LORAM®

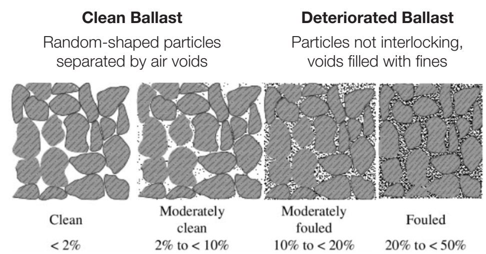
BALLAST CLEANING
CASE STUDY

Shoulder ballast cleaning reduces overall maintenance costs, extends life of ballast, ties and rail.

Challenge

As with all track components, ballast has a finite life. Ballast is considered to be at the end of its life when the voids between the particles become filled with fine material, diminishing the track's ability to adequately drain water and its ability to maintain a durable track lift after tamping. Studies show that at a specific Fouling Index, the permeability of the ballast decreases significantly, and this is often considered the end of ballast life. As ballast breaks down and generates fouling material due to traffic and dynamic application of train loads, the tracks internal drainage capabilities will diminish, causing settlement that will increase the rate of track degradation. As ballast fouling increases, the required frequency of tamping required to maintain acceptable geometry also increases.

Railroads need efficient ways to manage ballast fouling and drainage challenges to maximize returns on asset investments. Proper ballast maintenance at the right time and location extends the life of ballast, ties, and rail. The functions of proper ballast are to provide a drainage path, distribute loads into the subgrade, reduce rail stress, and provide an overall better foundation for improved rail performance.



Proper ballast maintenance and cleaning can extend the life of ballast and delay the need for ballast undercutting and renewal

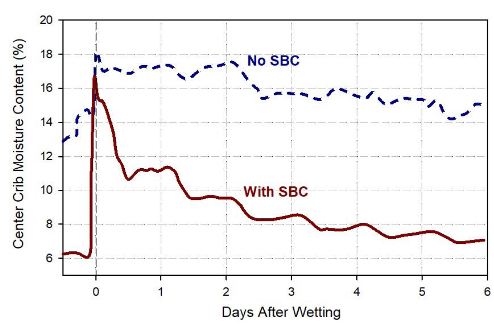
Solution

Shoulder ballast cleaning is a maintenance practice that involves removing the ballast at the end of the ties, screening that ballast to separate out and discard the fouling material, and restoring the clean, usable ballast to the track shoulder. Shoulder ballast cleaning is a cost-effective way to improve track drainage as it provides lateral drainage through the ballast layer and allows a portion of the fouling fines to migrate laterally from the center of the track into the newly cleaned ballast shoulders. A decrease in ballast fouling and moisture retention improves ballast strength and its resistance to deformation under loading, thereby reducing maintenance costs by making tamping more durable and less frequently required, and by delaying the need for ballast undercutting and renewal.

A track structure with clean ballast in the shoulder allows water to drain out of the track structure exponentially faster than in a track with fouled shoulders. Water trapped in the center of the track can drain within hours in a track with clean shoulders while water can pool on the surface for days in a track that has not undergone shoulder ballast cleaning.

Lack of an easy path for the water to flow out of the track structure, allows water to accumulate within the ballast resulting in a saturated structure. The saturation depth increases until the water pressure breaks the resistance of the fouled ballast to create internal flow paths or until surface flow carries water over the top of the ballast section.

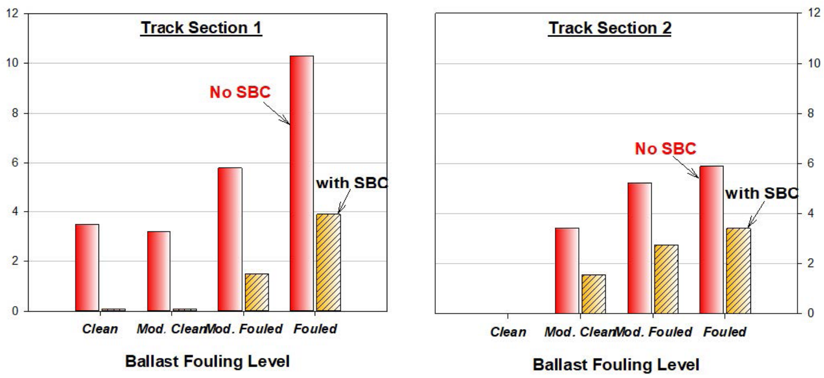
Loram SBC Shoulder Ballast Cleaner digging wheel and separator screens



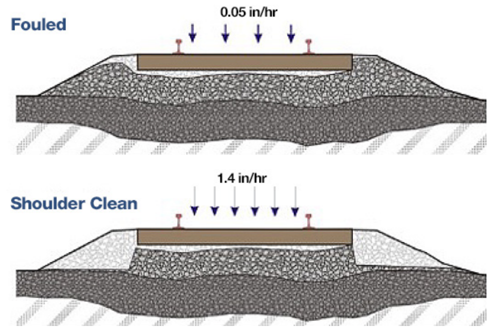
Reduction in Center Crib moisture content as a result of Shoulder Ballast Cleaning

Lab and Field Testing

Full-scale tests of fouled ballast have quantified the reduction of fouling material in the ballast due to shoulder ballast cleaning as water drains laterally and carries fine material with it into the cleaned shoulder. This migration of fines in turn provides economic benefits due to a stronger ballast that requires less frequent tamping as well as savings from the resulting delayed need for undercutting and replacement of ballast.



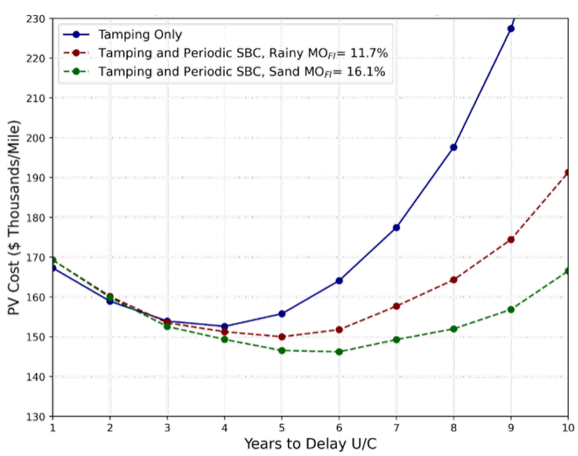
Average yearly increase in track-center ballast fouling[1]



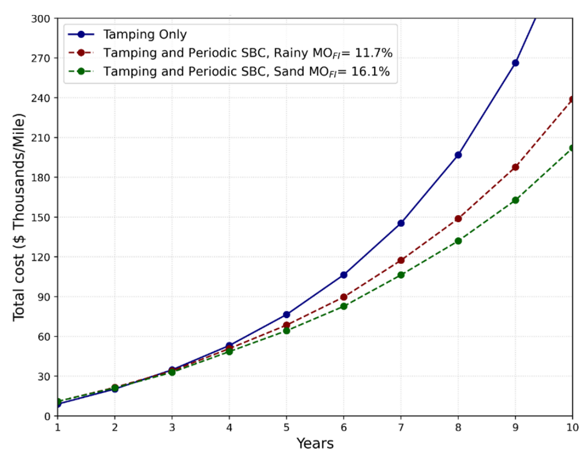
Drainage Capabilities of Fouled Track vs. Shoulder Ballast Cleaned Track

The graphic below shows the Present Value (PV) of all ballast-related costs for a Class 4 track with 80 MGT/yr of freight traffic. The three lines show relative cost of tamping only without shoulder ballast cleaning (SBC), and the cost comparison of performing periodic shoulder ballast cleaning and tamping (SBC + Tamping) in two different ballast fouling types. The 11.7% (Rainy fouled ballast) and 16.1% (Sandy fouled ballast) test-measured reductions in fouling show that the cost savings provided, relative to not using SBC and only tamping the ballast, is proportionate to the amount of fouling reduction produced by SBC. The cost savings results from the reduced fouling and the related reduced need for tamping, as well as the ability to postpone the need for costly undercutting to the year in which the PV cost is at a minimum.

Shoulder Ballast Cleaning reduces total maintenance costs, reduces the need for new ballast, and extends the life of ties and rail



Present value cost for freight loading, track Class 4[2]



Total cost of ballast maintenance over time[2]

Conclusion

Shoulder ballast cleaning:

- Maximizes ballast life; minimizes need for new ballast
- Breaks up mud caps; improves drainage
- Increases track stiffness; reduces settlement and surfacing cycles
- Reduces total maintenance costs

REFERENCE:

1) Wilk, S., 2021. “Substructure Systems”. 26th Annual AAR Research Review. Virtual Conference, March.
2) Kashani, H., Fanucci, F., Chrismer, S. (2022) “Using Test Measurements to Quantify the Economic Benefits of Shoulder Ballast Cleaning” AREMA Conference Proceedings, Denver, 2022.

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