



Control of SHARON reactor for autotrophic nitrogen removal in two-reactor configuration

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Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):

Valverde Perez, B., Mauricio Iglesias, M., & Sin, G. (2012). Control of SHARON reactor for autotrophic nitrogen removal in two-reactor configuration. Poster session presented at EcoTechnologies for Wastewater Treatment 2012 , Santiago de Compostela, Spain.

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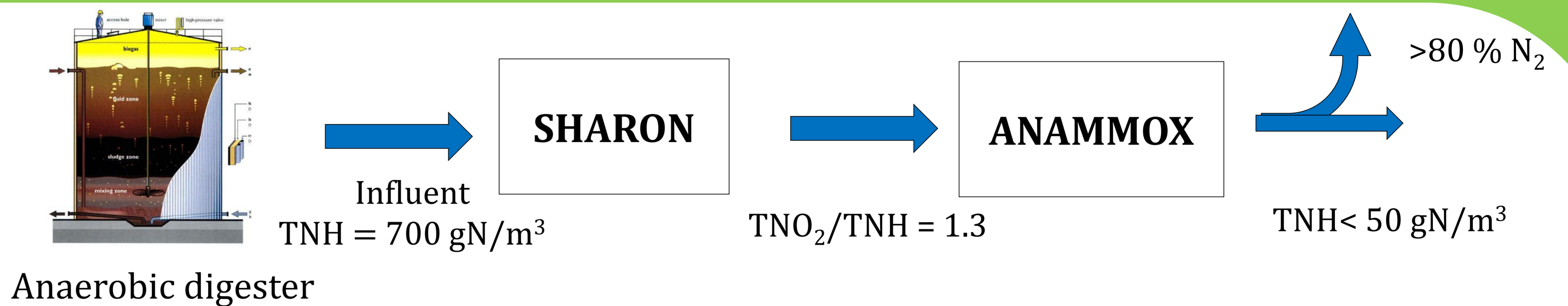
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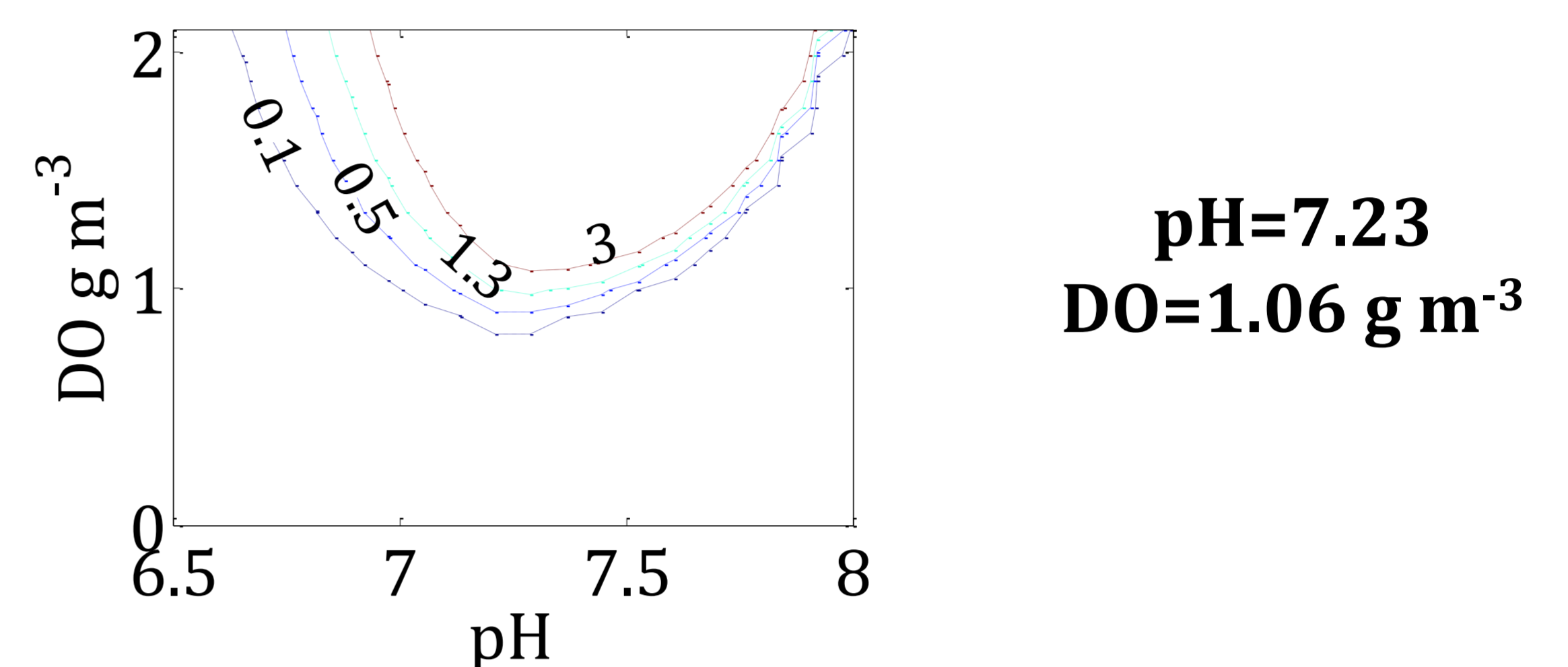
Introduction. Complete autotrophic nitrogen removal (CANR) by the SHARON-Anammox sequence depends critically on feeding the Anammox reactor with an appropriate relation of ammonium and nitrite. We incrementally design a control system, following a plantwide control methodology (Larsson *et al.* 2000) and based on an analysis of the disturbances and controlled variable selection.

Objectives



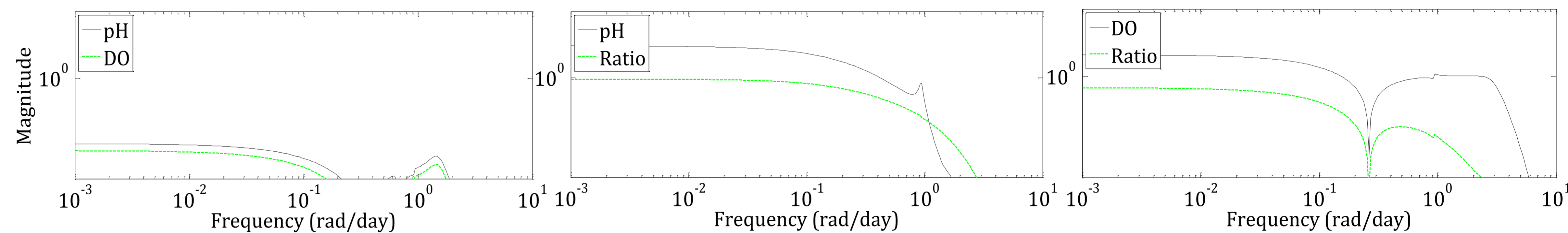
Top-down analysis

- Optimisation of operating conditions
- pH and DO \rightarrow $TNO_2/TNH = 1.3$?



Selection of controlled variables based on disturbance impact

$$CLDG = \tilde{G}(s)G^{-1}(s)G_d(s)$$

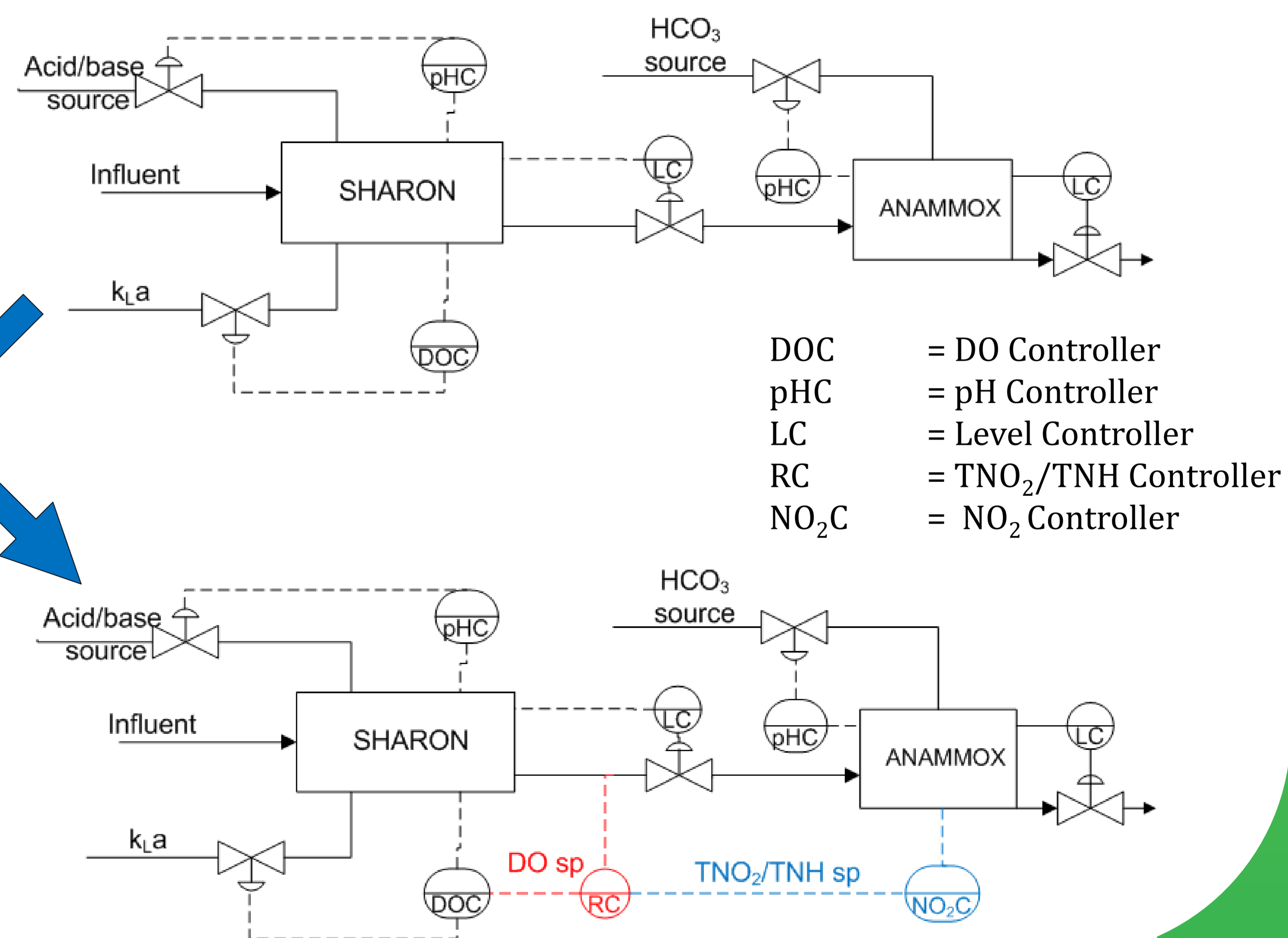


Bottom-up design

Regulatory layer

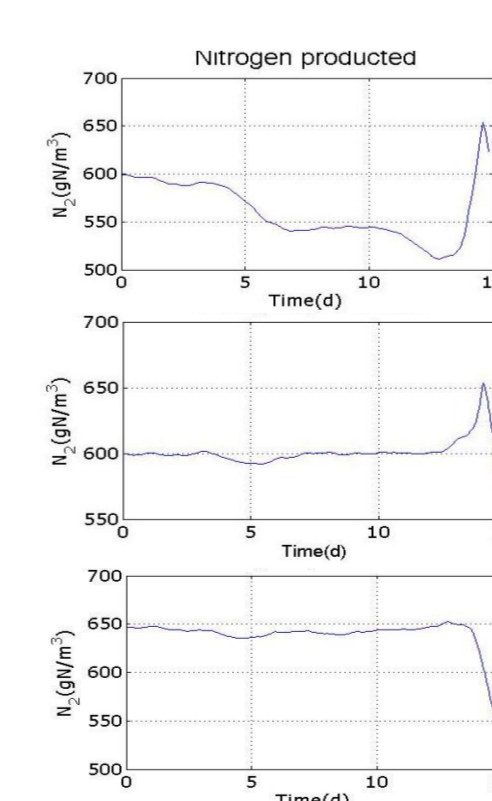
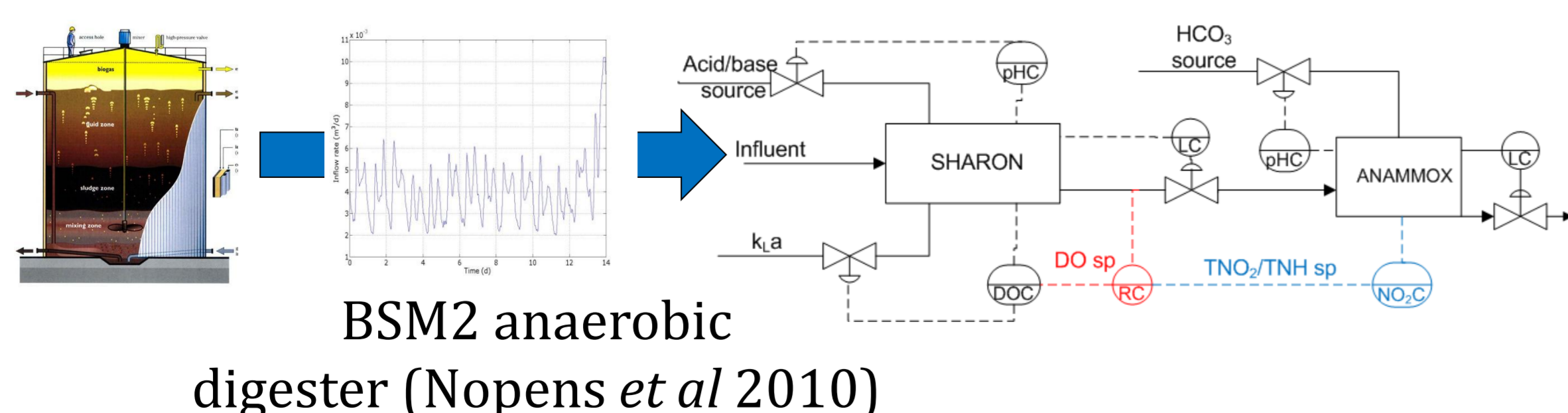
- To keep the $TNO_2/TNH = 1.3$
- Feedback from Anammox reactor

Supervisory layer



Evaluation

based on 15 days simulation



Structure	Nitrogen removal	DO loop	pH loop
Regulatory	78.1%	IAE (d) 0.45 TV 336 d ⁻¹	1.79 2.25·10 ⁻⁴ m ³ d ⁻¹
Cascade	85.7%	IAE (d) 1.12 TV 4.9510 ³ d ⁻¹	1.96 5.90·10 ⁻⁵ m ³ d ⁻¹
Nested cascade	91.4%	IAE (d) 1.68 TV 3.73·10 ³ d ⁻¹	1.83 5.30·10 ⁻⁵ m ³ d ⁻¹

Conclusions

- Three different control structures with incremental complexity were designed & evaluated for the SHARON – Anammox process
- A nested cascaded structure were found best in terms of rejecting disturbances and achieving the best nitrogen removal performance

Contact

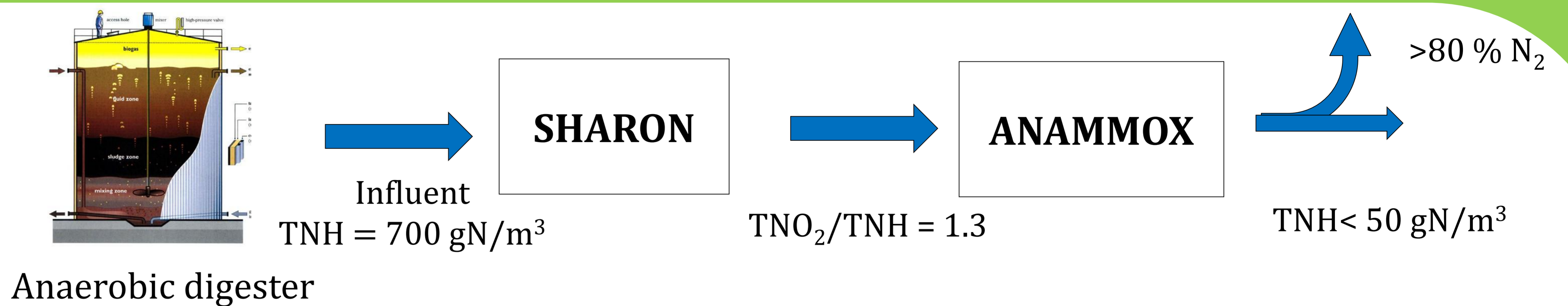
CAPEC DTU Chemical Engineering. Dr. Miguel Mauricio- Iglesias (mim@kt.dtu.dk) and Assoc. Prof. Gürkan Sin (gsi@kt.dtu.dk)

References:

Larsson & Skogestad (2000). Modelling, identification, control, 21/4, 209
Nopens *et al.* (2010). Water Sci. Technol. 62;9; 1967

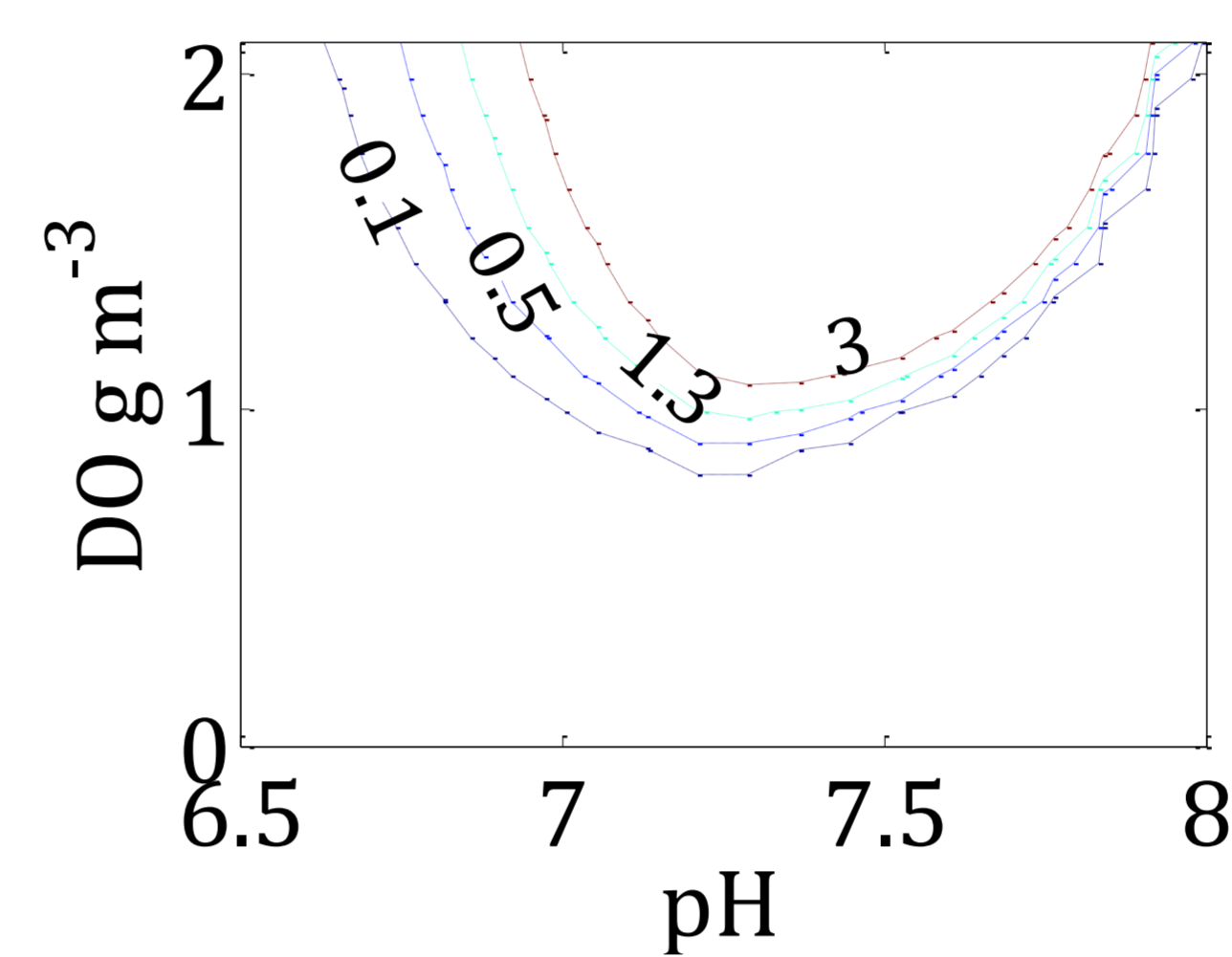
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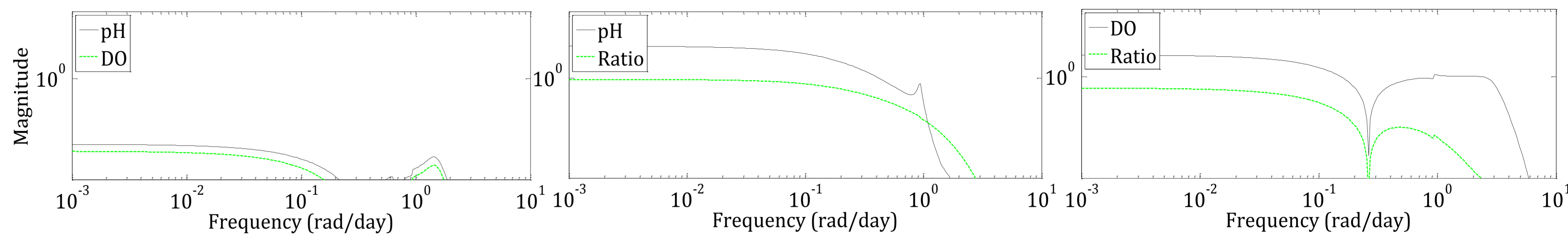
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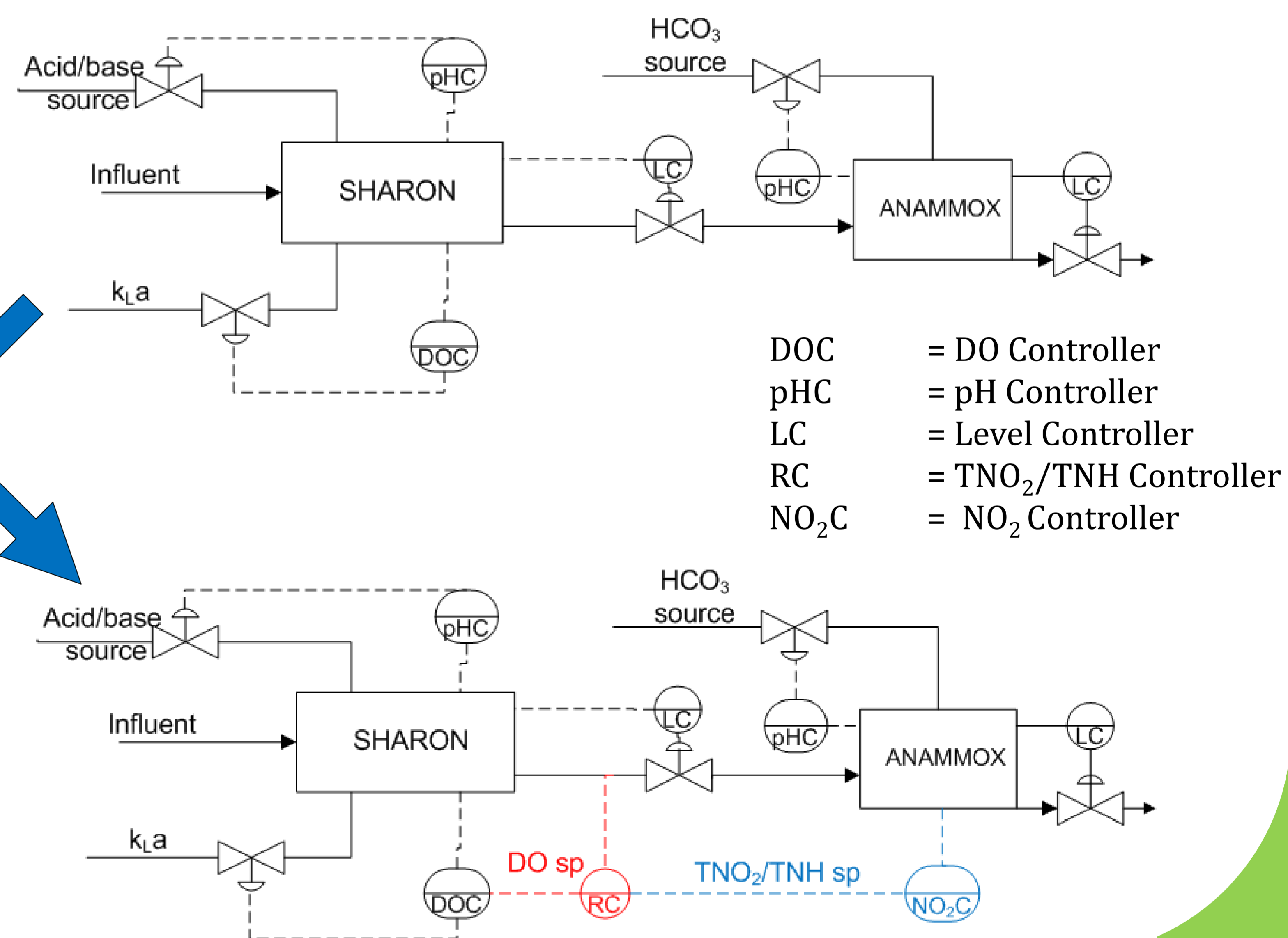


Bottom-up design

Regulatory layer

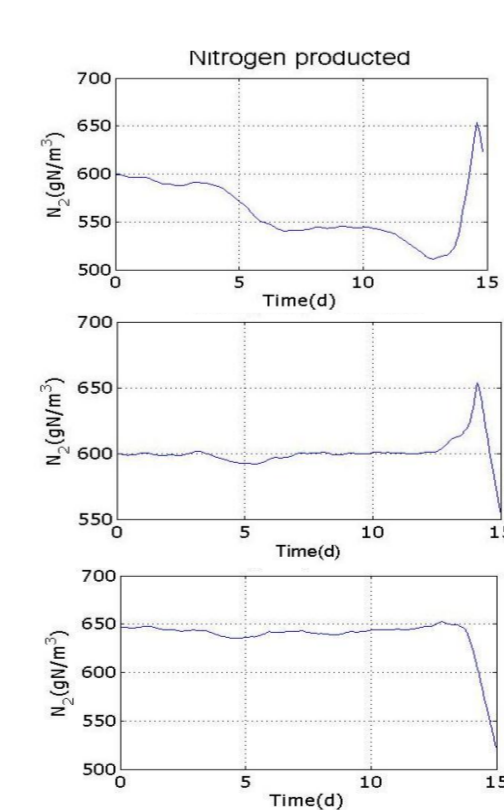
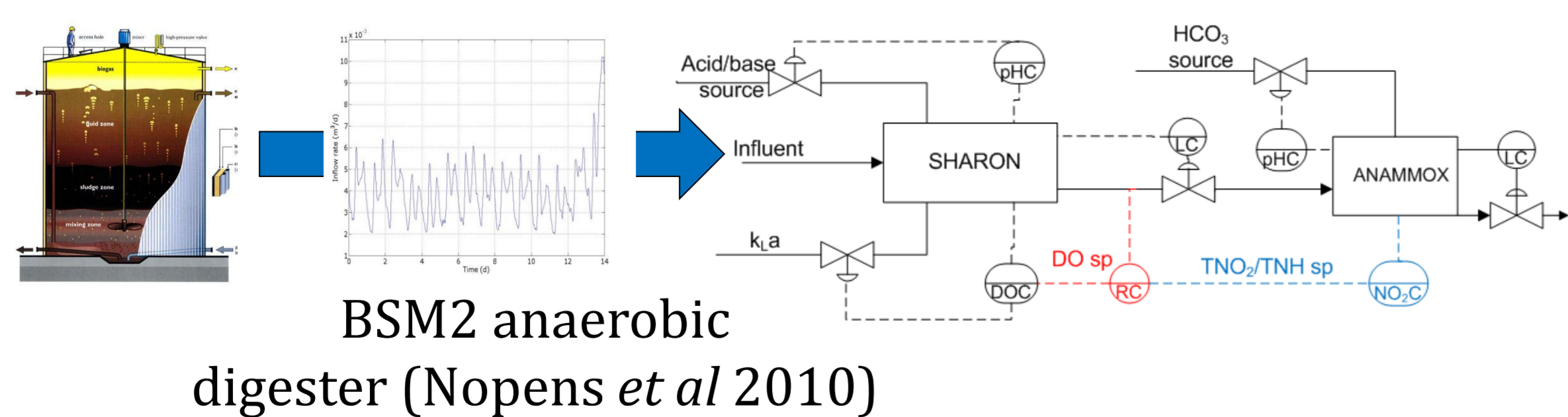
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