

## **Effects of Concrete Debris and Bottom Ash Usage on the Improvement of Ballast Degradation**

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### **Abstract**

Railway track bed degradation happens due to single-particle and angular corner breakage, which is the current research interest. However, there is a lack of study on the effects of certain inventory waste incorporation in reducing the particle damages. This study evaluates the damage that can be reduced by incorporating waste into conventional ballast (CB). The optimum percentage of waste that can be incorporated in order to have an undisrupted ballast function were also evaluated. Concrete debris (CD) waste from construction and demolition works and bottom ash (BA) waste from coal power plants were incorporated with conventional ballast (CB) in twelve different track design mixtures (TDM). These mixtures were studied by conducting Los Angeles Abrasion (LAA) to fasten deterioration and obtaining the initial and final particle size distribution (PSD). The Hardin breakage index (HBI), ballast breakage index (BBI), void contamination index (VCI) and fouling index (FI) were obtained through the PSD of each TDM. Using the data obtained the damage that is reduced and the optimum amount of CD and BA that can be incorporated with conventional ballast were determined. The microscopic image was used to support and validate the outcomes. When bottom ash and concrete debris were added in various percentage no more than 50% in total, the BBI value within the TDM improved by 22.95%. The HBI, FI, and VCI have all seen improvement of 64.52%, 5.5%, and 18.22%, respectively. This proves that waste incorporation reduces the overall track bed deterioration effectively. As a result, the BBI for waste-containing ballast fall between 0.34 and 0.6, whereas the HBI was in the range of 0 to 0.61. The fouling index was recorded less than 15.5%, and the VCI was in the range of 33.28% to 62.45%. Therefore, provision of various waste materials into conventional ballast considerably reduces the damages. In conclusion, the usage and the dependency of natural ballast can be reduced which promotes sustainable development in the railway construction industry.

*Keywords:* Los Angeles abrasion; Breakage reduction; Conventional ballast; Concrete debris; Bottom ash; Breakage index; Fouling index.