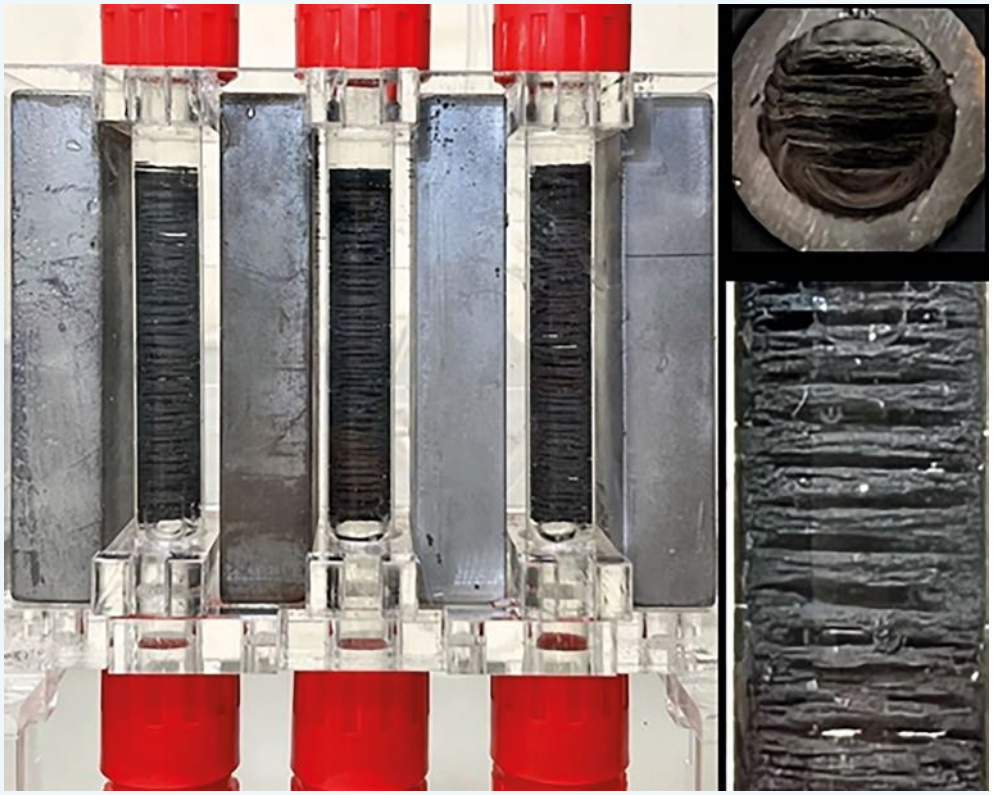
Research & Innovation

High-Performance Magnetic Flow-Through Water Treatment System

Arsenic contamination in groundwater is a severe issue globally, especially in remote areas without effective water treatment. Around 94 to 220 million people worldwide are exposed to unsafe arsenic levels (>10 μg/L per WHO guideline) through ingestion of groundwater that has received no or ineffective treatment. The effectiveness of widely employed zerovalent iron (ZVI)/sand filters for groundwater treatment is often hindered by ZVI surface passivation and filter clogging.

To address these challenges, a research group of the Department of Civil and Environmental Engineering has developed a novel magnetic confinement-enabled column reactor coupled with periodic ultrasonic de-passivation (MCCR-PUD) that can achieve fast and sustained removal of arsenic from water. With a short empty bed contact time of only 1.6 minutes, it can treat nearly ten times more water than a ZVI/sand filter in the same period.

This magnetic confinement water treatment system has been used successfully under both laboratory and field conditions to remove targeted contaminants efficiently and sustainably. Requiring no energy input, it also has low operating costs. The innovative design and superior performance of the MCCR-PUD overcomes the limitations of existing arsenic treatment technologies and has the potential for applications in decontaminating both distributed drinking water and industrial water/wastewater.



World-Class Research Infrastructure for Water Quality Improvement

PolyU's Hydraulic Lab is a distinctive facility capable of emulating the complete range of hydraulic, physical, chemical, and biological conditions found in actual hydraulic systems within a regulated setting. It is dedicated to investigating the determinants of and processes associated with water quality within various hydraulic systems, and to creating cutting-edge technologies and optimal strategies to safeguard water. With over **HK$20 million funding**, the research team has **published over 100 high-impact research papers** that report on substantial strides taken in the fundamental understanding of urban rainstorm dynamics, and coastal and oceanic processes. The knowledge on the development of sophisticated engineering technologies is pivotal in addressing and mitigating issues stemming from climate change.

Teaching & Learning

Improving Water Quality and Management in Vietnam

Against the backdrop of severe tap water issues in Vietnam and the several health and safety incidents that have exposed vulnerabilities in water quality management which sparked a national outcry, the Department of Management and Marketing hosted a study programme with timely field research amidst the urgent call for improved water regulation and management.

By studying cases such as those involving water treatment plant safety violations, students learned about the importance of rigorous standards and proper monitoring in maintaining water safety. By examining the causes of unusual fish deaths and the ripple effect along the water supply chain, they learned about the impact of industrial pollution on water sources and the need for stringent regulations. Furthermore, by examining gold mining activities in rural Vietnam that have led to chemical contamination of rivers and groundwater that residents rely on, students recognised the critical need for addressing pollution from various sources and ensuring safe drinking water for all communities.

With this knowledge in mind, students conducted practical research in Vietnam, assessing water samples from rivers and taps in both urban and rural areas. They used basic physicochemical parameters such as temperature, pH, and electrical conductivity, and surveyed residents to acquire insights into public perceptions and experiences of tap water safety. Through this experience, students not only honed their scientific and technical skills but also broadened their knowledge of the sociopolitical dimensions of water management. Moreover, by learning about the interaction between freshwater pollution and human activities, the potential environmental impacts, and the importance of effective regulation and community engagement in safeguarding water quality, they were equipped with the knowledge and tools to contribute to future improvements in water management and address the underlying causes of water quality issues in Vietnam.

Subject: Pollution Control, and Environmental Analysis

With a view to raising awareness among students of the environmental problems caused by industrial pollution and of associated prevention measures, this subject aims to equip them with fundamental concepts and technologies underlying industrial pollution control and water sanitation, and to allow them to carry out analysis of water and wastewater quality, and removal of pollutants. The subject enables students to explicate the functions of air pollutant control devices and various unit operations in water and wastewater treatment, as well as to deploy and apply the physical, chemical, biological principles and concepts related to the treatment processes. By recognising the sources and causes of pollution and assessing the impact of the pollutants on deterioration of environmental quality, students are expected to make use of their theoretical and technical knowledge and exercise critical analytical skills in a group project to formulate, integrate, and evaluate processes to control air pollutants and to treat water and wastewater in order to meet specific effluent discharge requirements.

Outreach & Engagement

Community-Based Water Education Initiatives

To raise awareness and foster active community involvement in water conservation initiatives, the Hydraulic Lab organises programmes that encourage both students and the public to take an active role in water stewardship. Being an interdisciplinary research and education hub, the Lab aims to educate local communities about efficient water management by focusing on water governance, utilisation, resources, and quality, with the aid of advanced on-campus PolyU facilities and field facilities in strategic locations to enrich its research and maximise impact.

In addition, two subjects focusing on environmental protection were offered. These subjects were: Environmental Management Systems, that introduces frameworks and strategies for managing environmental impacts within civil engineering projects and emphasises sustainable practices and compliance with environmental regulations; and Environmental and Safety and Health Legislation, where participants examine the legal frameworks governing environmental protection, safety, and health in the civil engineering industry, with a focus on compliance and best practices.

Governance & Operations

Sustainable Water Treatment and Conscious Water Usage

In an effort to integrate urban development with ecological water management practices on university-affiliated land beyond the main campus, locally and in wider the Greater Bay Area, the Department of Civil and Environmental Engineering partnered with the Water Supplies Department and Drainage Services Department of the Hong Kong Government and the Hong Kong Observatory to build a green water extraction infrastructure to ensure water sources and water supplies are conserved in the urban landscape. The treatment approach developed makes use of sustainable urban drainage systems to diminish surface water runoff and mitigate flood risks. It also emulates natural water habitats such as ponds, wetlands, swales, and basins, which in turn enhances environmental sustainability.

PolyU has been implementing measures under the Water Conservation Policy since 2014 and advocates green campus development, operation, and activity. Sustainable features are incorporated into smart building design and refurbishment, championing the reuse of grey water, minimising of wastage through proper maintenance, and achievement of quantifiable management goals. Importantly, their adoption aims to encourage conscious water usage, thereby raising awareness within the University community of the essence of water conservation.