For participation in USF's NSF-IRES team visiting UNESCO-IHE-Institute of Water Education, Delft, The Netherlands, Summer 2009	Statement of Purpose	Dipesh K. Dey Ph.D. Student Dept. of Civil & Env. Engg. University of South Florida

Career and Educational Plans

I completed 4 years of Bachelor's degree in Civil Engineering from Jadavpur University, Kolkata, India; followed by 2 years of Master's degree in Environmental Engineering & Management from Indian Institute of Technology Kanpur, India, before joining Ph.D. position in the Dept. of Civil & Environmental Engineering at University of South Florida. I work under the supervision of Dr. Jeffrey A. Cunningham and Dr. Daniel H. Yeh at USF.

My immediate educational plans are - to complete Ph.D. in Environmental Engineering, which I expect will help me accomplish a competent research aptitude that will be further refined by Post-doctoral research later. My career plans are to become a faculty in a University or a Research Institute and finally have a shining career as an environmental researcher who can add necessary scientific knowledge.

Research Experience

My Master's research was in the field of Microbial Ecology. The overall objective was to develop a tool to determine community structure via deconvolution of PLFA-FAME signature of mixed population (*Dey & Guha, 2007, Biotechnology & Bioengineering, 96(3): 409-420*). The long-term goal of the research was to develop an easy-to-use tool to routinely monitor the structure of microbial community in waste treatment bioreactors. It was hypothesized that monitoring microbial ecology may help indicate crucial stages of reactor performance as well as impending failure. The tool developed however is general in the sense that, apart from biological waste treatment, it can be utilized in research on bioremediation of soil and groundwater, studying microbial biodiversity in various ecosystems and help solving selective laboratory-culture-dependent issues in Biomedical Engineering.

The research consisted of an experimental part and two computational parts. The experimental part developed an experimental protocol to extract Phospho-Lipid Fatty Acids (PLFA) from bacterial cell walls, derivatize it to Fatty Acid Methyl Esters (FAME) that upon analysis by GC-FID/MS give biomarker FAME-signature of a particular species or a mixed population. The FAME signature of a mixed population being a convoluted mixture of FAME-signatures of all the component species, a tool was needed to resolve the mixed population signature and reveal the underlying FAME-signatures of all the individual species. Also the tool needed to be able to quantitatively report the percentage presence of each species in the mixture.

This tool was developed in the form of two "C" programming language codes to solve two cases – (i) when the FAME-signatures of each individual species were well known beforehand (from literature or from self-developed library of signatures obtained from pure cultures); in this case the code was based on Least Square Approximation (LSA) solving an over-determined equation system; and reported the relative presence of each species; (ii) when the signatures of individual species were not known and only the FAME-signature of the mixed population could be obtained; in this case another computer code was developed using concepts of Blind Source Separation via Independent Component Analysis (BSS-ICA) by optimizing the non-gaussianity of the mixed-population's FAME-signature data; this finally revealed the unknown FAME-signatures of all the component species and reported their percentage presence in the mixed population as well.

Time requirement per sample for the entire analysis should ideally be 1 hr to 3 hrs; the longest part being experimental determination of the FAME-signature, which fed into the codes, can reveal the microbial-ecology related condition of the concerned bioreactor at the time of sampling. The tools were to be tested with the microbial community in lab-scale followed by pilot-scale Upward Sludge Blanket Reactors (UASB) that were being optimized to better treat low-COD sewage using polymer additives. However, this testing part could not be completed by me, before I graduated. The project was funded by Swedish International Development Agency (SIDA) under the auspices of Asian Regional Research Program on Environmental Technology (AARPET) coordinated by Asian Institute of Technology (AIT), Bangkok.

After completion of 2 years of Master's, I stayed in the research project working as a Senior Research Associate for another 2 years. The 4 years there gave me opportunity to be a member of an international research team consisting of countries Sri Lanka, Thailand, Indonesia, Philippines, Vietnam, Malaysia and India, besides learning analytical instruments – mainly Gas Chromatography-Electron Capture Detector/Flame Ionization Detector/Mass Spectrometer (CD/FID/MS); and secondarily, Thin Layer Chromatography (TLC), Ion Chromatography (IC), High Pressure Liquid Chromatography (HPLC) and Atomic Absorption Spectroscopy (AAS) in order of familiarity.

Why Interested in IHE-IRES Program

I am interested because of the close proximity between the area of interest of my prospective IHE-mentor Dr. Gary Amy and my Ph.D. research area.

Dr. Amy is a leading researcher investigating Soil Aquifer Treatment (SAT) and River Bank Filtration (RBF) processes at Delft. Fate and transport of micro-constituents in these two processes are of great importance and interest due to water pollution, public health related issues and issues related to attempts of solving water scarcity problems by encouraging reuse.

The general question my research is trying to answer is how does the chemistry of a complex mixture (reclaimed water) affect the fate and transport of trace organic contaminants in the mixture, when the mixture is disposed off into the natural environment (terrestrial or aquatic). To be more precise, the overall objective is to examine how complex, ill-defined, organic, wastewater derived macro-molecules affect the sorption of the trace micro-constituents (mainly endocrine disrupting compounds); to characterize the sorptive competition amongst trace organics in terms of degree of competition, competition threshold etc.; and to find out the influence of effluent organic matter on the sorption and the sorptive competition. To do this, a necessary knowledge to have would probably be how to characterize the complex dissolved organic carbon (DOC) matrix present in the treated effluent and reclaimed water.

The two-story tall column reactors that the research team of Dr. Amy has built can give me an excellent opportunity to understand the RBF process more closely. The nifty set-up of Size Exclusion Chromatography (SEC) in tandem with UV/Fluorescence/DOC detectors offers an important technique to gain much insight on the size and structure of the effluent organic matter. Dr. Amy's field project on SAT gives me a chance to connect laboratory findings with field applications.

Also, a few more important aspects that appeal to me are – the benefit of being able to see the waste handling practices and infrastructure in The Netherlands; the experience gained via being part of a cutting-edge research team at globally important UNESCO; and, last but not the least, seeing a new country.

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