CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The overall program of this study is to determine the effects of by-product materials which include PFA and POFA and is fully experimental in nature whereby the investigation is focused on the development of these materials as cementitious materials in a normal use. The aim of this study is to investigate the micro-properties and the durability aspect of concrete towards corrosion resistance by incorporating the by-product materials. The study involves simulations to the selected mixes in order to investigate corrosion resistance towards reinforcements in concrete and to determine the effectiveness of the materials.

The properties of a selected material must meet a certain satisfactory criteria before it can be used in a mix design. The production and test procedures in evaluating the concrete mixes, the proportion and preparation of the test specimens and the standards referred in conducting the tests are presented and discussed in the following subtopics. The basic materials for producing concrete in this study were cement, water, sand and coarse aggregates. POFA and PFA were used as cement replacements. Specimens were subjected to different exposure conditions starting from day one which involved air, water, outdoor and wet-dry curing in order to study the effects of curing type towards its strength. Therefore, this chapter explains the experimental program and the material properties for this study. All the formulation of mix proportion and method of testing are stated in this chapter in order to achieve the objectives of this study as discussed in Chapter 1. The methodology adopted in this study is fully based on an experimental investigation.

3.2 MATERIAL INCORPORATED IN PRODUCING SPECIMENS

The concrete consisted of five types of raw materials namely, cement, sand, coarse aggregate, water and by-product materials which were either palm oil fuel ash (POFA) or pulverized fuel ash (PFA). The concrete was designed with the grade 40 MPa in the compressive strength. Therefore, the materials used must be in good quality and must meet the minimum specifications as set in the reference standard.

3.3 COARSE AGGREGATE

Generally, aggregates are parts of the concrete that constitute the bulk of the finished product. They comprise about 60 to 80 % of the volume of the concrete and have to be graded so that the entire mass of concrete acts as a relatively solid, homogeneous, dense combination, with the smaller size particles acting as an inert filler of the voids that exist between the larger particles. The coarse aggregate is a saturated surface dry condition to ensure the water cement ratio is not affected. A few characteristics of aggregates that affect the workability and bond between concrete matrixes are shape, texture, gradation and moisture content. In this study, crushed aggregates from a quarry with the nominal size of 20 mm in accordance to BS 882 (1992) were used.

3.4 SAND

The sand used was from a river and it has fulfilled the BS 882 (1992) requirement. The condition of the sand was the same as the coarse aggregate which was in a saturated surface dry condition in order to ensure the water cement ratio was not affected during mixing proses.

3.5 CEMENT

The Portland cement (PC) produced by Pahang Cement was used in this study as the binder. This Portland cement was made to meet the specification requirement of

ASTM C 150 (ASTM C 150:2005). The opened cement was stored in an airtight container to protect the quality of the Portland cement. Opened cement that are left exposed to atmospheric humidity for a long time has a lower quality due to reactions between cement and the moisture in the air.

3.6 WATER

In order to produce a concrete mix, water plays a very important role. Supposedly, the water used should not contain any substance that might affect the hydration of cement and affect the durability of concrete. Generally, the common tap water was used throughout the study in mixing, curing and other purposes.

3.7 PALM OIL FUEL ASH (POFA)

Palm oil fuel ash is a by-product material obtained in the form of ash when burning palm oil husks or fibers and palm kernel shells as fuel in palm oil mill boilers. POFA which was used in this study was collected from a factory processing palm oil situated at Felda Lepar Hilir at the area of Gambang, Pahang Darul Makmur. The ash was found in the flue of the tower where all the fine ashes are trapped while escaping from the burning chamber of the boiler.

3.7.1 POFA Preparation

POFA is a by-product from the burning processes in thermal power plants, where palm nuts and empty bunches are burnt at the temperature of about 300-400^{o}C. In this study, POFA was used as a cement replacement in concrete to study its potential as a ‘catalyst’ to seal the pores in the concrete and bind chlorides.

POFA was produced from the mill at the foot of the flue tower and only grayish looking POFA was selected, sorted out and collected for the specimens production. The black POFA had to reduce or avoid due to the high unburned carbon content that can cause ineffective reaction when used as a cement replacement. The origin of palm oil fuel ash and stages involved in waste generation as shown in Figure 3.1 to Figure 3.3.