On the Implementation of an MBR Process at Wastewater Treatment Plants

Klara Westling[1], Christian Baresel[1], Niklas Dahlén[2]

[1] IVL Swedish Environmental Research Institute, Sweden
[2] Stockholm Vatten VA AB, Sweden

Introduction

Many large wastewater treatment plants (LWWTPs) face both an increased load due to population growth and urbanisation as well as more stringent effluent quality requirements. In Stockholm, Sweden, for example, commitment to the Baltic Sea Action Plan (BSAP) and the implementation of the European water framework directive combined with an annual growth rate of 1.5% require actions for efficient municipal wastewater treatment, meeting the new requirements.

As it is difficult, or even impossible, for existing WWTPs surrounded by residential areas to expand physically, new treatment solutions are needed. Among others, Stockholm Water Company (Stockholm Vatten AB) has therefore decided to upgrade the existing Henriksdal WWTP (850 000 pe), currently operating with a conventional activated sludge (CAS) process, to a membrane bioreactor (MBR). By converting current post-sedimentation basins to membrane separation units and by other related adaptations the facility will be able to increase its capacity by almost the double (1 600 000 pe).

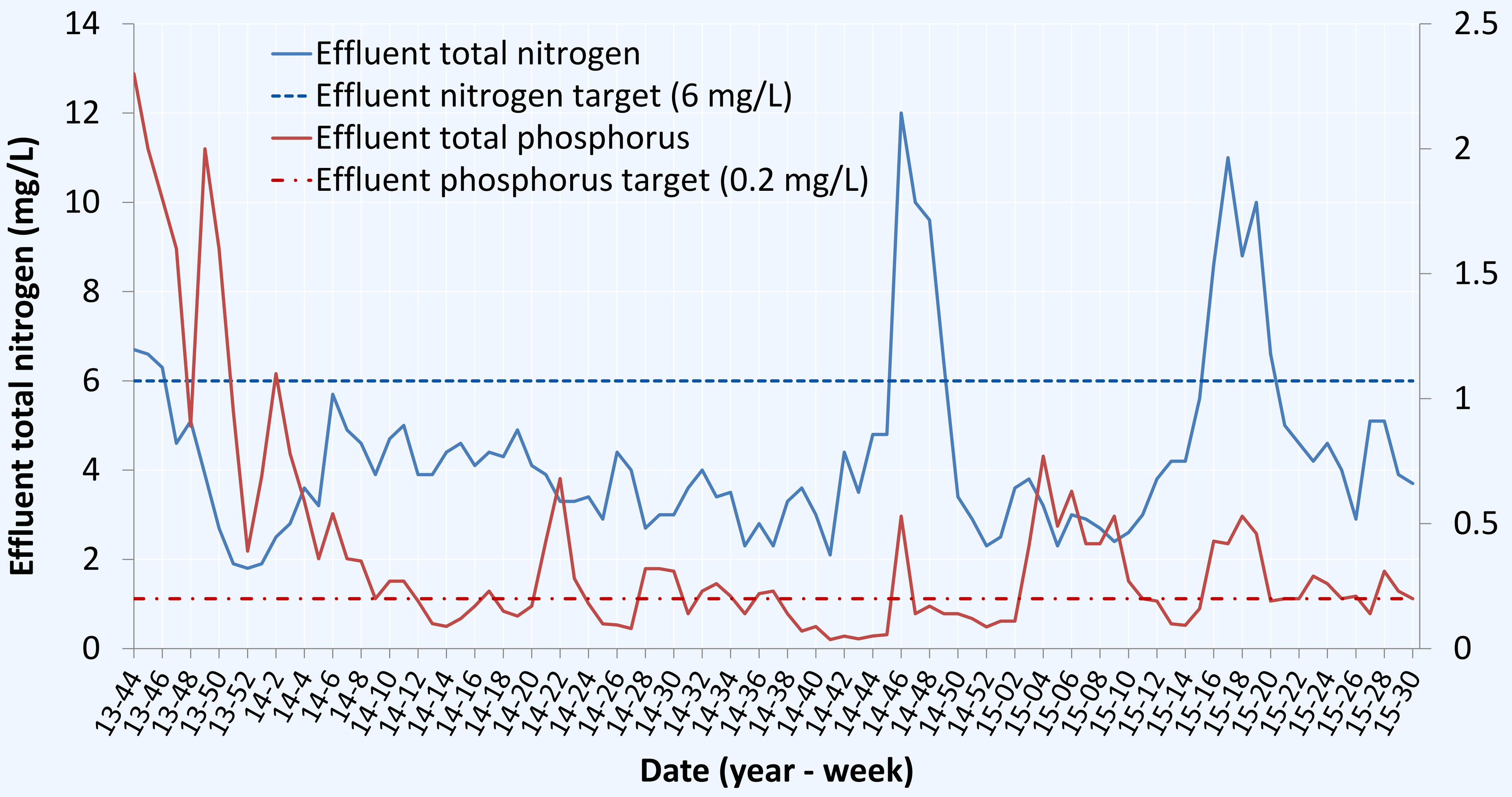
Materials and Methods

To guarantee a successful implementation of the process in the full scale WWTP, IVL Swedish Environmental Research Institute and Stockholm Water Company are since September 2013 operating a pilot-scale treatment line at the R&D-facility Hammarby Sjöstadsverk. The pilot-MBR line is built as an identical copy of the future configuration of the Henriksdal WWTP (0.014% of biological volume). It further uses the same influent wastewater as Henriksdal WWTP.

The aim of the studies are:

- to show that the process can achieve future effluent targets,
- to provide information on options and possibilities for operation and process design,
- to receive operational experience, and
- to study possible secondary effects

Results



Nitrogen and phosphorus removal between October 2013 and July 2015.
Peaks in effluent concentrations are due to test periods with no addition of external carbon source (nitrogen) and low dosage of precipitation chemicals (phosphorus) respectively.

The process operation has been stable with a significant better capacity than expected. The process reaches pre-defined effluent targets for nitrogen (6 mg/L) and phosphorus (0.2 mg/L), even at high loads. There is also a high removal of suspended solids (<1 mg/L).

Due to various test phases, varying loads and also occasional operation halts, concentrations as presented to the left may exceed target levels during some periods.

Also, side studies on greenhouse gas emissions and following removal of persistent organic substances both show lower emissions and an increased removal efficiency, compared to traditional wastewater treatment processes.

Conclusions

The studies show that more stringent effluent requirements can be reached. However, especially for the phosphorus removal, the type of chemicals used, amount and dosing point locations have a significant impact on membrane fouling. Furthermore, once a decrease in permeability occurs, it is often followed by a rapid further decrease, which requires a cleaning of membranes.

Long-term tests show that more membrane cleanings have been performed than initially expected. This is mainly explained by the fact that the pilot-scale MBR was mainly used for various tests implying harsher conditions than at normal operation.