

- Analyzed flux recovery under various CEB durations (20 to 75s) and concentrations (100 to 650 mg/L)

Effects of operating conditions on antibiotic resistance genes during anaerobic digestion Jul. 2021 – Feb. 2022

- Investigated the effects of solid retention time (SRT) under mesophilic and thermophilic conditions using a recuperative thickening process.
- Compared AD performance across varying SRTs, analyzing biogas production, volatile solid reduction, and microbial community dynamics
- Found that extended SRT and thermophilic conditions enhanced biogas production, with temperature playing a significant role in influencing microbial communities and antibiotic resistance gene (ARG) abundances

Effect of growth substrate concentration and microbial activity on biodegradation of micropollutants (MPs) in aerobic zone Jan. 2022 – Dec. 2023

- Investigated the role of growth substrate (ammonium and organic matter) concentrations and microbial activity (nitrifying and heterotrophic activity) on the biodegradation kinetics of 11 MPs
- Identified that MPs predominantly biodegraded by nitrifiers or heterotrophs exhibited varying responses to growth substrate concentrations and the associated predominant microbial activities

Effect of exposure of micropollutant on partial and full nitrification reactors Jan. 2022 – Jun. 2025

- Designing and operating partial and full nitrification reactors for high ammonium loading (700 – 800 mg NH₄-N/L·d)
- Response of partial and full nitrification reactors to exposure of micropollutant
- Determining whether biodegradation efficiency is affected solely by exposed micropollutants or if unexposed micropollutants are also impacted

Removal of total nitrogen in sidestream of WWTP using A/O-MBR process Jan. 2024 – Feb. 2025

- Treating high-strength wastewater from fecal supernatant (FS) and anaerobic digestion liquor (AL) in sidestreams of WWTPs
- Utilized FS as a carbon source for denitrification due to its high COD and suitable C/N ratio
- Achieved up to 61.4% TN removal and 98.2% COD reduction using an A/O-MBR system, with remaining challenges in optimizing further TN reduction strategies

Biodegradation of micropollutants (MPs) under endogenous respiration conditions Sep. 2024 – Jun. 2025

- Investigating the effect of MLSS concentration, pH, redox condition temperature, and the duration of endogenous respiration on the biodegradation of 7 MPs during endogenous respiration in an activated sludge process

RESEARCH INTERESTS

Biological Wastewater Treatment Technologies

- Enhancing efficiency and sustainability in biological treatment processes
- Optimizing carbon, nitrogen, and phosphorus removal in high-strength wastewaters

Emerging Contaminants and Micropollutants

- Exploring biological pathways for biodegradation of persistent organic pollutants

- Evaluating treatment strategies for emerging contaminants in water systems

Environmental Antimicrobial Resistance

- Investigating fate and transmission of antibiotic resistance genes (ARGs) in water treatment systems
- Studying microbial community dynamics and their role in contaminant removal
- Developing strategies to minimize environmental impact of emerging biological contaminants

Water and Sanitation Infrastructure Solutions

- Developing appropriate water treatment technologies for low- and middle-income countries

Biological treatment of Hazardous Industrial Wastewater

- Investigating and optimizing biological processes to effectively treat hazardous industrial wastewaters, including those from semiconductor manufacturing and medical facilities
- Exploring innovative technologies for recovering valuable materials (lithium, cobalt, nickel) from industrial wastewaters while ensuring effective treatment

Advanced Nitrogen Removal Processes

- Optimizing nitrogen removal in wastewater treatment using advanced biological methods such as Anammox and comammox to improve treatment efficiency

LAB SKILLS

- Proficient in Chromatography equipment: LC-MS, IC, GC
- Proficient in Water Quality Analysis Indicators: TOC, COD, TN, TP, TSS, VSS
- Experienced in Molecular Biology Techniques: DNA & RNA extraction, qPCR, Microbial analysis

PUBLICATIONS

1. Mezmir Dantie, M., Shin, J., **Lee, S.**, Min Park, C., Wang, J., Kim, Y.M., 2022. Effect of type of coagulants on removal efficiency and removal mechanisms of antibiotic resistance genes in anaerobic digestion of primary sludge produced via a chemically enhanced primary treatment process. *Bioresour. Technol.* 346. <https://doi.org/10.1016/j.biortech.2021.126599>
2. Park, S., Shim, J., Yoon, N., **Lee, Sungman**, Kwak, D., Lee, Seungyong, Kim, Y.M., Son, M., Cho, K.H., 2022. Deep reinforcement learning in an ultrafiltration system: Optimizing operating pressure and chemical cleaning conditions. *Chemosphere* 308, 136364. <https://doi.org/10.1016/j.chemosphere.2022.136364>
3. Shin, J., **Lee, S.**, Lee, J., Son, H., Lee, Y., Kim, Y.M., 2024. Impact of anaerobic zone on biodegradation of micropollutants: Comparison of micropollutants' removal efficiencies in lab-scale anaerobic bioreactor and in full-scale anaerobic zone. *Chem. Eng. J.* 481, 148356. <https://doi.org/10.1016/j.cej.2023.148356>
4. Shin, J., **Lee, S.**, Park, H., Son, H., Raza, S., Wang, J., Kim, Y.M., 2022. Effects of thermal hydrolysis on anaerobic digestion and abundance of antibiotic resistance genes during recuperative thickening digestate treatment of sewage sludge. *Chem. Eng. J.* 450, 138128. <https://doi.org/10.1016/j.cej.2022.138128>
5. **Lee, S.**, Heo, S., Lee, J., Son, H., Wang, J., Kim, Y.M., 2025. Aerobic biodegradation of micropollutants by nitrifiers and heterotrophs: Changes in biodegradation rate constant depending on levels of growth substrates and microbial activities. *Bioresour. Technol.* 425, 132332. <https://doi.org/10.1016/j.biortech.2025.132332>
6. Shin, J., Kim, S.J., Raza, S., **Lee, S.**, Lee, J., Son, H., Wang, J., Kim, Y.M., 2025. Temperature is

more important than solid retention time in biogas production and resistome dynamics in anaerobic digestion with recuperative thickening. Chem. Eng. J. 514.
<https://doi.org/10.1016/j.cej.2025.163355>

CONFERENCE PRESENTATIONS

1. **Lee, S.**, Kim, Y.M., Ammonia monooxygenase mediated co-metabolism for recalcitrant micropollutant removal by nitrifiers, Korean Society of Environmental Engineers Conference, 2022, *Poster presentation*.
2. **Lee, S.**, Shin, J., Nam, W., Kim, Y.M., Reduction of antibiotic resistance genes during anaerobic digestion with recuperative thickening and thermal hydrolysis process, Korean Society of Environmental Health and Toxicology Spring Conference, 2022, *Poster presentation*.
3. **Lee, S.**, Kim, Y.M., Impact of NH_4^+ , COD and microbial activity on biodegradation of pharmaceuticals in aerated tanks, Korean Society of Environmental Engineers Conference, 2023, *Oral presentation*.
4. Kim, Y. M., **Lee, S.**, Exploring biodegradation of micropollutants in aerobic activated sludge, 19th IWA Leading Edge Conference on Water and Wastewater Technologies, 2024, *Poster presentation*.
5. **Lee, S.**, Kim, Y.M., Effect of environmental factors on the biodegradation of micropollutants during endogenous respiration in an activated sludge process, Korean Society of Environmental Engineers Conference, 2024, *Oral presentation*.
6. **Lee, S.**, Heo, S., Kim, Y.M., Effect of substrate concentrations and microbial activities on the biodegradation of micropollutants, Korean Society of Water and Wastewater, 2024, *Oral presentation*.

AWARDS & SCHOLARSHIPS

- Academic Excellence Award, Hanyang University, 2020 (Rank: 4/54, GPA: 3.67/4.0, 2/3 tuition)
- Academic Excellence Award, Hanyang University, 2021 (Rank: 1/73, GPA: 4.0/4.0, Full tuition)
- Academic Achievement Award (Graduated with Honors, Summa cum laude), Hanyang University, 2022 (Rank: 5/66, GPA: 3.67/4.0)
- Excellent Oral Presentation Award, Korean Society of Environmental Engineers Conference, 2023
- Abbott Laboratories Fellowship, University of Illinois Urbana-Champaign, 2025