PURDUE CENTER FOR GLOBAL FOOD SECURITY

PCGFS-I²D LAB SEED GRANT SEMINAR

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Solar Ultraviolet Disinfection of Water

Thursday, April 27, 2017
3:00 - 4:00 PM, MRGN 121

ABSTRACT: Access to safe, affordable water is a pressing problem in many developing countries. Technological solutions to this problem exist, but their implementation is complicated by social, cultural, economic, and political constraints that are different from those experienced in developed countries. Sustainable solutions to safe water supply in developing countries tend to share some common characteristics, including the use of locally-available resources, both human and natural. This presentation will provide a summary of past and ongoing research to examine the use of one such resource, solar radiation, to disinfect water.

Ultraviolet (UV) radiation is known to be effective for inactivation of microbial pathogens; however, relatively little work has been conducted to define the responses of microbial pathogens to ambient solar radiation. To address this issue, laboratory experiments were conducted to define the action spectra (i.e., wavelength dependence) of the inactivation responses of bacterial and protozoan microbes. When combined with information (both measured and simulated) to describe ambient solar spectral irradiance, it was then possible to quantify the spectral efficacy of ambient solar radiation against these microbes. Experiments have been conducted with two reactor types that accomplish continuous disinfection, as would be relevant in a community setting. These reactor systems involved either a compound parabolic collector (CPC) or a Fresnel lens to amplify ambient solar spectral irradiance. Both were effective for inactivation of waterborne microbes, but involved different levels of complexity. However, the CPC turns out to have relatively simple mechanical requirements, and as such appears to be the preferred option for "direct solar' UV disinfection. Another approach that has merit involves the collection of solar energy on solar panels, with storage on a nearby battery. In turn, this electrical energy is used to power a small-scale commercial UV disinfection reactor. Testing of these "indirect solar" reactors has demonstrated their ability to disinfect large volumes of water with low electrical power requirement.

A life-cycle assessment was developed to allow comparisons of the overall impacts of direct and indirect solar UV disinfection. The results of this LCA indicated that the direct system is generally favored in small-scale applications, such as would be appropriate for a small cluster of houses. The indirect solar UV systems are better suited to larger-scale applications, such as the development of community-scale water supplies. An ongoing study is being conducted to examine the use of indirect reactors in several communities in western Kenya.

Dr. Ernest R. Blatchley III is a Professor with a joint appointment in the Lyles School of Civil Engineering and the Division of Environmental & Ecological Engineering. He teaches and conducts research in the general area of physico/chemical processes of Environmental Engineering. The focus of his research is in disinfection and advanced oxidation processes, especially those that involve the use of UV radiation, chlorine, or both.

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