Influences of waste inclusion on impact and crushing force resistance of track ballast

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ABSTRACT

Recently, the incorporation of various waste materials into the ballast is studied in terms of physical and mechanical behavior. However, the inclusion of concrete debris (CD) and bottom ash (BA) waste, which are enlisted as the inventory materials for railway ballast have not been thoroughly examined. Hence, this paper investigates the improvement in damage resistance of waste incorporated conventional ballast (CB) under impact and crushing force using impact hammer and crushing machine. The initial and final particle size distribution (PSD) were obtained to analyze the damages through the Hardin's breakage index and fouling index. The results show that the resistance against crushing and impact force is better when the composition is in the ratio of 1:1 of conventional ballast (CB) and concrete debris (CD). Under crushing load, mixture with 50% of CD recorded breakage index with 4% deviation compared to using 100% of CB. However, integrating with 40% of CD and 10% of BA proved that the values are 2.14% lower than the ACV limit and 9.09% higher than the AIV limit set by British Standard. Although the impact and crushing index of 100% CB aggregates are below the allowable limit, mixing the CD and BA also records results which is only slightly different than the threshold limit. This is due to the cushioning effect caused by the waste acting as the buffering material that reduces the time of impact, which saves the angular materials from wearing off. This will reduce the ballast maintenance intervals that indirectly reduce the service cost and promotes sustainable construction. Based on the results from this study, further experiments are recommended to be carried out to relate and understand which waste material plays a major role in damage reduction or causing higher maitenance cost.

KEYWORDS

Concrete debris; Bottom ash; Conventional ballast; Aggregate impact value; Aggregate crushing value; Fouling index; Hardin's breakage index

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