

IWA International Water Association
IWA Task Group on "Benchmarking of Control Strategies for Wastewater Treatment Plants"
Watermatex2007 Workshop, 6 May 2007, Washington DC, USA

IWA TG on Benchmarking of Control Strategies for WWTPs

Why is dynamic simulation useful for evaluation of control strategies ?

6 May 2007
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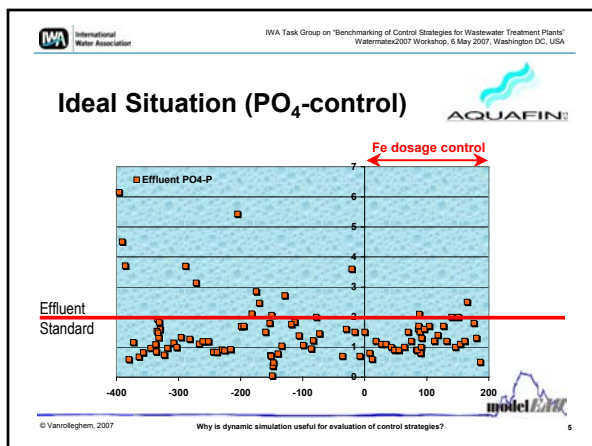
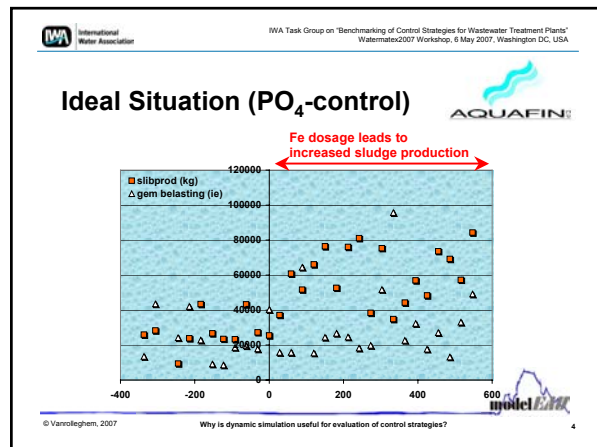
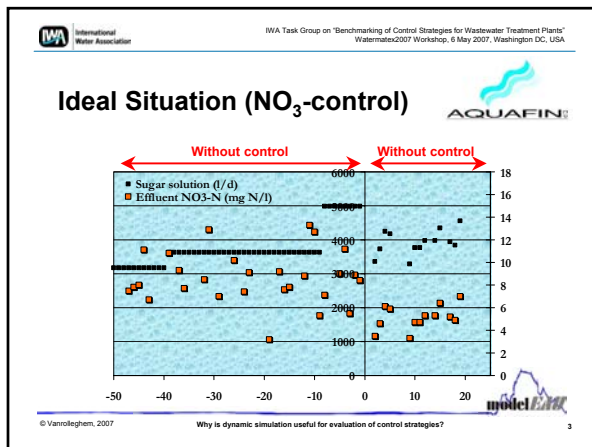
Outline

- Ideal situation
- Actual situation
- What can we do with dynamic simulation ?

BASIC QUESTION:
IS CONTROL USEFUL FOR MY PLANT ?




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Ideal Situation (PO₄-control)



- Cost calculations (35.000 PE):
 - Reduction in Fe-dosage : **-30%**
 - Reduction in sludge production: **-25%**
- Chemical P-removal for all plants with 30-100 kPE most of them now use this control
- NO₃-control using external carbon is installed on nearly all larger plants (> 20 kPE) as well.
- On top of that: Consistent results



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Actual situation

- Management doesn't allow one to perform the "Proof of principle" experiments
 - Expensive
 - Trust in the results
 - Too wild an idea
 - Why improve, it's running fine, doesn't it ?
- Vicious circle: You cannot prove the usefulness of control until you've proven its usefulness

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Actual situation

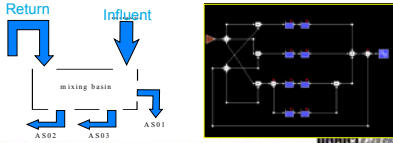
- Practical problems of comparative study:
 - Comparison in time doesn't work due to time-variation in process performance

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Actual situation

- Practical problems of comparative study:
 - Comparison in parallel systems doesn't work due to problems with "parallelisation":
 - Sludges are mixed up again due to combined clarifier underflows
 - Uneven distribution of loads into parallel lanes



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What to do ?

- Simulate !
- Realistically !
- Dynamically ! (we're talking about control after all)
- Crazy ideas are allowed, no damage done...
- Repeatable results, hence differences are more clear

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Is dynamic simulation useful?

- Only when the model is sufficiently realistic
- Virtual experimentation yields results so much faster than actual experimenting
- It's not prone to natural variability
- Its results are repeatable and therefore comparable
- It allows to tune the controller before going to practice
- The control idea can be jeopardized under extreme conditions and safety nets can be developed

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Dynamic simulation and control ...

- Influent generator
 - with interesting sequence of events
- Fault generator
 - testing safety nets under process/equipment failures
- Stability analysis
 - e.g. when process delays exist
 - when process properties change
- To tune controllers before going in the field
 - Don't send an engineer to Vietnam for a week...

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Dynamic simulation and control ...

- Triggers creativity
- Control structure selection
 - Cause-effect relationships
 - Which sensors / actuators should I connect
 - Control authority of a proposed structure
- Allows to deduce general rules of optimal operation
 - e.g. 1 mg NO₃/L is optimal at end of anoxic zone
 - rule-based or timer-based control strategies
- Optimal sensor choice and location
 - minimize delay, multiplex, ...

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Conclusions

- Ideal situation where you can prove usefulness of control by trying it out is not existing very often (Aquafin)
- Actual situation:
 - Problems (temporal and parallel comparison)
 - Vicious circle
- Dynamic simulation is a good alternative
 - "Play around" with control ideas
 - Triggers creativity
 - Test the controller under "extreme conditions"
 - Repeatable and fast

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