

UNIVERSITI TEKNOLOGI MARA

**THERMAL STRESS ANALYSIS ON
NON-METAL PIPE**

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ABSTRACT

The scope of this study is to find out the performance of non-metal pipe, namely Polyether Ether Ketone (PEEK) in high pressure and high temperature (HPHT) condition compared to normal steel pipe. The research is complete by applying thermal stress analysis. Thermal stress analysis consists of thermal and stress studies which is to investigate the temperature and stress distribution. The Fluid Structure Interaction (FLUENT) revealed that final temperature at steel pipe due to temperature distribution from internal fluid is higher than Polyether Ether Ketone which is 356.62 K compared to 301.26 K. The temperature is after pass through the material wall. Means that Polyether Ether Ketone sustain better temperature than steel. Equivalent strain and Equivalent Stress shows that Polyether Ether Ketone deals lower pressure than steel. The dimension changes after exerted by 15,000 psi pressure for steel is higher than Polyether Ether Ketone. In other words, Polyether Ether Ketone withstand low pressure compared to steel with the same input. Thus, Polyether Ether Ketone was preferable to be used in HPHT condition.

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TABLE OF CONTENT

	Page
PLAGIARISM FORM	i
AUTHOR’S DECLARATION	ii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENT	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF NOMENCLATURE	xii
 CHAPTER ONE	 1
1.1 Research Background	1
1.2 Problem Statement	2
1.3 Research Objective	2
1.4 Scope of Works	2
 CHAPTER TWO	 4
2.1 Introduction	4
2.2 The Effect of High Pressure and High Temperature	4
2.2.1 Corrosion	5
2.2.2 Corrosion Mitigation	7
2.2.3 The Effect of HPHT on Corrosion Inhibition for Water-Based Drilling Fluids	8
2.2.4 Bourdon Effect	9
2.3 Analysis Parameter	10
2.3.1 Pipe Material	10
2.3.2 Ambient Condition	13
2.3.4 Reinforced Thermoplastic (RTP)	15
2.4 Computational Fluid Dynamic (CFD) Analysis	16
2.4.1 Thermal Analysis	17

CHAPTER ONE

INTRODUCTION

1.1 Research Background

Subsea engineering is arguably one of the most important yet technically difficult aspect of the offshore petroleum industry. The increasing demand of composite material in piping system can be seen throughout the years. With the evolution in technology and research, a new system can be created to adapt with several bad condition. Manufacturing of pipe system nowadays, utilizing non-metal pipe for subsea production. Material such as Glass Fibre Reinforced Plastic (GRP) and Reinforced Thermoplastic (RTP) are used for the piping material (Meruva, Patel, Gonzalez, & Cridland, 2016).

Thermal stress analysis is an important subset of general finite element analysis (FEA) modelling. The temperature distribution for a model can be analyse by using Computational Fluid Dynamic (CFD) technique. Nowadays, there are many types of software that are used for CFD ranging from educational purpose until industrial use. Although many types of CFD are available, the base function is still the same which is to determine the temperature and pressure distribution. Why this is important? For industry purpose, the analysis can result in boost of the equipment quality and reduce the cost for the maintenance. Throughout the analysis, one can determine how much pressure and temperature that been exerted upon the object, thus can come out with solution such that a material that can resist kind of temperature and pressure. Spontaneously, as the quality of material meet the requirement of the surrounding condition, the cost of maintenance can be avoided.

In this study, thermal stress analysis will be done onto non-metal pipe at the high pressure high temperature (HPHT) condition such as deep subsea. High hydrostatic pressure and high temperature in subsea is very extreme for a metal pipe to handle and quite expensive, thus an idea comes out to use non-metal material for this condition. The use of non-metal pipe for HPHT condition is popular among the engineers because of the resistance that is provided by the material itself.