Part IV: Prediction of Fuel Saving from Friction Control in Revenue Service

As part of the initiative to reduce fuel consumption during the last three decades, the railroad industry has been very active in research and test to identify the benefits derived from the implementation of friction control measures. The results from this research have shown that friction control implementation not only helps reduce fuel consumption but also helps in increasing rail life and mitigate noise and vibration effects due to higher speeds and axle loads. Closed loop (controlled) testing at the Facility for Accelerated Service Testing and limited revenue service demonstrations of implementing friction control systems have documented a reduction in fuel usage between 3% and 15% depending on the route, train handling, and existing practices.

Friction control also provides other benefits, such as reduced rail wear and improved curving forces, which should be considered in the overall economic cost/benefit analysis. Train energy savings predicted from this modeling are site and system specific. Results, from both a closed loop and field test sites, have also shown a reduction in rail wear with the implementation of rail gage face lubrication. Typically, this results in an increase of rail life in the range of 2 to 3, meaning that if rail is replaced every 3 years lubrication can extend the rail replacement from 6 to 9 years.

In a study conducted by TTCI researchers, TTCI's Train Energy Model was used to predict the energy savings over several revenue service routes on a western railroad using gage face (GF) and top of rail (TOR) friction control systems. Predicted energy savings were route specific and ranged from 2.9% to 10.6% when both systems were active and applying the product correctly over the entire route length. TOR specific savings dominated the total energy reduction on routes with long tangents and few curves; whereas, in mountainous routes, with mostly curved track, GF systems provided 50% of the total savings.

The table shows the results of the simulations. For every simulation, the following test train was used: Three SD60 locomotives and twenty 5-pack double-stack container cars with a gross rail load of 230 tons for a total trailing tonnage of 4,600 tons. For each simulation, the results are shown for both dry and lubricated conditions. The savings shown in the table are a combination of both TOR and gage face lubrication. Savings are shown in three different ways for each section of track. This allows for a better comparison of the savings depending on the specific route of interest. The data suggests each terrain affords a different savings. System-wide benefits are best seen from mobile based systems, usually locomotive mounted, and allowing friction control to be applied at all locations along a given route. To predict the exact savings in fuel consumption requires detailed information on train operating characteristics (car weight and train speed), route (curves and grades) and status of existing lubrication systems.

Route	Distance (mi)	Route	Total Fuel Dry (gal)	Total Fuel Lubed (gal)	Delta (gal)	Savings (gal/mi)	Savings (%)
A	483	Very little grade or curvature. Average speed of 60 mph	2,334	2,170	164	0.34	7.0
B	470	Very little grade or curvature. Average speed of 60 mph	2,998	2,807	191	0.41	6.4
C	55	Moderate grade and curvature. Average speed 30 mph	684	664	20	0.36	2.9
D	423	Moderate grade and curvature. Average speed 55 mph	1,704	1,575	129	0.30	7.6
E	170	Moderate grade heavy curvature, average speed 27 mph	1,571	1,496	75	0.44	4.8
F	105	Moderate grade heavy curvature. Average speed 45 mph	218	195	23	0.22	10.6

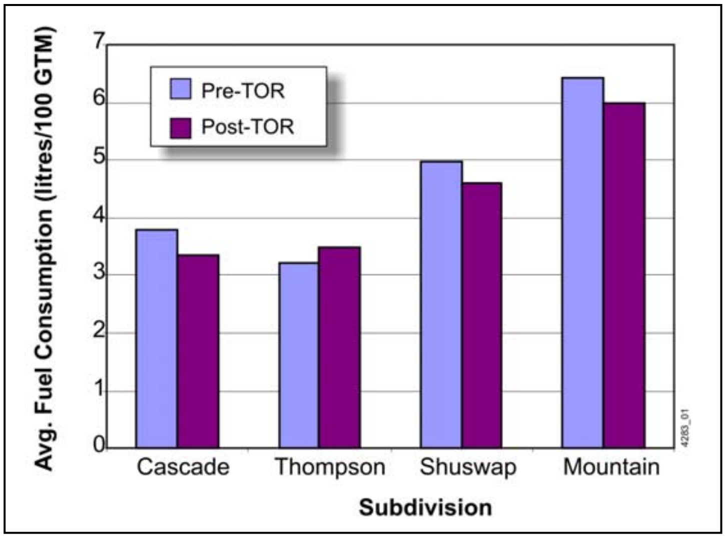
A large-scale implementation of TOR friction control is currently under way at CP Rail over sections of their western coal routes. In order to help pay for a large investment of wayside TOR friction control units, the CP management required that budget dollars be transferred from the fuel budget to the engineering budget, demanding auditable and accurate estimates. The business case required to go ahead with a large-scale implementation of TOR friction management presented a particular challenge when it came to estimating the potential fuel savings, according to Mike Roney, CP's General Manager Track Maintenance.

As of April 2009, 137 TOR units, out of the 325 planned for the western corridor and coal route, had been installed and commissioned to add to the 14 existing units, The installation of the TOR units was completed in three subdivisions including the Cascade, Thompson, and Shuswap subdivisions, plus one half of the Mountain Subdivision.

The below figure compares the fuel consumption of liters per 1,000-gross-ton miles over each of the four subdivisions for the period September 2007-March 2008; i.e., the equivalent periods before and after addition of TOR friction modifiers. The sample of trains included 1,606 trains over this 488 mile length of the railway before implementation of the TOR friction modification program and 1,350 trains over the routing after TOR.

"The measured fuel savings compared before and after implementation of TOR friction management were greater than 5%, which was greater than the 3% assumed in the business case," says Roney.

"This was in spite of the fact that the audit period covered the most severe cold weather and snow conditions of the year. The fuel savings would have averaged closer to 8%, except that the audit showed an increase in fuel on the Thompson Subdivision, which resulted from an increase in fuel consumption during a large work program when the lubricators and the TOR units had been turned off," he added.



Measured Fuel Consumption in Liters per Million Ton-Miles before and after implementation of Top of Rail Friction Modification (Courtesy of CP Rail)