Removal of Organic Micropollutants Under Dry and Wet Weather in a Full-Scale Aerobic Granular Sludge Plant

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4.07.A.T-03 Removal of Organic Micropollutants Under Dry and Wet Weather in a Full-Scale Aerobic Granular Sludge Plant

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Aerobic granular sludge (AGS) is an effective wastewater treatment widely applied worldwide for the removal of nutrients and organic matter. However, limited information is available on the effectiveness of full-scale AGS plants for removing organic micropollutants (OMP), particularly during wet weather. This study investigated the occurrence and removal of OMPs, including 19 pharmaceuticals and 2 industrial compounds, in a full-scale AGS plant during both dry and wet weather over one year.

We selected a full-scale AGS plant located in Utrecht, the Netherlands as the targeted AGS plant, and collected monthly 24-hour composite water samples and grab sludge samples from May 2023 to April 2024. 21 OMPs were extracted from water and sludge samples and measured by LC/MS. Concentrations of ammonia and organic matter (both particulate and soluble) were measured with HACH Lange GMBH kits.

The results show that Influent concentrations of 5 pharmaceuticals and 1 industrial compound exceeded 1 ?g L-1, which were diluted by rainfall. Influent loadings of 7 OMPs (absolute OMP amount in ?g day-1) were significantly increased during wet weather, likely from sewage sediment resuspension and urban runoff. Average removal efficiencies of 11 compounds achieved greater than 20%, with 5 of them exceeding 50%, in the AGS plants. Simple linear regression results between OMP removal efficiencies and flow rates showed that biodegradable OMPs were more strongly affected by increased influent volumes (as indicated by steeper slopes) than OMPs primarily removed through sorption. Additionally, correlation analysis results showed that the removal of soluble organic matter was significantly correlated (p-value < 0.05) with the removal of 14 OMPs, suggesting that organic matter removal may be an indicator for OMP removal in the AGS plant. After AGS treatment, 8 compounds in the effluent remained above their predicted no-effect concentration levels, indicating potential ecological and human health risks in the receiving water. During wet weather, effluent OMP loadings increased mainly driven by reduced removal efficiency. Additionally, compared to activated sludge plants, the AGS plant exhibited comparable or slightly higher OMP removal efficiency during dry weather. Overall, this study is the first to investigate OMP removal during wet weather in a full-scale AGS plant and propose the potential impact of increased flow rates on biodegradable OMPs or OMPs mainly removed through sorption.