

# CHAPTER I

## INTRODUCTION

### 1.1. Background

Well cementing is the process of placing a cement slurry in the annulus space between the well casing and the geological formations surrounding the well bore in order to provide zonal isolation in oil, gas, and water wells (Shahriar, 2011). The goal is to exclude fluids such as water or gas to move from one zone to another zone in the well. Incomplete zonal isolation and/or a weak hydraulic seal between the casing and the cement and between the cement and the formations, may cause oil spills and the well may never run at its full producing potential (Calvert, 2006). The appropriate cement slurry design for well cementing is a function of various parameters, those are physical and chemical characteristic. Both physical and chemical characteristic of oil well cement (OWC) slurries must be optimized to achieve an effective well cementing operation.

Over the last few decades, several types of new chemical admixtures such as super plasticizers, retarders, expanders, viscosity modifying admixtures, etc. have been introduced to optimize the physical and chemical characteristic of oil well cement (Shahriar, 2011). For example, by calcium carbonate as an additive for the cement slurry, it will change the mechanical properties of the cement compare to the ordinary portland cement without additive. Properties that changing are shear bond strength (from 2.16 MPa to 13.07 MPa), and compressive strength (from 24.69 MPa to 19.36 MPa). It can be concluded that the calcium carbonate will

improve the shear bond strength but in other hand it will reduce the compressive strength of the cement (Paramatya, 2014). There is also another additive that can improve the mechanical properties of cement, and that is silica fume. By adding silica fume to the cement slurry, it will improve the compressive strength (from 28.61 MPa to 31.64 MPa). It can be concluded that the silica fume can be used as an additive to improve the compressive strength of the cement (Souza et al., 2012).

In this research, the author tries to find the best composition of the cement and the additive in order to improve the shear bond strength and the compressive strength of the oil well cement by using the combination of calcium carbonate and silica fume as the additive. Calcium carbonate and silica fume can both be used as the additive to improve the physical properties of the oil well cement slurries when it is hardened. The calcium carbonate will increase the shear bond strength of the cement, but it also will reduce the compressive strength. Therefore, the silica fume can also be added in order to improve the compressive strength of the oil well cement.

## **1.2. Problem Statement**

Based on the background the problem statement are:

1. What is the effect the combination of calcium carbonate and silica fume as the additive of oil well cement?
2. How many percent by weight of cement (BWOC) of calcium carbonate and silica fume that will be used to increase both compressive strength and shear bond strength of oil well cement?

## **1.3. Limitations**

In order to make this research focused in the main problem, several limitations must be followed:

1. This research is only focused on the physical characteristic of the oil well cement with the calcium carbonate and silica fume as the additive
2. The test that will be done are compressive strength and shear bond strength
3. The size of specimens are 75 mm x 150 mm for compressive strength and 25.4 mm x 50.8 mm (1 inch x 2 inch) for shear bond strength
4. The percentage of calcium carbonate and silica fume that will be tested are 0% calcium carbonate (CC) + 0% silica fume (SS), 5% CC + 5% SF, 10% CC + 10% SF, 15% CC + 15% SF, 20% CC + 20% SF
5. This research will not discuss about the economic aspect of the oil well cement with the calcium carbonate and silica fume as the additive

#### **1.4. Objectives**

1. To describe the effect of calcium carbonate and silica fume to the shear bond strength and the compressive strength of the oil well cement
2. To find the optimum composition of oil well cement with the combination of calcium carbonate and silica fume as the additive to improve shear bond strength and compressive strength

#### **1.5 Final Project Originality**

There are some research about additive of oil well cement to improve the physical characteristic of oil well cement that has been conducted, but the research about the usage of both calcium carbonate and silica fume as the additive of oil well cement has never been conducted before.