CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Cement concrete is generally used as a construction material in the worldwide. Concrete is a mixing of cement and aggregates likes fine and course aggregates. All these materials are building up by specific mixing rate as established. Cement concrete widely used because of its strength, durability, economy and others. The strength of concrete is depends on the curing age, shape surface of aggregate, the use of admixture and others.

Delayed ettringite formation (DEF) can be defined as a cracking and expansion of concrete or formation of ettringite in the cement materials with a cement hydration process after the concrete has hardened. Usually, the concrete related with the delayed formation of mineral ettringite. The mineral ettringite is a normal product at early stage of cement hydration. DEF is occurs from the highly temperature (above 70°C to 80°C). Any damage in a concrete that caused by DEF is a common phenomenon. A few external sources needed for the reaction to occur likes water or moisture from surrounding. Taylor et al., (2001) define the formation of ettringite in a cementitious material by a process that begins after hardening in substantially complete and in which none of the sulfate comes from outside the cement paste. DEF also can related to the sulphate attack (Collepardi, 2003). This formation occurs because of the expansion. However, not necessarily any sulphate attack is caused by ettringite formation (Collepardi, 2003). For example, at early
stage of ettringite formation (EEF), it can occurs immediately (within hours) (Collepardi, 2003). Delayed ettringite formation (DEF) usually occurs at late ages. It is related to heterogeneous expansion in a very rigid hardened concrete that can cause cracking and spalling. There is two different mechanisms of DEF. Firstly, it based on the thermal decomposition of ettringite in high temperature cured concrete elements and the subsequent re-formation of ettringite at ambient temperature in a saturated atmosphere. Based on the second mechanism, it is depends on a chain of three essential events such as micro cracking, late sulfate release and exposure to water. Delayed ettringite formation will occur even at room temperature.

An admixture is defined as an ingredient that's added in concrete other than Portland cement, water, and aggregates. Those admixtures are added directly during mixing or before mixing concrete. There are two types of admixtures such as chemical admixtures and mineral admixtures. A chemical admixture likes plasticizers, super plasticizers, accelerators and set retarders. While, a mineral admixture such as POFA, fly ash, silica fume, rice husk and others. Basically, the use of admixture is to reduce the cost of concrete during construction at site. It is also can increase the quality of concrete during mixing and curing.

Today, combination of cement POFA, fly ash (FA), rice husk, silica fume or pozzolanic in concrete become a new practice in construction, especially the using of POFA. The properties of concrete in both fresh and hardened states can be improved when using POFA. It can show the differences in the rate on strength development and formation of ettringite in concrete. When properly rounded and places, POFA concrete widely shows an improvement in workability, durability, ultimate strength, drying shrinkage and others.

Since Malaysia is one of the largest producers in palm oil industry, the wastage of the palm oil can be used in concrete as a partial cement replacement. Nowadays, the use of recycled materials as concrete materials in the development increase because of environmental laws increasingly stringent. In addition, there is a
large study on different materials for the use of cement substitute and replacement such as POFA, fly ash (FA), and others pozzolanic material.

The palm oil industry is one of the most important agricultural industries in Malaysia. In addition to the production of crude palm oil, a big amount of solid waste output from the palm oil industry. As has been proven (Zarina, et al., 2013) every year, 4 million tons of solid waste from oil palm residues produced The waste are from coconut fibers, shells, and empty fruit bunches. The use of POFA is minimal and not control, while the quantity increases every year and most of POFA are disposed of as waste in landfills causing environmental problems. Many researchers have studied the use of agricultural waste ash as a component of concrete, for example rice husk ash (Ventura, et al., 2015) wood waste ash (Cheah and Ramli, 2011) and bagasse ash (Chusilp et al., 2009). The results showed that agricultural waste ash contained high amounts of amorphous silica in the form and can be used as a pozzolanic material. According to ASTM C 618 (2001) defines pozzolanic materials as containing siliceous or siliceous and aluminous by composition.

POFA is one of the residual ash agricultural chemical composition contains a large amount of silica and that has a high potential to be used as a substitute for cement (Rahmat et al., 2012).

Most of the concrete produced today is a multi-component product that contains one or more additives as an additional to the four basic components of cement, water, fine aggregate and coarse aggregate. For each component, one usually has a few options that can affect the cost of the final product and in service behavior. Among the constituent components, however, cement or cementitious materials as a whole plays an important role in producing the concrete is strong and durable. For various purposes pozzolan which has been considered as a replacement for part of the cement in concrete.