

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WORK

7.1 Summary

7.1.1 The Effect of Aluminium Powder on Strength and Density of Aerated Concrete without Autoclaving

In the aerated concrete process, the creation of air voids in the solid matrix is produced by the pore-forming agent, such as zinc or aluminium powder. The metallic agent of a pore-forming agent reacts with lime or alkali to generate hydrogen gas and form bubbles. This brings a reduction in the density of aerated concrete. However, each mix proportion has its own optimum of pore-forming agent content. In this study, aluminium powder was used as the pore-forming agent at the levels of 0.1, 0.3, 0.5, 0.7 and 0.9% by weight of the binder (OPC and lime). The increase in aluminium powder content gained the reduction of dry density and compressive strength of aerated concrete. Nevertheless, both dry density and compressive strength became stable when the aluminium content was at 0.5%. This indicated that the optimum level of aluminium powder content in this study was 0.5% by weight of the binder, which was also used in the next section.

7.1.2 The Effects of Autoclaving Times and Temperatures on Properties of Aerated Concrete incorporating RHA

This research was proposed to study the effects of RHA incorporated into the starting materials of aerated concrete production, including the effect of curing conditions and autoclaving temperatures and times. The results have shown that the presence of RHA could be attributed to dry density and compressive strength loss even through a change in curing conditions or an increase in autoclaving temperature and time. This is because the RHA characteristics presented as lower specific gravity and higher porous structure than quartz sand. Therefore, the sand replacement by RHA attained more water requirement for maintaining workability in each mixture and resulting in strength reduction. In the microstructure, the increasing content of RHA tended to reduce the initial Ca/Si ratio due to the relatively high reactivity of silica compared with quartz sand. This phenomenon has a positive effect on CSH converting to tobermorite crystalline at a low autoclaving temperature and time. It can be concluded that the incorporation of RHA in aerated

concrete contributed to the autoclaving temperature and time loss, and has a beneficial effect in terms of being economically and environmentally friendly.

In regards to the effects of autoclaving temperature and time, the samples prepared at a high temperature of 180°C achieved an increase in the degree of reaction within a short autoclaving time. This corresponded with the high compressive strength improvement during the first 2 hr of autoclaving time and became stable after 4 hr. While at a temperature of 160°C, this can accelerate the degree of the reaction of the starting materials into equilibrium by using a long autoclaving time (18h). At a low temperature of 140°C, this has no significance on tobermorite formation in mixtures with high concentrations of quartz sand, such as reference and RHC25, even with further autoclaving time. Moreover, the RHC75 and RHC100 exceeded the strength and dry density requirement of ASTM standard. Thus, the mix proportion of RHC75 was also used to observe the effect in the next section.

7.1.3 The Effects of Al-containing Waste Fineness on Properties of Autoclaved Aerated Concrete Incorporating RHA

The previous research studies have reported that the reactivity of silica source, the amount of Al and the presence of alkali compounds strongly affected the formation of tobermorite. Thus, this study focused on the effect of AW fineness and RHA, as means of the Al and the reactivity of silica source, respectively, on the final properties of AAC. The AW was used to substitute the metallic aluminium powder at 5, 10, 15 and 20% by weight. Results found that the introduction of AW, except 5% both medium and low finenesses AW, has negative effect on compressive strength and dry density. The minimum strength was occurring with high AW fineness at all both replacement ratios and autoclaving times. In microstructure, the presence of AW, especially high fineness AW, retarded the dissolution of silicate anion on the surface of siliceous materials (RHA and quartz sand) and also incorporated in silicate framework. These reactions played crucial role on tobermorite formation. The increase in the amount of Al_2O_3 caused the transformation of crumble-foiled tobermorite in the reference sample through the plate-like and lath-like tobermorite by the increasing Ca/Si ratio in the system.

7.2 Recommendations

1. Although, the utilization of RHA in aerated concrete can reduce the dry density, the drawback is the requirement of more water for maintaining workability in its mixture. This effect also played crucial role on compressive strength. Therefore, the enhancement of such drawback is the addition of superplasticizers or high range water-reducers agent. It can be reduced the water consumption.
2. This study has shown the possibility of the utilization of agricultural and industrial wastes in autoclave aerated concrete for reducing waste released into the ecosystem. Another benefit of utilization of these wastes was reduction in autoclaving time or temperature, which related with the energy consumption. Thus, this indicated that other by-products, such as bagasse ash and palm oil fuel ash, may be also used to produce the autoclave aerated concrete.
3. Due to the fact that aerated concrete has high amounts of air voids, the moisture condition or functional properties, such as water absorption, capillarity, durability and sorptivity, also need to be indicated.
4. From the overall results, the suitable mix proportion in this thesis for making AAC that saved energy consumption and exceeded the ASTM standard requirement on AAC-6 was 45% OPC, 5% CaO, 12.5% sand, 37.5% RHA and the addition of aluminium powder 0.45% wt. of binder combined with low fineness AW of 0.05% wt. of binder. In addition, the optimum autoclaved condition was at temperature of 180°C for 4 hr.