

2017 Herb Ward Distinguished Lectureship in Environmental Science and Engineering Honors:



Michael Robert Hoffmann, NAE
Theodore Y. Wu Professor of Environmental Science
Caltech Division of Engineering and Applied Science

Fri., Mar. 3rd
2:00 – 3:00 PM

**Semiconductor Electrochemical Wastewater Treatment:
From a Design Concept To Full-Scale Manufacturing in Five Years**

Ryon Lab 201
Department of Civil & Environmental Engineering
Rice University
6100 Main Street, Building #70
Houston, TX 77005

ABSTRACT:

The Hoffman research group at Caltech developed self-contained and transportable reactor systems that have been designed for the onsite treatment of domestic wastewater. After pre-treatment with a sequential anaerobic/aerobic baffled bioreactor, the effluent is processed further by semiconductor electrochemical arrays in which the COD and microbial loads are reduced to below US EPA reuse standards. Smaller-scale electrochemical reactors are used to convert gray water and hand washing water back into near potable water for reuse. Treated black water is recycled into flush water reservoirs without discharge to the surrounding environment. Domestic human wastewater is clarified with elimination of suspended particles along with a >95% reduction in chemical oxygen demand (COD) and total elimination of viable fecal coliforms, E. coli, viruses, and total coliforms. Enteric organism disinfection is achieved for bacteria and viruses via anodic reactive chlorine generation from in situ chloride ion oxidation coupled with the cathodic reduction of water to form molecular hydrogen. Performance and durability improvement of core semi-

conductor anodes and materials modifications to reduce production costs is ongoing. Second- and third-generation prototypes are undergoing field-testing in locations lacking conventional urban infrastructure for wastewater discharge and treatment; the packaged treatment systems can operate without an external source of electricity or fresh water. Manufacturing and extensive field-testing in China and India is underway. Two Caltech-China joint-venture companies, Eco-San and Entrustech, have been established in Yixing, China to manufacture self-contained solar toilet units for the developing world and electrochemical reactor systems, while at the same time additional industrial collaborations have been established in India with ERAM Scientific and with the Kohler Company (USA/India) for production of units to be used in urban and peri-urban environments in India. At the current time, larger-scale units are being assembled for use in South Africa, Peru, Southern China, and Cambodia.

<http://hoffmann.caltech.edu/biography/>

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