INNOVATIVE BALLAST REPLACEMENT MATERIAL (IBRM) IN-LINE WITH GEO-TECHNOLOGY PILLAR OF IR4.0 IN CONSTRUCTION

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BACKGROUND OF INVENTION AND OBJECTIVE

To reduce the damages exerted on existing granite ballast, waste materials such as concrete debris from construction and demolition process and bottom ash from coal energy production mixed in different proportion with granite ballast, creating IBRM.
IBRM will be scrutinized to replace the track ballast upto to 50% depending on the speed of train and load exerted on the rail.

MODEL AND MATERIAL IMAGES

Granite Ballast

Granite Ballast + Concrete Debris

Granite Ballast + Bottom Ash

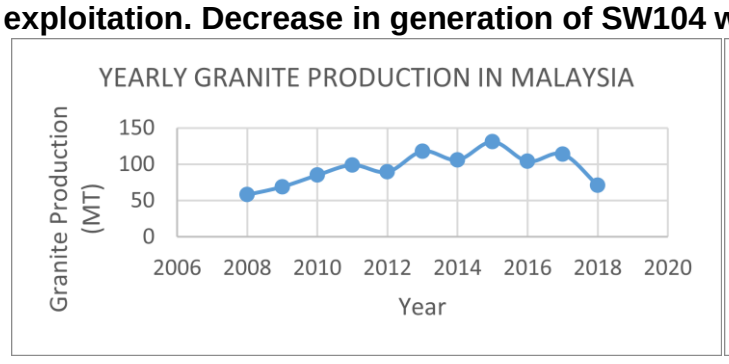
Granite Ballast + Concrete Debris + Bottom Ash

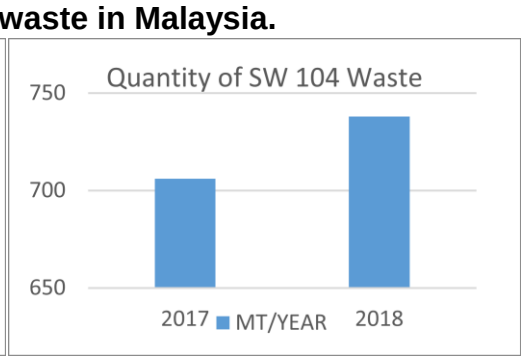
Status of Innovation

Material has been tested in terms of physical properties & engineering properties which are particle size, resistance towards sudden shock, resistance towards abrasion, resistance towards gradually applied load and the data were collected and analysed under laboratory conditions referring to the specification of Malaysian railway standard.

Environmental Impact

Reduction in construction & demolition waste dumped in landfills. Decline in granite exploitation. Decrease in generation of SW104 waste in Malaysia.

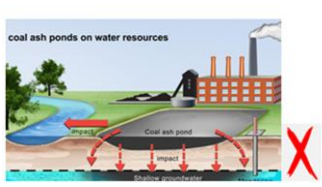




Cost Analysis

Replacing 50% of ballast material with waste will reduce the original cost up to 30-40%. Currently, ballast quantity for 1 Km Long Welded Rail (LWR) track on single line Broad Gauge (BG) with 300 mm granite ballast cushion is 813.65 tonnes which will cost 0.2 million Malaysian Ringgit approximately.

Benefits



Marketability & Commercialisation

Many ongoing railway projects in Malaysia are delayed due to expensive cost such as ECRL, Klang Valey Double Track , Johor Bahru-Singapore, Sarawak rail transportation. Usage of waste material in certain percentage can solve the problem.

Publication Title

Conference: 4th National onference on Wind and Earthquake Engineering (NCWE 2020)

Title: Performance Of Concrete Debris And Bottom Ash As An Alternative Track Ballast.

Reference

-Guo, Y., Markine, V., Qiang, W., Zhang, H., & Jing, G. (2019). Effects of crumb rubber size and percentage on degradation reduction of railway ballast. *Construction and Building Materials*, *212*, 210–224. https://doi.org/10.1016/j.conbuildmat.2019.03.315
- Chamling, P. K., Haldar, S., & Patra, S. (2020). Physico-Chemical and Mechanical Characterization of Steel Slag as Railway Ballast. *Indian Geotechnical Journal*, *50*(2), 267–275. https://doi.org/10.1007/s40098-020-00421-7

Track Mixture Samples

Mixture Sample	Track Ballast	Furnace Bottom Ash	Concrete Debris From Demolition
A	1.0	0.0	0.0
B	0.0	0.0	1.0
C	0.5	0.0	0.5
D	0.5	0.25	0.25
E	0.5	0.5	0.0

Findings

Sieve analysis

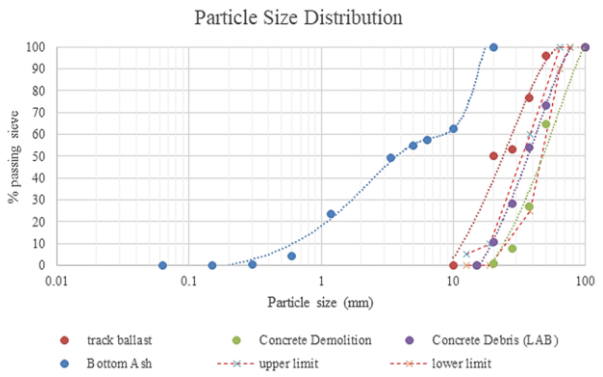


Figure a . Particle size distribution curve

Aggregate Abrasion Value

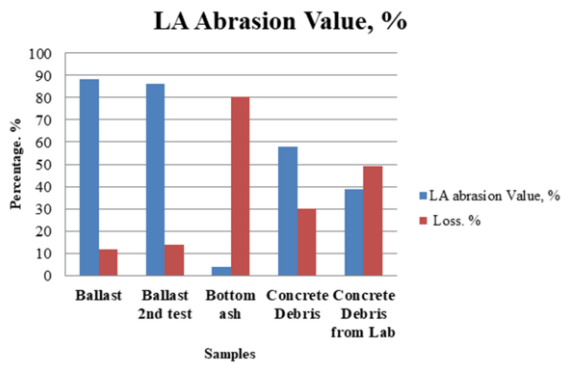


Figure b . Samples vs percentage of LA abrasion and loss.

Aggregate Crushing Value

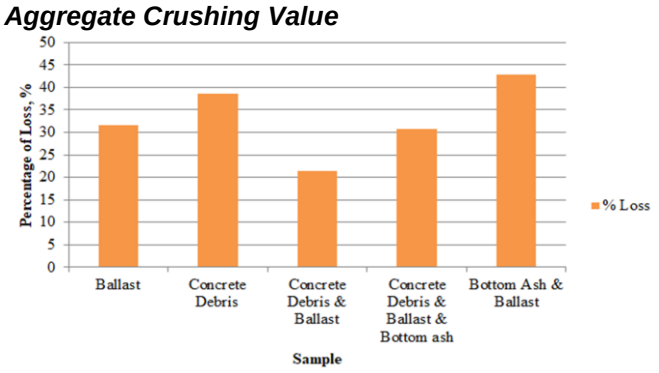


Figure c. Bar graph of percentage of loss, %

Aggregate Impact Value

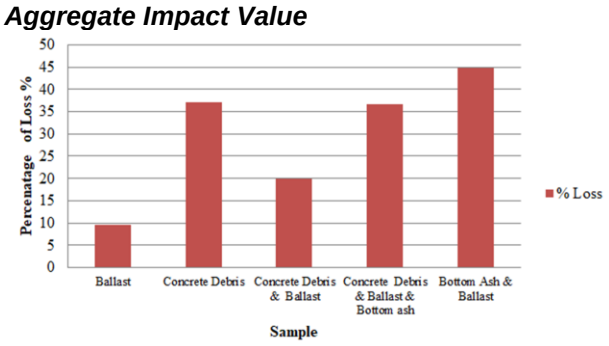


Figure d Bar graph showing results of AIV

Novelty/ Originality/ Inventiveness

- TRIZ **PRINCIPLE NO: 11, 16, 22, 25, 40**
- **Reducing the dependence on natural resources for construction.**
- **Solving the accumulation of by product of energy production**
- **Increase the reusage ofconcrete waste**