Automated Air/Fuel Ratio Controls

NaturalGas EPA POLLUTION PREVENTER

Partner Reported Opportunities (PROs) for Reducing Methane Emissions

PRO Fact Sheet No. 111

Applicable sector(s):

- [x] Production
- [x] Processing
- [x] Transmission and Distribution

Partners reporting this PRO: ChevronTexaco

Other related PROs: Reduce the Frequency of Engine Starts with Gas, Replace Gas Starters with Air, Replace Ignition—Reduce False Starts, Convert Engine Starting to Nitrogen

- Compressors/Engines [x]
- Dehydrators [ ]
- Pipelines [ ]
- Pneumatics/Controls [ ]
- Tanks [ ]
- Valves [ ]
- Wells [ ]
- Other [ ]

Technology/Practice Overview

Methane Savings: Averaged 128 Mcf per unit per year

Costs

Capital Costs (including installation)

[ ] <$1,000 [ ] $1,000 – $10,000 [x] >$10,000

Operating and Maintenance Costs (annual)

[x] Installing system reduces maintenance costs

Payback (Years)

[ ] 0–1 [x] 1–3 [ ] 3–10 [ ] >10

Benefits

Increasing profitability by reducing fuel consumption and maintenance cost was the primary reason for installing the controllers. Reducing methane and pollutant emissions were associated benefits of the project.

Description

Natural gas-fueled internal combustion engines can provide continuous duty operations over a set range of air to fuel ratios (AFR). In general, high fuel to air mixtures (rich) are used when more power is desired and a high AFR mixture (lean) is used when less power and more fuel efficiency is the goal. Rich conditions result in greater unburned fuel emissions (primarily methane), higher CO emissions, and less NO_x emissions. Lean conditions produce less methane emissions, lower CO emissions, but higher NO_x emissions. Manufacturers' engine performance curves for standard rich burn engines indicate that when AFRs exceed a value of 18:1 (stoichiometric conditions are approximately 16:1 AFR) temperature, power and NO_x emissions start to decrease. These engines, equipped with conventional controls that continuously monitor exhaust gas oxygen levels with a single sensor, are not capable of operating for extended periods with AFRs in excess of 20:1. Typically, specially configured lean burn engines (AFRs 20:1 to 50:1) with turbo chargers or pre-combustion chambers are used where low NO_x emissions is the goal.

One partner has achieved a fuel savings of 18 percent to 24 percent and reduced associated emissions by installing an automated AFR control system called REMVue. REMVue monitors several engine parameters to correct imbalances. The system, marketed by REM Technology Inc., achieves the reported results through a combination of electronic control, use of a high-energy long duration spark to ensure reliable ignition, and other mechanical modifications to the engine. Alarm or shut-down triggers can be set to react to various real-time engine operating parameters, which can reduce the rate of catastrophic failure. Equipment life and routine maintenance are also improved but are more difficult to quantify.

Operating Requirements

The technology can communicate/interface with most existing electronic control and telemetry systems.

Applicability

The greatest opportunities for system and efficiency improvements are on rich burn, high-speed, turbocharged engines (1,000 hp to 3,000 hp).

Methane Emissions Reductions

Unburned fuel is a source of methane emissions from reciprocating natural gas-fueled engines. A partner has reduced its fuel consumption by 18 percent to 24 percent by installing automated AFR controls on 51 selected engines in its Gulf of Mexico operations. It achieved an average emission reduction of 128 Mcf of methane (AP-42 emission factors) per unit per year by reducing the engines' fuel consumption. Using the vendors "as found" methane emission factors for similar engine conditions, the reduction is 758 Mcf. The vendor found that operators, in general, run engines in a rich AFR state that provides the most reliability for field operations. Their emission factors are greater than those reported in AP-42.

Economic Analysis

Basis for Costs and Savings

The partner reported a reduction in fuel consumption in excess of 2,900 MMcf during a two-year period as the result of installing the REMVue technology on 51 engines, or an average of 78 Mcf per day per engine when adjusted for load. This represents a 39 percent increase in estimated fuel savings (based upon a sample inventory, which yielded a pre-job fuel savings estimate of 56 Mcf per day). The total reported cost was $6.1 million. Capital costs, including installation, ranged from $85,000 to $140,000 per unit, with the average cost for the last two years being $120,000 per installation. At a nominal value of $3 per Mcf, the fuel savings was more than $4.35 million for a calculated payout of 1.4 years.

Discussion

Payout economics are based solely on the value of the fuel reduction and capital cost to install the system on the 51 engines. Other reported benefits of fewer misfires, easier engine starting, and more reliable operations (reduced blowdown emissions) are not included. The partner found that the additional cost of operating the REMVue systems is offset by the reduction in engine maintenance costs. A reduction in NO_x and CO_2 emissions are an added benefit of the system.

A post-audit was conducted on 20 percent of the installed base in 2004. Among the engines that were revisited, there were some that were retrofitted as early as 2001. The post audit reviewed pre-, post- and post-post-values for fuel consumption, emissions reductions, availability, and economics based on a normalized gas price. The emissions reduction results showed that unburned hydrocarbons were down 3,549 tons per year, CO_2 emissions were down 2,309 tons per year, and CO emissions were down 83,300 tons per year. There were no changes in NO_x emissions. Availability increased 2.25 percent for the 12 months pre-installation versus 12 months post-installation.