# Fuel Consumption and Emission Tests of the Saarthi Hydrogen Fuel Systems Technology

Saarthi K-20™ & K-30 Hydrogen Fuel System on GM - Chevrolet Tavera Neo 2 – 2.5 Liter Diesel Engine

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## About Saarthi Hydrogen Systems

Saarthi GreenTech, based in India & Australia, is a company devoted to minimizing fossil fuel emissions and fuel consumption through their innovative hybrid fuel technology, which employs patented HHO (Brown Hydrogen) generation systems. Established in 2022, Saarthi GreenTech was formally known as Saarthi GreenTech Private Limited.

For over a decade, our researchers have been actively engaged in designing, developing, and implementing hydrogen fuel systems for various vehicles. The team's primary goal is to reduce emissions and carbon footprints, conserve fuel, and accelerate the transition towards cleaner energy. To achieve this, they consistently create and refine systems that can enhance fuel efficiency and lower emissions for vehicles of various sizes, including earthmovers, without compromising safety or the driving experience.

Saarthi GreenTech manufacturing facility and laboratory at Chakan in Pune, India, collaborate with certified research and testing labs to ensure that their work remains relevant and aligned with the rapidly evolving automotive industry.

## Our mission & Goal

Our goal is to be a pioneering, top-tier engineering team dedicated to promoting the creation and rapid adoption of secure, eco-friendly, and high-performance technologies and strategies that aid in decreasing emissions and fuel consumption in fossil fuel-powered vehicles and engines around the world.

# Table Of Contents

## List of figures



## List of tables

## Context

Saarthi GreenTech team relies in providing tested and proven technologies to its clients. The team ensured that the testing of the units should less in lab and more in practical conditions that give results that are closer to the real scenario.

While it is a proven through several research across the world, that HHO can help reduce emissions and help reduce fuel consumption, it is critical that Saarthi GreenTech tests its own models and comes out with the true data of emission and fuel reduction.

**Vehicle for testing** – Mahindra Dumper: Blazo X 28, with Engine of 7200 cc. The engine runs on latest BS6 emission standards as per the regulations of Government of India. The year of manufacturing of the dumper truck is 2022 and age of vehicle when tested is little less than 8 months. Fuel used by the Dumper truck is Diesel.

Vehicle Class: The dumper truck is CLASS 8 vehicle with 28000 Kg as gross vehicle weight (GVW).

## Technology

Saarthi-HFS™ technology is designed for on-road, off-road and static applications with Class 1 - 9 vehicles, Earthmovers, Static engine applications like Gen Sets and marine engines. Saarthi-HFS™ is a portable, safe, and reliable aftermarket unit that produces hydrogen and oxygen (HHO) on demand, from the electrolysis of distilled water. The addition of hydrogen and oxygen gases through the air intake would improve the combustion resulting in a more complete fuel burn which woulddeliver increased fuel economy, increased torque, lower emissions, and extend engine oil life. The systemruns directly from the vehicles power system providing for high electrical efficiency and shuts off when thetruck key is off.

Saarthi GreenTech currently focusses on commercial vehicles & heavy vehicles produces two versions of Saarthi-HFS systems that cater to 12V and 24V power supply that is available from the vehicle, producing 3 to 6 liters of Hydrogen suitable for different engine sizes from class 4 to 9 vehicles. The models, K30 and K40 produce upto 3 to 6 Liters of HHO per minute even with power consumption of less than 600 watts, while running on a 12V/ 24V battery system of a vehicle. This is the highest in the industry and opens up potential for higher savings even in very big engines as compared to any other systems tested so far.

1. K-20 systems have been used in this test which is not in production.
2. K-30 systems are designed for Class 4 to 6 vehicles operating with 12V battery.
3. K-40 systems are designed for Class 7 to 8 vehicles operating with 24V battery.
4. For Earthmovers and very big sized engines, 2 K-30 or 2 K-40 systems should be sufficient* *(Pending field validations)*

## Getting Emission & Fuel Savings with HHO

Saarthi researchers have reasons to believe that 1:0.5 to 1:1 ratio of Hydrogen against the engine CC is best to give optimal emission & fuel savings. This means a 2.5 Liters engine can get best fuel savings with 1.25 to 2.5 liters of Hydrogen per minute. Any more Hydrogen than that may not bring significant difference to the fuel savings but will improve engine power and reduce emission. Saarthi-HFS produce highest HHO with small size and low energy making them stand out as a technology innovation in the field of hybrid hydrogen-based fuel system technologies.

Our research reveals four stages of fuel and emission reduction for any on-road vehicle. If all these stages are followed, it will lead to optimal savings of any vehicle.

1. Using HHO from Saarthi-HFS unit – The first and highest savings are achieved with this stage. Our test results done for Class 1-3 vehicle (GM – Chevrolet Tavera 2499cc Diesel Engine) has shown average 40% of fuel savings in a real-life condition on the roads of Pune (India).

2. Decarbonizing the engine – Engines typically are carbonized as they run. While most engine manufacturers do not specifically ask for this, it is advisable to decarbonize the engines after every 30,000 km to restore the milage and driving comfort. With Saarthi-HFS the engines automatically decarbonize within 30 to 60 days of vehicle running and remains decarbonized thereafter. It is expected to get more savings on fuel and emission after 60 days of Saarthi-HFS in operation on the vehicle.

3. Nozzle cleaning – With Diesel engines, nozzle cleaning can give another small savings as decarbonization does not cover the fuel nozzles. While there are fuel additives to aid this outcome, the same can be done while engine maintenance in any garage. For petrol engines, this part is not applicable.

4. Using Electronic Fuel Enhancer – This electronic component alters the fuel injection pattern based on HHO usage and can further give fuel and emission reduction of 2 to 7%. Careful and better driving style after HHO unit installation can also give similar savings as HHO improves the power of the engine. Saarthi is in discussion with leading OEM players in Indian market for making further improvements through their sensor technologies.

# Methodology

## Test site

Saarthi testing team decided to conduct the milage test on real time traffic in the Indian City of Pune. This was done to ensure that realistic outcomes on fuel savings are achieved as static lab tests might give better results and may not reflect real driving conditions.

City of Pune with a population of more than 12 million is one of the large cities in India and good traffic conditions in city allows average driving speed of 25 km per hour while on surrounding highways average speed can be average of 50 km per hour. On intercity highways the speed can be more than 70 km/hr.

Two milage tests were done by driving the vehicle within city and second on surrounding highway. For milage on highway, one liter bottle was used as temporary tank to check fuel efficiency while on highway a 2-liter bottle was used to test fuel efficiency.

Emission testing was done as per lab recommendations in the workshop for 5 different RPM.

# Test vehicles

Vehicle configurations are presented in Table 1. Figures 2 and 3 present photos of the test vehicle.

**Table 1. Vehicle data**

| ***Parameters*** | ***Test vehicle*** |
|---|---|
| Vehicle Class | **Class 3** |
| Vehicle ID | **MH.12.FP.3686**<br>**(Indian registration)** |
| Make and model | GM – Chevrolet Tavera Neo2 |
| Build year (model year) | 2010 (2010) |
| Engine make and model | GM – Chevrolet Tavera – 2499cc<br>4 Cylinder - TCDi Diesel Engine |
| Emission label info | BS III |
| Rated power | 78bhp@3800rpm |
| Peak torque | 176nm@1400-2600 |
| Transmission | Manual |
| Tires | Tubeless |
| Tire pressure (cold) | 29 psi |
| Test Weight | 1712 Kg. |

## Saarthi - K20 and K30 Hydrogen Fuel systems

Saarthi has complete prototype of the systems in place that were put for the purpose of testing. The products are part of the lab setup where Saarthi develops its new products. The same system will be manufactured at a later date and the system installation will be more presentable.
The system generated HHO was pushed into the engine by inserting the HHO tube into Air Intake immediately after the Air Filter.


**Figure 1. Test vehicle - Front**


**Figure 2. Test Vehicle - Back.**

# Fuel consumption test procedure

The test procedure was based on actual service conditions: this applies to real traffic and road conditions, load, weather, wind, etc.

Two milage tests were done by driving the vehicle within city and second on surrounding highway. For milage on highway, one liter bottle was used as temporary tank to check fuel efficiency while on highway a 2-liter bottle was used to test fuel efficiency. The tests were conducted twice for each condition of traffic – Once without HHO and other with HHO with K20 model. Conditions of test were real life with no variation from the real-life driving conditions of a vehicle. Vehicle was test driven by two drivers who normally drove that vehicle and were familiar with the vehicle functioning and could authentically tell the difference in driving and milage before and after the tests.

Driver 1 – Satyavan (Owner of the vehicle)

Driver 2 – Mangesh Bhalekar (Test Driver from Saarthi GreenTech Private Limited)

**Figure 3. Installation of the test setup – K20 on the vehicle.**

# Emissions measurement procedure

Emission test on the vehicle was conducted with two different units of Saarthi Hydrogen Fuel Systems. The K20 system that is designed for Class 1-3 commercial vehicles and the next level of system that is designed for Class 4 to 6 commercial vehicles.

- K20 system tested Hydrogen generation range varies from 1.8 liters to 3.2 Liters per minute. On running vehicle we can safely assume the average Hydrogen generation to be 2.5 Liters per minutes.
- K30 system tested Hydrogen generation range from 3 to 4.8 Lit per minute. ON a running vehicle we can safely assume an average Hydrogen production of 4 Lit/ min.

Emission Testing collection partner "**Tulsi Environmental Services & Consultant**" and Test Lab Partner – "**Neetal Laboratories and Environmental Services Private Limited**" ***(Certifications part of Annexure)*** based out of Pune was chosen to do emission testing of the vehicle under different RPM as well as by running the vehicle without any HHO, running with K20 installed and running with K30 installed. The company, Tulsi collects the test samples from the sites and the samples are tested and report released from Neetal labs are certified by Central Pollution Control Board to conduct emission tests and release reports. They are also ISO/IEC 17025:2017 certified that refers to 'General requirements for the competence of testing and calibration laboratories'.

The purpose of this emission test is to check on the following two objectives:

1. Will there be emission reduction on the vehicle by using K20 system?
2. Does increasing the HHO level by almost two times using the K30 model will bring further positive change in overall emission over K20?


**Figure 4. Test vehicle during emissions measurement**

## Test equipment

The following equipment was used during the tests:

| | | |
|---|---|---|
| **07) Instrument Details** | **Make/ Model No.** | **Shree Scientfic and Calibration /SEM-150,220508** |
| | **Lab ID** | **NLES/Lab/Inst/01** |
| | **Calibration Date** | **Calibration on:11/05/2022, Due On:10/05/2023** |

**Figure 5. Emission testing equipment in operation**

K20 and K30 Installation on vehicle remained same as that of the time fuel testing setup with Tank, Bubbler, power supply and electrolyser under passenger seat of the vehicle.

# Test results – Fuel Consumption

## Fuel consumption test results

Fuel efficiency tests were conducted with K20 and K30 models on The 2.5 Liter diesel engine. While K20 meant for upto Class 3 vehicles is the right design for the engine, this test was to understand if K30 which is designed for Class 4-6 vehicles can bring additional savings or not.

Fuel savings with Saarthi Systems depend on various factors. The key 4 factors that bring optimal savings are

1. Supply of HHO gas in the engine (Key factor)
2. Engine decarbonization (over sustained running for 30 to 60 days on Saarthi Systems)
3. Electronic Fuel Enhancer (Optional item)
4. Diesel spay nozzle cleaning (Done while servicing the engine)

**This test was done with the Key factor of supply of HHO in the engine in optimal quantity.**

**The following results were obtained for K20 and K30 Models of Saarthi:**

- First test – On Highway with average speed of 50 Km/ Hour (see Table 2):
  - Fuel savings With K20: **45.41%**
  - Fuel Savings with K30: **45.80%**

- Second test – On City Road with average speed of 30 km/ hour (see Table 3):
  - Fuel savings with K20 : **41.13%**
  - Fuel Savings with K30 : **41.93 %**

**Test data show that there is not much difference in fuel savings with excess HHO to the engine. Both the models K20 and K30 give almost the same result under test. The average fuel savings are between 41 to 45% on Chevrolet Tavera Neo 2 vehicle with 2.5 Lit Diesel engine. The test was conducted in the city of Pune (India) between 20th March 2023 and 29th March 2023.**

Tables 2 and 3 summarize the results and details of the baseline and test segments are presented inAppendix A. Appendix B presents data analysis.

**Table 2. Summary of test results: On highway in outskirts of Pune – India**
**(Average speed 50km/hr)**

| *Baseline segment, March 26 2023 (Only Diesel)* | | | *Test segment, March 26 2023 (With HHO)* | | |
|---|---|---|---|---|---|
| *Test runs* | *Milage – Km*<br>Test Vehicle - MH.12.FP.3686 | *Fuel Volume* | *Model* | *Consumed fuel, Lit*<br>Test Vehicle - MH.12.FP.3686 | *Fuel Volume* |
| 1 | 26.2 | 2 Lit | K20 | 38.1 | 2 Lit |
| 2 | 26.2 | 2 Lit | K30 | 38.2 | 2 Lit |
| Average Milage in Km/ lit | | 13.1 | Average Milage in Km/Lit | | 19.075 |
| Fuel savings, % with K20 | | | **45.41%** | | |
| Fuel savings % with K30 | | | **45.80%** | | |

**Table 3. Summary of test results: In average city Traffic in Pune – India (Average speed 35 Km/hr)**

| *Baseline segment, March 30 2023 (Only Diesel)* | | | *Test segment, March 30 2023 (With HHO)* | | |
|---|---|---|---|---|---|
| *Test runs* | *Milage – Km*<br>Test Vehicle - MH.12.FP.3686 | *Fuel Volume* | *Test Model* | *Consumed fuel, Lit*<br>Test Vehicle - MH.12.FP.3686 | *Fuel Volume* |
| 1 | 12.4 | 1 Lit | K20 | 17.5 | 1 Lit |
| 2 | 12.4 | 1 Lit | K30 | 17.6 | 1 Lit |
| Average Milage in Km/ lit | | 12.5 | Average Milage in Km/Lit | | 17.55 |
| Fuel savings % with K20 | | | **41.13%** | | |
| Fuel savings % with K30 | | | **41.93%** | | |

The two tests clearly reveal that fuel savings are linked with average vehicle speed and with higher speed of the vehicle, more savings can be achieved. These tests have been performed without using a DC power supply and Fuel Enhancer that could have given better average theoretically. Engine decarbonization takes place within 30to 60 days of the vehicle regular running on HHO system will further improve the fuel average of the engine.
The ARAI Tests on Chevrolet Tavera Neo 2 model has given fuel rating from 12.2 to 13.6 Km/ Lit of diesel. Our tests on diesel only comes well within this range. With HHO from Saarthi - K20 system, the milage clearly improves way beyond the tested milage of ARAI. This proves that use of K-20* on Class 3 vehicle can give 40 to 45% additional milage which is way beyond the tested and approved milage of this make of vehicle.

**(K-20 produces 2 to 3.5 Liters and K30 produces 2.8 to 5 Lit/ min of Hydrogen under real-life conditions.)*

# Test Results - Emissions

**Process of engine emission**

When fuel burns in a diesel engine, both carbon monoxide (CO) and carbon dioxide ($CO_2$) are produced as by-products. The combustion process in a diesel engine involves the reaction between the hydrocarbon fuel and oxygen in the air, which leads to the formation of water ($H_2O$), CO, $CO_2$, and other compounds, including nitrogen oxides ($NO_x$) and particulate matter (PM). Ideally, complete combustion of the fuel would result in only $CO_2$ and water as by-products. However, real-world combustion processes are not perfect, and several factors can lead to the formation of CO and other emissions:

1. Incomplete combustion: Insufficient oxygen, poor fuel atomization, or inadequate mixing of air and fuel can result in incomplete combustion. This can cause some of the carbon in the fuel to combine with a smaller amount of oxygen, forming CO instead of $CO_2$.
2. Cold-start conditions: When a diesel engine is cold, the combustion process may not be as efficient, leading to the production of more CO and other pollutants.
3. Engine operating conditions: Different engine operating conditions, such as idling or high-load situations, can affect the combustion process and the balance of CO and $CO_2$ emissions.

While $CO_2$ is a significant greenhouse gas and contributes to global warming, CO is a toxic gas that can be harmful to human health. Diesel engines are designed to minimize the production of CO and other harmful emissions by optimizing combustion, fuel injection, and exhaust after-treatment systems. Modern diesel engines are equipped with advanced emission control systems, such as diesel particulate filters (DPFs) and selective catalytic reduction (SCR) systems, to further reduce CO, $NO_x$, and PM emissions.

## Impact of HHO on Emission

Introducing HHO (hydrogen-oxygen gas mixture, also known as oxyhydrogen or Brown's Gas) into an internal combustion engine like that with Saarthi Hydrogen Fuel Systems, can improve fuel efficiency and reduce emissions. This is due to the following reasons:

1. Improved combustion efficiency: HHO has a higher flame speed and lower ignition energy than conventional fuels, such as gasoline or diesel. When HHO is mixed with the air-fuel mixture in the engine, it can enhance the combustion process, leading to a more complete burning of the fuel. As a result, the engine can extract more energy from the same amount of fuel, improving its efficiency.

2. Reduction in harmful emissions: Since the combustion process becomes more complete with the introduction of HHO, fewer unburned hydrocarbons and partially oxidized compounds, such as carbon monoxide (CO), are produced. Furthermore, the hydrogen in HHO reacts with oxygen during combustion to produce water ($H_2O$) as its primary byproduct instead of carbon dioxide ($CO_2$). This can lead to a reduction in $CO_2$ and CO emissions.

3. Lower combustion temperature: The addition of HHO can result in a lower overall combustion temperature. This can help to reduce the formation of nitrogen oxides ($NO_x$), which are harmful pollutants that form at high temperatures.

4. Reduction in particulate matter: In diesel engines, HHO can help to improve the atomization of the fuel, leading to smaller fuel droplets and better mixing with air. This can lead to more complete combustion, reducing the amount of particulate matter (PM) produced during the combustion process.

It is important to note that while introducing HHO into an engine can potentially improve fuel efficiency and reduce emissions. HHO as an efficiency and emission reduction strategy can vary depending on the specific engine type, setup, and operating conditions.

*Table 4 presents the results of emissions measurement.*

Tests were done with two different models of Saarthi Hydrogen Fuel Systems. The K20 model which delivers hydrogen between 2 to 3.5 Liters per minute and is designed for Class 3 commercial vehicles. The next, K30 model which delivers 2.8 to 5 Liters of Hydrogen per minute and is designed for Class 4 to 6 type of vehicles. The purpose of emission testing of these two models on a 2.5 Liter Diesel engine of Chevrolet Tavera New 2 model was for the following two objectives:

A. What happens to emission if Hydrogen supply is 1:1 with engine capacity (2.5 Lit engine CC gets 2.5 Liters of Hydrogen)

B. What happens to emission if Hydrogen supply is 1:2 with engine capacity (2.5 Lit engine CC gets about 4.5 to 5 liters of Hydrogen).

The results are showing significant decreases in emission levels between baseline and final measurements in both the cases. K20 gives a reasonable savings while K30 gives even more significant and notable savings.

**Table 4. Summary of emissions measurement results for test vehicle on 29th March-2023**

**Table 4 - Emission test results - Baseline Operation on Diesel without HHO**

| Sl. No. | Parameter | UOM | 1000RPM | 1500 RPM | 2000 RPM | 2500 RPM | 3000 RPM | Average |
|---|---|---|---|---|---|---|---|---|
| 1 | Suspended Particulate Matter (SPM) | µg/m³ | 100.3 | 96.7 | 90.12 | 87.5 | 82.2 | 91.364 |
| 2 | HC (Hydrocarbons) | µg/m³ | 0.22 | 0.2 | 0.18 | 0.19 | 0.18 | 0.194 |
| 3 | Oxides of Nitrogen (NOx) | mg/m3 | 0.227 | 0.223 | 0.22 | 0.219 | 0.216 | 0.221 |
| 4 | Carbon Dioxide (CO2) | mg/m3 | 672.53 | 670.69 | 668.32 | 664.59 | 660.87 | 667.4 |
| 5 | Carbon Monoxides (CO) | µg/m³ | 0.768 | 0.765 | 0.76 | 0.758 | 0.752 | 0.7606 |

**Table 5 - Emission Test Results - Diesel with K20 HFS (Average 2.5 Lit/ Min. Hydrogen)**

| Sl.No | Parameter | UOM | Results | Results | Results | Results | Results | |
|---|---|---|---|---|---|---|---|---|
| | | | 1000RPM | 1500 RPM | 2000 RPM | 2500 RPM | 3000 RPM | Average |
| | RPM(After-K-20) | | K-20 | K-20 | K-20 | K-20 | K-20 | |
| 1 | Suspended Particulate Matter (SPM) | µg/m³ | 80.3 | 75.3 | 72.1 | 68.4 | 63.2 | 71.86 |
| 2 | HC (Hydrocarbons) | µg/m³ | 0.15 | 0.13 | 0.12 | 0.1 | 0.09 | 0.118 |
| 3 | Oxides of Nitrogen (NOx) | mg/m3 | 0.126 | 0.123 | 0.12 | 0.118 | 0.115 | 0.1204 |
| 4 | Carbon Dioxide (CO2) | mg/m3 | 657.38 | 648.5 | 632.39 | 624.42 | 618.4 | 636.218 |
| 5 | Carbon Monoxides (CO) | µg/m³ | 0.409 | 0.397 | 0.384 | 0.376 | 0.36 | 0.3852 |

**Table 6 - Emission Test Results - Diesel with K30 HFS (Average 4 Lit/ Min. Hydrogen)**

| Sl.No | Parameter | UOM | Results | Results | Results | Results | Results | |
|---|---|---|---|---|---|---|---|---|
| | | | 1000RPM | 1500 RPM | 2000 RPM | 2500 RPM | 3000 RPM | Average |
| | RPM(After-K-30) | | K-30 | K-30 | K-30 | K-30 | K-30 | |
| **1** | **Suspended Particulate Matter (SPM)** | **µg/m³** | **20.2** | **18.3** | **15.4** | **13.5** | **10.2** | **15.52** |
| **2** | **HC (Hydrocarbons)** | **µg/m³** | **0.08** | **0.07** | **0.05** | **0.05** | **0.04** | **0.058** |
| **3** | **Oxides of Nitrogen (NOx)** | **mg/m3** | **0.1** | **0.098** | **0.092** | **0.083** | **0.07** | **0.0886** |
| **4** | **Carbon Dioxide (CO2)** | **mg/m3** | **568.4** | **542.62** | **540.12** | **536.25** | **500.46** | **537.57** |
| **5** | **Carbon Monoxides (CO)** | **µg/m³** | **0.32** | **0.312** | **0.278** | **0.254** | **0.243** | **0.2814** |

Test results demonstrate the higher impact of emission reduction using K30 while K20 gives significant emission reduction from the baseline data. Tests however demonstrate that fuel efficiency was not much different with K20 and K30 being used.

**Table 7 – Emission Comparison : Baseline, K20 & K30 systems on 2.5 Litre Diesel Engine**

| Sl. No | Parameter | UOM | Average - Baseline | Average - K20 | Average - K30 | % Improvement- K20 | % Improvement K30 |
|---|---|---|---|---|---|---|---|
| 1 | Suspended Particulate Matter (SPM) | µg/m³ | 91.364 | 71.86 | 15.52 | 21.35% | 83.01% |
| 2 | HC (Hydrocarbons) | µg/m³ | 0.194 | 0.118 | 0.058 | 39.18% | 70.10% |
| 3 | Oxides of Nitrogen (NOx) | mg/m3 | 0.221 | 0.1204 | 0.0886 | 45.52% | 59.91% |
| 4 | Carbon Dioxide (CO2) | mg/m3 | 667.4 | 636.218 | 537.57 | 4.67% | 19.45% |
| 5 | Carbon Monoxides (CO) | µg/m³ | 0.7606 | 0.3852 | 0.2814 | 49.36% | 63.00% |

**Table 8 – Emission Comparison : Baseline, K20 & K30 systems on 2.5 Litre Diesel Engine - Idle Speed (1000 RPM)**

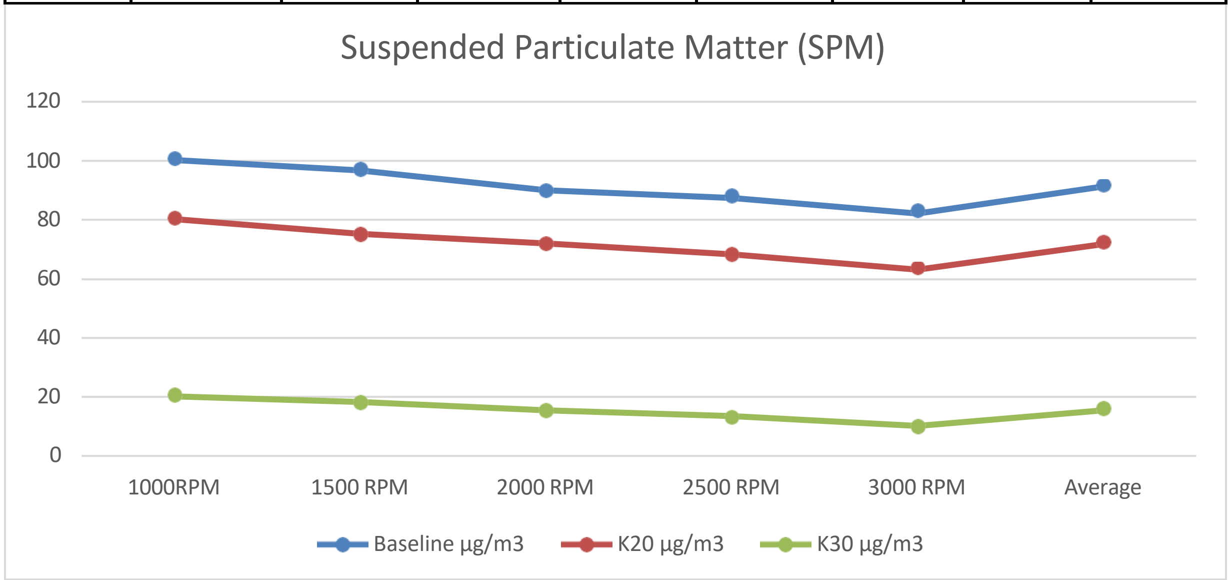
| Sl. No | Parameter | UOM | 1000 RPM - Baseline | 1000 RPM - K20 | 1000 RPM - K30 | % Improvement- K20 (1000 RPM) | % Improvement K30 (1000 RPM) |
|---|---|---|---|---|---|---|---|
| 1 | Suspended Particulate Matter (SPM) | µg/m³ | 100.3 | 80.3 | 20.2 | 19.94% | 79.86% |
| 2 | HC (Hydrocarbons) | µg/m³ | 0.22 | 0.15 | 0.08 | 31.82% | 63.64% |
| 3 | Oxides of Nitrogen (NOx) | mg/m3 | 0.227 | 0.126 | 0.1 | 44.49% | 55.95% |
| 4 | Carbon Dioxide (CO2) | mg/m3 | 672.53 | 657.38 | 568.4 | 2.25% | 15.48% |
| 5 | Carbon Monoxides (CO) | µg/m³ | 0.768 | 0.409 | 0.32 | 46.74% | 58.33% |

**Table 9 – Emission Comparison : Baseline, K20 & K30 systems on 2.5 Litre Diesel Engine - High Speed (3000 RPM)**

| Sl. No | Parameter | UOM | 3000 RPM - Baseline | 3000 RPM - K20 | 3000 RPM - K30 | % Improvement- K20 (3000 RPM) | % Improvement K30 (3000 RPM) |
|---|---|---|---|---|---|---|---|
| 1 | Suspended Particulate Matter (SPM) | µg/m³ | 82.2 | 63.2 | 10.2 | 23.11% | 87.59% |
| 2 | HC (Hydrocarbons) | µg/m³ | 0.18 | 0.09 | 0.04 | 50.00% | 77.78% |
| 3 | Oxides of Nitrogen (NOx) | mg/m3 | 0.216 | 0.115 | 0.07 | 46.76% | 67.59% |
| 4 | Carbon Dioxide (CO2) | mg/m3 | 660.87 | 618.4 | 500.46 | 6.43% | 24.27% |
| 5 | Carbon Monoxides (CO) | µg/m³ | 0.752 | 0.36 | 0.243 | 52.13% | 67.69% |

**Table 10 - Suspended Particulate Matter (SPM) - Comparative Chart**

| Sl. No | Parameter | UOM | 1000RPM | 1500 RPM | 2000 RPM | 2500 RPM | 3000 RPM | Average |
|---|---|---|---|---|---|---|---|---|
| 1 | Baseline | µg/m³ | 100.3 | 96.7 | 90.12 | 87.5 | 82.2 | 91.364 |
| 2 | K20 | µg/m³ | 80.3 | 75.3 | 72.1 | 68.4 | 63.2 | 71.86 |
| 3 | K30 | µg/m³ | 20.2 | 18.3 | 15.4 | 13.5 | 10.2 | 15.52 |

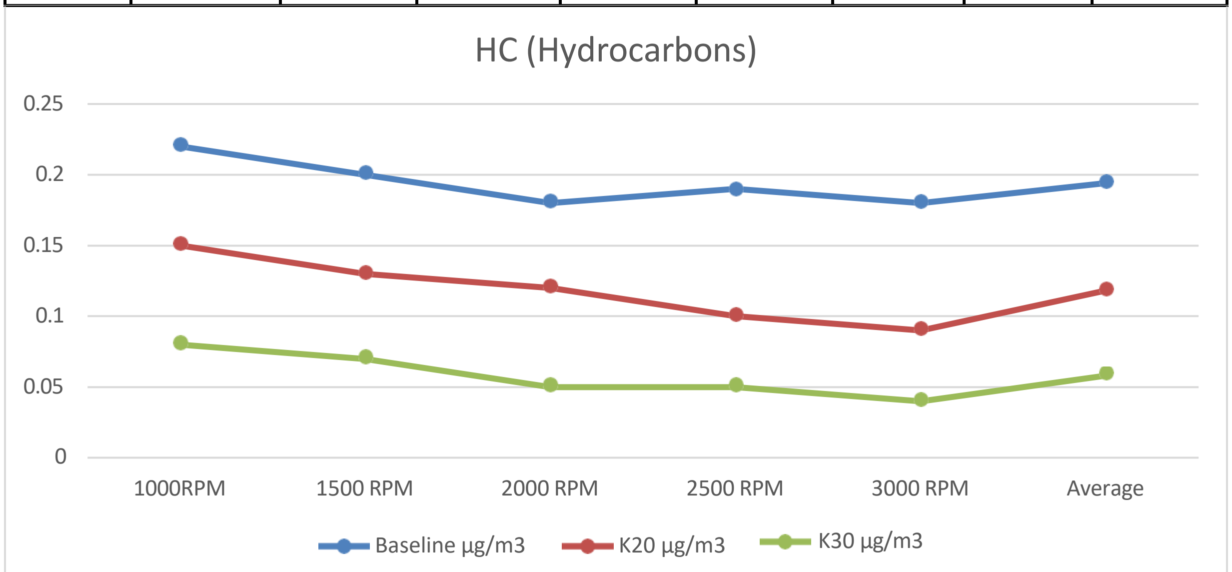



Induction of HHO (hydrogen-oxygen gas mixture) into an internal combustion engine can lead to a significant reduction in Suspended Particulate Matter (SPM) emissions. This is due to the following reasons:

1. Improved combustion efficiency: Introducing HHO into the engine can enhance the combustion process, leading to more complete burning of the fuel. With a more efficient combustion, the amount of unburned or partially burned fuel particles that form SPM is reduced.
2. Better fuel atomization: In diesel engines, HHO can help to improve the atomization of the fuel, leading to smaller fuel droplets and better mixing with air. Smaller fuel droplets have a higher surface area to volume ratio, which allows for more efficient and complete combustion. As a result, the formation of SPM is reduced.
3. Hydrogen as a combustion enhancer: When HHO is introduced into the engine, the hydrogen in the mixture reacts with oxygen during combustion. This reaction produces water (H2O) as its primary by-product, which can help to reduce the peak combustion temperature. Lower combustion temperatures can lead to a reduction in the formation of particulate matter.
4. Reduction of soot formation: The presence of hydrogen in HHO can help to reduce soot formation during combustion. Hydrogen can react with soot particles or their precursors, promoting their oxidation to less harmful gaseous compounds, which can result in a reduction of SPM emissions.

**Table 11 - HC (Hydrocarbons) - Comparative Chart**

| Sl. No. | Parameter | UOM | 1000RPM | 1500 RPM | 2000 RPM | 2500 RPM | 3000 RPM | Average |
|---|---|---|---|---|---|---|---|---|
| 1 | Baseline | µg/m³ | 0.22 | 0.2 | 0.18 | 0.19 | 0.18 | 0.194 |
| 2 | K20 | µg/m³ | 0.15 | 0.13 | 0.12 | 0.1 | 0.09 | 0.118 |
| 3 | K30 | µg/m³ | 0.08 | 0.07 | 0.05 | 0.05 | 0.04 | 0.058 |




Induction of HHO (hydrogen-oxygen gas mixture) into an internal combustion engine can lead to a significant reduction in Hydrocarbon (HC) emissions. This is due to the following reasons:

1. Improved combustion efficiency: Introducing HHO into the engine can enhance the combustion process, leading to more complete burning of the fuel. As a result, fewer unburned hydrocarbons (HC) are produced and emitted as exhaust gases.

2. Hydrogen as a combustion enhancer: The hydrogen in HHO reacts with oxygen during combustion, increasing the flame speed and improving the overall combustion efficiency. This results in a more complete burning of the fuel and a reduction in the amount of unburned hydrocarbons.

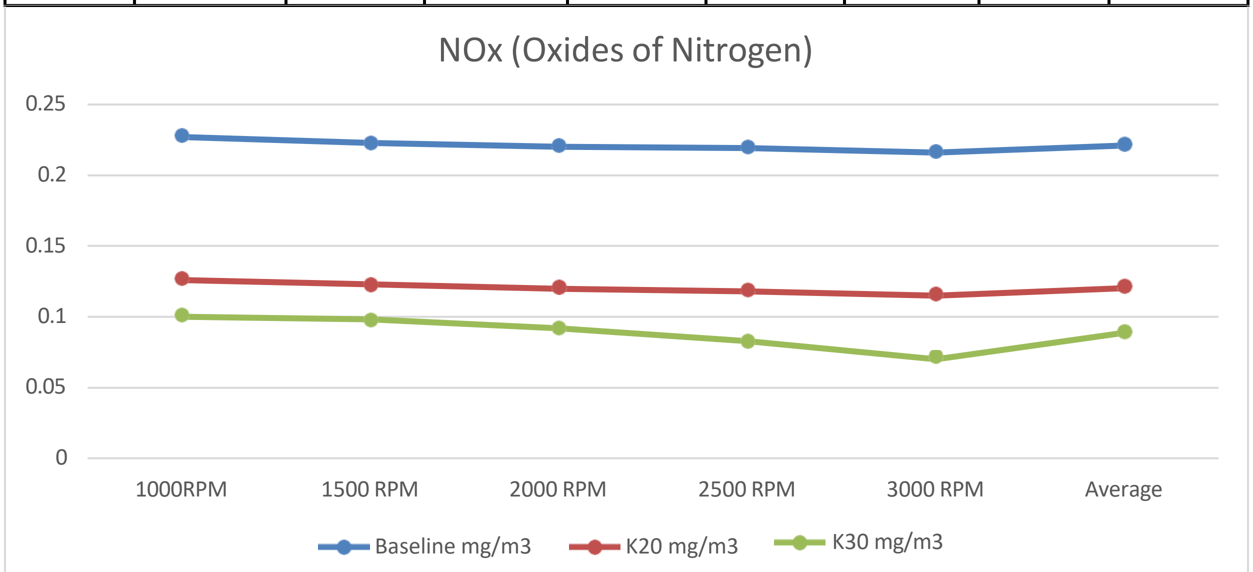
3. Better fuel atomization: In diesel engines, HHO can help to improve the atomization of the fuel, leading to smaller fuel droplets and better mixing with air. Smaller fuel droplets have a higher surface area to volume ratio, which allows for more efficient and complete combustion. This, in turn, leads to a reduction in unburned hydrocarbon emissions.

4. Oxidation of hydrocarbons: The presence of hydrogen in HHO can promote the oxidation of unburned hydrocarbons in the combustion chamber, converting them into less harmful compounds, such as CO2 and water, which helps in reducing HC emissions.

5. Reduction in cold-start emissions: Cold-start emissions typically have higher concentrations of unburned hydrocarbons due to inefficient combustion when the engine is still warming up. Introducing HHO can help improve the combustion efficiency even during cold-start conditions, reducing the amount of unburned hydrocarbons emitted.

**Table 12 - Oxides of Nitrogen (NOx) – Comparative Chart**

| Sl. No. | Parameter | UOM | 1000RPM | 1500 RPM | 2000 RPM | 2500 RPM | 3000 RPM | Average |
|---|---|---|---|---|---|---|---|---|
| 1 | Baseline | mg/m3 | 0.227 | 0.223 | 0.22 | 0.219 | 0.216 | 0.221 |
| 2 | K20 | mg/m3 | 0.126 | 0.123 | 0.12 | 0.118 | 0.115 | 0.1204 |
| 3 | K30 | mg/m3 | 0.1 | 0.098 | 0.092 | 0.083 | 0.07 | 0.0886 |

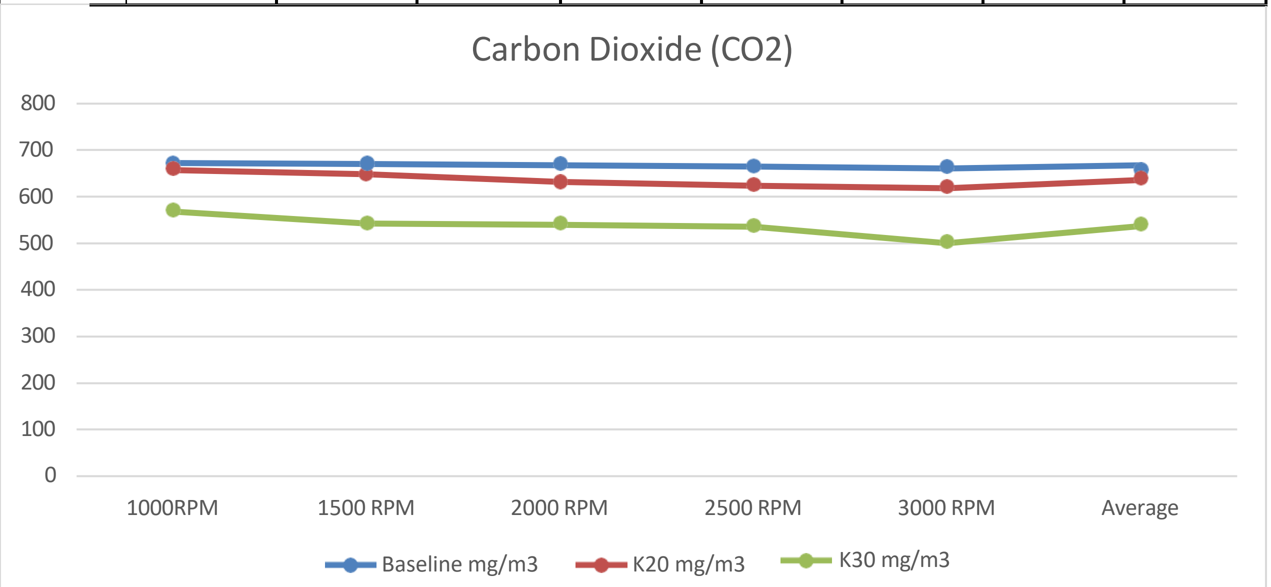



Induction of HHO (hydrogen-oxygen gas mixture) into an internal combustion engine can lead to a significant reduction in Oxides of Nitrogen (NOx) emissions. This is due to the following reasons:

1. Lower combustion temperatures: The presence of hydrogen in the HHO mixture can help reduce the peak combustion temperature. The formation of NOx is highly temperature-dependent, as it occurs when nitrogen and oxygen in the air react at high temperatures. By reducing the peak combustion temperature, the rate of NOx formation is decreased.
2. Hydrogen as a combustion enhancer: The hydrogen in HHO improves combustion efficiency by increasing the flame speed and promoting a more complete burning of the fuel. This results in a more uniform and controlled combustion process, which can contribute to a reduction in NOx emissions.
3. Exhaust gas recirculation (EGR) effect: When HHO is introduced into the engine, the water produced during combustion can have a similar effect to exhaust gas recirculation (EGR). The water vapor dilutes the combustion mixture, absorbs heat, and lowers the combustion temperature. This helps to reduce the formation of NOx emissions.
4. Better fuel atomization: In diesel engines, the introduction of HHO can improve fuel atomization, leading to smaller fuel droplets and better mixing with air. This allows for a more controlled and efficient combustion process, which can contribute to a reduction in NOx emissions.
5. Reduction in oxygen concentration: The hydrogen in HHO reacts with oxygen during combustion, which can lead to a reduction in the local oxygen concentration within the combustion chamber. This can help to decrease the rate of NOx formation.

**Table 13 - Carbon Dioxide (CO2) - Comparative Chart**

| Sl. No. | Parameter | UOM | 1000RPM | 1500 RPM | 2000 RPM | 2500 RPM | 3000 RPM | Average |
|---|---|---|---|---|---|---|---|---|
| 1 | Baseline | $mg/m_3$ | 672.53 | 670.69 | 668.32 | 664.59 | 660.87 | 667.4 |
| 2 | K20 | $mg/m_3$ | 657.38 | 648.5 | 632.39 | 624.42 | 618.4 | 636.218 |
| 3 | K30 | $mg/m_3$ | 568.4 | 542.62 | 540.12 | 536.25 | 500.46 | 537.57 |

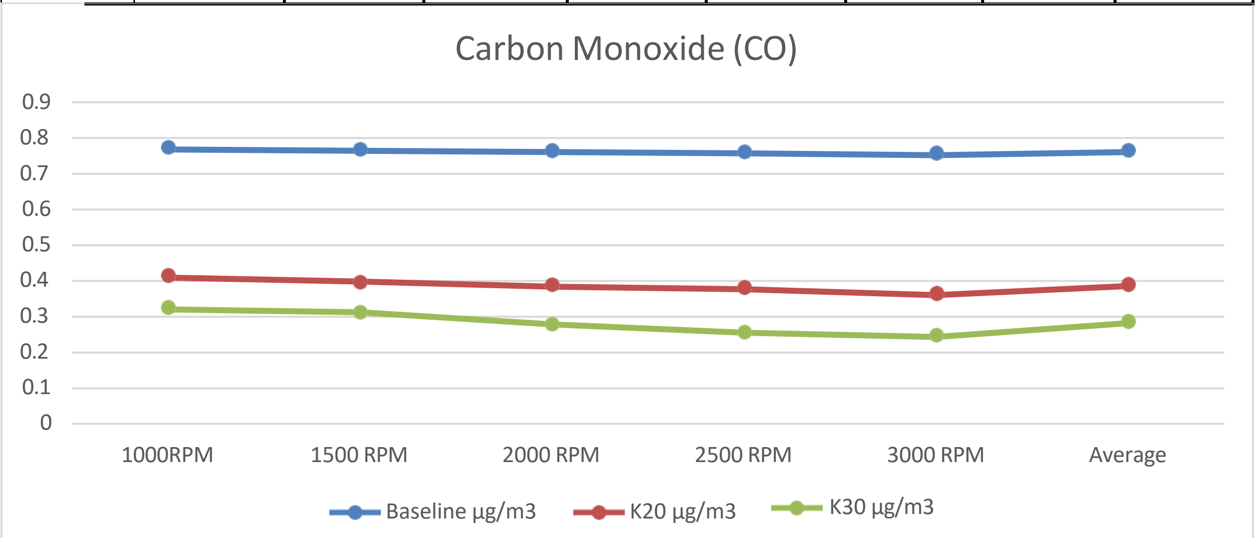



Induction of HHO (hydrogen-oxygen gas mixture) into an internal combustion engine can lead to a reduction in Carbon Dioxide (CO2) emissions. This is due to the following reasons:

1. Improved combustion efficiency: Introducing HHO into the engine can enhance the combustion process, leading to more complete burning of the fuel. More efficient combustion means that less fuel is needed to produce the same amount of power, which in turn results in reduced CO2 emissions.
2. Hydrogen as a combustion enhancer: The hydrogen in HHO reacts with oxygen during combustion, producing water (H2O) as its primary byproduct instead of CO2. Since a portion of the fuel is replaced by hydrogen, the overall production of CO2 is reduced.
3. Better fuel atomization: In diesel engines, HHO can help to improve the atomization of the fuel, leading to smaller fuel droplets and better mixing with air. Smaller fuel droplets have a higher surface area to volume ratio, which allows for more efficient and complete combustion. This can lead to a reduction in the amount of fuel consumed and, consequently, a decrease in CO2 emissions.
4. Reduction in engine load: The introduction of HHO can result in a more efficient combustion process, providing additional power and torque to the engine. This can help reduce the engine load, enabling it to operate at a more efficient point in its operating range and thereby reducing CO2 emissions.

**Table 14 - Carbon Monoxide (CO) - Comparative Chart**

| Sl. No. | Parameter | UOM | 1000RPM | 1500 RPM | 2000 RPM | 2500 RPM | 3000 RPM | Average |
|---|---|---|---|---|---|---|---|---|
| 1 | Baseline | µg/m³ | 0.768 | 0.765 | 0.76 | 0.758 | 0.752 | 0.7606 |
| 2 | K20 | µg/m³ | 0.409 | 0.397 | 0.384 | 0.376 | 0.36 | 0.3852 |
| 3 | K30 | µg/m³ | 0.32 | 0.312 | 0.278 | 0.254 | 0.243 | 0.2814 |




Induction of HHO (hydrogen-oxygen gas mixture) into an internal combustion engine can lead to a significant reduction in Carbon Monoxide (CO) emissions. This is due to the following reasons:

1. Improved combustion efficiency: Introducing HHO into the engine enhances the combustion process, leading to more complete burning of the fuel. Carbon Monoxide is primarily formed due to incomplete combustion of the fuel. When combustion efficiency is improved with HHO, more fuel is converted into carbon dioxide (CO2) and water (H2O), leaving less unburned fuel that could form CO.
2. Hydrogen, acting as a combustion enhancer in HHO, increases flame speed and promotes more complete, uniform fuel burning while having a lower ignition energy and a wider flammability range compared to hydrocarbon fuels, which enables it to ignite more easily and burn more quickly, thereby ensuring a more efficient combustion process that reduces CO emissions as more of the fuel is fully oxidized to CO2.
3. Better fuel atomization: In diesel engines, the introduction of HHO can improve fuel atomization, leading to smaller fuel droplets and better mixing with air. Smaller fuel droplets have a higher surface area to volume ratio, which allows for more efficient and complete combustion, leading to reduced CO emissions.
4. Leaner air-fuel mixture: The addition of hydrogen and oxygen from HHO can lead to a leaner air-fuel mixture in the combustion chamber. Leaner mixtures tend to have more available oxygen, which promotes more complete combustion and reduces the likelihood of CO formation.

## Driving Experience

Drivers Mr. Mangesh Bhalekar from Saarthi drove the vehicle most of the time during the test procedure while Mr. Satyavan, the owner of the vehicle spend about 20% of the time driving the vehicle with K20 system installed. The drivers reported the following improvement in the driving experience:

1. Engine sound was much lower than normal. Engine was quieter.

2. General vibration caused by engine in baseline testing was lower while the vehicle was tested with K20 and K30.

3. Engine power appeared better and the pickup and climbing gradients appeared easier than in baseline.

4. There was no noticeable driving difference when K20 and K30 systems were installed and running in the vehicle. In both cases the driving experience was better as compared to baseline.

5. There was no negative driving experience during driving to report.

## Summary

Table 5 presents the fuel consumption and emission reduction test results obtained for the Hydrogen Fuel System, K-20 (K20) and K-30 (K30) technology from Saarthi GreenTech Private Limited,expressed for the confidence level of 95%. Any variation to the fuel saving test result will be the result of changed conditions of traffic, load or vehicle condition. The test was conducted in real life traffic and highway condition while the emission test was done in the workshop as per the recommendations of the emission testing lab.

**Table 15. Summary of test results**

| Fuel Improvement – Using K20 (2.5 Lit Hydrogen/ Min) & K30 (4.5 Lit of Hydrogen) | | |
|---|---|---|
| **Test Segment** | **Test 1 – Highway in Pune (50 km/hr average speed)** | **Test 2 – Normal Pune city traffic (35 km/hr average speed)** |
| **Test date** | **March 26, 2023** | **March 28, 2023** |
| Fuel savings with K20 | 45.10% | 41.11% |
| Fuel Savings with K30 | 45.70% | 41.25% |
| **Emission Improvement using K20 and K30** | | |
| **Parameter** | **K20 - % Improvement (Average between 1000 to 3000 rpm)** | **K30 - % Improvement (Average between 1000 to 3000 rpm)** |
| Suspended Particulate Matter (SPM) | 21.35% | 83.01% |
| HC (Hydrocarbons) | 39.18% | 70.10% |
| Oxides of Nitrogen (NOx) | 45.52% | 59.91% |
| Carbon Dioxide (CO2) | 4.67% | 19.45% (Net 54%) |
| Carbon Monoxides (CO) | 49.36% | 63.00% |

Emission measurements are showing significant decreases in emission levels between baseline and final test segment measurements with K20 and with K30. While almost half for carbon monoxide (CO), hydrocarbons (HC), and fornitrogen oxides (NOx) reduced with K20. With K30 there was a marked improvement in every emission parameter. Emissions of $CO_2$ where about 5% with K20 but with K30 average reduction was about 20%. The results suggested better engine performance and fuel burning.

## Disclaimer

This outcome pertains exclusively to the vehicle and specific technology sample tested, following the procedures and conditions outlined in this report. Saarthi cannot assure that these results will be reproducible under specific operating conditions.

# Annexure

**NEETAL LABORATORIES**
**And Environmental Services Pvt. Ltd.**

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An ISO 9001 & 45001 Certified Company

SOURCE (STACK) EMISSION MONITORING REPORT

| Client's Name & Address | Report No. | NLES/23-24/04/ST/RE/29 |
|---|---|---|
| M/s KiTech Hydrogen System( India) Pvt Ltd<br>Plot no-14,Gat no-357/86,Near Parkson<br>Packaging,Waghjainagar,Kharabwadi,chakan Pune-410501. | Date of Reporting | 05-04-2023 |

SAMPLING DETAILS

| | | |
|---|---|---|
| 01) Location of Sampling | MH-12-FB 3686(Tavera) | |
| 02) Sample Status (Sealed/Unsealed ) | Sealed | |
| 03) Sample Collected By | M/s. Tulsi Environmental Services & Consultant | |
| 04) Date of Sampling | 29-03-2023 | |
| 05) Time of Sampling & Sampling Duration | From 11:30 AM to 11:50 AM | |
| 06) Date of Received in Lab | 31/03/2023 | |
| 07) Instrument Details | Make/ Model No. | Shree Scientfic and Calibration /SEM-150,220508 |
| | Lab ID | NLES/Lab/Inst/01 |
| | Calibration Date | Calibration on:11/05/2022, Due On:10/05/2023 |

RESULTS

| Sr. No | Parameter | UOM | Results | Results | Results | Results | Results | Limits as Per MPCB Consent |
|---|---|---|---|---|---|---|---|---|
| | RPM(Before) | | 1000RPM<br>11.30 AM | 1500 RPM<br>11.35 AM | 2000 RPM<br>11.40 AM | 2500 RPM<br>11.45 AM | 3000 RPM<br>11.50 AM | |
| 1 | Suspended Particulate Matter(SPM) | $\mu g/m^3$ | 100.3 | 96.7 | 90.12 | 87.5 | 82.2 | ≤ 150 |
| 2 | HC(Hydrocarbons) | $\mu g/m^3$ | 0.22 | 0.20 | 0.18 | 0.19 | 0.18 | - |
| 3 | Oxides of Nitrogen (NOx) | mg/m3 | 0.227 | 0.223 | 0.220 | 0.219 | 0.216 | - |
| 4 | Carbon Dioxide(CO2) | $mg/m^3$ | 672.53 | 670.69 | 668.32 | 664.59 | 660.87 | - |
| 5 | Carbon Monoxides (CO) | $\mu g/m^3$ | 0.768 | 0.765 | 0.760 | 0.758 | 0.752 | - |

UOM: Unit of Measurement

Remarks: - All above results are within MPCB Limits.

| Reviewed By | | Authorized Signatory |
|---|---|---|
| Kalyani | Neetal Laboratories & Environmental Services Pvt. Ltd. PUNE | Abhi |
| (Ms. Kalyani Gore)<br>(Technical Manager) | | (Mr. Abhishek Tope)<br>(Quality Manager) |

******************End of Report****************

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- This Report is valid for tested sample only
- The results shown in this test report may differ based on various factors including temperature, humidity, pressure, retention time etc.
- The test report cannot be reproduced wholly or in part and cannot be used for promotional or publicity purpose without the written consent of laboratory, NLES.



AN ENVIRONMENTAL LABORATORY RECOGNISED UNDER EPA, ENVIRONMENT (PROTECTION) ACT BY (MoEF & CC) MINISTRY OF ENVIRONMENT FOREST & CLIMATE CHANGE

Address : H.NO. 43, SANTOSH NAGAR, WAKI BK., TAL. KHED, DIST. PUNE - 410 501
Website : www.neetalenvirolab.com, Email: sales@neetalenvirolab.com / neetalenviro@gmail.com, Mob. 8669699854 / 52

# NEETAL LABORATORIES
## And Environmental Services Pvt. Ltd.

An ISO 9001 & 45001 Certified Company

SOURCE (STACK) EMISSION MONITORING REPORT

| Client's Name & Address | Report No. | NLES/23-24/04/ST/RE/30 |
|---|---|---|
| M/s KiTech Hydrogen System( India) Pvt Ltd<br>Plot no-14,Gat no-357/86,Near Parkson Packaging,Waghjainagar,Kharabwadi,chakan Pune-410501. | Date of Reporting | 05-04-2023 |

SAMPLING DETAILS

| | | |
|---|---|---|
| 01) Location of Sampling | MH-12-FB 3686(Tavera) | |
| 02) Sample Status (Sealed/Unsealed ) | Sealed | |
| 03) Sample Collected By | M/s. Tulsi Environmental Services & Consultant | |
| 04) Date of Sampling | 29-03-2023 | |
| 05) Time of Sampling & Sampling Duration | From 12:30 PM to 12:50 PM | |
| 06) Date of Received in Lab | 31/03/2023 | |
| 07) Instrument Details | Make/ Model No. | Shree Scientfic and Calibration /SEM-150,220508 |
| | Lab ID | NLES/Lab/Inst/01 |
| | Calibration Date | Calibration on:11/05/2022, Due On:10/05/2023 |

RESULTS

| Sr. No | Parameter | UOM | Results | Results | Results | Results | Results | Limits as Per MPCB Consent |
|---|---|---|---|---|---|---|---|---|
| | RPM(After-K-20) | | 1000RPM K-20 12.30 PM | 1500 RPM K-20 12.35 PM | 2000 RPM K-20 12.40 PM | 2500 RPM K-20 12.45 PM | 3000 RPM K-20 12.50 PM | |
| 1 | Suspended Particulate Matter(SPM) | $\mu g/m^3$ | 80.3 | 75.3 | 72.1 | 68.4 | 63.2 | ≤ 150 |
| 2 | HC(Hydrocarbons) | $\mu g/m^3$ | 0.15 | 0.13 | 0.12 | 0.10 | 0.09 | - |
| 3 | Oxides of Nitrogen(NOx) | mg/m3 | 0.126 | 0.123 | 0.120 | 0.118 | 0.115 | - |
| 4 | Carbon Dioxide(CO2) | $mg/m^3$ | 657.38 | 648.50 | 632.39 | 624.42 | 618.40 | - |
| 5 | Carbon Monoxides (CO) | $\mu g/m^3$ | 0.409 | 0.397 | 0.384 | 0.376 | 0.360 | - |

**UOM: Unit of Measurement**

Remarks: - **All above results are within MPCB Limits.**

Reviewed By

Kalyani

(Ms. Kalyani Gore)
(Technical Manager)

Neetal Laboratories & Environmental Services Pvt. Ltd. PUNE

Authorized Signatory

(Mr. Abhishek Tope)
(Quality Manager)

******************End of Report*****************

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NEETAL LABORATORIES
And Environmental Services Pvt. Ltd.
An ISO 9001 & 45001 Certified Company

SOURCE (STACK) EMISSION MONITORING REPORT

| Client's Name & Address | Report No. | NLES/23-24/04/ST/RE/31 |
|---|---|---|
| M/s KiTech Hydrogen System( India) Pvt Ltd<br>Plot no-14,Gat no-357/86,Near Parkson<br>Packaging,Waghjainagar,Kharabwadi,chakan Pune-410501. | Date of Reporting | 05-04-2023 |

SAMPLING DETAILS

| | | |
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| 01) Location of Sampling | MH-12-FB 3686(Tavera) | |
| 02) Sample Status (Sealed/Unsealed ) | Sealed | |
| 03) Sample Collected By | M/s. Tulsi Environmental Services & Consultant | |
| 04) Date of Sampling | 29-03-2023 | |
| 05) Time of Sampling & Sampling Duration | From 13:30 PM to 13:50 PM | |
| 06) Date of Received in Lab | 31/03/2023 | |
| 07) Instrument Details | Make/ Model No. | Shree Scientfic and Calibration /SEM-150,220508 |
| | Lab ID | NLES/Lab/Inst/01 |
| | Calibration Date | Calibration on:11/05/2022, Due On:10/05/2023 |

RESULTS

| Sr. No | Parameter | UOM | Results | Results | Results | Results | Results | Limits as Per MPCB Consent |
|---|---|---|---|---|---|---|---|---|
| | RPM(After-K-30) | | 1000RPM<br>K-30<br>13.30 PM | 1500 RPM<br>K-30<br>13.35 PM | 2000 RPM<br>K-30<br>13.40 PM | 2500 RPM<br>K-30<br>13.45 PM | 3000 RPM<br>K-30<br>13.50 PM | |
| 1 | Suspended Particulate Matter(SPM) | $\mu g/m^3$ | 20.2 | 18.3 | 15.4 | 13.5 | 10.2 | ≤ 150 |
| 2 | HC(Hydrocarbons) | $\mu g/m^3$ | 0.08 | 0.07 | 0.05 | 0.05 | 0.04 | - |
| 3 | Oxides of Nitrogen(NOx) | mg/m3 | 0.100 | 0.098 | 0.092 | 0.083 | 0.070 | - |
| 4 | Carbon Dioxide(CO2) | $mg/m^3$ | 568.40 | 542.62 | 540.12 | 536.25 | 500.46 | - |
| 5 | Carbon Monoxides (CO) | $\mu g/m^3$ | 0.320 | 0.312 | 0.278 | 0.254 | 0.243 | - |

UOM: Unit of Measurement

Remarks: - All above results are within MPCB Limits.

Reviewed By

Kalyani

(Ms. Kalyani Gore)
(Technical Manager)

Neetal Laboratories & Environmental Services Pvt. Ltd. * PUNE

Authorized Signatory

(Mr. Abhishek Tope)
(Quality Manager)

*****************End of Report**************

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BY (MoEF & CC) MINISTRY OF ENVIRONMENT FOREST & CLIMATE CHANGE

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Website : www.neetalenvirolab.com, Email: sales@neetalenvirolab.com / neetalenviro@gmail.com, Mob. 8669699854 / 52

केन्द्रीय प्रदूषण नियंत्रण बोर्ड
CENTRAL POLLUTION CONTROL BOARD
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय भारत सरकार
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE GOVT. OF INDIA

F.No. LB/99/7/2021-INST LAB-HO-CPCB-HO/Pvt./ 9129

Dated: 28th January 2023

**Provisional Certificate**

To,

**Head of Laboratory,**
**M/s Neetal laboratories and Environmental Services Private Limited,**
**H. No.-43, Santosh Nagar, Waki Budruk, Tal. Khed, Dist. Pune,**
**Maharashtra-410501.**

**Subject: Recognition of M/s Neetal laboratories and Environmental Services Private Limited, H. No.-43, Santosh Nagar, Waki Budruk Pune, Maharashtra- 410501 as Environmental laboratory under the Environmental (Protection) Act- 1986.**

Sir,

I am directed to refer the online application, dated 12/12/2022 for the recognition of your laboratory under Environmental (Protection) Act, 1986. Based on the recommendations of the concerned Division, approval of Competent Authority for recognition of Environmental laboratories and your acceptance of the revised terms and conditions at Annexure-III & IV of the guidelines for recognition of environmental laboratories, CPCB approves the recognition of **M/s Neetal laboratories and Environmental Services Private Limited, H. No.-43, Santosh Nagar, Waki Budruk Pune, Maharashtra- 410501** and shall be notified in the Gazette of India. Considering the current requirement of mandatory accreditation/ certifications of the laboratory, **this recognition shall be valid up to 23/11/2024.**

2. As sought in the aforementioned application, **M/s Neetal laboratories and Environmental Services Private Limited, H. No.-43, Santosh Nagar, Waki Budruk, Pune, Maharashtra-410501** may undertake the following tests:

   i. **Physical Tests**-Conductivity, Colour, pH, Fixed & Volatile Solids, Total Solids, Total Dissolved Solids, Total Suspended Solids, Turbidity, Temperature, Velocity & Discharge Measurement of Industrial Effluent Stream, Flocculation Test (Jar test), Odour, Salinity, Settleable Solids and Sludge Volume Index.
   ii. **Inorganic (General and Non-metallic):** Acidity, Alkalinity, Ammonical Nitrogen, Chloride, Chlorine Residual, Dissolved Oxygen, Fluoride, Total Hardness, Total Kjeldahl Nitrogen (TKN), Nitrite Nitrogen, Nitrate Nitrogen, Phosphate, Sulphate, Bromide, Chlorine Demand, Iodine, Sulphite, Silica, Cyanide and Sulphide.
   iii. **Inorganic (Trace Metals):** Boron, Cadmium, Calcium, Total Chromium, Chromium Hexavalent, Copper, Iron, Lead, Magnesium, Mercury, Nickel, Potassium, Sodium, Sodium Absorption Ratio, Zinc, Arsenic, Aluminium, Beryllium, Barium, Manganese, Selenium, Silver, and Cobalt.
   iv. **Organics (General) and Trace Organics:** Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Oil and Grease, Phenolic Compounds, Pesticides (each) (Organo-Chlorine and Organo Nitrogen-Phosphorus), Surfactant, Poly-Chlorinated Biphenyl (PCB's) each, Poly-Nuclear Aromatic Hydrocarbon (PAH), Organic Carbon (in Solid) and Carbon/Nitrogen Ratio.
   v. **Microbiological Test:** Total Coliform, Faecal Coliform, *E. coli*, *Faecal Streptococci* and Total Plate Count.
   vi. **Toxicological Tests:** Bioassay Method for Evaluation of Toxicity Using Fish and Measurement of Toxicity Using Daphnia or Other Organism.
   vii. **Biological Test:** Benthic Organism Identification and Count, Macrophytic Identification and Planktonic Identification Count.
   viii. **Characterization of Hazardous Waste:** Corrosivity, Reactivity and Measurement of Heavy Metals/Pesticides in the Waste/Leachate.

**Contd.**

ix. **Soil/Sludge/Sediment and Solid Waste:** Boron, Cation Exchange Capacity (CEC), Electrical Conductivity, Nitrogen (Available), Organic Carbon/Matter (Chemical Method), pH, Phosphorous (Available), Phosphate (Ortho), Phosphate (Total), Potassium, SAR in Soil Extract, Sodium, Soil moisture, TKN, Calorific Value, Ammonia, Bicarbonate, Calcium, Calcium Carbonate, Chloride, Colour, Gypsum Requirement, H.Acid, Heavy Metal, Magnesium, Nitrate, Nitrite, Potash (Available), Sulphate, Sulphur, Total Water Soluble Salt and Water Holding Capacity.

x. **Ambient Air/ Fugitive Emissions:** Nitrogen Dioxide ($NO_2$), Sulphur Dioxide ($SO_2$), Total Suspended Particulate Matter, Respirable Suspended Particulate Matter $PM_{10}$, Ammonia, Carbon Monoxide, Fluoride, Lead, Ozone, Benzene Toluene Xylene (BTX) and $PM_{2.5}$.

xi. **Stack Gases/ Source Emission:** Particulate Matter, Sulphur Dioxide, Velocity & Flow, Carbon Dioxide, Carbon Monoxide, Temperature, Oxygen, Oxides of Nitrogen, Acid Mist, Ammonia, Chlorine, Fluoride(Particulate) and Total Hydrocarbon.

xii. **Noise Level:** Noise Level Measurement (20-140 dBa) and Ambient Noise and Source Specific Noise.

xiii. **Meteorological:** Ambient Temperature, Wind Direction, Wind Speed, Relative Humidity, and Rainfall.

3. Further, the following analysts have been approved as Government Analysts.

    i. Mrs. Kalyani Yuvraj Gore
    ii. Sh. Abhishek Dattatray Tope
    iii. Mrs. Dipa Nilesh Mahajan

4. The laboratory shall compulsorily participate in the Analytical Quality Exercise conducted by the Central Pollution Control Board (CPCB) to ascertain the capability of the laboratory and analysis carried out and shall submit quarterly progress report to CPCB.

5. The surprise inspection/periodic surveillance of the recognized environment laboratory will be undertaken by CPCB to assess its proper functioning systematic operation and reliability of data generated at the laboratory.

6. It is also mandatory for the laboratory to have requisite accreditations of the ISO: 17025 and ISO:45001 and its renewal as per accreditation rules. This recognition is subject to such accreditations and renewals as applicable. The laboratory is required to apply online for further renewal of recognition through CPCB web portal after renewal of the mandatory accreditations / certifications concerned.

7. The laboratory should compulsorily follow the accepted terms and conditions. In case of serious non-compliance of any of the terms and conditions, the laboratory may be black listed for a minimum period of two years and civil/criminal proceedings, as applicable, may be initiated for performing functions on behalf of the Government in an unauthorized manner.

Yours faithfully,

K. R... 28/2/23

(Dr. K. Ranganathan)
Scientist-E & Divisional Head
Instrumentation laboratory

डॉ. के. रंगनाथन / Dr. K. Ranganathan
वैज्ञानिक 'ई' / Scientist 'E'
प्रभारी जल एवं उपकरणीय प्रयोगशाला
Div. Head-Water & Instrumentation Laboratory
केंद्रीय प्रदूषण नियंत्रण बोर्ड
Central Pollution Control Board
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार
(M/o Environment, Forest & Climate Change, Govt. of India)
परिवेश भवन, पूर्वी अर्जुन नगर, दिल्ली-110032
Parivesh Bhawan, East Arjun Nagar, Delhi-110032

National Accreditation Board for
Testing and Calibration Laboratories

NABL

## CERTIFICATE OF ACCREDITATION

# NEETAL LABORATORIES AND ENVIRONMENTAL SERVICES PRIVATE LIMITED

**has been assessed and accredited in accordance with the standard**

## ISO/IEC 17025:2017

## "General Requirements for the Competence of Testing & Calibration Laboratories"

**for its facilities at**

**HOUSE NO. 43, SANTOSH NAGAR, AT POST: WAKI BUDRUK, PUNE, MAHARASHTRA, INDIA**

**in the field of**

## TESTING

**Certificate Number:** TC-11184

**Issue Date:** 24/11/2022 **Valid Until:** 23/11/2024

**This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.**
**(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)**

**Name of Legal Identity :** Neetal Laboratories and Environmental Services Private Limited

**Signed for and on behalf of NABL**

**N. Venkateswaran**
**Chief Executive Officer**


## Further Inquiry:

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