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Can nitrogen removal be a win-win situation?

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This study focuses on the expected trade-off between higher N removal rates and higher energy demand, and the associated carbon footprint (i.e. direct and indirect GHG emissions to the atmosphere). To do so, an analysis of eco-efficiency of a large sample of WWTPs is proposed with a twofold objective: to determine how N removal affects efficiency and to estimate the principal operational drivers of the eco-efficiency. Operation data were gathered from published literature and regional water agencies [1]. N_2O emissions were estimated using a new estimation model based on long-term measurements at eight Austrian WWTPs, which relate emissions to degree of N removal [2]. A total of 153 WWTPs plants are assessed by a two-step analysis. In the first stage eco-efficiency scores are estimated by data envelopment analysis (DEA) using energy consumption (kWh/kgN_{in}), which can be considered a good proxy of indirect GHG emissions, and direct N_2O emissions (kgN_20/kgN_{in}), which represent the main contributor to direct GHG emissions, as inputs and mass of N removed as output. Subsequently, a regression analysis is carried out using the DEA eco-efficiency ratio as the dependent variable and relevant characteristics of the WWTPs as explanatory variables. In this way, it is possible to identify influential variables and evaluate their importance. A regression model is developed describing the relationship between eco-efficiency (θ) and operational variables. Analysis demonstrated a strong relationship between changes in nutrient removal rate and eco-efficiency (Fig. 1). The regression coefficient indicated that on average, 1 percent increase in N removal rate increases the eco-efficiency score by 0.20 percent. According to the data, MBR plants obtained lower eco-efficiency than conventional BNR due to their higher energy consumption. Future perspectives for this research include complete description of predictor variables including plant size and country of origin.

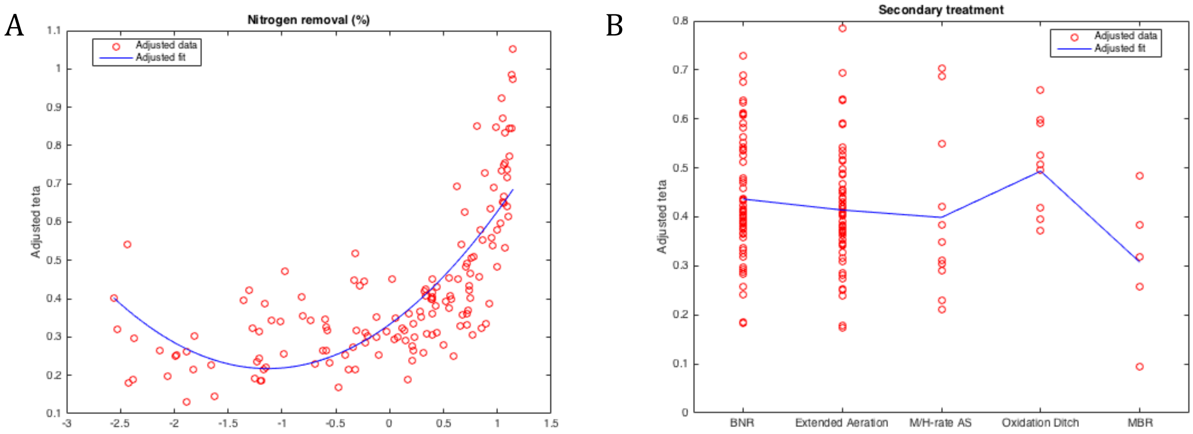

Figure 1. Adjusted response plots of Nitrogen removal (A) and Secondary treatment (B). The adjusted response plot shows the fitted response as a function of selected variable, with the other variables averaged. Data are centred and scaled.

References

1. Longo, S. et al. (2016). Monitoring and diagnosis of energy consumption in wastewater treatment plants. A state of the art and proposals for improvement. *Applied Energy*, *179*, 1251-1268.
2. Parravicini, V. et al. (2016). Greenhouse Gas Emissions from Wastewater Treatment Plants. *Energy Procedia*, *97*, 246-253.

TUESDAY 3rd OCTOBER

	ROOM B3 (Cont.)	ROOM B4 (Cont.)	ROOM C1 (Cont.)
11:30 - 13:00 h	TOPIC 2 1 Thermo dynamics-Applications Chairs: Magee, Sarti	TOPIC 7.1-Resources Use & Sustainable Technologies 2 Chairs: Wolfson, Garcia-Calvo	JE-ESCAPE27T1 Modeling and Simulation Chairs: Prof. Gürkan Sin and Dr. Moisès Graells
	OC-49996 Fluorinated ionic liquids: Novel task-specific biomaterials A. Pereiro, M. Ferreira, N. Vieira, J. Bastos, J. Araújo, L. Rebelo Portugal	**OC-74966 Comprehensive study of the reaction kinetics of the solventless production of solketal with sulphonic ion exchange resins** J. Esteban, M. Ladero, F. García-Ochoa United Kingdom	**T7.- CAPE applications addressing Global Grand Challenges** 12:10 Surrogate-based Optimization for Pharmaceutical Manufacturing Processes 2797 **Zilong Wang, M. Sebastian Escotet-Espinoza, Ravendra Singh and Marianthi Ierapetritou**
	OC-62996 The Different Faces of Aqueous Biphasic Systems in Protein Purification: From Poly(alkylene glycol) s to Nature-Inspired Ionic Fluids, and From Macroscale to Microscale S. Carvalho, J. Bastos, M. Ferreira, A. Pereiro, L. N. Rebelo, J. Araújo Portugal	**OC-73361 Life Cycle Assessment of transformation end-of-life RO membrane moduls alternatives into UF and NF membrane modules in pilot scale.** J. Senán Salinas, R. García-Pacheco, S. Mollina, J. Landaburu-Aguirre, E. García-Calvo Spain	12:50 How to Use mechanistic Metabolic Modeling to Ensure High Quality Glycoprotein Production 2839 **Alireza Ehsani, Sebastian Niedenfuehr, Thomas Eissing, Swantje Behnken and Andreas Schuppert**
	OC-66846 Thermodynamic modeling of fast pyrolysis bio-oil by group contribution S.Pereda, Y. Ille, F. Sánchez, N. Dahmen Argentina	**OC-71486 Hydrogen production from steam reforming of phenol as a coal pyrolysis product** X. Luo, C. Pang, T. Wu China PR	
	SOC-37226 Multiscale modelling of poly-ε-caprolactone in acetone-water mixture A. Lavino, P. Carbone, D. Marchisio Italy	**OC-61336 Can nitrogen removal be a win-win situation?** S. Longo, J. Lema, M. Mauricio Iglesias, A. Hospido Spain	
	SOC-59756 Development and validation of a predictive design model for single-phase multi-component supersonic ejector A. Esmaeili, H. Bashiri, Z. Aidoun Canada	**OC-58706 Strategies to meet carbon footprint reduction target for sustainable cement production** C. Pinheiro, R. Filipe, H. Matos Portugal	

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