BIOREMEDIATION OF PCB CONTAMINATED SURFACE SOIL - A MICROCOSM STUDY

by

Swati Das

Thesis submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Master of Science

in

Crop and Soil Environmental Sciences

Duane F. Berry, Chairperson
Nancy G. Love
Lucian W. Zelazny

February 12, 1998
Blacksburg, Virginia

Keywords: PCBs, Bioremediation, Methanogenic consortium, Contaminated soil

BIOREMEDIATION OF PCB CONTAMINATED SURFACE SOIL – A MICROCOSM STUDY

by

Swati Das
Committee Chairperson: Duane F. Berry
Crop and Soil Environmental Sciences

(ABSTRACT)

This feasibility study was performed at Virginia Polytechnic Institute and State University (Blacksburg, VA) in collaboration with BioSystems Technology, Inc. (Blacksburg, VA). In this study, degradability of PCBs (Aroclor 1242) from an aged surface soil was evaluated using serum bottle microcosms containing aceticlastic methanogenic consortium, enriched from a municipal anaerobic digester. Two different experiments, "intermediate feed" and "starve and feed" were conducted by manipulating the methanogenic consortium with different amounts of acetate feeding, during 30 days of incubation. Disappearance of Aroclor 1242 in the microcosms was quantified using gas chromatography (GC). Significant differences in Aroclor 1242 removal between inoculated and uninoculated (control) microcosms were observed suggesting that the methanogenic consortium was responsible for Aroclor 1242 disappearance. However, GC-mass spectrometry (GC-MS) results could not confirm that disappearance of Aroclor 1242 was due to anaerobic dehalogenation. From another experiment, it was confirmed that removal of Aroclor 1242 was not due to evaporation losses during sample extraction.

Toxicity of an aged Aroclor 1242 contaminated surface soil was evaluated on an aceticlastic methanogenic consortium, enriched from a municipal anaerobic digester. Microcosms were set up using different amounts of soil and inoculum. Total gas production in the microcosms was monitored during 30 days of incubation, using a glass syringe. Total methane production in the microcosms was quantitated using GC. Toxicity of the soil on the methanogenic inoculum was determined based on the decreased rate of methane production in the microcosms relative to non-

soil containing controls. Compared to the control, there was reduction in total methane production in soil containing microcosms. Between 3-27% reduction in total methane production was noticed in microcosms containing different amounts of soil and consortium. Reduction in methane production seemed to increase with increasing amount of soil. Whether this decrease in methane production was due to toxicity of Aroclor 1242 on the methanogenic consortium or due possibly to the toxicity of trapped oxygen in the soil could not be determined. The rate of gas production in the soil microcosm was linear.

DEDICATION

I would like to dedicate this thesis to my husband and best friend, Prakriti K. Das. Without his love, understanding, encouragement, and support, none of this would have been possible. His neverending support and love have given me the desire and momentum to complete my degree. I will always appreciate his unfailing faith and understanding in me, despite having to leave apart for the past two years. Finally, we realize that our personal sacrifices were well worth.

ACKNOWLEDGMENTS

I wish to express my true appreciation to my advisor Dr. Duane F. Berry for his guidance, help, support, and encouragement during the course of my studies and research. His guidance helped me in realizing my goals.

I would like to thank my committee members Dr. Nancy G. Love and Dr. Lucian W. Zelazny for their ideas, contributions, and support.

I would like to thank BioSystems Technology, Inc. (Blacksburg, VA) for providing financial support for this research. A special thanks to Dr. Ronald H. Taraban for his help with the equipment operation, and his input into the research.

I wish to thank Hubert Walker Jr. for all his assistance in the laboratory. Also, I like to extend my thanks to the staff of the Pesticide laboratory at Virginia Tech (under the supervision of Dr. R. Y. Young) for their help with the operation of the GC-MS in their laboratory.

Last but definitely not least, a special thank goes to my husband Prakriti, my entire family and friends for their understanding and support during the pursuit of my degree.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES