CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In construction, concrete is the most important thing or material that has been used since a long time ago. Continuous research in area of concrete material has resulted in many types of concrete known in various names each having unique characteristics to fulfill the current construction industry demands. However, Malaysia is the second largest exporter of palm oil and it was reported in 2011 that 5 mil ha area of land was used for oil palm plantation (Lim et al., 2013). This resulted in the annual production of about 61.1 million tons of solid waste such as empty fruit branches, fibres and kernels in the country. These waste materials are usually discarded on-site after the palm oil extraction process. This cause unnecessary piling of wastes in the vicinity of factories and posed serious land pollution.

Palm oil fuel ash (POFA) is produced by the palm oil industry as a result of the burning of empty fruit bunch (EFB), fiber and oil palm shell (OPS) as fuel to generate electricity at temperatures of about 800–1000 °C and the waste, collected as ash, becomes POFA (Nagaratnam et al., 2015). Malaysia produced about 3 million tons of POFA in 2007 (Johari et al., 2012) while 100,000 tons of POFA is being produced annually in Thailand, and this production rate is likely to increase due to increased plantation of palm oil trees (Chindaprasirt et al., 2007). The POFA produced in the palm oil mills is dumped into open fields without any profitable return resulting in massive solid disposal which occupies vast fields and causes environmental pollution (Chindaprasirt et al., 2007). In view of environmental contamination, palm oil industry has started to look for an effective solution so that this huge volume of waste can be
utilized. A successful approach to this problem can be linked to utilizing POFA as an alternative material in concrete and construction material. It is seen that utilizing waste materials from the palm oil industry such as Palm Oil Fuel Ash (POFA) as replacement for conventional materials in the production of concrete would reduce amount waste disposed at landfill.

1.2 PROBLEM STATEMENT

Concrete is a combination consists of cement, aggregate and water. The consumption of natural sand taken from the river was too high due to its excessive use in concrete. The demands for this natural sand were increasing from time to time, especially on developing countries, for instance, Malaysia. For every concrete structure basically required tons of sand and gravel coated together with cement. Only some sands are suitable to use for making concrete. In fact, the properties of the sand utilized as a part of concrete can affect its quality. For example, desert sand generally not suitable to use for construction because the wind erosion of sand in the desert results in smooth and desert grains are too round which do not bind well. Furthermore, desert sand is mono-grained which means similar size. This sand is absolutely makes it unsuitable to use in concrete because concrete required sand which is small, intermediate, and coarser particles to prevent voids between grains to reduce the amount of water necessary. Generally, sand which is use for concrete was obtained by mined from land quarries and riverbeds. Natural sand is being extracted at an increasing rate due to growing global population which leads an expanding demand for building and housing. This action has caused the expansion of mining to coastal areas and dredging of the seafloor and indirectly increasing the possibility of flooding, affect the marine and river biodiversity, causing coastal and inland erosion, exacerbating the risk of drought and lowering the water table in some areas. Thus, the construction industries are in stress to identify alternative methods and materials to reduce the demand for natural sand.

Palm oil is the main product in tropical climate countries and Malaysia is the top producer of it. Generally, after combustion process was completed, about 5% palm oil fuel ash by weight of solid waste is produced (Sata et al., 2004). Palm oil fuel ash
(POFA) is one of the most abundant wastes found in Malaysia. If this waste were not managed properly, it will become hazardous to the surrounding residential area. This problems also have been highlighted by Tay and Show (1995) who stated that this ash has also caused potential health hazard and environmental problems. The utilization of waste materials from the palm oil industry provides immense benefit to various sectors of the construction industry. Channelling this waste material into the building industry helps to promote sustainability besides overcoming waste disposal problems. Environmental pollution due to inappropriate waste management system can also be drastically reduced. In order to overcome this problem, use the waste as the main substance in the production of concrete containing palm oil fuel ash (POFA) as partial sand replacement.

1.3 OBJECTIVES

The main aim of this research is to study the mechanical performance of concrete containing palm oil fuel ash as partial sand replacement. The objectives of this study are as follows:

i) To investigate the effect of unground palm oil fuel ash as partial sand replacement on workability and compressive strength of concrete.

ii) To investigate the effect of unground palm oil fuel ash as partial sand replacement on flexural strength of concrete.

1.4 SCOPE OF RESEARCH

This study is focused on the behavior of the concrete mixture when it containing various percentage of POFA as partial sand replacement. The percentage varies from 0%, 5%, 10%, 15%, and 20% by weight of sand. Two mixes were prepared during this study, which are control mix and modified mix. The difference between these two mixes is the percentage of POFA included where the control mix consist 0% of POFA while the modified mix consist varies of POFA percentage. Slump test readied performed to determine the workability of the concrete which comply the ASTM C143/C143M (2005). For the compression strength test, the dimension used for the cubes is 100mm x