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Liu, Qipeng P.; Flores Alsina, X.; Ramin, E.; Gernaey, K.V.

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Analysis of green oxygen from PtX for wastewater treatment applications

***Qipeng P. Liu**, X. Flores-Alsina, E.Ramin, K.V. Gernaey, DTU Kemiteknik**

Introduction: New EU standards on wastewater (2022), water reuse (2023) and drinking water (2023) are emphasizing the importance on elimination of emerging pollutants, such as endocrine disruptor, PFAS, as well as micro-pollutants. Meanwhile, the energy system is under huge transition for renewable and energy conversions. The PtX capacity is planned to reach 6 GW in Denmark, whereas green oxygen (99.3% purity) from water electrolysis is estimated to generate ~23040 ton per day. Such green oxygen provides a great opportunity for wastewater treatment plants to conduct aeration and oxidation with better efficiency, than conventional methods using air.

Methods and data: Benchmark Simulation Model No.2 (BSM2) is a plant-wide simulation platform for conventional secondary wastewater treatment plant. The BSM2 represents a 100,000 people equivalent (p.e.) treatment plant and consists of primary and secondary clarification units, activated sludge reactors, an anaerobic digester, a thickener and dewatering units. The model can perform one-year dynamic simulation with 15-minute intervals. To evaluate the implementation of PtX for wastewater treatment applications, the International Water Association (IWA) BSM2 serves as a standardised simulation platform. Three types of potential integration between PtX and wastewater treatment were evaluated at steady state: green hydrogen for bio-methanation of carbon dioxide from anaerobic digester; green oxygen for aeration in the aeration tank; green oxygen for ozone oxidation at the effluent discharge point.

Results:

- 0.67 MW, 1.82 MW and 3.11 MW capacity of water electrolysis are required respectively for bio-methanation, aeration and ozone oxidation for full-scale BSM2 application.
- Three electrolysers' combination of 1 MW, 2 MW, 2 MW can be an option for dynamic control and scheduling.
- Total green oxygen demand for all DK UWWTPs to implement pure oxygen aeration and effluent ozone oxidation requires ~4000 ton oxygen/day.

Discussion and take-home message:

- The applications can be partial and intermittent, if the electricity is from renewable source, e.g. wind.
- Onsite storage units can be considered to balance the demand and supply, for both hydrogen and oxygen.
- PtX has to be managed with caution at the discharge points of wastewater treatment plant (for example, ozone oxidation, hydrogen to oxygen impurity, etc).

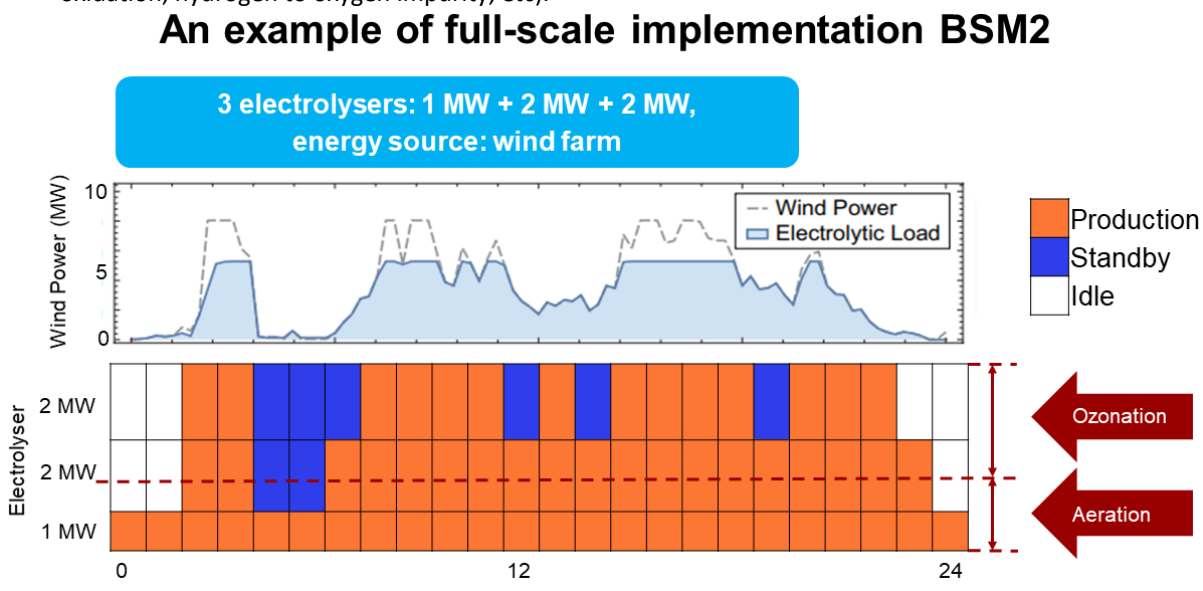

Figure 1. An example of electrolysers' control state for full-scale application of PtX at BSM2

*qipli@dtu.dk; xfa@dtu.dk; elhr@dtu.dk; kvg@dtu.dk; Søltofts Plads, Bygning 227, 2800 Kgs. Lyngby