Hybrid Nano-bioreactors For The Treatment Of Recalcitrant Contaminants In Drinking Water.

Project Type: Annual Base Grant
ProjectID: 2020RI206B

Project Impact:

This project focused on the use of hybrid systems combining nanomaterials and microorganisms. Two model systems were studied Pseudomonas putida and manganese oxide nanoparticles and Escherichia coli and 2-dimensional nanomaterials. Microparticles and manganese oxides (MnOx) nanoparticles are strong oxidants, and they are ubiquitous in marine and freshwater environments. In nature, the biological synthesis of MnOx is thought to be the dominant particle formation process. Firstly, we work to isolate microorganisms from water wells and distribution systems in the town of South Kingstown (RI), which have been reported to have high Mn or MnOx deposits. Additionally, we acquired a marine isolated Pseudomonas putida Mn1 strain from a collaborator with known properties to produce MnOx. One of the challenges to using microbial cultures to produce MnOx nanoparticles is that they are produced during the stationary stage of the growth, which limits the design of continuous systems. The results of this first phase of this research provided us insight into the biogenic formation of MnOx nanoparticles and the determination of their reactivity using a dye (leucoberbelin blue) as a proxy of their capabilities to degrade recalcitrant compounds. We have not been able to develop a continuous culture, but semi-culture systems have been successfully performed.
The other systems used were the hybrid systems consisting of bacteria and 2-dimensional (2D) nanomaterials such as graphene oxide, molybdenum disulfide, and molybdenum diselenide. The 2D nanomaterials selected have unique electrical and adsorptive properties. They could potentially be used as reactive support material that could promote the culture of fluidized biofilm to treat impaired water with recalcitrant pollutants. The study performed with the support of this grant determined the differences in the biocompatibility of these materials with the microorganism used and that the culture conditions also affect the level compatibility achieved. The most promising conditions will be tested on bioreactors in semi-continuous and continuous mode.

Does this project relate to research, outreach and engagement, or education and training? (enter one of these options in the space below)

Research

Which of these USGS science priorities best aligns with this project: water observing; water availability; water prediction; water related emergencies and conflicts; or water-data infrastructure? (enter one of these options in the space below)

Water availability

Please list up to three keywords that are most relevant to this project (see keyword list provided in the instruction document):

water reuse, water quality

The Applicability Of South Korean Aquatic Litter Management Strategies To Rhode Island Freshwater Bodies

Project Type: Annual Base Grant
ProjectID: 2020RI208B

Project Impact:

The researcher did not carry out this project because the student who planned to be supported by this project received another funding source. Therefore there is nothing to report.
This project was awarded eight months before the center's new director was appointed, and the previous administration did not notify the new director. Because the funds are allocated to researchers from colleges that are different from the one the director of the center is faculty, the director does not have access to tracking balances of the accounts.
Unfortunately, this issue was detected by the new director too late to allocate unused funds to other activities; therefore, the funds were not used.
The new director brought this to the attention of the newly formed Executive Committee, and it was decided to add a new requirement to report quarterly on the use of the funds for awarded projects to prevent this situation happens again.

Does this project relate to research, outreach and engagement, or education and training? (enter one of these options in the space below)

Which of these USGS science priorities best aligns with this project: water observing; water availability; water prediction; water related emergencies and conflicts; or water-data infrastructure? (enter one of these options in the space below)

Please list up to three keywords that are most relevant to this project (see keyword list provided in the instruction document):

Understanding Urban Water Resources And Energy Nexus In Rhode Island

Project Type: Annual Base Grant
ProjectID: 2020RI207B

Project Impact:

Activities:

a) Land Surface Temperature is calculated using remotely sensed images of Landsat 8 data for Rhode Island to determine the Urban Heat Island (UHI) extent. The LST values are validated using air temperature data from 5 weather stations of Rhode Island.
b) A statewide evaluation of pollution sources and protection areas related to public water supply
c) Determined high-resolution population vulnerability indices related to urban heat, water stress and pollution.
d) A comprehensive up-to-date database of urban water-for-energy use, energy-for-water supply, and treatment with relevant climatic and anthropogenic variables is compiled.

Findings:
a) Urban areas show higher LST than rural areas. Densely populated communities tend to be more severely affected by high temperatures. According to the Land Use Land Cover type, developed areas show higher LST exposure.
b) Among the sole source aquifer, wellhead protection area, surface water protection area, the wellhead protection areas are potentially most affected according to the status of developed land as they feature a significantly increased share of impervious surface, the most released toxic air pollutants, and the highest mileage in relation to major roads. On the other hand, surface water protection areas show less affected by development.
c) Due to the elevated land surface temperature, over 40% of the state's citizens are potentially affected by temperatures above 25°C, which amounts to more than 80% for areas over 20°C. This indicates a high level of potential impacts ranging from heat stress, higher energy and water demand, and easier transmission of pathogens. Population vulnerability is highly influenced by population density and income.
d) From 1990 to 2010, total water uses in MGD from 1990 to 2010 based on eight categories for RI and energy intensity are included. A comparison of total water uses among selected US states is also incorporated in the database. Also, total generation capacity along with the monthly generation of the six biggest power plants in Rhode Island is included. Information (capacity, cooling type, cooling water sources, discharge, and water for energy) regarding the cooling system of the 3 biggest power plants in RI is also incorporated.

Does this project relate to research, outreach and engagement, or education and training? (enter one of these options in the space below)

Research

Which of these USGS science priorities best aligns with this project: water observing; water availability; water prediction; water related emergencies and conflicts; or water-data infrastructure? (enter one of these options in the space below)

Water availability

Please list up to three keywords that are most relevant to this project (see keyword list provided in the instruction document):

water budget, water supply