Stone Blowing: An Alternative Approach to Track Surfacing

The maintenance of the geometry of the track structure is a critical part of overall track-maintenance activity. Track geometry maintenance, and in particular the maintenance of the vertical geometry (surface and crosslevel), is traditionally performed by tamping. As noted in last month's Tracking R&D, however, tamping has some potential drawbacks, which include damage to the ballast particles and the creation of "fines."

In order to overcome some of the drawbacks of tamping, alternate track surface maintenance techniques have been studied. One of these techniques, stone blowing, was developed as a potential alternative to tamping by British Rail in the early 1980s.

The concept behind stone blowing is the insertion of a pre-measured amount of fresh stone under low ties, in order to restore the level of the track. The British Rail approach was an attempt to mechanize the old labor-intensive techniques of "measured shovel packing," or "troweling," where the fresh stone was inserted by hand (or shovel) under the low ties.

The stone-blowing technique uses an open tube to "blow" a pre-measured weight of stone under the raised ties. This avoids disturbing the consolidated ballast bed under the tie, and, as a result, is expected to increase the durability of the track (and reduce its rate of degradation under traffic). Tests on British Rail have in fact shown that this technique has a lower rate of track degradation than conventional tamping techniques, although the rate of production (the productivity) of the stone-blowing technique is slower than that of conventional tamping methods (1, 2).

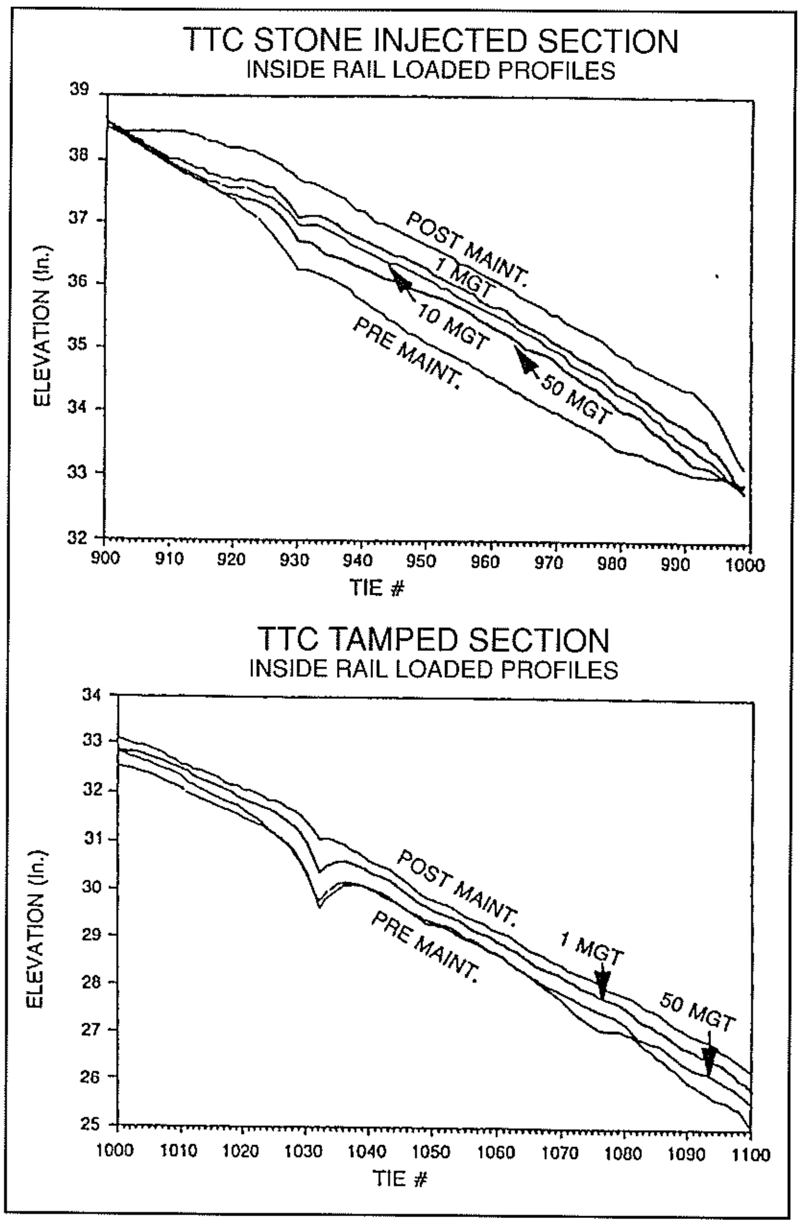

Figure 1 — Profile of Transportation Test Center track before and after stone injection and tamping (3).

In-track tests

Research by the Association of American Railroads has attempted to examine the effect of stone blowing on North American trackage, which is subject to higher axle loads than found in Europe (3). In a series of tests performed at the Transportation Test Center and on two North American freight railroads, stone blowing was compared to conventional tamping from the point of view of "durability" and "performance" (RT&S, May, p. 19).

Figure 1 presents the results of the tests at the Transportation Test Center which show that the tamped track returned to its original profile in about 50 MGT, while the stone-injected track still maintained an improved profile after 50 MGT. (Note that the TTC performed less than one-inch lifts.)

Figure 2 presents the results of the tests on one U.S. freight railroad, where the track adjacent to a road crossing was tamped and stone injected (3). Due to the restriction of the crossing, a small controlled lift (less than one inch) was performed. In both cases, a distinct (and comparable) improvement in track geometry was measured. Furthermore, as can be seen in this Figure, the tamped track returned to its original pre-maintenance level after approximately 50 MGT, while the stone injected track reached almost 90 MGT before reaching this level. Similar results were obtained at a second road crossing.

Figure 3 presents the results of the AAR tests on a second U.S. railroad. In this case, the test was performed on an open stretch of track, with no locations that fixed the track elevation. The comparison here was between stone blowing and conventional tamping using larger than one-inch lifts, which was the normal tamping practice of the railroad (3).

As can be seen from Figure 3, the results were different than in the previous cases. In this case, the tamping appeared to provide for a more significant (and more immediate) improvement in the geometry. In fact, stone injection did not appear to bring the track back to a level comparable to that of tamping (noting, however, that the initial condition of the track was more severely deteriorated). In addition, the tamped track maintained its raise well as traffic accumulated. In this case, the stone injected track did not show the same type of improvement over tamping as in previous tests (3).

The results of these tests seem to indicate that stone blowing provides a more durable lift than tamping when the lift is small (less than one inch). When the tamping lift is greater than the mid-sized ballast particles, tamping provided a durable lift (3). Since the rate of tamping production is greater than stone injection, the decision as to which is the most effective technique comes down to a question of economics. As in the case of many maintenance operations, the trade-off between improved performance and decreased productivity (and hence increased cost) must be carefully examined before a final decision can be made.

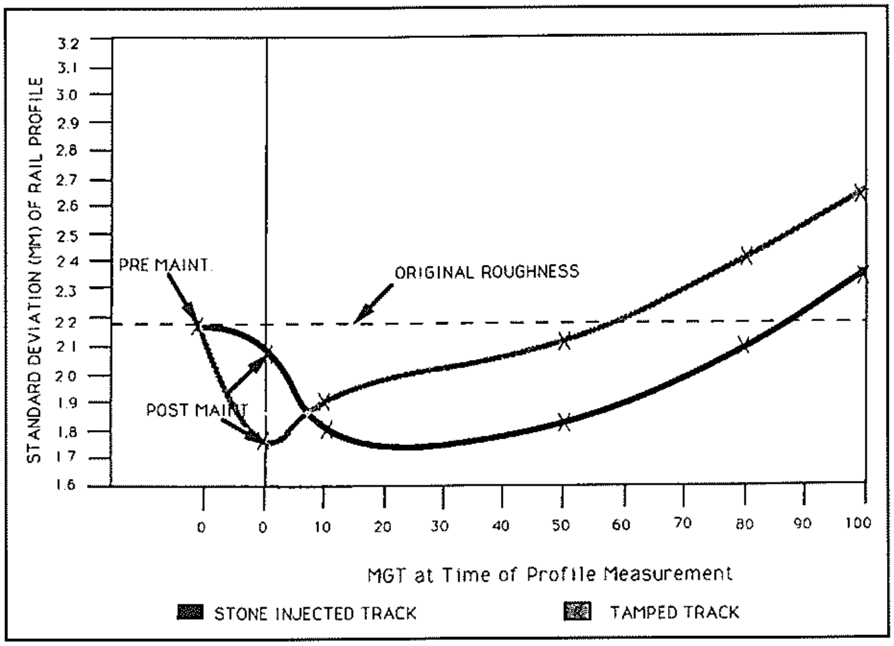

Figure 2 — Track profile roughness of Norfolk Southern crossing number two before and after stone injection and tamping (3).

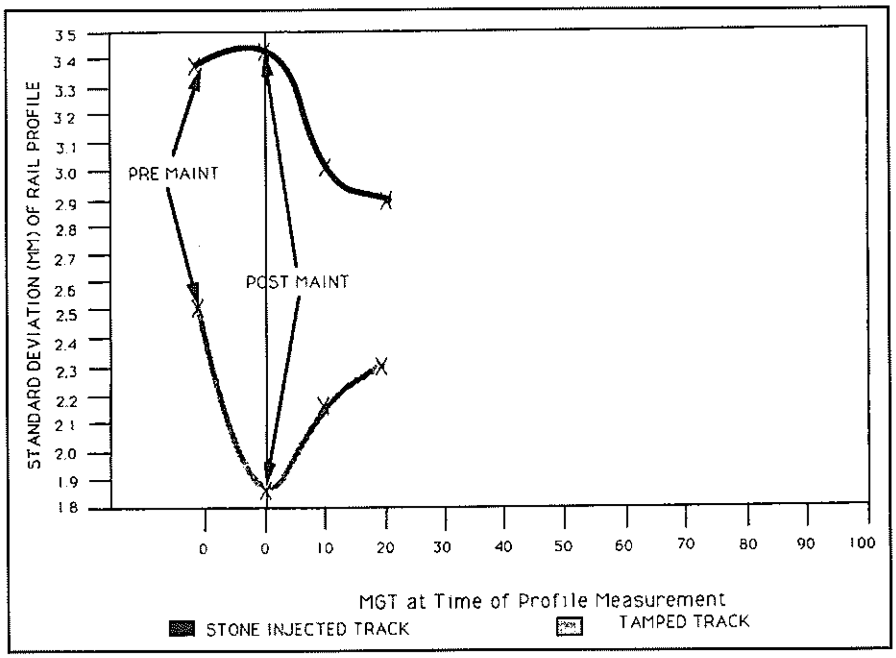

Figure 3 — Track profile roughness of Burlington Northern track before and after stone injection and tamping (3).

References

(1) Johnson, David M., "The Introduction of British Rail's Stone Blowing Technique as an Alternative to Tamping," Bulletin of the American Railway Engineering Association, Bulletin 693, Volume 84, October 1983.

(2) McMichael, P. L., "Stone Blowing from Theory to Practice," Third International Heavy Haul Railway Conference, October 1986, Vancouver, B.C.

(3) Chrismer, S. M., "Track Surfacing with Conventional Tamping and Stone Injection," Bulletin of the American Railway Engineering Association, Bulletin 728, Volume 91, December 1990.