Ain-Shams University
Faculty of Engineering
Department of Structure Engineering

UTILIZATION OF CLAY AND GEOMEMBRANE LINING IN LANDFILLS

By
FADY MOHAMED BADRAN MOHAMED
B.Sc. in Civil Engineering (Hon.) (2004)

A Thesis
Submitted in Partial Fulfillment of the Requirements of the Degree of
Master of Science in Civil Engineering (Structural Engineering)

Under the supervision of:

Prof. Dr. Mona Mustafa Eid

Professor of Geotechnical & Foundation Eng.
Faculty of Engineering – Ain-Shams University

Dr. Mohamed Taha Abdel Rahman

Assistant professor of Geotechnical & Foundation Eng.- Faculty of Engineering – Ain-Shams University

April – 2008
Cairo – Egypt

ABSTRACT OF M.SC. THESIS

Title : UTILIZATION OF CLAY AND GEOMEMBRANE LINING IN LANDFILLS

Submitted by : Fady Mohamed Badran Mohamed

Supervisors : Prof. Dr. Mona Mustafa Eid   Dr. Mohamed Taha

ABSTRACT

Landfills are different to dumps or tips, which are what most people think of when they hear about landfills, because they are carefully constructed with special lining and covering systems to contain the waste. The aim is to avoid any hydraulic [water-related] connection between the wastes and the surrounding environment, particularly groundwater. Traditionally, these liner systems are composite of compacted clayey soil and a synthetic membrane. However, In Egypt most of the engineered landfills are having a single liner system consisting from geomembrane (HDPE) sheets. For that purpose, part of this study investigates the effect of imperfections of the HDPE sheets on the overall permeability of the composite liner to emphasize the importance of the secondary liner in the prevention of the ground water table contamination.

Engineering specifications for a compacted clay liner are based mainly in a permeability coefficient less than 10^{-7}cm/s and the need for stability during construction and operation of the landfill.

Sand-bentonite mixtures are often used as a barrier material when there is a lack of naturally occurring clayey soils at the landfill site. The addition of relatively small amounts of bentonite (5-15%) can improve the performance of a granular material providing both a low permeability and an enhanced mechanical stability. In addition, bentonites, obtained in dry, powdered forms, are much easier to blend with onsite sandy soils and to be compacted than wet, sticky clods of clay.

The central part of the experimental program focused on the detailed investigation of the permeability coefficient of the sand-bentonite mixtures. The factors affecting it such as the bentonite content and the vertical stress are studied. The impact of real municipal solid waste leachate on the liner permeability is also investigated.

Volume change after inundation is also investigated taking into consideration the effect of the bentonite content and the type of the permeating fluid

The results are presented and analyzed. These results are implemented to elaborate a frame work to the liner design procedure. Recommendations for future researches are made.

Keywords: *MSW Landfills, Sand-bentonite mixtures, Natural Clay liner, Geomembrane, MSW Leachate, Coefficient of Permeability, Composite Liner.*

INFORMATION ABOUT THE RESEARCHER

Name	:	Fady Mohamed Badran Mohamed
Date of Birth	:	June. 1, 1982
Place of Birth	:	Cairo, Egypt.
Qualifications	:	B. Sc. Degree in Civil Engineering (Structural Eng.) Faculty of Engineering, Ain- Shams University-Hon. (2004)- Distinction with honor degree.
Present Job	:	Teaching Assistant in Structural Engineering Department (Geotechnical group), Faculty of Engineering, Ain- Shams University

EXAMINING COMMITTEE

Name and Affiliation	Signature
Prof.Dr. Abdel Fattah Abdel Kader Youssef Prof. of Geotechnical & Foundation Engineering Monufia University	....
Prof.Dr. Ezzat Abdel Fattah Emera Prof. of Geotechnical & Foundation Engineering Ain-Shams University	....
Prof. Dr. Mona Mustafa Eid Prof. of Geotechnical & Foundation Engineering Ain-Shams University	....

DATE: 10 / 04 / 2008

STATEMENT

This dissertation is submitted to Ain-Shams University for the degree of Master of Science in Civil Engineering (Structural Engineering).

The work included in this thesis has been carried out by the author in the Department of Structural Engineering, Ain-Shams University, from 2006 to 2008.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

Date : 10 / 04 / 2008

Name : FADY MOHAMED BADRAN MOHAMED

Signature : *Fadymbadra*

ACKNOWLEDGMENTS

First of all I want to thank Allah who guided me and helped me to finish this work in a proper shape.

I would like to thank Dr. Mohamed Taha for getting me into the Geo-environmental engineering field, and providing a relaxed and positive working environment. Your Help made this thesis what it is. Special thanks also go to Prof. Mona Eid for her support and parental attitude. Her continuous discussions and suggestions are really appreciated. I would like to thank also Prof. Fathallah El-Nahas for his complete support. His help, guidance and enthusiasm are gratefully acknowledged.

I would like to thank AMA Arab Environmental Company especially the Engineering Department for keeping me in touch with what was going on at the landfills. Thanks also go to FCC Company for supplying me with the factual Leachate giving this work reliability and practical applications. I would like also to thank Dr. Gamal Abdel El Nasser for giving me a complete chemical analysis for the leachate used in this study for free.

My thanks are extended to all the staff members of Geotechnical group in Ain Shams University. Also I would like to thank all the technicians in the laboratory of Soil Mechanics for their help in the laboratory testing and their guidance.

I would like to thank my parents, my brother, my grandfather and all of my family for supporting me throughout my education, especially in college.

Fady Mohamed Badran
Cairo-2008

TABLE OF CONTENTS

LIST OF FIGURES