The Hydrogen-Based Membrane Biofilm Reactor for Reducing Oxidized Contaminants

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Venue: LG1/F - Lecture Theatre C, Chow Yei Ching Building,
The University of Hong Kong

Abstract
Among the most challenging water pollutants are those whose common characteristic is that they are chemically oxidized. They are the “other side of the coin” from biochemical oxygen demand (BOD), the conventional target of biological treatment. The "classic" oxidized pollutants are nitrate and nitrite, and emerging oxidized pollutants include perchlorate, selenate, chromate, chlorinated solvents, pesticides, and radionuclides. For all of the oxidized contaminants, microbiological reduction leads to innocuous products. For example, nitrate is reduced to harmless N₂ gas, while perchlorate is reduced to H₂O and Cl⁻ ion. A novel biological treatment process able to reduce all of the oxidized pollutants is the hydrogen-based Membrane Biofilm Reactor (MBfR). Hydrogen gas (H₂) is fed to the interior of hollow fiber membranes, diffuses through the membrane wall, and is then consumed by biofilm bacteria that use it as their electron-donor substrate while reducing one or more of the oxidized pollutants as their electron-acceptor substrate. Over the past 15 years, we have carried out extensive studies to evaluate the fundamentals and the application of the MBfR for reduction of nitrate, perchlorate, and the larger suite of oxidized contaminants. This presentation addresses the conceptual basis for the MBfR, advantages of using H₂, our vast experience reducing nitrate and perchlorate, our successes reducing other oxidized contaminants, and an update on the status of field testing and commercialization. It shows that delivering H₂ gas directly to the biofilm is technically and economically attractive, which now makes it realistic to remove from water the wide range of oxidized contaminants.

About the Speaker
Dr. Bruce E. Rittmann is Regents’ Professor of Environmental Engineering and Director of the Biodesign Swette Center for Environmental Biotechnology at Arizona State University. His research focuses on the science and engineering needed to “manage microbial communities to provide services to society.” Services include generating renewable energy, cleaning water and soil, and improving human health. Dr. Rittmann is a member of the National Academy of Engineering; a Fellow of AAAS, WEF, IWA, and NAI; and a Distinguished Member of ASCE. Dr. Rittmann was awarded the first Clarke Prize for Outstanding Achievements in Water Science and Technology from the NWRI, the Walter Huber Research Prize and the Simon Freese Award from ASCE, the G.M. Fair Award from AAEES, and the Perry L. McCarty/AEESP Founders Award. He is the co-winner of the 2018 Stockholm Water Prize. Dr. Rittmann has published over 670 journal articles, books, and book chapters, and he has 16 patents. With Dr. Perry McCarty, Dr. Rittmann co-authored the textbook Environmental Biotechnology: Principles and Applications (McGraw-Hill Book Co.).

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