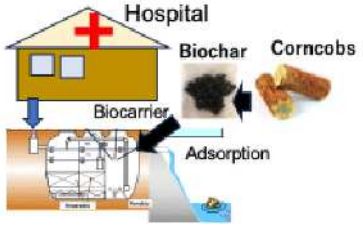
Name	Job Title	Area of Expertise
ITAYAMA Tomoaki	Professor	Water Environmental Engineering

1. Main Research Topics

① Monitoring of toxic cyanobacteria in lakes and reservoirs, prediction of their occurrence, and development of ecosystem control and purification technologies

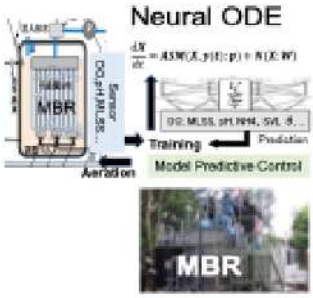
Excessive loading of nutrients such as N and P have caused eutrophication of lakes and reservoirs, leading to the proliferation of toxic cyanobacteria (toxic cyanobacteria) that produce toxins linked to liver cancer and other health issues. In developing countries with inadequate water treatment, this poses a direct health risk. Therefore, our laboratory studies on the methods to predict the occurrence of toxic cyanobacteria using IoT-based simple sensing, Bayesian statistics, deep learning, and molecular ecology. Additionally, we are exploring eco-friendly and low-cost purification methods using biochar. Moreover, theoretical foundations for ecosystem control techniques leveraging the predation of zooplankton, and practical technologies for reducing toxic cyanobacteria.

② Development of wastewater treatment technology for small hospitals in developing countries affected by water pollution caused by antibiotics and other substances



Hospital wastewater contains a high concentration of antibiotics and dangerous pathogens. In developing countries where much of this wastewater is discharged untreated, this poses significant health risks to humans and ecological risks to ecosystems. Additionally, not only antibiotics but also disinfectants and surfactants contribute to the increase of antibiotic-resistant bacteria in the environment. Therefore, a low-cost wastewater treatment system is essential for small-scale hospital wastewater treatment in rural areas of developing countries. We are also researching low-cost wastewater treatment methods that utilize the synergistic effects of inexpensive biological treatment methods and biochar derived from agricultural waste (such as corncobs), which possesses adsorption properties and serves as a microbial carrier. Additionally, we are advancing the implementation of IoT for remote monitoring and control.

③ Study on sensing and AI predictive control methods for wastewater treatment system



In biological wastewater treatment, it is extremely important to simultaneously reduce aeration volume and improve treatment efficiency while advancing automation of control systems. To this end, we are conducting research on sensing technologies for controlling activated sludge treatment, predictive methodologies such as time-series deep learning using AI predictions and neural differential equations that learn nonlinear dynamics, as well as model predictive control. In these efforts, we are utilizing a bench scale model wastewater treatment systems and a mini-plant-scale MBR (membrane bioreactor) system at Nagasaki University.

2. Keywords

toxic cyanobacteria, molecular ecology, wastewater treatment, ecological engineering, developing countries, hospital wastewater, antibiotics, surfactants, antibiotic-resistant bacteria (ARB), aqua informatics, sensors, AI, deep learning, Bayesian statistics

3. Remarks and Websites

We have successfully removed more than 95% of toxic cyanobacteria and cyanotoxins from Lake Victoria (Kenya) using a Biofence system using Biochar. Meanwhile, the use of biochar as a carbon sequestration technology is gaining global attention, and water treatment technologies utilizing biochar are particularly important in developing countries. Additionally, we have developed a Bayesian statistical method to predict the occurrence of toxic cyanobacteria in reservoirs. Furthermore, we are conducting water quality prediction for wastewater treatment using deep learning techniques and neural differential equations.

researchmap: https://researchmap.jp/read0080703-Itayama