Texas Water Resources Institute: Mills Scholarship Program (2010-2011)

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4. **Research Description** :

Alkylphenols, present in soaps and detergents, are common wastewater contaminants. Presence of alkylphenols in treated wastewater effluents is of concern because of their ability to "interfere with natural hormones that are responsible for the maintenance of homeostasis, reproduction, development, and/or behavior" in exposed aquatic organisms. The ambient water quality criteria for nonylphenol published in 2006 established 28 μg/L and 6.6 μg/L as the no observed adverse effect level for acute and chronic aquatic toxicity, respectively. Because nonylphenol and other alklyphenols are commonly present in treated wastewater effluent at levels approaching or exceeding the ambient water quality criteria for nonylphenol, research exploring technologies used to remove alklyphenols from wastewater effluents used in reuse applications is of interest for utilities and public stakeholders in Texas.

Removing alklyphenols from effluents used in wastewater reuse by oxidation with manganese oxide (MnO_2) to oxidize is an exciting area of research that has yet to be explored. The primary goals of this research are to understand the degradation pathway for alkylphenols in the presence of MnO_2 and to develop a hybrid MnO_2-geopolymer membrane system for future scale up applications. The following two primary objectives will achieve the research goals:

<u>Objective 1: Determine the mechanism for alkylphenols removal in the presence of MnO_2 and the factors affecting its efficiency</u>

This objective is important because the resulting data will address current gaps in the literature and establish factors effecting the application of MnO_2 as an oxidant in reuse treatment technologies. To achieve this objective, the removal efficacy of alkylphenols by oxidation using MnO_2 will be determined. The order with respect to alkylphenol loading, MnO_2 concentration, and pH will be determined in subsequent experiments. The efficacy of removal will then be evaluated in the presence of co-solutes (Zn^{2+},Cu^{2+},Fe^{3+},Mn^{2+}) and organic matter (humic and tannic acid). Alkylphenols and their degradation products will be analyzed using gas chromatography mass spectrometry. Based on the resulting data, a reaction pathway will be proposed.

Objective 2: Develop a hybrid MnO_2-geopolymer membrane for alkylphenol removal

This objective is important because a basic understanding concerning how to create a hybrid MnO_2-geopolymer membrane is currently undetermined. The hybrid membrane will be prepared and characterized using a scanning electron microscope equipped with energy dispersive spectroscopy to determine the presence of MnO_2 in and on the membrane. The BET surface area will also be measured. The hybrid MnO_2-geopolymer membrane will be washed with aqueous solutions to determine the stability of the MnO_2 on the hybrid membrane surface as a function of pH and time. This hybrid system will then be evaluated for alkylphenol removal.

The outcome of this research will provide knowledge concerning the ability of manganese oxide based systems to reduce the overall alkylphenol content of wastewaters. The resulting knowledge will educate public stakeholders across the State of Texas. Findings from the tasks carried out for Objectives 1 and 2 will be disseminated to the scientific community through peer-reviewed papers.

5. Academic Qualification:

Ph.D	Civil Engineering (Environmental), Texas A&M Univ, **GPA-**	**Expected Aug' 12**
M.S.	Civil Engineering (Environmental), Texas A&M Univ **GPA-**	**Aug' 09**
B.Tech.	Chemical Engineering, National Institute of Tech (NIT), Surat **GPA-**	**May' 07**

GRE Scores:

Courses Taken:

Course Name	**Grade**	**Course Name**	**Grade**
ENVIRON ENGG PROCESSES I		RENEWABLE ENERGY	
ENVIRON ENGG PROCESSES II		ENVIRONMENTAL MEASUREMENTS (CVEN)	
ENVIRON ENGG PROCESSES III		ENVIRONMENTAL GEOCHEMISTRY	
ENVIRON ENGINEERING MGMT		SUSTAINABILITY&OPTIMIZATION	
ENVIRON RISK ASSESSMENT		PROCESS SAFETY	
STATISTICAL ANALYSIS		LEADERSHIP & MGMNT OF E-NGO	
ENVIRON REMEDIATION		ENVIRONMENTAL MEASUREMENTS (SRPH)	

6. Proposed Use of funds:

Funds available from the Mills Scholarship Program will be used to pay tuition and fees. A portion of the funds will also be used to purchase laboratory consumables.

7. Intended Career Path:

I want to continue enjoying research. After finishing my doctoral degree I dream of joining an R&D company in the near future. I also want to devote time teaching high school students to prepare them for a career in Engineering & Science. Additionally, I want to continue participating in service oriented programs.