Corrective vs. Preventive Grinding: Recent Results

As reported several times in this column, rail grinding has emerged over the last several years as a powerful and cost-effective tool for controlling rail defects and extending the life of rail in the field. Preventative or maintenance grinding has recently emerged as an effective technique to control rail contact fatigue defects, which include corrugations, spalling and shelling.

This technique, presented in an earlier Tracking R&D column (*RT&S* Dec., 1986, p. 11) attempts to control the development of fatigue cracks on the surface of the rail before they begin to propagate. The process requires frequent grinding to eliminate these surface cracks as they initiate. However, since these cracks are extremely shallow in this early stage, the depth of cut required for these frequent grinds is relatively small. Thus, preventive or maintenance grinding requires frequent, but shallow, grinding passes to control the development of rail surface fatigue and the propagation of associated rail surface defects. (This is in contrast to the more traditional corrective grinding approach which allows surface cracks and defects to develop before removing them by means of deeper grinding, either at slow speeds or with multiple grinding passes.)

Several recently reported applications of the preventive grinding approach have provided data on the effectiveness of this technique under heavy-axle-load conditions[1]. Using shallow grinding cuts of between 0.002 and 0.006 ins. (achieved by using a large grinding

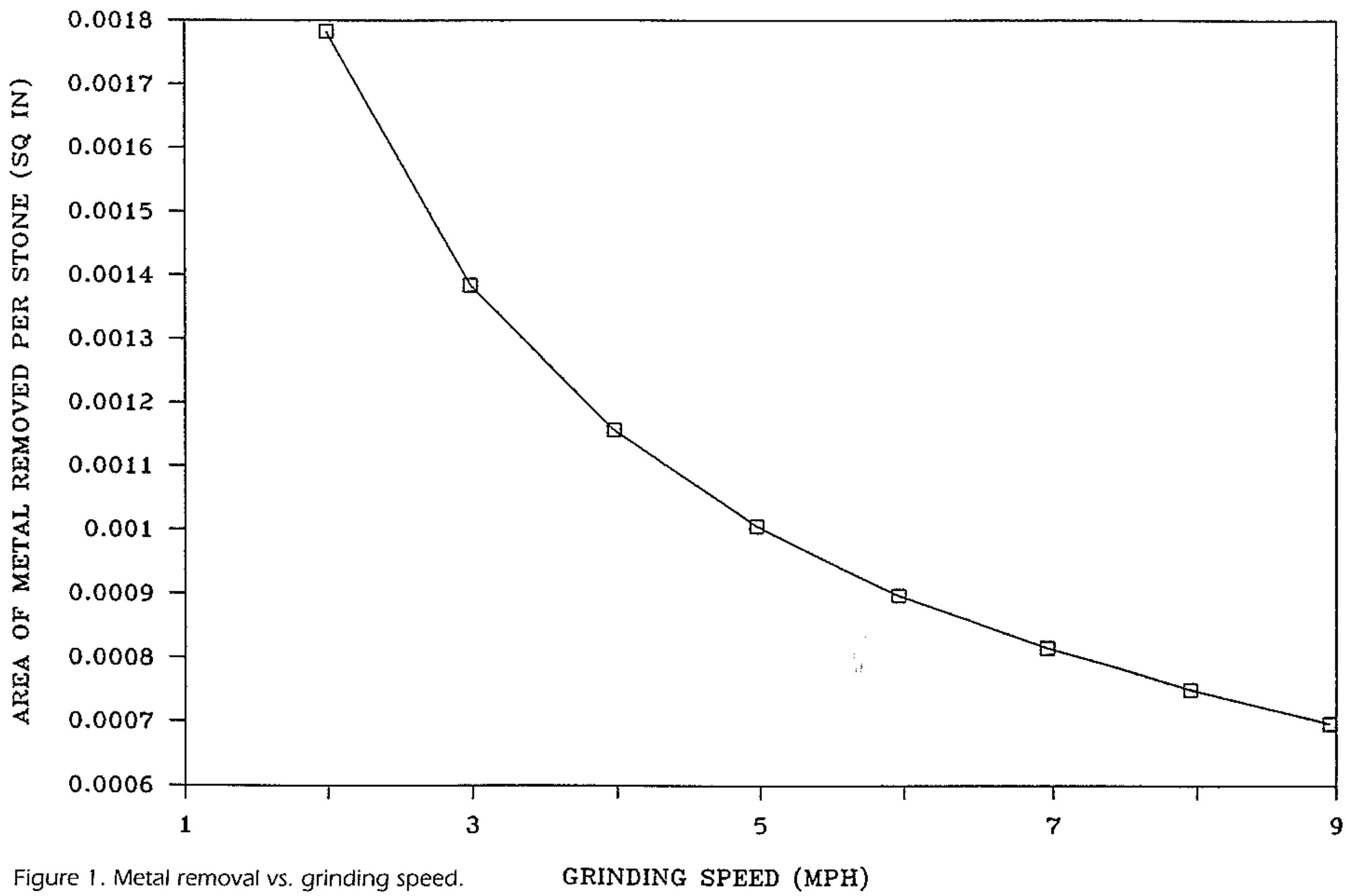

Figure 1. Metal removal vs. grinding speed.

TABLE I Metal Removal On A Sharp Curve[1]			
Grinding Method	**Metal Removal Wear and Grinding (Inch/MGT)**	**Metal Loss at 100 MGT (Inch)**	**Rail Life at 0.75" Head Loss**
Preventive Grinding (8 MGT Interval)	0.001	0.100	750 MGT
Corrective Grinding (25 MGT Interval)	0.0017	0.170	441 MGT
Corrective Grinding (50 MGT Interval)	0.0020	0.200	375 MGT

Table 1 — Metal removal on a sharp curve.

machine at high speed or a smaller machine at low speeds) at intervals of between 5 and 10 MGT (for sharp curves), a set of test curves on two western Canadian railroads was kept free of surface cracks and corrugations for a two-year test period. In those cases where rail surface defects were initially present, a heavy corrective grind was first applied to eliminate any surface cracks. Then, a preventive grinding program was introduced. (It should be noted that the grinding patterns used were profile patterns developed for the specific wheel profiles on those lines, and designed to optimize the wheel/rail contact geometry[1,2].) Based on the results of these tests, rail lives were predicted based on both preventive and corrective grinding techniques for sharp curves under heavy (100-ton) axle loads[1]. (Predictions were based on control of rail-surface fatigue and associated rail defects. Other rail life limiting mechanisms were not considered.) These results are presented in Table 1.

Speed and metal removal

In addition to examining the validity of the preventive grinding approach, this study also addressed the relationship between metal removal and grinding speed (the forward speed of the grinding train) using both laboratory and field tests[1]. The resulting relationship between metal removal, defined by area of metal removed per grinding stone, and grinding speed was non-linear, as presented in Figure 1. (Metal removal is related to several key parameters, including power, stone type and hardness, grinding equipment and rail condition. These parameters have been fixed for the results presented here.) This relationship indicates that for the preventative type of grinding, increasing the speed of the grinding train results in a less than linear decrease in metal removal and a corresponding increase in the "productivity of grinding"[1]. Thus, multiple passes at high speed results in a greater overall amount of metal removal than for a proportionate number of passes at low speed (i.e., four passes at 8 mph removes more metal than one pass at 2 mph). Since grinding costs are usually linear with time or mileage, this relationship translates into a reduced cost per unit of metal removed for higher speed grinding.

These results indicate that frequent, light grinds, carried out at high grinding speeds can result in significant extension of rail life and corresponding cost savings for North American mainline freight operations. This result, which is supported by earlier reported research[3], indicates that even further potential for rail life extension and associated rail cost reduction exists in today's (and tomorrow's) operating environment.

References

(1) Kalousek, J., Sroba, P., and Hegelund, C.. "Analysis of Rail Grinding Tests and Implications for Corrective and Preventive Grinding," 4th International Heavy Haul Railways Conference, Brisbane, Australia, September 1989.

(2) Zarembski, A. M., "The Evolution and Application of Rail Profile Grinding," Bulletin of the American Railway Engineering Association, Bulletin 718, Volume 89, December 1988.

(3) Zarembski, A. M., "The Economics of Rail Grinding and Rail Surface Maintenance," 3rd International Heavy Haul Railways Conference, Vancouver, B. C. Canada, October 1986.