A Review of an Investigation of Prefabricated Hybrid Fibre Concrete Panel (FCP) For Industrialised Building System Tank

MA Azizan[1*], *N.Z.Noriman*[2] , *N. Ishak*[3] , *H Desa*[4] , *ZM Razlan*[5]

1,3 Faculty of Civil Engineering Technology, Universiti Malaysia Perlis,
P. O. Box 77, d/a Pejabat, Pos Besar, 01000 Kangar, Perlis, Malaysia
2,4,5 Faculty of Mechanical Engineering Technology, Universiti Malaysia Perlis,
P. O. Box 77, d/a Pejabat, Pos Besar, 01000 Kangar, Perlis, Malaysia

[*]Corresponding author's email: aziziazizan@unimap.edu.my

ABSTRACT: As a component of the IBS (Industrialized Building System), FCP panel is used to cover the interior of a building tank, notably a water-based tank, in both commercial and home applications Siding made of fibre concrete can be purchased as sheets that can be applied to the tank deck and wall system, as well as an underlayment for tiles. As a waterproofing element, fibre concrete siding can also be used as an alternative for Waterproof Membrane in high-moisture zones. In terms of thermal resistance and sound transmission, fibre concrete products differ substantially. In general, the thicker and denser a product is, the higher its resistance to temperature and sound transfer is likely to be. Once installed and painted, the external cladding components require very little upkeep. Thick/dense fibre concrete has great impact resistance, however thinner/less dense products must be protected from impact. Compared to conventional tank siding, fibre concrete is not susceptible to water absorbance or decay. The most important that this product is in the Green Hybrid conceptual which is contained with natural cellulose fibre from EFB (Empty Fruit Bunch), Bottom Ash and Fibreglass (chopped strand mat) for the surfaces. The jointing between concrete and fibre especially in hybrid material EFB will believe to give more strength to the bonding of concrete.

Keywords: *Water Tank; Hybrid Material; Bottom Ash*

1. INTRODUCTION

It is a composite material comprised of sand, cement, and cellulose fibre. It is a lightweight material that may be used for a variety of applications. Facial fibre concrete siding is typically made out of horizontal boards that overlap, mimicking wood siding, and clapboard and imitation roofing tiles [1][2][5]. Siding made of fibre concrete can be purchased as sheets that can be applied to the tank deck and wall system, as well as an underlayment for tiles. Fibre concrete siding is not only used as an interior siding acting as a waterproofing element but it can also be utilized as a substitute for Waterproof Membrane in high density moisture areas [2][5][6]. In terms of thermal resistance and sound transmission, fibre concrete products differ substantially. In general, the thicker and denser a product is, the higher its resistance to temperature and sound transfer is likely to be. Once installed and painted, the external cladding components require very little upkeep. Thick/dense fibre concrete has great impact resistance, however thinner/less dense products must be protected from impact. Compared to conventional tank siding, fibre concrete is not susceptible to water absorbance or decay. The most important that this product is in the Green Hybrid conceptual which is contained with natural cellulose fibre from EFB (Empty Fruit Bunch) and Fibreglass (chopped strand mat) for the surfaces [1][3][6]. The jointing between concrete and fibre especially in hybrid material EFB will believe to give more strength to the bonding of concrete [4]. The product has been desired by the contractors in generally on the installation, insulation, strength and cost and believes this is the most dynamic IBS component that able to decrease the cost and increase the quality.

2. GREEN MATERIAL IN FCP FORMULATION

Green material in FCP formulation consist cellulose fibre from Empty Fruit Bunch (EFB) as main raw fibres are define as a green mixture whereas EFB are under the waste category in palm oil plantation industry. Basically, EFB will enhance the bonding with fibreglass by the resins mixture which is design for concrete and cement integration surfaces. Several alternatives as green material also had been identified such as bottom ash from coal burning wastage.

2.1 Bottom Ash as Alternative Green Material

Coal bottom ash was collected from T4 Tanjung Bin Power Plant, Malakoff Corporation Berhad, Pontian, Johor, Malaysia. The chemical analysis of coal bottom ash was performed using energy dispersive spectrometer (EDS). In this case, two samples from two distinct labs were analysed. coal bottom ash is a mixture that contains iron, silica dioxide, aluminium, magnesium sulphate and other compounds. Al2O3 and iron oxide (Fe2O3) in coal bottom ash ranged from 94.21 percent to 91.57 percent, and as such, the coal bottom ash employed in this study corresponded to ASTM C 618-03 Class F ash. The coal bottom ash ignition loss was less than 1 percent. The pycnometer method was used to determine the specific gravity of coal bottom ash, which was 1.48.

3. COMBINATIONS OF GREEN MATERIALS IN RESERVOIR WATER TANK CONSTRUCTION

The integration between several kinds of green categorised material in reservoir water tank construction seems in the significant procedures and protocol. However, there are several procedures keen to be undergoing in purpose for safety and health impacts. The heavy metals in bottom ash are compulsory to be treated as well as to ensure the functionality of reservoir water tank is well equipped. The chlorination procedures are one of the alternatives to become a treatment option for bottom ash before will become as a part of mixture in the concreting reservoir water tank. The usage of fibreglass and resins as enhancing bond between the surfaces material also will be the same procedures whereas the designing of treatment procedures according to the approval from authorities.

4. REMOVAL HEAVY METALS

Ashes can be managed, processed, and treated in a number of different ways. To begin, ash can be stored in landfills or monofills forever. To make a viable result, additional processing can be used (such as aggregate). Heavy metals will be present in the ash in any circumstance. At the very least, any management strategy should involve ash testing to identify the possible threat of heavy metals present in the ash. In order to comply with current rules and to assure the safety of the ash in the environment, a range of treatment techniques can be used to minimise the amount and/or mobility of heavy metals contained in the ash. In order to remove heavy metals from the bottom ash, a thermo-chlorinated treatment would be used in the reactor. The addition of chlorinating agent will increase the evaporation rate of the heavy metals such as copper, zinc, lead and cadmium. Previous studies have shown that the volatilization of heavy metals is related to their matrix, physical/chemical properties and the operation conditions. Therefore, before conducting the thermo-chlorinated treatment, it is necessary to investigate and identify the factors that affect the transformation and volatilization of heavy metals.

Bottom ash samples will be mixed with chlorinating agents at different weight percentage. The samples will be placed in a porcelain boat and heated at 1000 °C for 1-5 hours with dry air supplied to entrain the volatile matters. It was then removed from the oven and allowed to cool to room temperature. Then, the porcelain boat's slag residue was collected for heavy metal analysis. When it came to the pure bottom ash, studies had to be redone under the same conditions as before. So that the metal initially connected with the chlorinating agent remains in the bottom ash and does not cause any environmental problems when disposed of in landfills, the oxide MO should be chemically stable and have a low vapour pressure. The untreated and treated bottom ash will be sent for characterization such as X-ray fluorescence (XRF), X-ray diffraction (XRD), atomic absorption spectroscopy (AAS), energy dispersive X-ray spectroscopy (EDS) and scanning electron microscope (SEM).

5. FCP RESERVOIR WATER TANK AS FUTURE DEMAND

The development of new technologies for prefabricated super low-cost tank system that reduce cost and labor, reduce construction time, improve quality and the most preference from client is flexibility in design and construction using prefabricated hybrid fibre concrete panel besides able to describe the special jointing of hybrid material with fiberglass and concrete together with bottom ash with relevant properties and standards.

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REFERENCES

[1] Mao, L., Barnett, S., Begg, D., Schleyer, G., & Wight, G. Numerical simulation of ultra high performance fibre reinforced concrete panel subjected to blast loading. *International Journal of Impact Engineering*, ***64***, 91-100 (2014).

[2] Paramasivam, P., & Nathan, G. K. Prefabricated ferrocement water tank. (1984).

[3] Tilton, R. W. *U.S. Patent No. 4,477,399*. Washington, DC: U.S. Patent and Trademark Office. (1984).

[4] Azizan, M. A., Noriman, N. Z., Ishak, N., Hazry, D., Dahham, O. S., Umar, M. U., & Jaya, H. (2020, March). Application of coal bottom ash as raw material for concrete brick in housing construction. In *AIP Conference Proceedings* (Vol. 2213, No. 1, p. 020269). AIP Publishing LLC.

[5] Tighiouart, B., Benmokrane, B., & Gao, D. Investigation of bond in concrete member with fibre reinforced polymer (FRP) bars. *Construction and building materials*, ***12*****(8)**, 453-462. (1998).

[6] bin Azizan, M. A., & bin Sk Abd Razak, S. (2016). The Barriers and Strategies of Implementing the New Building Material (Fibre Cement Wall) in Malaysia Case Study: Aurum Synergy, Perlis, Malaysia. In *Materials Science Forum* (Vol. 857, pp. 314-318). Trans Tech Publications Ltd.