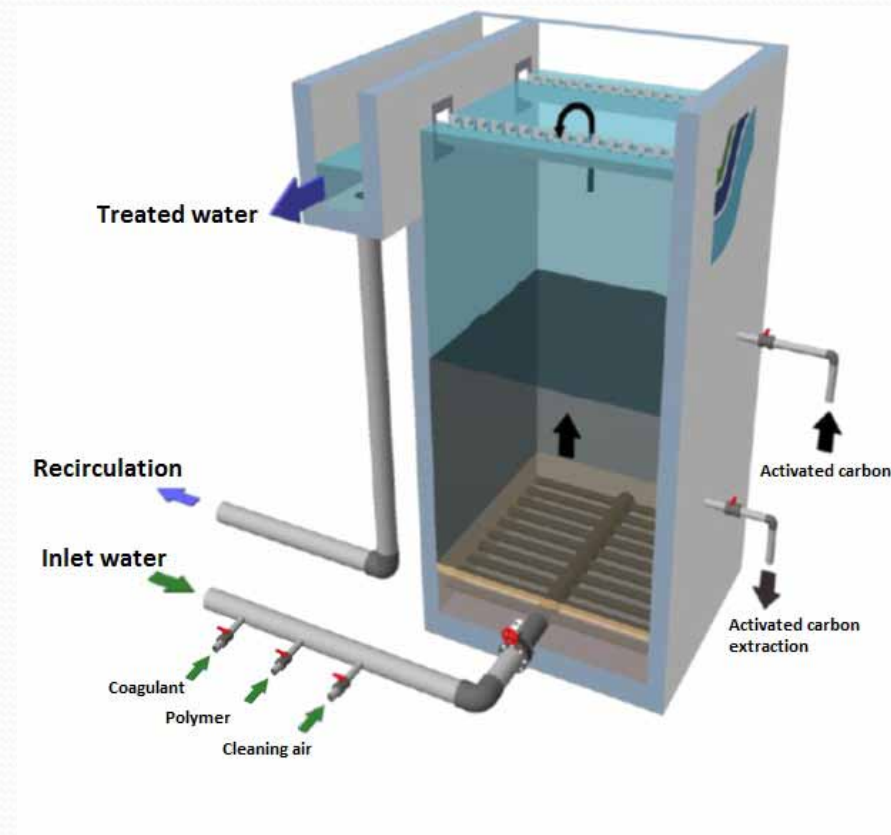
Issues and goals

- Primary and biological treatments
 - Efficiency of biofiltration for micropollutants ? Comparison with conventional activated sludge (CAS) treatment
 - MBR a relevant solution to improve biological treatment of micropollutants ?
 - Removal mechanisms at industrial scale
 - Comparison of the three main biological treatments (process and facility)
- Need to develop tertiary treatments and to study them
 - What about emerging pollutants ?
 - Efficiency of activated carbon for persistent pollutants ?
 - Impact of operational parameters ?
 - Type and dose of activated carbon ?
 - How to regulate micropollutants adsorption processes ?
UV signal a relevant indicator ?
- Presentation: *focus on tertiary treatment*

CarboPlus®



- Concept
 - Contact of PAC with water in a reactor
 - Fluidized bed of PAC
 - Coagulant and polymer addition prevents PAC discharge with water
 - *No filtration system needed*
- Operational parameters
 - Capacity of 50 m³/h
 - SRT of a couple of days (3-7)
 - HRT of about 15 minutes
- Fed with treated water from biofiltration unit (SIAAP - Seine Centre)



Organization of campaigns

Phase 1

PAC
Optimization

June – october 2013
(16 weeks)

Phase 2

PAC
Optimized regime

October – december 2013
(13 weeks)

Phase 3

Micro-grain
configuration

January – november 2014
(48 weeks)

12 campaigns

4 configurations

Influence of operational
conditions, dose and type
of PAC

6 campaigns

Best configuration
Variability of results,
efficiency and cost of
CarboPlus, removal
mechanisms

12 campaigns

Comparison between
powder and micro-grain
Efficiency, cost, biological
activity, etc. ?

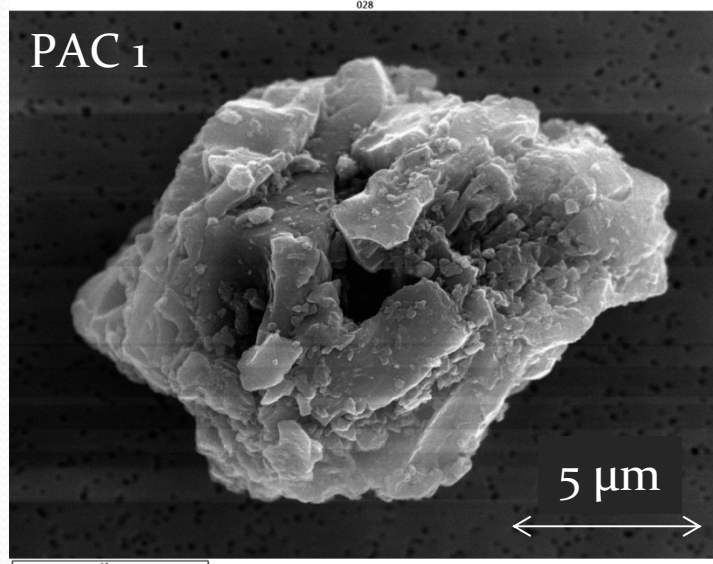
Sampling strategy

- Screening: 135 persistent and/or problematic compounds
 - Pharmaceuticals and hormones
 - Pesticides
 - Priority substances (WFD)
 - Metals
 - Accredited laboratory for all compounds except metals (independent protocol - LEESU)
 - Sampling of inlet and outlet water with automatic samplers (4°C)
 - 24 h average samples (organics) or punctual (metals)
 - Measure of total fraction and UV signal
 - 30 campaigns in 18 months (70 samples)
- ➔ *Large scale and high frequency approach*



Primary results

- Characterization of 4 activated carbons
 - Laser granulometry
 - Electron microscopy
 - Removal of UV₂₅₄ signal after 45min contact



Effect of activated carbon type

10 mg/L	UV before	UV after	Removal (%)
PAC 1	0,651	0,574	12
PAC 2	0,651	0,586	10
PAC 3	0,651	0,611	6
PAC 4	0,651	0,638	2

Effect of activated carbon dose

PAC 1	UV before	UV after	Removal (%)
5 mg/L	0,639	0,605	5
10 mg/L	0,639	0,562	12
20 mg/L	0,639	0,504	21

Developing countries...



- A vague notion: what a developing country ?
 - Diversity in terms of infrastructures (i.e. Brazil vs. Mozambique)
 - Inequality between economically dynamic countries and the poorest countries
- Significance:
 - Wastewater treatment and quality of discharges are crucial issues
 - Improving knowledge on contamination and treatment of wastewater is useful for all operators and scientists in the world
 - Tertiary treatments could be directly applied in developing countries where biological treatment often doesn't exist
- Limitations: a developed countries issue ?
 - In the 59 poorest countries in the world, half of the people have no access to water and sewer system ([United Nations source](#))
 - Sewer systems often in poor condition (when they exist !)
 - When sewer systems: other conventional water quality parameters are more problematic (nitrogenous/phosphorous pollution, total suspended solids, etc.)
 - A lot of countries couldn't afford tertiary treatment now

Planning

- Conventional treatments
 - Final correction and submission of an article (July 2013)
 - Campaigns on MBR unit from SIAAP's La Morée WWTP (second semester of 2014)
- Tertiary treatments
 - Large scale pilot campaigns: from June 2013 to November 2014
 - Complementary lab scale experiments (2013-2014)
 - Paper (2015)
- PhD oral presentation (end of 2015)

Thank you for your attention

Any questions ?

