2010-11 TWRI Mills Scholarship Application

1. Name: Jasjeet Kaur

2. Contact Information:

3. Name and contact information for Faculty Advisor:

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4. Description of the student's proposed research:

Removal of Waterborne Pathogens using Advanced Photocatalytic Processes

Bacteria are the leading cause of impairment of surface waters, including rivers, lakes, and streams in the U.S. (USEPA, 2008). Rural Texas streams are increasingly being identified as bacterially impaired and are being placed on the Texas Water Quality Inventory and 303(d) List. As of January 2007, 197 water bodies in the State of Texas were impaired because they did not meet the bacteria concentration criteria established by the state to protect contact recreation use. Fecal contamination of a water body is commonly determined by detecting the presence of indicator organisms. *E. coli* is used as an indicator organism to identify fecal contamination of water bodies. Presence of indicator organisms suggests occurrence of pathogenic strains of the bacteria, protozoa, virus, and fungi. High levels of waterborne pathogens in water bodies may cause severe illness when humans get in close contact or ingest contaminated water.

Several treatment processes including chlorination, ozonation, and UV, solar, and photocatalytic disinfection have been applied to remove or inactivate waterborne pathogenic microorganisms. Residual amount of chlorine in the water after chlorination prevents the re-growth of microorganisms which enables its wide application. But, the by-products from the chlorine treatment may result in potential carcinogens (Galvez et al., 2007). Ozone is highly reactive but very unstable in water. Moreover, ozonation is an expensive process. Disinfection using high-energy UV radiation distorts thymine bases present in microbial DNA. This hinders the DNA replication resulting in inactivation of the microorganisms. However, bacteria have shown a tendency for photo-reactivation or dark repair mechanism to repair disrupted thymine bases. This reactivation seems to be highly significant in natural waters after the wastewater effluents are discharged (Lindenauer and Darby, 1994; Quek and Hu, 2008).

Advanced photocatalytic processes generate highly reactive species in water, which enables the mineralization of cellular organic compounds (Galvez et al., 2007). Titanium dioxide (TiO_2) is the most widely studied photocatalyst in water disinfection (Theron et al., 2008). I plan to conduct lab-scale research to study the reactivation potentials of heterotrophic wastewater bacteria and *E. coli* in treated effluents resulting from a wastewater treatment plant (WWTP) in College Station, TX. Reactivation studies will be conducted with and without TiO_2 to study the effect of TiO_2 on photo repair of bacteria. It is hypothesized that the presence of TiO_2 will decrease the rate of photoreactivation in the WWTP effluent. The results from the study would be beneficial in lowering the bacterial loading from the WWTP effluent, which would lower the health risks associated with waterborne pathogens. Ultimately, this would help in reducing the number of impaired streams due to bacteria in the State of Texas.

References:

Galvez, J. B., Ibanez, P. F., and S. M. Rodriguez. 2007. Solar photocatalytic detoxification and disinfection of water: recent overview. *Transactions of ASME*, 129, 4-14.

Lindenauer, K. G. and J. L. Darby. 1994. Ultraviolet disinfection of wastewater: effect of dose on subsequent photoreactivation. *Water Research*, 28(4), 805-817.

Quek, P. H. and J. Hu. 2008. Indicators for photoreactivation and dark repair studies following ultraviolet disinfection. *J Ind Microbiol Biotechnol*, 35: 533-541.

USEPA. 2008. Causes of impairment for 303(d) listed waters. Washington, D.C. U.S. Environmental Protection Agency.

Theron, J., Walker, J. A., and T. E. Cloete. 2008. Nanotechnology and water treatment: applications and emerging opportunities. *Critical reviews in Microbiology*, 34: 43-69.

5. Academic qualifications:

Ph.D. Biological and Agricultural Engineering, Texas A&M University, College Station, TX; GPA:

M.S. Agricultural Engineering, Iowa State University, Ames, IA.; GPA:

B.S. Agricultural Engineering, Punjab Agricultural University, India.; GPA:

Objective Tests: GRE:; TOEFL:
List of Relevant Courses: Environmental Microbiology, Environmental Engineering Processes II, Water Quality Engineering, Special topics in Engineering Microbial processes, Introduction to Environmental Engineering, Hydrology, Biochemical Engineering, GIS & Natural Resource Management
Awards & Activities: Gold Medalist (Punjab Agricultural University); Winner of Running Trophy for Best Academic Performance for three years (Punjab Agricultural University); Student Member (2009 – till date) American Society for Agricultural and Biological Engineering.

6. Proposed use of funds resulting from this scholarship: I plan to use the funds for publishing my research work and presenting results at a national/international conference related to water research.

7. Intended career path the student anticipates pursuing: I intend to pursue a research career related to water quality engineering. I would like to join either a nonprofit organization or academia to contribute my research knowledge in solving issues related to drinking and wastewater treatment.