COMPOSITE PIPES IN THE OIL AND GAS INDUSTRY

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

CHAPTER ONE

1 Introduction

Composites have been in use long before it was given its name. Historical accounts show that before modern applications of composites, man has applied innovative ways of using composite materials. Israelites before Christ understood that clay, reinforced with straw could be used in constructing buildings and structures which have lasted; some even to this present day. Other major examples include the invention of writing materials from the papyrus plant (4000 B.C.),[1] the use of the use of bamboo shoots as reinforcements in mud walls, glued laminated wood by Egyptians (1500B.C.), as well as laminated metals in forging swords (A.D. 1800).[2].

Continuous research and innovation in the last few decades have given rise to improved applications of composites - even in our everyday lives. As early as the 20th century, modern composites were used. In the 1930's, an example of such modern composites, developed by reinforcing resins using glass fibers, were used in building boats. Another application of these composites, commonly known as *–glass fibers"* is in the construction of aircrafts.

The last 100 years in particular has seen an upsurge in the research, development, and increased use of composites [3]. Applications of composites can be seen ranging from large complex structures such as airplanes, buildings, automotive, to small household appliances.

Fiberglass composites have been used in the petroleum industry for transportation of natural gas for a long time. However, they have not been used in high volume high-pressure natural gas transmission applications in any significant way. There are a number of different resins and fiber reinforcement materials used in composite pipes manufactured today. Glass fiber is the most prevalent reinforcement material, used in over 90% of all resin/filament wound composites manufactured today [4].

Regardless of the advances in composite pipe usage, there are a couple of limitations involved. These range from design, production and a lack of enough test data. Different methods in strengthening the mechanical properties of high performance composite materials have been employed so as to replace conventional steel pipes in usage today. Glass fibers

have proven to be structurally dependable and have a balance between costs and performance and are increasingly employed in the oil and gas industry [5].

1.1 Aims and Objectives

Pipework is one of the most successful application areas for composites in oil and gas industry and have been used for low and high pressure applications with a wide variety of fluids. However the industry has a lack of knowledge on composites behaviour under different temperatures, types of loading and influence of the chemicals on their mechanical properties.

This project is aimed at

- Familiarising with the composite pipes used in oil and gas industry;
- A literature review on composite pipes design and production; and
- Mechanical testing of composite pipes using Instron Machine.

1.2 Scope of project

This report will cover the definition of composites in general, while underlining its structural applications. It will address composite classifications, understanding the strengths and limitations. Composite types will be discussed with emphasis on structural applications in the oil and gas industry. Composite pipe design and manufacturing will be discussed and modelling of pipe structures. Joining methodology of pipes and test methods will be addressed. Finally, mechanical testing of composites will be conducted to analyse the behaviour of a composite pipe. However, mechanical testing will be limited to compression and bending tests conducted on a thin-walled carbon fiber reinforced plastic pipe.