

Production of Bricks Using Mill Waste and Tyre Crumbs at a Low Temperature by Alkali-Activation

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Abstract : Since automobiles became widely popular around the early 20th century, end-of-life tyres have been one of the major types of waste humans encounter. Every minute, there are considerable quantities of tyres being disposed of around the world. Most end-of-life tyres are simply landfilled or simply stockpiled, other than recycling. To address the potential issues caused by tyre waste, incorporating it into construction materials can be a possibility. This research investigated the viability of manufacturing bricks using mill waste and tyre crumb by alkali-activation at a relatively low temperature. The mill waste was extracted from a brick factory located in Melbourne, Australia, and the tyre crumbs were supplied by a local recycling company. As the main precursor, the mill waste was activated by the alkaline solution, which was comprised of sodium hydroxide (8m) and sodium silicate (liquid). The introduction ratio of alkaline solution (relative to the solid weight) and the weight ratio between sodium hydroxide and sodium silicate was fixed at 20 wt.% and 1:1, respectively. The tyre crumb was introduced to substitute part of the mill waste at four ratios by weight, namely 0, 5, 10 and 15%. The mixture of mill waste and tyre crumbs were firstly dry-mixed for 2 min to ensure the homogeneity, followed by a 2.5-min wet mixing after adding the solution. The ready mixture subsequently was press-moulded into blocks with the size of 109 mm in length, 112.5 mm in width and 76 mm in height. The blocks were cured at 50°C with 95% relative humidity for 2 days, followed by a 110°C oven-curing for 1 day. All the samples were then placed under the ambient environment until the age of 7 and 28 days for testing. A series of tests were conducted to evaluate the linear shrinkage, compressive strength and water absorption of the samples. In addition, the microstructure of the samples was examined via the scanning electron microscope (SEM) test. The results showed the highest compressive strength was 17.6 MPa, found in the 28-day-old group using 5 wt.% tyre crumbs. Such strength has been able to satisfy the requirement of ASTM C67. However, the increasing addition of tyre crumb weakened the compressive strength of samples. Apart from the strength, the linear shrinkage and water absorption of all the groups can meet the requirements of the standard. It is worth noting that the use of tyre crumbs tended to decrease the shrinkage and even caused expansion when the tyre content was over 15 wt.%. The research also found that there was a significant reduction in compressive strength for the samples after water absorption tests. In conclusion, the tyre crumbs have the potential to be used as a filler material in brick manufacturing, but more research needs to be done to tackle the durability problem in the future.

Keywords : bricks, mill waste, tyre crumbs, waste recycling

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