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TECHNICAL EXPLANATION OF THE RESULTS OF THE FPC-1® TEST AT SOUTHWEST RESEARCH INSTITUTE

The following are technical explanations for the observed effect of FPC-1® fuel treatment upon engine performance and fuel properties during the Association of American Railroads (AAR) Recommended Practice 503 (RP-503) recently conducted by Southwest Research Institute (SwRI).

Fuel Economy

Fuel economy is improved by either a more complete combustion of the fuel in the engine, higher combustion rates (reduced time losses), or both in combination. Steady-state laboratory tests, such as the RP-503, involve like new engines operated under ideal conditions. Consequently, steady-state laboratory tests tend to minimize the potential for fuel economy improvement. In fact, measured fuel economy is usually lower for laboratory studies than for field studies with similar equipment.

No field engine is operated at fixed engine speed (rpm) and load. The non-steady state operation of engines in the field creates transient phenomena which lead to combustion inefficiencies. For example, field tests with FPC® Catalyst of several EMD, GE and Alco engines have shown gains of 3-8% in bsfc, nearly five times the 1.74% improvement seen in the RP-503.

Similarly, U.S. EPA Federal Test Procedures (FTP) and Highway Fuel Economy Tests (HFET) at what used to be referred to as "EPA approved laboratories" with FPC-1® in high speed diesel engines show an average 4% improvement in fuel economy. Field tests in over 2000 high speed diesel engines at 31 different field sites show an average improvement of 6.7%.

Emissions

The emissions levels in the SwRI engine were already very low in the baseline steady-state operating condition. Most of the main formation mechanism for CO, HC, and particulate, such as crevice and quenching effects, are largely unaffected by reductions in combustion time losses and small changes in the overall fuel/air ratios. We have seen the same trend in field tests of large equipment fleets--fuel consumption decreases while emissions remain unchanged, if the emissions levels were low to begin with. However, one important difference exists between the SwRI laboratory test and field tests--most medium and high speed diesel engines produce CO, HC, and particulate at levels much higher than the twelve-cylinder EMD 645E3B engine. In these cases, FPC Catalyst has improved not only the bsfc but also substantially reduced the CO, HC, and particulate emissions.

Engine Life

The 1G2 engine wear test confirmed FPC® Catalyst fuel treatment has no harmful effect upon engine life. Non-steady state field tests have shown FPC® Catalyst can actually increase engine component life.

Many of the engines tested with FPC® Catalyst appeared to have had significant carbon build-up in the combustion chamber and on the pistons prior to treatment with the catalyst. At the conclusion of well more than a dozen different tests with the catalyst, engine tear-downs revealed markedly reduced and softer deposits in the combustion chamber and on the piston crown and rings. After observation of many field evaluations and laboratory tests, it appears that the measured improvement in fuel economy with the catalyst, which is almost always greater for "dirty" (smoking) engines than for like-new engines, results from decreased time losses, reduced combustion gas blow-by, and increased completeness of combustion. The increased combustion efficiency necessarily leads to reduced CO, HC, and particulate levels. Additionally, the softening and removal of carbon deposits reduces engine wear, and can have a positive effect upon engine life in field engine operation.

Fuel Properties

Because the FPC® Catalyst active ingredient is so effective, only minute quantities need be added to the fuel. Consequently, fuel properties remain unaffected after FPC® Catalyst treatment.

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