CHAPTER 2: STRENGTH DEVELOPMENT OF HIGH PERFORMANCE CONCRETE UTILISING MICRO POFA

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2.0 Introduction

As the world's second largest producer in the palm oil industry, Malaysia is now facing difficulties in handling the by-products of palm oil mills. By 2020, the palm oil solid biomass is expected to increase to up to 100 million dry tonnes, and generally, about 5 million tonnes of Palm Oil Fuel Ash (POFA) is produced from the aforementioned biomass (National Innovation Agency of Malaysia, 2013). The wastes from the production of crude oil and palm kernel oil can be used as fuel to generate steam and electricity for the palm oil mills (Safiuddin *et al.*, 2011). Generally, about 5% of Palm Oil Fuel Ash (POFA) is produced after the combustion process in the boiler (Sata *et al.*, 2007). As this greyish ash does not have sufficient nutrients to be used as fertilizer, it is usually disposed as waste within the factory compound thus creating environmental pollution. In view of this environmental problem, researchers have begun to look for a solution to utilise the huge amount of waste produced. One of the efforts taken is by utilising POFA as a supplementary cementing material (SCM).

The first study of POFA as an SCM was done by Tay (1990), and subsequently, several studies (Awal and Hussin, 1997; Chindaprasirt *et al.*, 2007; Tangchirapat and Jaturapitakkul, 2010) were carried out to investigate the effect of POFA on the strength and durability of concrete. The utilisation of POFA was proven to improve the durability behaviour of concrete due to the production of secondary calcium silicate hydrate (C-S-H) gel through the pozzolanic reaction caused by the presence of silica in the ash. In addition, the degree of POFA fineness is one essential property in the concrete mixture. The studies conducted by Awal and Hussin (1999), as well as Sata *et al.* (2004), suggest that POFA with a higher degree of fineness is more reactive in pozzolanic reaction and therefore can be used in producing high performance concrete. It was also reported that for the early and rapid strength development of concrete, a high fineness of POFA is essential (Ismail *et al.*, 2010). The optimum replacement level for the micro POFA with the size of 10, 15 and 45 μm was observed to be ranged between 20% to 30% (Chindaprasirt *et al.*, 2007; Sata *et al.*, 2004; Tangchirapat *et al.*, 2012). However, the effect of integrating POFA of 2μm as partial cement replacement when used in small percentage towards the properties of high performance concrete remains to be investigated. Therefore, the present study aims at