

Green Technologies for Improved Operations at FAST



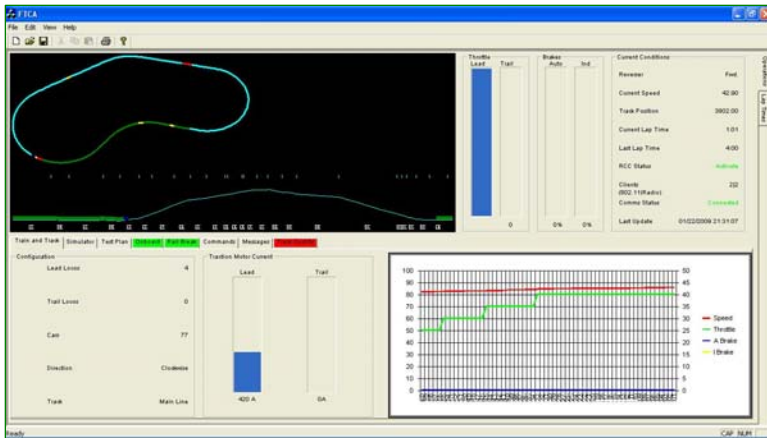
Test Train at FAST

TTCI engineers begin unmanned operations at the Facility for Accelerated Service Testing (FAST), Transportation Technology Center, Pueblo, Colorado

Green Engineering is defined by the US Environmental Protection Agency as "the design, commercialization, and use of processes and products, which are feasible and economical while minimizing risks to human health and the environment." One related effort undertaken by TTCI engineers has focused on gradually automating the train operations at FAST.

TTCI engineers have implemented a cruise control algorithm and successfully operated the FAST train with a one-person crew over a period of two years. The ultimate goal was to operate the train without an engineer in the cab. At the end of 2008, unmanned train operation trials began. Since January 2009, a 13,000-ton train comprised of four locomotives and eighty 315,000-pound cars traveling at 40 mph constant speed began operating without a locomotive engineer at FAST. The train is operated over the 2.7 mile High Tonnage Loop, where a number of controlled experiments are being conducted, to determine the impact of heavy axle load cars on track components and maintenance procedures. The Association of American Railroads and the Federal Railroad Administration jointly fund the program.

The automated train movements at FAST are controlled by an integrated onboard computer that uses GPS, track information, train makeup, wayside system data, and dynamic train input. The system varies throttle position in response to changing conditions (wind, precipitation, rail lubrication, grade, etc.). Throttle control has been optimized to reduce in-train forces. The onboard system will bring the train to a stop if a rail break is detected by the track circuit, or if directed to do so by remote command. The onboard system provides feedback to the Train Controller (TC) and Locomotive Engineer (LE) on the ground, if it is unable to make track speed, if it detects wheel slip, or if it detects a trainline alarm.



Locomotive Engineer/Test Controller Control Screen

TTCI developed a “real-time” onboard track monitoring system to replace the engineer’s knowledge of and feel for the track. The onboard system reports abnormal accelerations at the locomotive truck and frame. The ride quality indices are reported to the TC and LE within 15-20 seconds of passing a detected spot, allowing time to stop the train if necessary. Track condition and exceptions are stored for later review.

MeteorComm™ data radios handle critical communication. These radios are also being used as part of current Positive Train Control development work by TTCI. Noncritical operational information, with redundancy, is passed through an outdoor 802.11 G radio network. Final redundancy is a 2-way end-of-train device and head-end-units that can activate stop commands remotely.

Reduction in locomotive idle time at FAST

Initially, weekly FAST train operations began on Sunday night. As a result, the locomotives would idle over the weekend to reduce the likelihood of start-up trouble on Sunday night when no support staff was available on site. Recently, the train operating schedule was changed to reduce locomotive idle time, and now start-up begins on Monday night so that the locomotives are shutdown over the weekend and start-up can be handled by the daytime crew on Monday.

The change in the operating schedule reduced locomotive idle time by an average of 260 hours per week during normal operations at FAST (about 25 weeks per year). FAST locomotives burn about 6 gallons of diesel/hour. The reduction in idle time results in savings of about 1560 gallons/week or 39,000 gallons/year. Total fuel savings since the program was instituted in 2006 are estimated at 86,000 gallons.

Reducing fuel and wear through lubrication at FAST Another way TTCI helps railroads go green

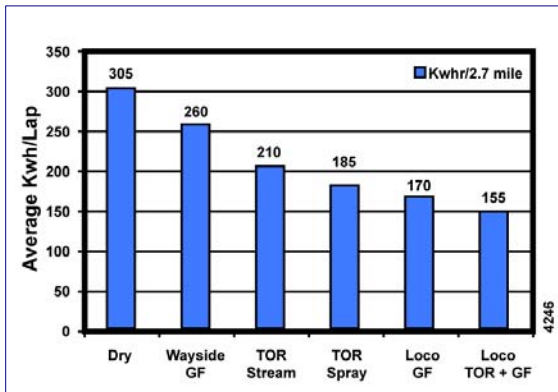
Just like oiling the sliding surfaces and pulleys on your garage door, railroads have gained significant benefits by applying lubricants and friction modifiers to the wheel and rail interface. By reducing friction on the side of the rail, energy needed to pull long and heavy trains around curves can be significantly reduced. Railroads now use an

array of specialized products and purposely built application systems to get the right product at the correct location on top and/or side of the rail. This has shown benefits by reducing fuel consumption 5% to 15%, wear of rails by over 50%, and curving forces by at least 30%.

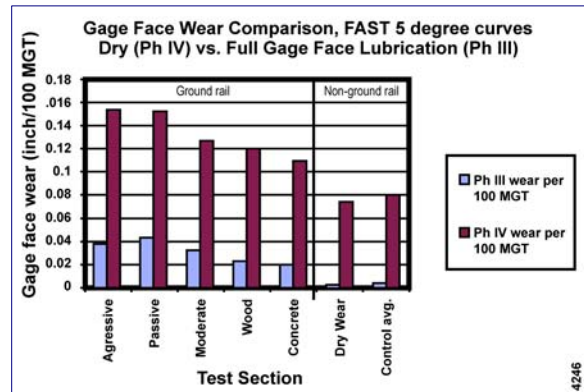
The net effect of extending rail wear life by 50% reduces the need for new resources not only to produce new rails, but for the cost of transporting and installing, all of which reduces emissions, thus the carbon footprint of the industry. Even a 5% reduction in fuel consumption, when coupled with the 3-billion gallons used annually by railroads, places a significant dent in the railroad's impact to the environment, while at the same time eliminating thousands of truck loads from the highway, and reducing America's use of fuel and subsequent emissions.

Testing different application systems on a closed loop at FAST is one way of assessing impacts to energy and wear. The first plot shows the effect on side wear (gage face) of sharp curves with and without lubrication. The raw difference (unground) life of rail is increased by a factor of 50 with consistent lubrication. When normal rail grinding maintenance is factored, this same difference is still a factor of 10 or more.

Likewise, the second graph shows energy consumed over a closed loop, indicating energy (in the form of kilowatt hours) can be reduced by over 40%. While results from closed loop tests represent carefully controlled systems, field implementation of these same lubricant systems has shown reductions in energy of 5% to 15% and increases rail life by at least a factor of 5.



**Energy Consumption:
Closed Loop with a Range
of Application Systems**



**Rail wear: With (blue) and
Without (red) Lubrication**