# Nevada Water Resources Research Institute
# Division of Hydrologic Sciences

## Annual Technical Report
## 2019

## Products

Peer-reviewed publications

1. Ziedman A. Rodriguez O.M., Moon J., Bandala E.R. 2020. Removal of antibiotics in aqueous phase using silica-based immobilized nanomaterials: A review. Environmental Technology & Innovation 20, 101030.
2. Clurman, A.M., Rodriguez-Narvaez O.M., Jayarathne A., De Silva G., Ranasinghe M.I., Goonetilleke A., Bandala E.R. 2020 Influence of surface hydrophobicity/hydrophilicity of biochar on the removal of emerging contaminants. Chemical Engineering Journal 402, 126277.
3. Hong N., Goonetilleke A., Bandala E.R., Liu A. 2020. Assessing the effect of surface hydrophobicity/hydrophilicity on pollutant leaching potential of biochar in water treatment. Journal of Industrial and Engineering Chemistry 89, 222-232.
4. Mortazavian S., Bandala E.R., Bae J., Chun D., Moon J. 2020. Assessment of p-nitroso dimethylaniline (pNDA) suitability as a hydroxyl radical probe: Investigating bleaching mechanism using immobilized zero-valent iron nanoparticles. Chemical Engineering Journal 385, 123748.
5. Laney B., Rodriguez-Narvaez O.M., Apambire B., Bandala E.R. 2020. Water defluoridation using sequentially coupled Moringa oleifera seed extract and electrocoagulation. Groundwater Monitoring & Remediation 40(3), 67-74.
6. Ling Zhang, Fanjiang Zeng, Christopher McKay, Rafael Navarro-Gazalez, Henry Sun. Optimizing chiral nutrient use for practical life detection. Astrobiology, in revision.

Conference presentations

6. Clurman, A., Rodriguez O., Bandala E.R. Degradation of Antibiotics in Aqueous Phase using PMS Catalytic Decomposition with Zero-Valent Iron Nanoparticles Immobilized in SBA-15. 2020 NWRA Annual Conference, Las Vegas, NV February 11-13, 2020.
7. Zeidman A. Bandala E.R. Application of Peroxymonosulfate Decomposition with Heat-Treated Biochar for the Removal of Acetaminophen. 2020 NWRA Annual Conference, Las Vegas, NV February 11-13, 2020.

## Information Transfer Program

The project to evaluate the prevalence of antibiotic resistance genes has been reported by *NWRRI Newsletter* on July 1, 2019, Volume 5, Issue 3. A video documentary on water and sediment sampling from the Las Vegas Wash to identify antibiotic resistance genes has been made and



disseminated by DRI via Facebook, Instagram and YouTube in August 2019 (https://www.youtube.com/watch?v=0PfRxzM6GDs).

The project, Improving Wastewater Treatment Using Biofilms That Degrade Phenolic And Aromatic Contaminants, has a provisional patent applications have been initiated with the University of Nevada Las Vegas Intellectual Property Transfer Office to protect both novelties from this project, the bioreactor design and the bisphenol A degrading bacterium.

The quarterly newsletter disseminated each quarter of FY19 that spotlighted specific research projects, PIs, and students and are posted on the NWRRI website at https://www.dri.edu/nwrri/nwrri-news-and-reports/.

## Student Support

A total of 11 undergraduate students, 5 master's students and 1 high school student were supported by the annual base grant and/or matching funds.

## Notable Achievements and Awards

Ahdee Zeidman, 2nd Place in the 2020 NWRA Annual Conference, Graduate Student poster competition.
Adam Clurman, 2nd Place in the 2020 NWRA Annual Conference, Undergraduate Student poster competition.

# Degradation Of Emerging Contaminants In Treated Wastewater Using Immobilized Non-zero Valent Iron

**Project Type:** Annual Base Grant
**Project ID:** 2019NV167B

**Project Impact:**

The novel synthesized nano zero-valent iron immobilized on Santa Barbara-15 (nZVI/SBA-15) composite was tested as catalyst of peroxymonosulfate (PMS) decomposition for the degradation of different antibiotics. For example, the nZVI/SBA-15/PMS oxidation system was found highly efficient in the degradation of sulfamethoxazole (SMX). The best experimental conditions for SMX degradation were using 1g/L of nZVI/SBA-15 and 5mM of PMS which produced 90% SMX removal within the first 15 minutes of reaction. Results of experimental trials on tetracycline degradation using mild nZVI/SBA-15/PMS conditions showed a significant reduction on the biological effect of the treated effluents on bacterial communities in tests bioassays. In all the cases, kinetics studies suggest that the degradation process occurs within the first five minutes.

# Evaluation Of Antibiotic Resistance Genes (ARGS) In The Urban Wetland Exosystem: Las Vegas Wash

**Project Type:** Annual Base Grant
**Project ID:** 2019NV168B

**Project Impact:**

The study evaluated the prevalence of six antibiotic resistance genes (ARGs) corresponding to sulfamethoxazole (sul1 and sul2), ampicillin (ampC), tetracycline (tetO and tetW), and vancomycin (vanA) in the Las Vegas Wash. The results show that the gene copies of 16S rRNA and the target ARGs were much lower in the water and sediments collected in summer than winter, which may be due to greater water flow. Among the target ARGs, the most prevalent genes found were sul1, sul2, and vanA, and tetO and tetW were less detectable. For both water and sediments, the ARGs were found more prevalent in the upstream sites than the downstream sites. The results demonstrated that the prevalence of the target ARGs were affected by the sampling location and season. The results indicate that the Las Vegas Wash wetlands are an important reservoir of ARGs from receiving wastewater discharges, and ARG concentrations decrease before water flows into Lake Mead. The study also identified the antibiotic resistant bacteria in the sediments using heterotrophic plate count (HPC) method and PCR combined with Sanger Sequencing. The HPC resulted in 1.9 × 105 colony forming unit (CFU) per gram. The results showed that 54 antibiotic resistant isolates were obtained in the plates spiked with the target antibiotics, where 14 bacterial isolates were found resistant to ampicillin, 30 bacterial isolates were resistant to sulfamethoxazole, and 10 bacterial isolates were resistant to vancomycin. There were no tetracycline resistant bacteria present in the sample.

# Improving Wastewater Treatment Using Biofilms That Degrade Phenolic And Aromatic Contaminants

**Project Type:** Annual Base Grant
**Project ID:** 2019NV169B

**Project Impact:**

A novel bioreactor design for enriching bacteria from environmental samples for species that are capable of efficient degradation of aromatic contaminants was developed. Tests resulted in the recovery of a bacterium that uses bisphenol A, which is present in thermoplastics monomer, as the sole carbon and energy source. The bacterium is a super degrader of bisphenol A, capable of eliminating saturated levels of the compound in 2-3 days.