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FPC[®] CATALYST RAILROAD TESTING

Association of American Railroads RP-503 Test Procedure

Of the many procedures by which fuel additives are tested, the standards set by the Association of American Railroads (AAR) are the most stringent. The AAR Recommended Practice (RP)-503 procedure involves a three phase test sequence in which baseline and treated fuel specifications are analyzed and compared, combustion products and engine wear effects are carefully examined, and finally, fuel consumption changes are precisely measured in a "like new" EMD645E3B diesel engine.

This test procedure was conducted at Southwest Research Institute (SwRI), San Antonio, Texas, using diesel fuel treated with the FPC[®] Fuel Performance Catalyst. The findings of the test program reported in the final SwRI report were:

- (1) A measured **1.74%** reduction in fuel consumption as a result of FPC[®] fuel treatment. *(That effect under controlled laboratory conditions and at optimum engine operating conditions translates to a 5% to 8% improvement under normal operating conditions as confirmed by U.S. and Australian experience).*
- (2) No adverse wear or deposits on engine components.
- (3) No increase in regulated exhaust emissions.
- (4) No alteration of fuel specifications.
- (5) A transition engine preconditioning period of several hundred hours from the start of FPC[®] fuel treatment to the point of the new level of engine performance was observed, and verified (see Appendix 1, 200 Hour Preconditioning Test on FPC-1[®]). The preconditioning period had been observed in a number of prior laboratory and field trials.

Six U.S. and one Australian railroad have now run controlled tests with the FPC[®] fuel catalyst and the results are summarized below.

Willamette and Pacific Railroad, Inc.

The W&P operates a fleet of 31 locomotives dominated by GP39-2's. The W&P elected to evaluate FPC[®] for fuel economy and emissions by testing six identical GP39-2 locomotives. The test fleet was divided into two groups, three treated and three control. All locomotives were tested at throttle notch settings 2, 4, 6, and 8, while loaded to 80%.

After testing all six locomotives on base fuel, the treated fleet was run on FPC[®] treated fuel during normal service for one month, and the test procedures repeated. The average fuel economy improvement compared to the control fleet was **4.3%**. Smoke was reduced **15%**. These results were achieved after only 250 hours of pre-conditioning the locomotives. The recommended pre-conditioning period is 500 hours.

The W&P has used FPC[®] catalyst for approximately 4 years. They have observed reduced exhaust smoking cleaner eductor tubes and air boxes, and virtual elimination of fouled injector problems.

Kyle Railroad

Kyle Railroad operates approximately 34 locomotives, including 16 U30's. Kyle Railroad tested FPC[®] on five U30C-2 GE engines while self loaded. Tests at multiple notch settings (2, 4 and 6) were **5.4%** more fuel efficient after six weeks of FPC[®] fuel treatment. Smoke emissions were reduced **21%**. The five locomotives tested had only 300 hours of pre-conditioning, 200 hours less than the recommended pre-conditioning period of 500 hours.

Kyle Railroad has used FPC[®] catalyst for approximately 3 ½ years.

Alaska Railroad Corporation

This state-owned railroad operates 51 locomotives. The ARR undertook to measure the effect of the FPC[®] Catalyst on a fleet of GP40-2 locomotives. Baseline tests at 80% load and multiple throttle notches were first conducted, followed by a six-week preconditioning period (approximately 500 hours of operation) and finally a second test identical to the first, only with FPC[®] treated fuel.

Fuel consumption was reduced **8.2%** after FPC[®] treatment. Exhaust smoke was reduced **36.1%** at idle and **24.3%** on average across all notch settings.

Wisconsin Central Transportation

Using two different methods for measuring fuel consumption with a loadbox, four normally aspirated (roots blown) locomotives were tested before and after FPC[®] fuel treatment. Two SW1500 Switchers, and two GP35's (modified to normal aspiration) were first tested on the loadbox with base fuel. Fuel was then treated with FPC[®] and after a two month engine preconditioning period, the treated fuel tests were conducted.

Fuel economy was improved an average **6.5%**, as measured by an indirect method of determining fuel flow rate at multiple throttle notch settings (2, 4, and 6). A second method using a weigh scale showed an average **5%** improvement (throttle setting of 6 only). Fuel economies were more profound in the two SW1500s, as these locomotives operated in the yard only, and were consistently treated with FPC[®], unlike the two GP35s that missed approximately three weeks of treatment during the preconditioning period. The SW1500 were treated for the entire period.

Mechanics also observed reduced exhaust smoking, and cleaner spark arresters, carbon plugs, eductor tubes and air boxes. Exhaust sparking was visibly reduced. A "bar over" on one of the GP35's revealed reduced carbon buildup on piston crowns and in ring zone areas.

Several weeks later, a third test was conducted using the weigh scale method, and a SD45 locomotive (a turbocharged 645 EMD). The test showed a **4.54%** reduction in bsfc (pounds of fuel per horsepower hour) at throttle setting 8, even after the test locomotive missed four fuel treatments during the engine preconditioning period (45 days).

Wisconsin Central implemented FPC[®] treatment of select locomotives during 1998 to observe long term benefits of FPC[®] Catalyst. Based on the extremely positive results of this test, full system treatment was initiated in January 1999 on approximately 240 locomotives.

Montana Rail Link/Washington Central Test (Columbia Basin Railroad)

Montana Rail Link operates 114 locomotives over 957 miles of track. Washington Central operated a fleet of seven locomotives. Washington Central Railroad (WCR) and Montana Rail Link (MRL) collaborated on a test of FPC-2[®] with four MRL owned SD9 locomotives on lease to the WCR. The four normally aspirated 567C EMD engines were tested before and after FPC-2[®] fuel treatment. All engines were connected to a loadbox and tested at full load. Fuel consumption was reduced **9.4%**, **6.9%** and **6.8%** at throttle notches 2,4, and 6.

Engine exhaust smoke density was also reduced with FPC[®] treated fuels. Smoke density was reduced **36%** at idle, **31%** at notch 2, **24%** at notch 4, **26%** at notch 6, and **17%** at notch 8.

Montana Rail Link, as a result of this test, has been treating their fuel system with FPC[®] Catalyst since the spring of 1997. Columbia Basin Railroad (a.k.a. Washington Central) has also been treating with FPC[®] since the summer of 1997.

Australian Railroad Test

Goldworthy Mining Limited (GML) operates a fleet of 10 locomotives comprised of English Electric 6CSRKT and 12CSVV, and a Clyde EMD JT42C. The GML fleet had been treated with FPC[®] for several years when a change in management resulted in catalyst fuel treatment being discontinued for a time. A statistical study at the time the mine ceased using FPC[®] showed fuel consumption increased 4.8% after the catalyst was discontinued.

CONCLUSION

The U.S. and Australian field tests with EMD, GE, and English Electric powered locomotives confirm the significant fuel savings potential of FPC[®], and that under normal commercial operating conditions, the fuel economies achieved are much higher than that measured under a controlled laboratory test in a like-new engine, operating under optimum conditions.

The tests confirm fuel consumption will be reduced from 5% to 8% average for a fleet of locomotives operating on FPC[®] treated diesel fuel.

Secondary but significant benefits of FPC[®] have also been well documented in these studies. These benefits include:

- **Reduced smoke emissions (15-36%)**
- **Reduced carbon buildup on engine components**
- **Reduced exhaust sparks, leading to the reduction of wayside fires**
- **Cleaner eductor tubes, air boxes, carbon plug, and spark arrestors**

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