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# Road and Rail Infrastructure V

Stjepan Lakušić – EDITOR



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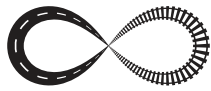
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## EXPERIMENTAL INVESTIGATION OF STONEBLOWING AND UNDER SLEEPER PADS RAILWAY MAINTENANCE TECHNIQUES

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### Abstract

This work presents results of experiments carried out to investigate the potential application of two techniques of railway track adjustment: “stoneblowing” (SB), where ballast stones are injected into gaps in the ballast bed beneath sleepers, and “under sleeper pads” (USPs), where special pads are placed between the sleepers and the ballast. It was reported that they can potentially result in improved track quality compared to traditional methods, such as tamping (TM). Despite potential benefits, these two techniques have found so far quite limited application. In order to understand performance of a surfaced railway ballast and develop maintenance procedures we conducted series of experiments at the Railway Experimental Ring in Scherbinka, Russia. It was demonstrated that railway track, adjusted by SB and by USPs showed better track stability in vertical plane in comparison to track adjusted by TM. We also showed that application of SB resulted in higher values of resistance to lateral displacement of railway track in the area of rail joint, compared to TM. Moreover, railway tracks adjusted by SB and USP techniques were proved to show good results under high load, thus, have potential application for heavy-load railways.

*Keywords: stoneblowing, under sleeper pads, ballasted railway track, track maintenance*

### 1 Introduction

The railway track service life is limited by service lives of its components: rails, sleepers, rail fastenings, railpads, ballast, etc. Ballast is known to have service life of 350 millions of tons of traffic, which is the minimal value among all the components. Thus, by increasing service life of ballast, it is possible to increase the service life of the whole railway track and potentially reduce maintenance costs.

Due to the constant degradation under load, ballast requires periodical maintenance, which is most commonly conducted by means of the tamping technique. TM is reported to result in quick revert to a pre-maintenance geometry and to cause ballast damage [1], thus leading to an increase of the maintenance frequency and shortening of the ballast service life. After TM adjustment ballast particles are put into a disturbed state. For example, in case of the small railway subsidence (10-12 mm) TM adjustment leads to substantial structural deformations, where some of the ballast particles stand vertically on their short side. The ballast adjusted by means of TM may also contains cavities. Alternative techniques, such as SB and USP, are reported to cause less ballast disturbance and result in better ballast stability. While USB is a well-known, commercially available technology, which has already found some application [2], stone-blowing, originally developed in Great Britain, is a comparatively new technology and its application remains very limited. In our previously conducted laboratory experiments it was demonstrated that adjustment by means of SB leads to a constant and predictable

settlement level [3]. We consider this article as a next step, following on from the previous research, which is meant to compare effectiveness of different adjustment techniques by means of experiments, performed in situ.

## **2 Materials and methods**

All experiments were conducted at the Railway Experimental Ring in Scherbinka, Russia. Measurements of settlement relative to a reference point were performed with a laser level at points along the rail above eight subsequent sleepers.

### **2.1 Adjustment of a rail joint by means of under-sleeper pads.**

Under-sleeper pads (USPs) were placed under the rail joint under study during the scheduled railway maintenance procedure (joint is located between rails №№ 402 and 403, 3-5 milepost, 3rd kilometer of II track). Six sleepers were adjusted by USPs: three on each side of the rail joint. As a reference level we used a position of a bolt of pole-guy №105. Detailed description of the procedure can be found in [4]. Unfortunately, during the experiment, it was impossible to perform measurement in case of load 2.5 million tons for under-sleeper pads due to technical reasons.

### **2.2 Adjustment of a rail joint by means of stoneblowing.**

Ballast was removed from the place between sleepers in checkerboard order leaving a 25 cm long and sleeper-deep area from both sides of the rail. Lifting height of the rail head was selected taking into account settlement of the track panel under its own weight after adjustment and removal of lifting jacks (10-15 mm) and settlement of the small gravel during the first 7 days of exploitation after adjustment (10-15 mm). Distance from the sleeper bed to the bearing surface was not less than 34 mm. As a reference level we used a position of a bolt of pole-guy №103.

### **2.3 Adjustment of a rail joint by means of tamping.**

As a control experiment, track level adjustment was performed by tamping, following a standard technology used at JSC RZhD [5]. The control joint 292-293 is neighbouring the joint 291-292, used for stoneblowing experiment, and the same reference level (a bolt of pole-guy №103) was used.

## **3 Results and discussion**

Figure 1 shows, that the settlement in case of TM is much higher than in cases of adjustment by means of SB and USB. Also it is important to note that level stability was reached at lower values of total passed traffic load in the case of SB and USB in comparison to the adjustment by TM. By visual inspection (Figure 2) it was discovered that in the control joint sleepers started to shift relative to each other violating the correct track panel geometry. Moreover, the track vibration level in case of TM was much higher compared to the vibration level of track adjusted by SB (Figure 3).

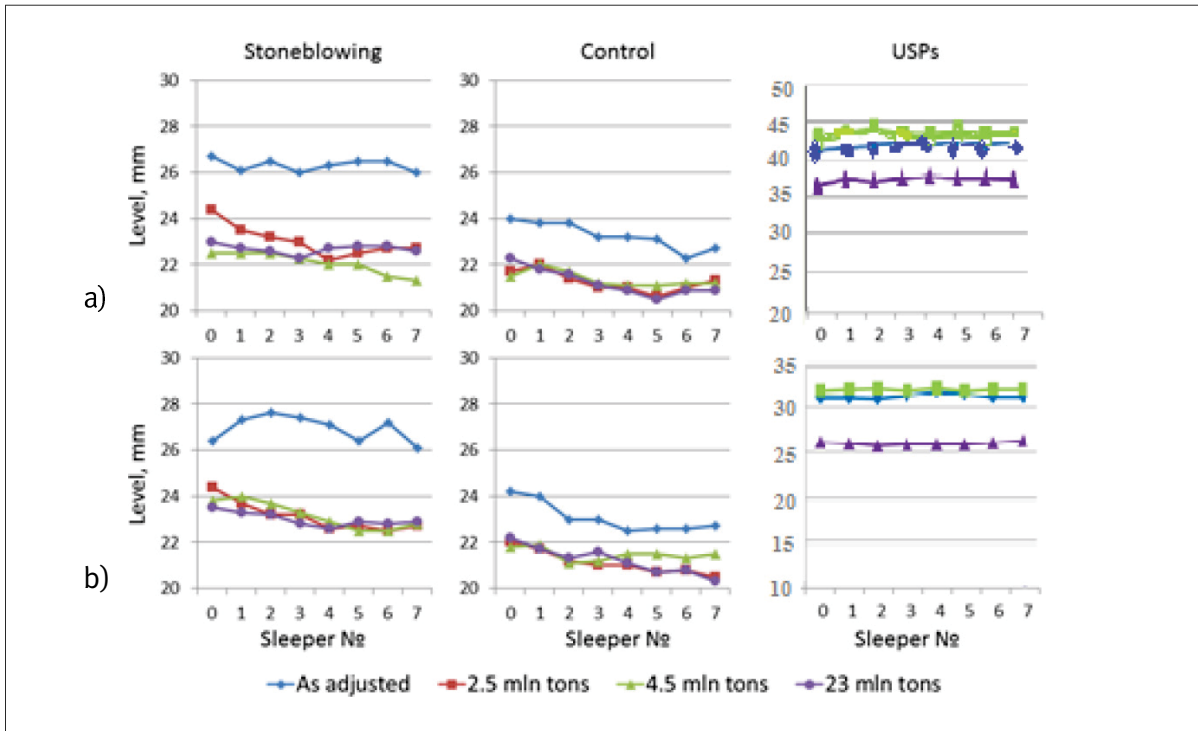


Figure 1 Sleeper level dynamics for different adjustment techniques (a – left rail, b – right rail)



Figure 2 The final state of the track bed, adjusted by TM



Figure 3 Visual control of trackbed vibrations in the case of adjustment by means of SB (left) and TM (right)

## 4 Conclusions

In this study it was showed, that railway track, adjusted by stoneblowing and by “under sleeper pads” techniques showed better track stability in vertical plane in comparison to track adjusted by tamping technology. Track adjustment by means of SB resulted in higher values of resistance to lateral displacement of railway track in the area of rail joint, compared to the tamping procedure. Experimental railway tracks, adjusted by SB and USP techniques showed good results under high load. Obtained results demonstrate, that methods SB and USP have high potential in terms of the provided track quality.

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