IWA TG on Benchmarking of Control Strategies for WWTPs

Industrial benefits of a benchmark system

10 September 2008
Vienna, Austria

Cyrille LEMOINE
Veolia Environnement – Anjou Recherche
France

IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

Outline

- Context
- Industrial key issues
- The industrial benefit of BSM1
- Conclusion

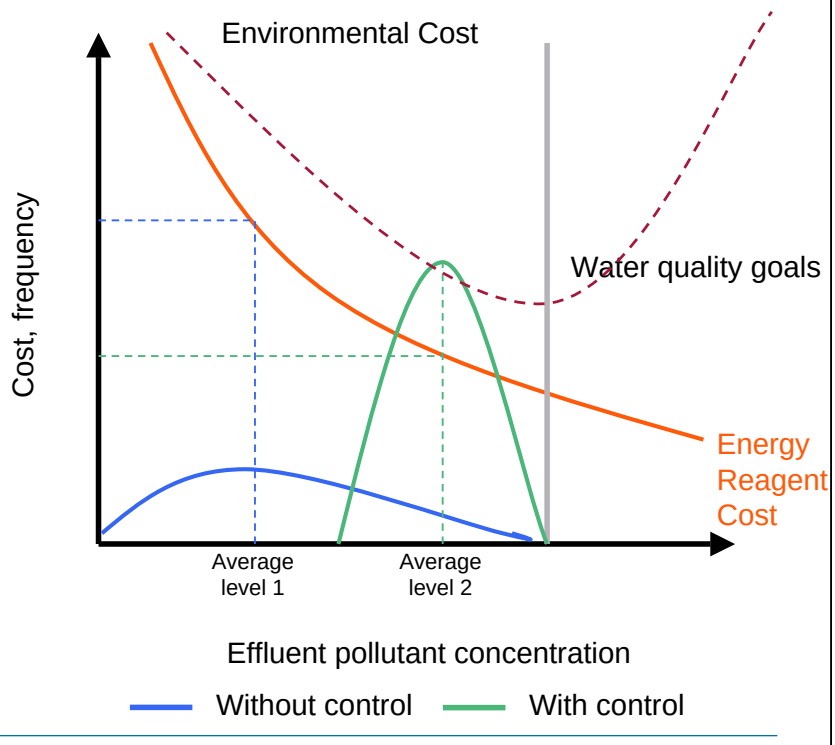
Outline

- Context
- Industrial key issues
- The industrial benefit of BSM1
- Conclusion

International Water Association
VEOLIA ENVIRONNEMENT
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

Context

- "The best plant is not the plant with the best outlet water quality".
- If you don't have the control of our plant, you take safety margin and produce water better than you should.



Outline

- Context
- Industrial key issues
- The industrial benefit of BSM1
- Conclusion

International Water Association
VEOLIA ENVIRONNEMENT
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

Outline

- Context
- Industrial key issues
- The industrial benefit of BSM1
- Conclusion

Industrial Key Issues

- Develop control strategies allow us to
  - Reach water quality goals on time without over or under performance
  - Minimize cost (reagent and energy) to reach these goals

- **But, how to validate the efficiency of control strategies ?**

International Water Association
VEOLIA ENVIRONNEMENT
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

Industrial Key Issues

- Use experimental validation of control strategies.
  - Full scale plant or pilot ?
  - How long does it take ?
  - What is the sensitivity and reputability of the test ?
  - Confidence interval ?

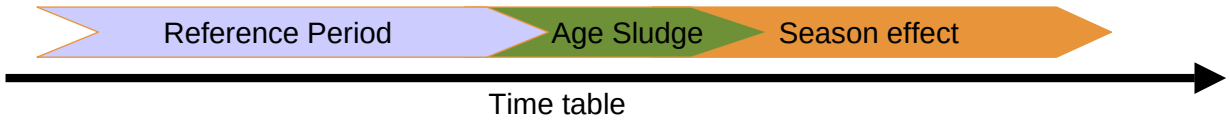
Industrial Key Issues

- Use experimental validation of control strategies.
  - Full scale plant or pilot ?
  - **How long does it take ?**
  - What is the sensitivity and reputability of the test ?
  - Confidence interval ?

International Water Association
VEOLIA ENVIRONNEMENT
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

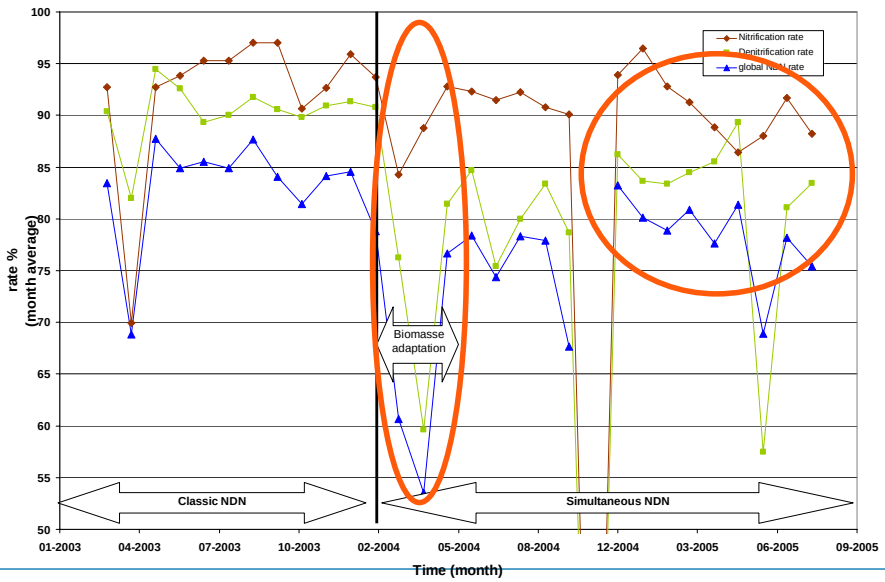
Industrial Key Issues

- How long does it take for activated sludge control strategy ?
  - Biological processes : need to wait 3 sludge age to reach steady state (2/3 months)
  - Impact of temperature, season effect (so one year of test).
  - It difficult to have simultaneously 2 plants or tread with exactly the same influent to get reference.
  - Find the best set points for the control law…
- **So you need about 2 years of test to validate the control strategy !**



Industrial Key Issues

- Example of time needed to reach steady state, outlet water quality



Set point changes

International Water Association
VEOLIA ENVIRONNEMENT
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

Industrial Key Issues

- 2 years of test mean risk for the results ?
  - Evolution of the raw water (new connection on sewer network)
  - Change, maintenance of the utilities on the plant
  - Obtain high amount of data during this period.
    - Flow, pollutant concentration for each flow…for mass balance
  - What is the effect of your interaction with the operator ?
    - Interference in operating procedure due to the test. Trouble for the reference periode

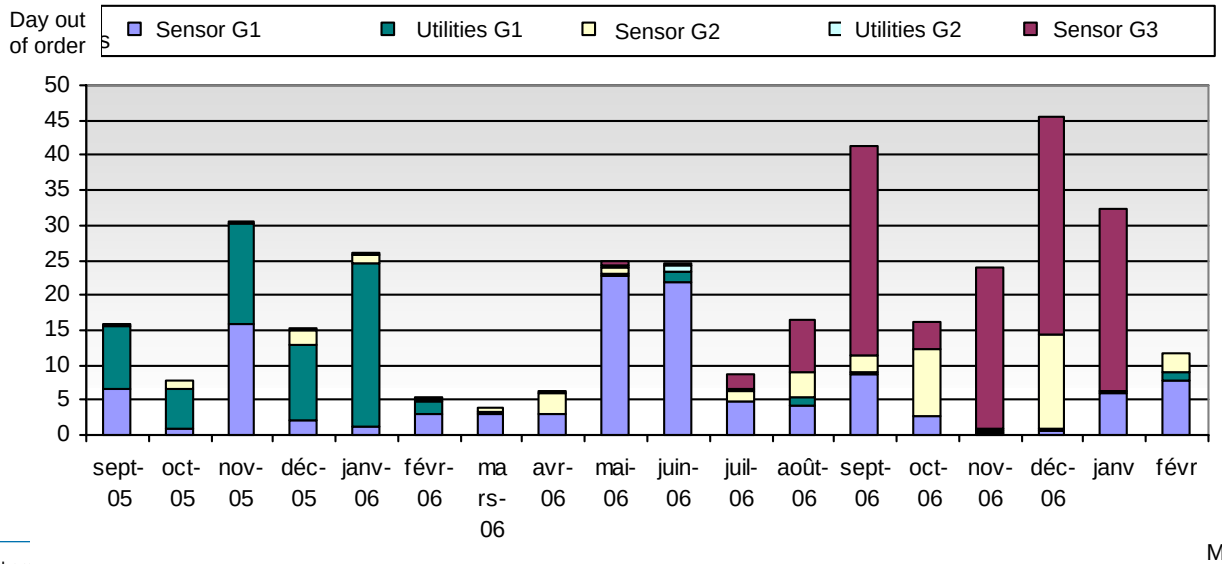
Industrial Key Issues

- 2 years of test mean risk for the results ?
  - Evolution of the raw water (new connection on sewer network)
  - Change, maintenance of the utilities on the plant
  - **Obtain high amount of data during this period.**
    - Flow, pollutant concentration for each flow…
  - What is the effect of your interaction with the operator ?
    - Interference in operating procedure due to the test. Trouble for the reference periode

International Water Association
VEOLIA ENVIRONNEMENT
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

Industrial Key Issues

- Example : cumulative time stop for online measurement

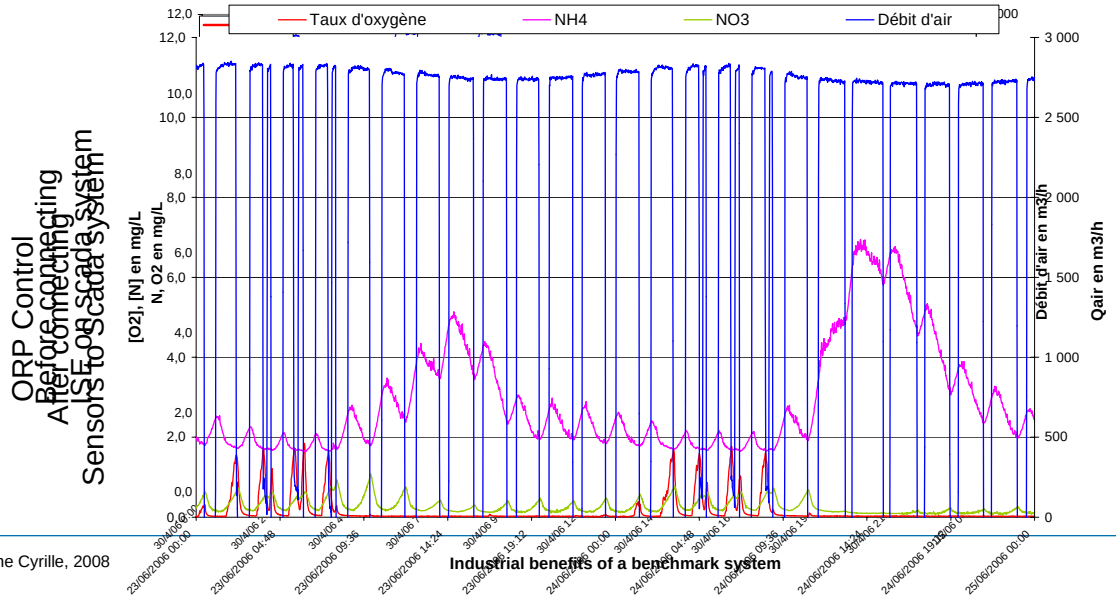


Industrial Key Issues

- 2 years of test mean risk for the results ?
  - Evolution of the raw water (new connection on sewer network)
  - Change, maintenance of the utilities on the plant
  - Obtain high amount of data during this period.
    - Flow, pollutant concentration for each flow…
  - **What is the effect of your interaction with the operator ?**
    - Interference in operating procedure due to the test. Trouble for the reference periode

Industrial Key Issues

- Example : Changes induce by ISE probe on the on site ORP control



Outline

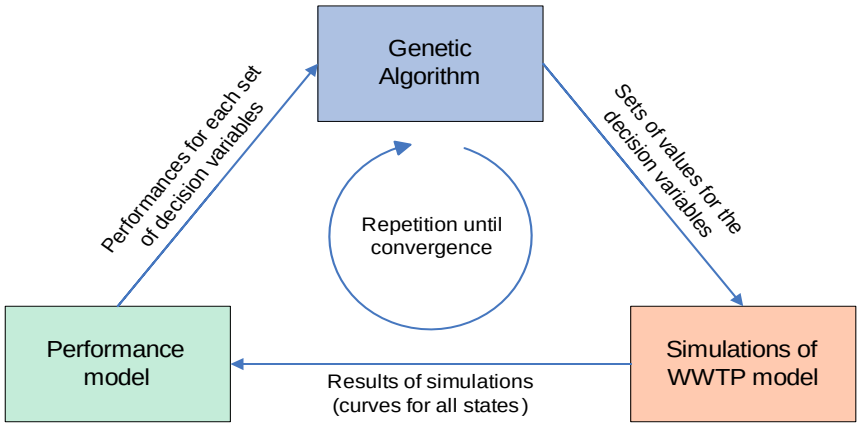
- Context
- Industrial key issues
- The industrial benefit of BSM1
- Conclusion

International Water Association
VEOLIA ENVIRONNEMENT
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

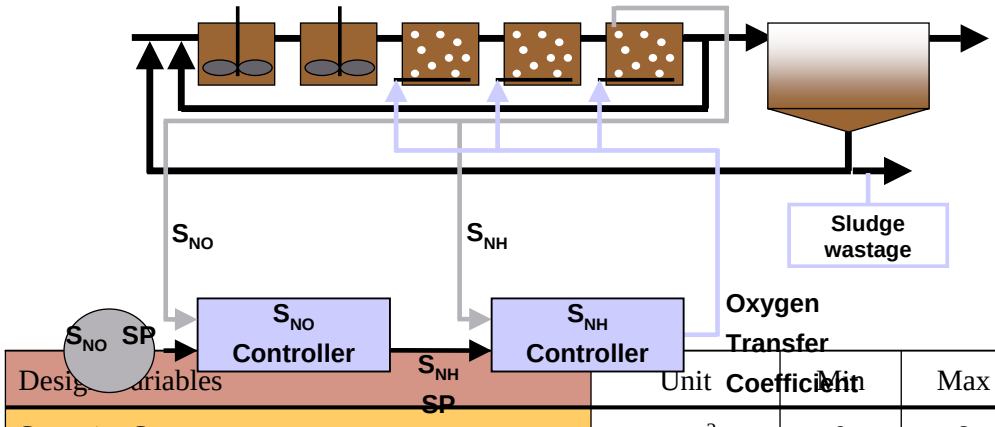
Outline

- Context
- Industrial key issues
- The industrial benefit of BSM1
- Conclusion

Use BSM1 to compare and optimize control strategies (B. BERAUD PhD student)



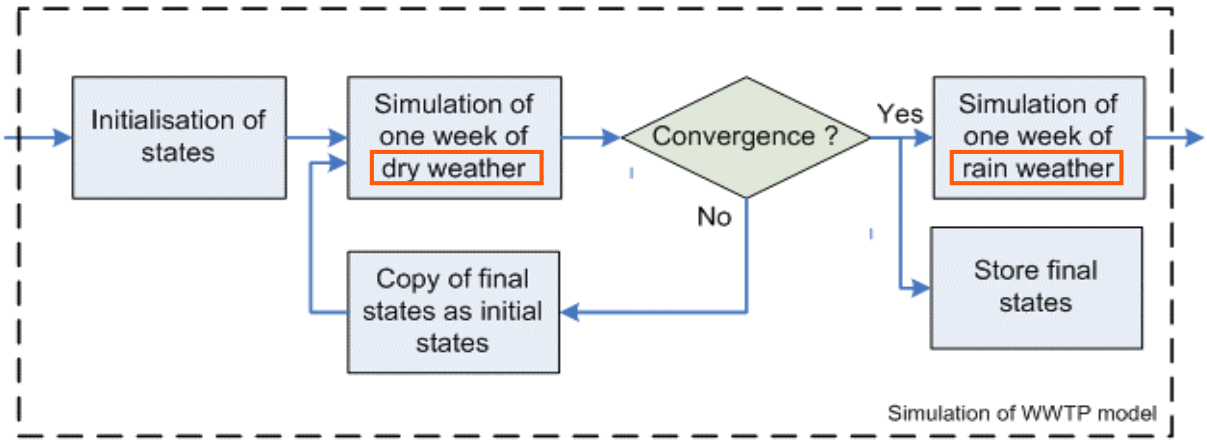
Control law for simultaneous N/DN



Design variables	Unit	Min	Max
Set point S_{NO}	$g.m^{-3}$	0	8
Minimum Set point S_{NH}	$g.m^{-3}$	0	8
Delta Set point S_{NH}	$g.m^{-3}$	0	8
Wastage flow rate	$m^3.d^{-1}$	0	400

Methodology for quick simulation

Enhanced simulation procedure for quick simulations with BSM input file:



Long term performances

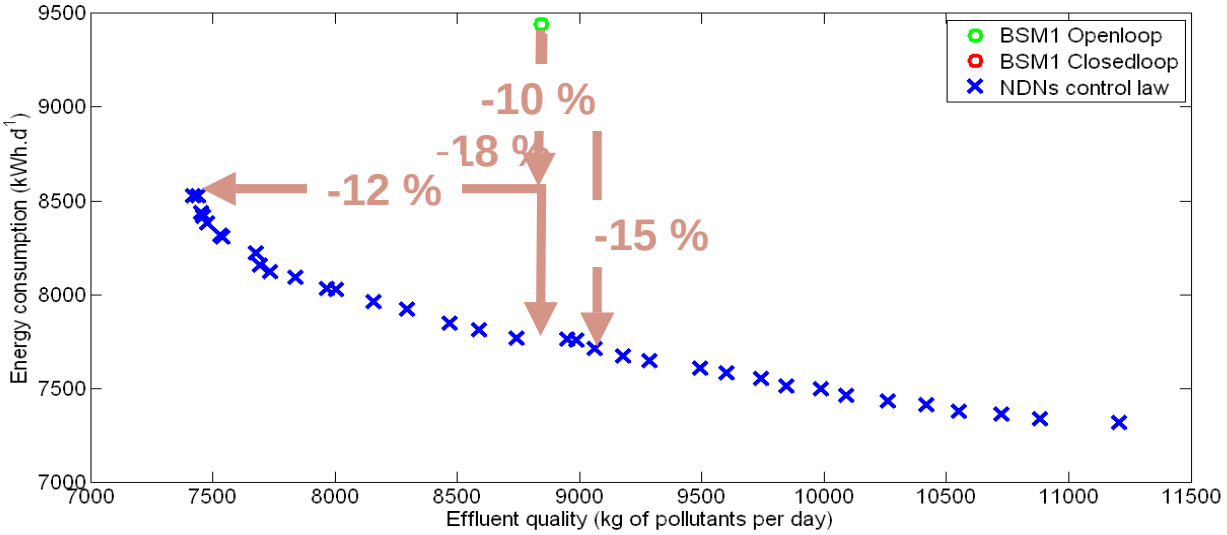
Goal:

- Assess the robustness of the settings issued from the optimization

Methodology:

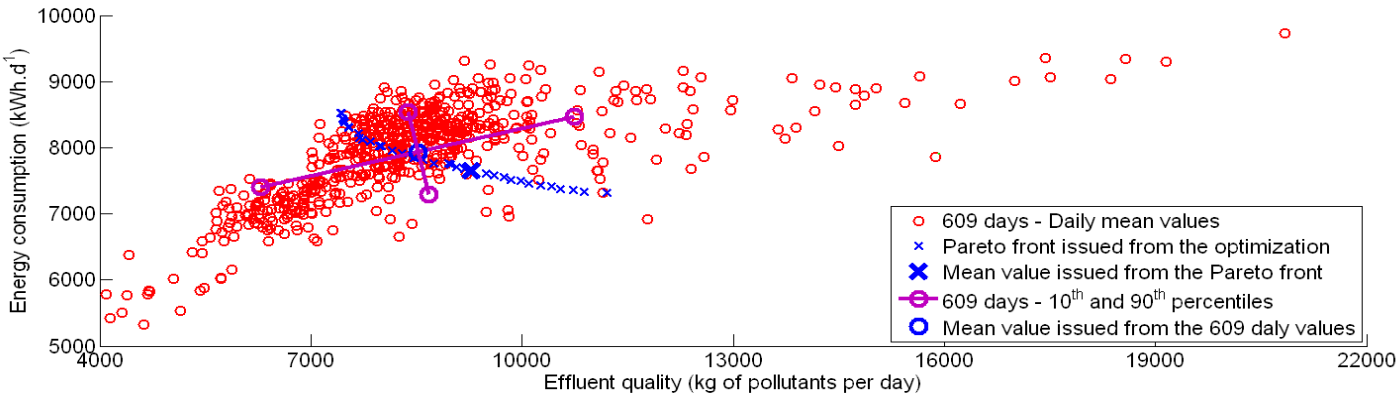
- Simulation of 609 days **(BSM1_LT)**
- Computation of daily performances
- Principal component analysis **(PCA)**

Results of the methodology



Results of the methodology

Long term performances of one solution:



Outline

- Context
- Industrial key issues
- The industrial benefit of BSM1
- Conclusion

International Water Association
VEOLIA ENVIRONNEMENT
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

Outline

- Context
- Industrial key issues
- The industrial benefit of BSM1
- Conclusion

Conclusion

- It really difficult to obtain validation of control strategies on full scale plant
  - Longer, risky…
  - But it's necessary…

- Industrial Benefit of BSM1
  - Reduce time to develop
    - Preliminary selectection of the best solution for full scale plant tests
    - Evaluation of robustness for the different solutions
  - So reduction of cost development, and improvement of the efficiency

International Water Association
VEOLIA ENVIRONNEMENT
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
IWA2008 Workshop, 10 September 2008, Vienna, Austria

IWA TG on Benchmarking of Control Strategies for WWTPs

Industrial benefits of a benchmark system

10 September 2008
Vienna, Austria

THANK YOU

Cyrille LEMOINE
Veolia Environnement – Anjou Recherche
France

VEOLIA ENVIRONNEMENT
Recherche & Développement
Centre de Recherche sur l'Eau