White Sands "CleanBoost-Low Emissions" Test Data Analysis for testing done by Texas Commission on Environmental Quality (TCEQ) and Environmental Protection Agency (EPA)

Overview

CleanBoost-LowEmissions (CB-LE) has been formulated to reduce the exhaust emissions from high aromatic low cetane diesel fuels to produce the same emissions as a low aromatic high cetane diesel fuel, known as CARB or TxLED fuels. CB-LE is a fuel additive developed on the science of combustion, and tested at the accredited Southwest Reach Institute (SwRI) in San Antonio, Texas.

CB-LE can be injected directly into the diesel fuel at terminals, refineries or storage tanks using standard equipment with no special storage or handling requirements. When added to diesel fuel CB-LE significantly reduces emissions of nitrogen oxides (NOx), hydrocarbons (HC), particulate matter (PM), and carbon monoxide (CO) without sacrificing fuel economy or power.

In addition to the emissions reduction CB-LE increases the cetane number of the fuel and can reduce the costs associated with the use of terminal or refinery additives. When CB-LE is introduced into low cetane, high aromatic content diesel fuel, the treated fuel qualifies as a TxLED-compliant Premium diesel fuel.

Emission Reductions

Results may vary as each fuel responds differently. CB-LE was added to a high aromatic, low cetane ULSD fuel, (Candidate). This fuel is expected to produce high exhaust emissions, and is representative of fuels burned in Texas today. The results would be compared to a low aromatic, high cetane ULSD fuel, (Reference). This fuel is expected to produce the lowest exhaust emissions in diesel fuel today (TxLED or CARB). Each fuel had intricate analyses completed to verify its integrity before and after dosing and engine testing.

Before testing, a detailed test plan with fuel analyses and chains of custody was presented to TCEQ. This plan was reviewed and approved by TCEQ for verification of comparable exhaust emission results between the treated Candidate fuel and the Reference fuel. The

EPA accepts this test as a certified result comparing the two fuels' exhaust emissions. Testing was performed under the observation of TCEQ at SwRI. Emissions were captured on filters, bagged, and compared using a calculator designed by the EPA. The average exhaust emission results using the treated candidate fuel were compared to the adjusted average exhaust emission results using the reference fuel.

- NOx emissions from the Treated Candidate fuel were found to be 0.02% lower in the Treated Candidate fuel than the Reference fuel.
- PM emissions from the Treated Candidate fuel were found to be 0.3% lower in the Treated Candidate fuel than the Reference fuel.
- HC emissions from the Treated Candidate fuel were found to be 13% lower in the Treated Candidate fuel than the Reference fuel.
- NMHC emissions from the Treated Candidate fuel were found to be 13% lower in the Treated Candidate fuel than the Reference fuel.
- CO emissions from the Treated Candidate fuel were found to be 1.5% lower in the Treated Candidate fuel than the Reference fuel.

Results of testing were analyzed by technical review by TCEQ and the EPA. The results show an average diesel fuel treated with CB-LE has the potential to burn as clean if not cleaner than a fuel that only a handful of refineries have the ability to produce. Counties with attainment issues can incorporate CB-LE into SIP plans without burdening the public with costly solutions.

Testing Procedures

The following brief description of the testing procedures may aid in understanding the results:

The test plan selected was 1of 4 options made available by the EPA and TCEQ. This particular plan was designed for products that have a residual effect.

1. Run at least 6 tests on the approved reference fuel to measure emissions.
2. Condition the motor with Treated Candidate fuel up to 72 hours.
3. Run at least 9 tests for averaging with the treated Candidate fuel.
4. Run the Reference fuel 6 tests to observe any negative impact the additive might have on the Reference fuel base line emissions.

Keeping the above steps in mind, White Sands did the following:

1. Ran 9 tests for averaging.
2. Ran a 24 hour conditioning period. (most companies run the fuel 72 hours)
3. 9 tests were run.
4. 6 tests were run.

A 99% confidence level was used to ensure the validity of equipment and tests results. NOx reductions are the main target for TxLED but the rules state you can not raise the

other emissions above the Reference fuel levels. Therefore, the Candidate would have to have reductions on other emissions to achieve a pass.

The following graph will demonstrate how CB-LE reduced emissions in a Candidate fuel to meet those of the Reference fuel, and further reduced the emissions from the Reference due to the residual effect of using CB-LE. CB-LE cannot only make a high emission fuel respond like the cleanest fuel available but can make a clean fuel even cleaner.

NOx R (Blue) is Reference fuel run first. NOx C (Purple) line is Treated Candidate fuel run 2nd. NOx RR (Yellow) is Re-run of Reference fuel run 3rd.
It should be noted that after only 24 hours of conditioning CB-LE treated Candidate fuel (Purple) shows a trend of continued reduction. The Candidate fuel untreated in a prior uncertified test showed a base NOx number of 5.100 g/bhphr. The NOx RR (Yellow) shows a reduction in reference fuel NOx resulting from the residual effect of CB-LE.

- CB-LE has been tested in a range of fuels and undergone watershed, stability and no-harms testing.
- CB-LE contains neither oxygenating components nor organometallics. The formula can be splash blended with little to no disruptions to any company's operations.
- CB-LE is registered with the EPA (EPA Registration Number 201920002)