UNIVERSITY of HOUSTON

CULLEN COLLEGE of ENGINEERING

Department of Civil & Environmental Engineering

CIVE 6111 Graduate Seminar

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Development and Global Applications of Hybrid Ion Exchange Nanotechnology (HIX-Nano): From Decontamination to Desalination

Friday, November 3, 2017
2:45PM-3:45PM
Classroom Business Building (CBB) Room 122

Abstract

Zirconium, the 21st most abundant element in the world, is stable, chemically innocuous and non-hazardous. Nanoparticles of zirconium oxide (ZrO2) have unique sorption properties to bind a variety of trace contaminants including arsenic, fluoride, phosphate and lead. We have developed a process to disperse ZrO2 nanoparticles within the gel phase of an anion exchanger with quaternary ammonium functional group. The resulting hybrid ion exchanger, referred to as HIX-NanoZr, is a robust sorbent material that is also amenable to regeneration and reuse (1).

Although unknown nearly twenty five years ago, natural arsenic contamination of groundwater has emerged as a major global crisis affecting over fifty countries including the USA. Nearly 200 million people in Asia and Africa drink groundwater that contains toxic levels of fluoride and arsenic. Both HIX-NanoZr and HIX-NanoFe are now commercial materials and over two million people around the world drink arsenic- and fluoride-safe water through use of these sorbents.

Brackish water desalination plants are mostly located inland and must resort to expensive concentrate disposal methods like deep well injection or evaporation ponds. Increasing the recovery of RO process would obviously reduce the volume of concentrate to be disposed of but cannot be implemented due to scaling of sulfate (CaSO4, BaSO4, etc.) and silica (SiO2) resulting in fouling of RO membranes. We have developed a hybrid Ion Exchange-Reverse Osmosis (HIX-RO) process where tunable anion exchange resins can eliminate sulfate precipitation (2) and silica fouling without addition of external regenerants or anti-scaling chemicals. Results from the field experiments will be presented.

References:
1. SenGupta, A. K. (2017) "Ion Exchange in Environmental Processes." Wiley & Sons, Hoboken, New Jersey.
2. Smith, R.C. and SenGupta, A.K. "Integrating tunable anion exchange with reverse osmosis for enhanced recovery during inland brackish water desalination." Environ. Sci. Technol. (2015), 49, 5637-5644.

About the Speaker:

ARUP K. SENGUPTA is currently the P.C.Rossin professor of the department of civil and environmental engineering and the department of chemical engineering at Lehigh University in Pennsylvania, USA. He received his BS in chemical engineering in 1972 from Jadavpur University in Kolkata, India and PhD in environmental engineering in 1984 from the University of Houston, TX in the USA. SenGupta authored the book '*Ion Exchange in Environmental Processes*' by Wilie & Sons. SenGupta is the recipient of 11 US patents and his research in environmental processes and sustainable materials have received recognitions from national and international organizations: 2009 Astellas Foundation Award from the American Chemical Society (ACS), 2009 Lawrence K. Cecil Award from the American Institute of Chemical Engineers (AIChE), 2007 Grainger Challenge Award from the National Academy of Engineering and 2012 Intel Environmental Award for Technology Benefiting Humanity among others.

SenGupta co-founded three social enterprises to address global water related issues: Tagore-SenGupta Foundation (www.thetsfoundation.org); Technology with a Human Face (www.techhumanface.org) and DrinkWell (www.drinkwellsystems.com).