Impact of Ethanol-Diesel Blend on Engine Performance and Exhaust Emissions on a Non-Road Engine Application

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ECT 2023 Conference and Exposition, New Delhi

Authors :

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Head, CoE, TMTL, Alwar

Classification: Internal

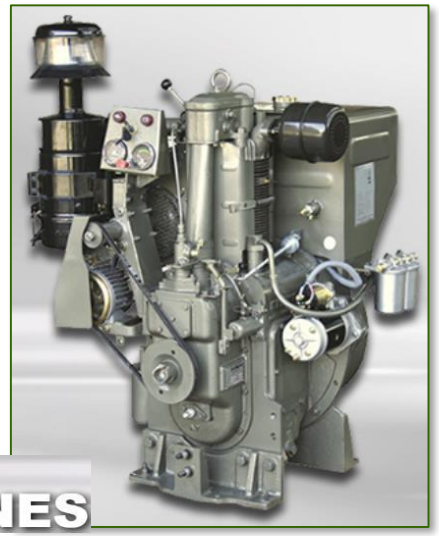
Product portfolio

Tractors

TAFE POWER

Power Generators

Agro Engines



Industrial Engines

Classification: Internal

Quality Certifications:


TÜV NORD

CERTIFICATE

Management system as per
ISO 9001 : 2015

The Certification Body TÜV NORD CERT GmbH hereby confirms as a result of the audit, assessment and certification decision according to ISO/IEC 17021-1:2015, that the organization

TAFE MOTORS AND TRACTORS LIMITED (TMTL)
ENGINE DIVISION
Itarana Road, Alwar - 301 001,
Rajasthan,
India
And other regional offices as per Annexure

operates a management system in accordance with the requirements of ISO 9001:2015 and will be assessed for conformity within the 3 year term of validity of the certificate. This certificate is valid in conjunction with the main certificate.

Scope -

Design, Manufacture, Marketing & Service of Auto Engine, Standalone Engines and Spare Parts.

Certificate Registration No. 04 100 940270/06
Audit Report No. 2.5-1814/2000
Valid from 27.10.2021
Valid until 03.09.2024
Initial certification 16.12.2016

Certification Body
at TÜV NORD CERT GmbH
Mumbai, 27.10.2021

TÜV NORD CERT GmbH Langemarckstrasse 20 45141 Essen www.tuev-nord-cert.com

TUV India Pvt. Ltd., 801, Raheja Plaza – 1, L.B.S. Marg, Ghatkopar (W), Mumbai - 400 086, India www.tuv-nord.com/in

IAF DAkkS

ISO 9001:2015


TÜV NORD

CERTIFICATE

Management system as per
ISO 14001 : 2015

The Certification Body TÜV NORD CERT GmbH hereby confirms as a result of the audit, assessment and certification decision according to ISO/IEC 17021-1:2015, that the organization

TAFE MOTORS AND TRACTORS LIMITED (TMTL)
ENGINE DIVISION
Itarana Road, Alwar-301 001,
Rajasthan,
India

operates a management system in accordance with the requirements of ISO 14001:2015 and will be assessed for conformity within the 3 year term of validity of the certificate. This certificate is valid in conjunction with the main certificate.

Scope -

Design, Manufacture, Marketing & Service of Auto Engine, Standalone Engines and Spare Parts.

Certificate Registration No. 04 104 040104/05
Audit Report No. 2.5-1814/2000
Valid from 27.10.2021
Valid until 03.09.2024
Initial certification 07.08.2007

Certification Body
at TÜV NORD CERT GmbH
Mumbai, 27.10.2021

TÜV NORD CERT GmbH Langemarckstrasse 20 45141 Essen www.tuev-nord-cert.com

TUV India Pvt. Ltd., 801, Raheja Plaza – 1, L.B.S. Marg, Ghatkopar (W), Mumbai - 400 086, India www.tuv-nord.com/in

IAF DAkkS

ISO 14001:2015


TÜV NORD

CERTIFICATE

Management system as per
ISO 45001 : 2018

The Certification Body TÜV NORD CERT GmbH hereby confirms as a result of the audit, assessment and certification decision according to ISO/IEC 17021-1:2015, that the organization

TAFE MOTORS AND TRACTORS LIMITED (TMTL)
ENGINE DIVISION,
Itarana Road, Alwar-301 001,
Rajasthan,
India

operates a management system in accordance with the requirements of ISO 45001:2018 and will be assessed for conformity within the 3 year term of validity of the certificate. This certificate is valid in conjunction with the main certificate.

Scope -

Design, Manufacture, Marketing & Service of Auto Engine, Standalone Engines and Spare Parts.

Certificate Registration No. 44 126 19392533/04
Audit Report No. 2.5-1814/2000
Valid from 27.10.2021
Valid until 03.09.2024
Initial certification 03.09.2013 (BS OHSAS 18001)

Certification Body
at TÜV NORD CERT GmbH
Mumbai, 27.10.2021

TÜV NORD CERT GmbH Langemarckstrasse 20 45141 Essen www.tuev-nord-cert.com

TUV India Pvt. Ltd., 801, Raheja Plaza – 1, L.B.S. Marg, Ghatkopar (W), Mumbai - 400 086, India www.tuv-nord.com/in

IAF DAkkS

ISO 45001:2018

Classification: Internal

Latest Emission Upgrade:

Single Cylinder series
7.5,10 & 15 kVA

Air cooled series
25, 30 & 35 kVA

Water cooled series
40, 45 & 60 kVA

Classification: Internal

Contents

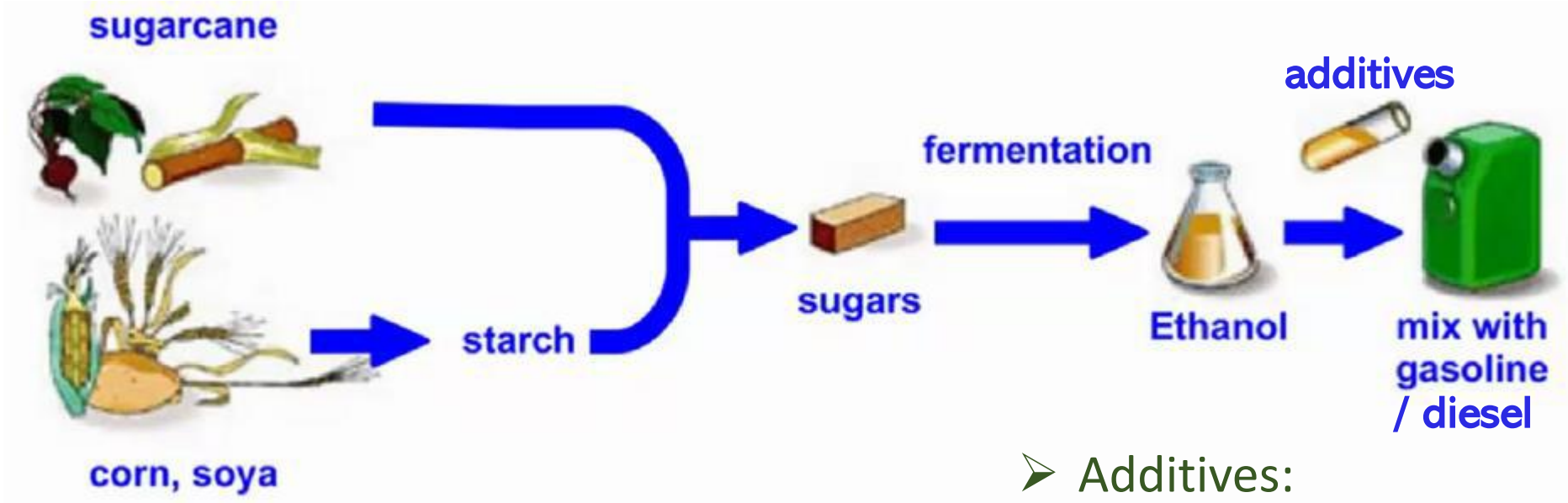
- Ethanol Blend
- Key Observations:
  - Impact on the Performance
  - Impact Emissions
  - Impact on Engine Life
- Modifications on Engine Applications

Classification: Internal

Ethanol Blend

- Ethanol Blend = Fossil Fuel (Gasoline or Diesel) + Ethanol + Additive

~ 10 – 95 % < ~ 85% < ~2.5%



- Additives:
  - Stabilizer / Binder,
  - Cetane improver,
  - Corrosion inhibitor and
  - Lubricity improver

Classification: Internal

Ethanol Blend

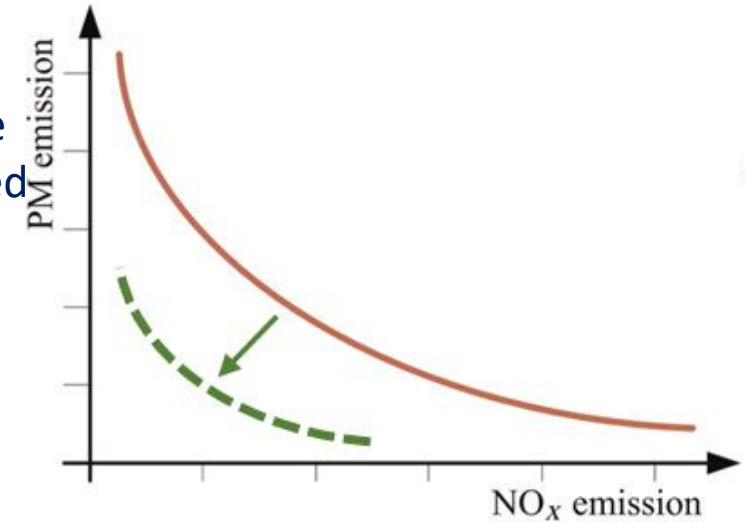
- BP 44, Sector 43, Gurgaon
- Oct 08, 2023

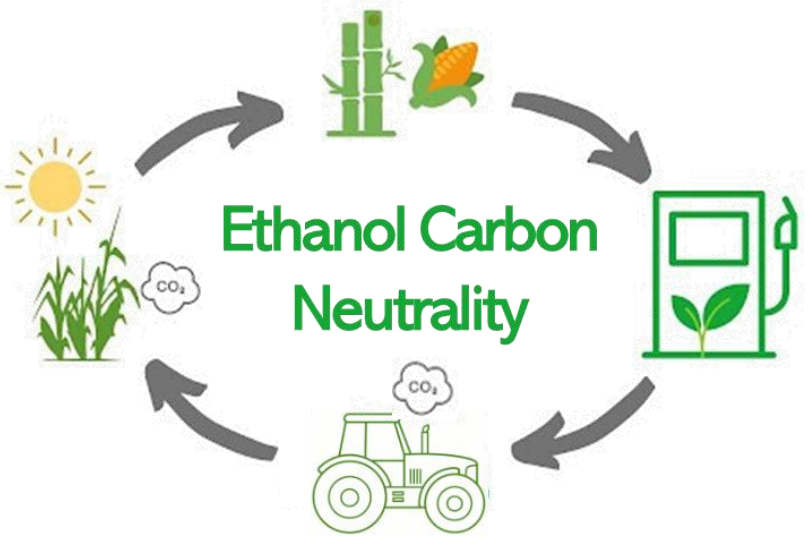
Classification: Internal

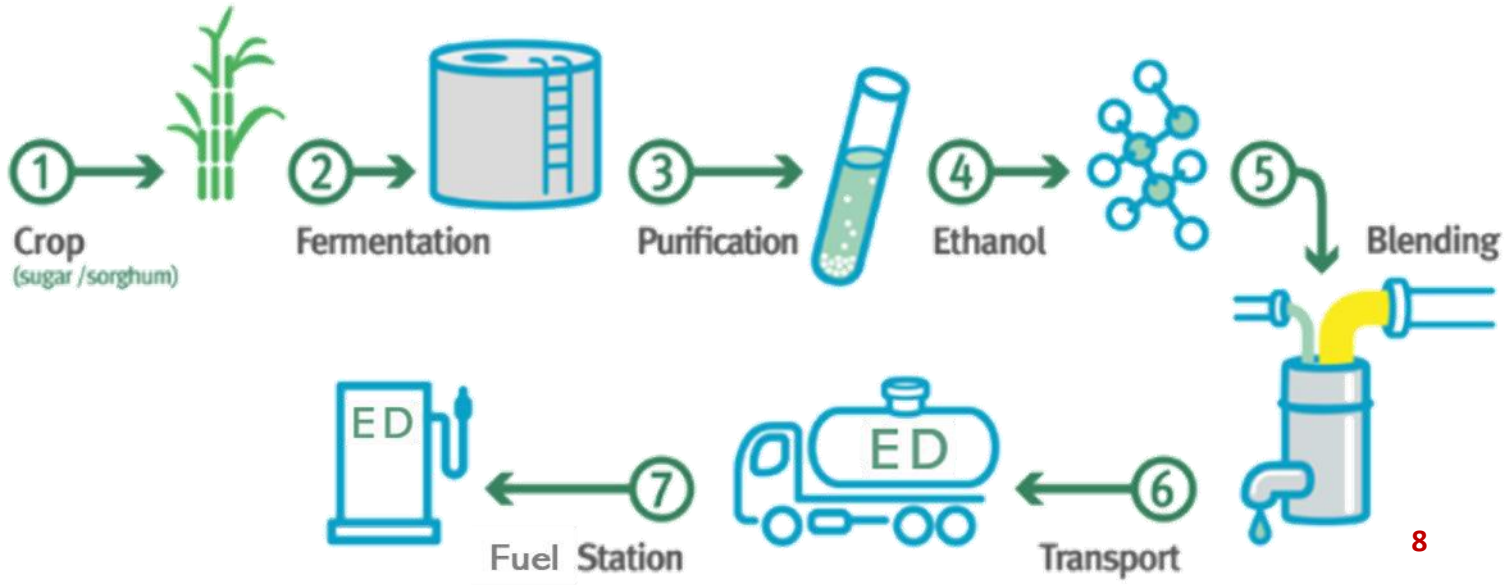
Ethanol Blend

➢ Why Ethanol Blend?

- In India, ethanol is largely derived from **sugarcane** via a fermentation process. Since it is a **plant-based fuel**, ethanol is considered **renewable**.
- Ethanol is **high in oxygen** content, engines using ethanol blends combust fuel more efficiency. Hence, this process will also help **reduce** the country's **carbon footprint.**
- Easy to handle in comparison with pressurised gaseous fuel
- Helps to **reduce import bill / trade deficit**
- Reduction in **emissions** – both NOx and PM
- No need to make additional **eco-system** for handling as gasoline blend is already implemented.

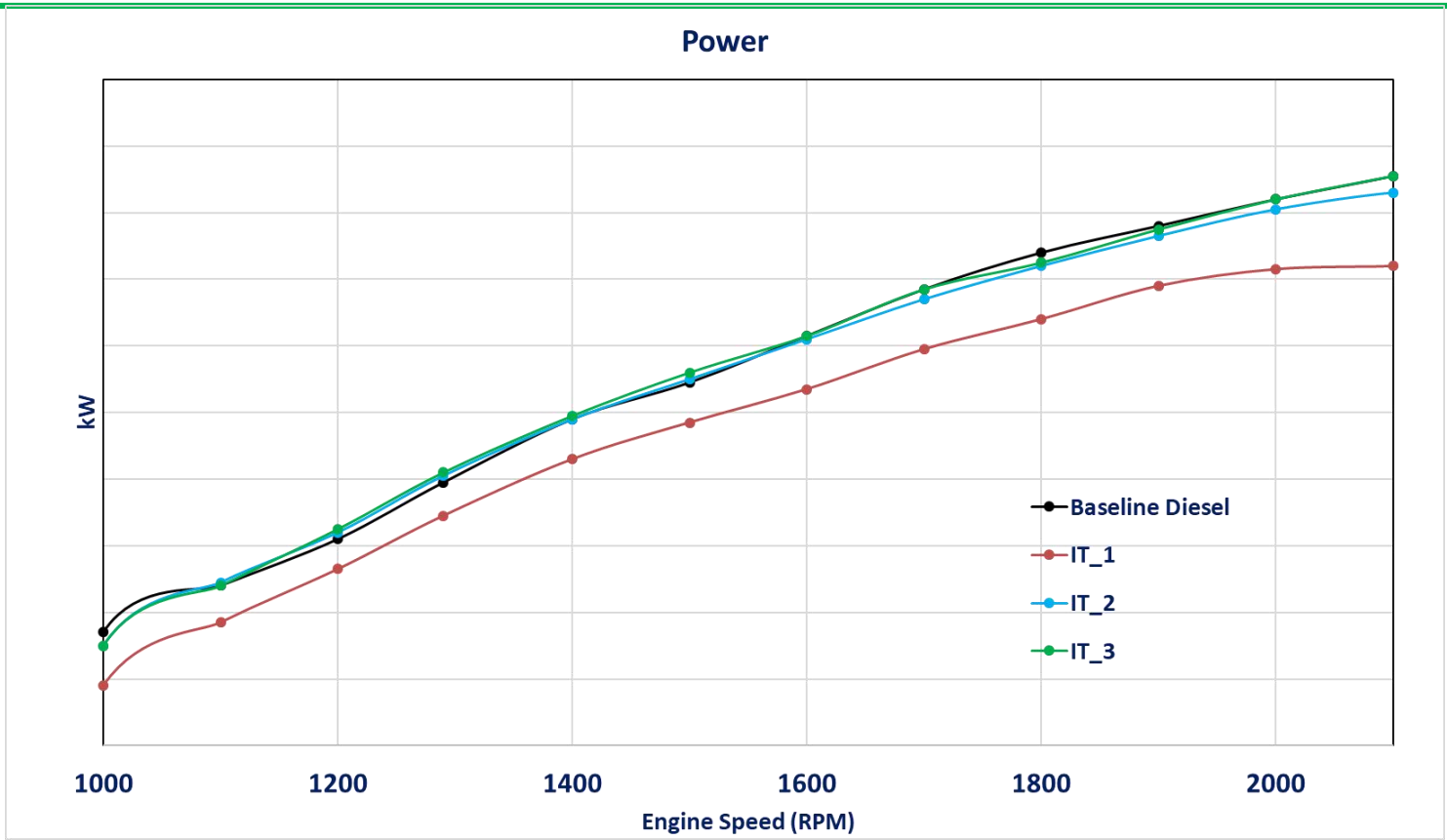






Classification: Internal

Key Observations: Impact on Performance

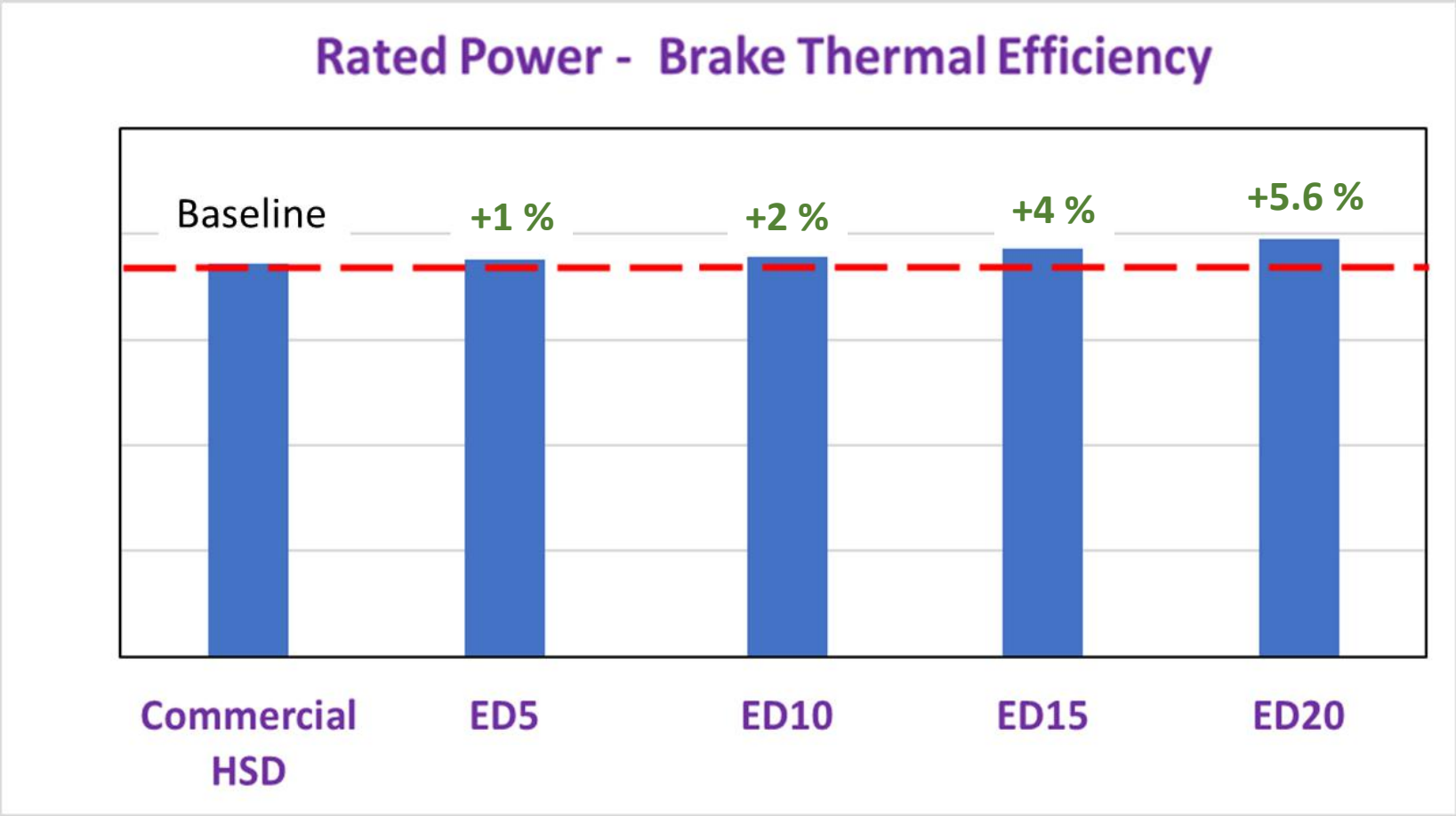


- Reduction in engine power / torque characteristics observed when switching from diesel to ethanol blend
- Re-calibration required to restore the power and torque characteristics

The ethanol-diesel performance can be retained by the re-calibration of the fuel system

Classification: Internal

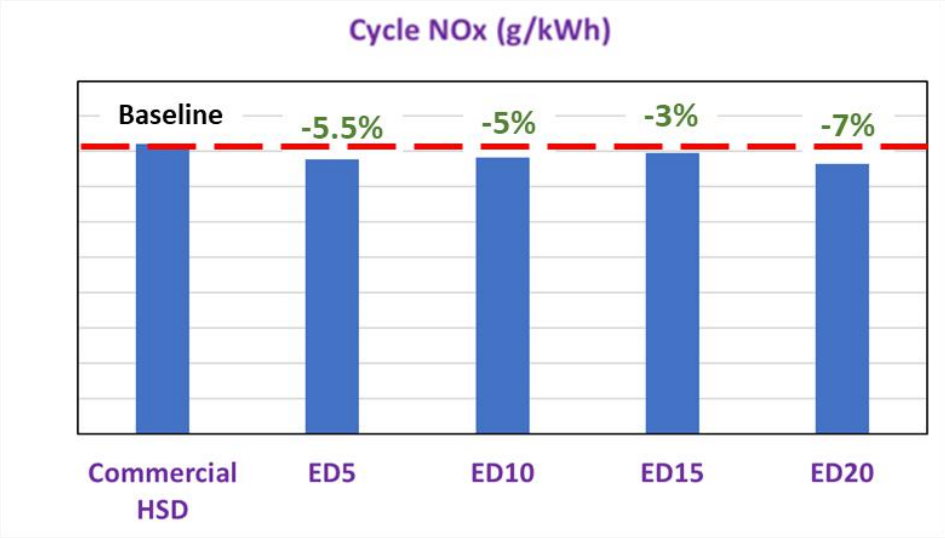
Key Observations: Impact on Performance

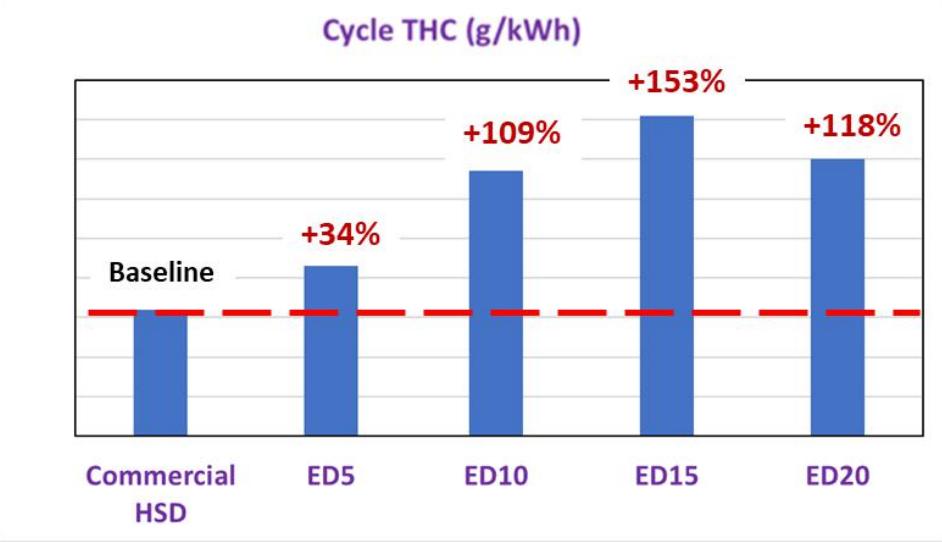


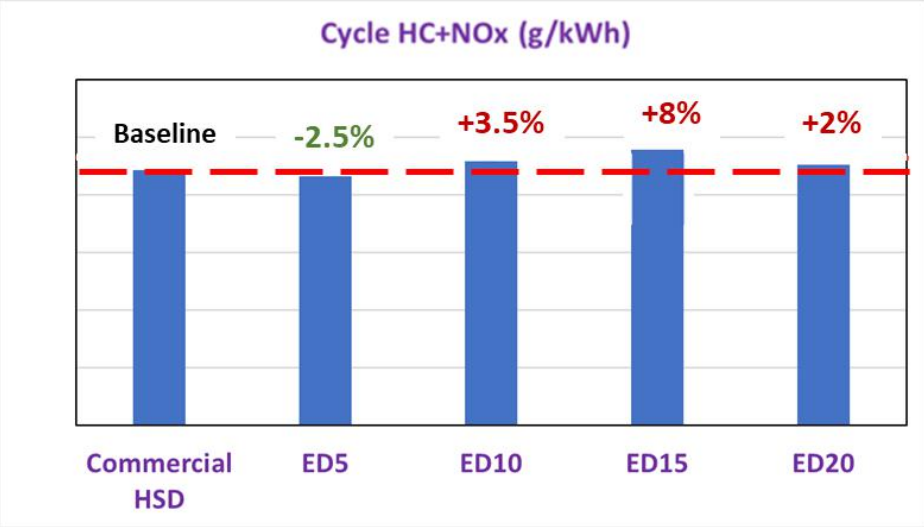
Ethanol blend improves the overall thermal efficiency

Classification: Internal

Key Observations: Impact on Emissions





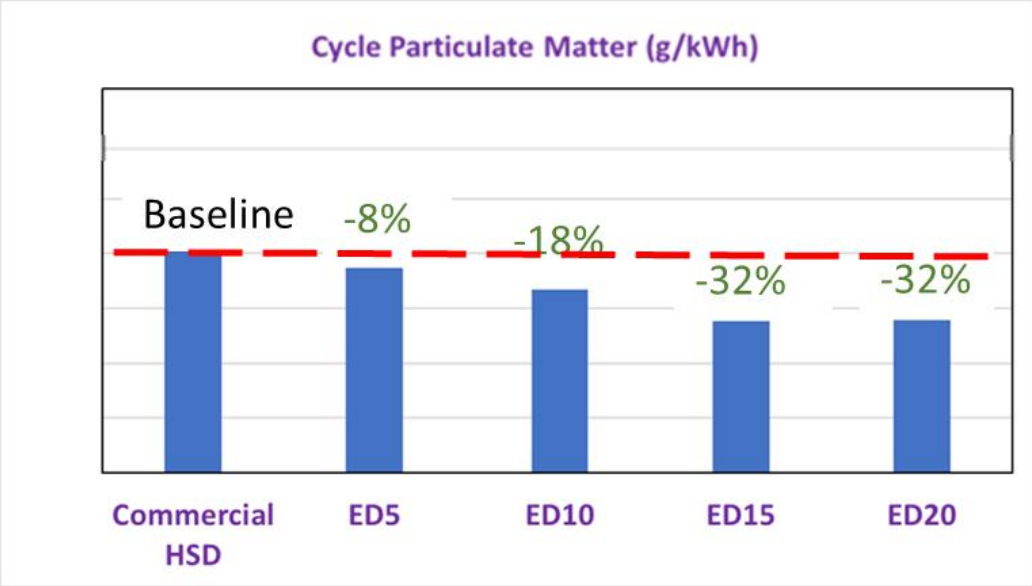


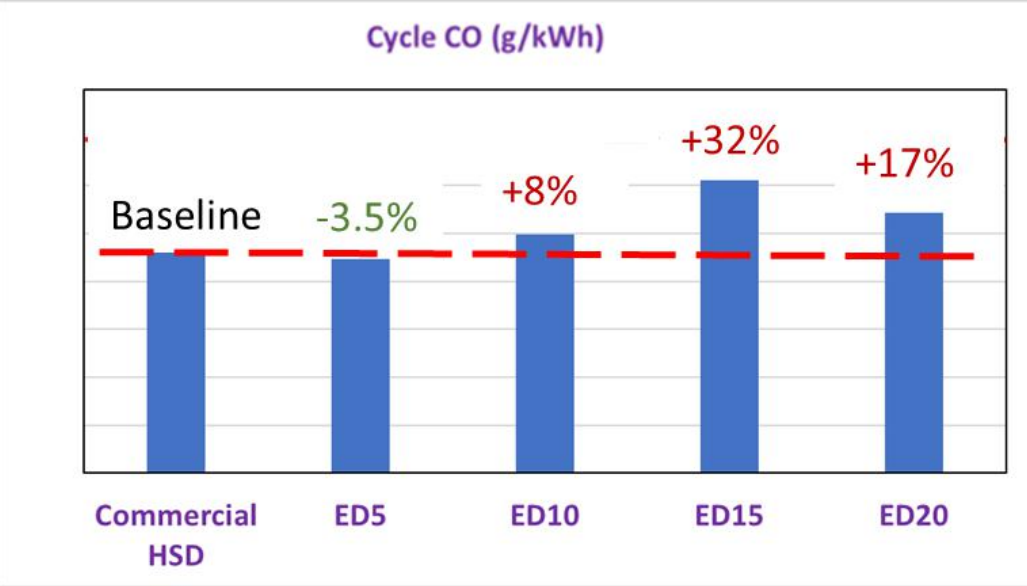
- NOx observed reduced, THC increase is relatively high.
- Total (NOx + THC) remains in similar range.
- THC major increase constituents are aldehydes, ethanol vapour and ethylene

Overall Cycle NOx + THC emissions remains in a similar band of Diesel fuel

Classification: Internal

Key Observations: Impact on Emissions





Impact on PM:

- Relatively shorter hydrocarbon chains
- Increased oxygen content

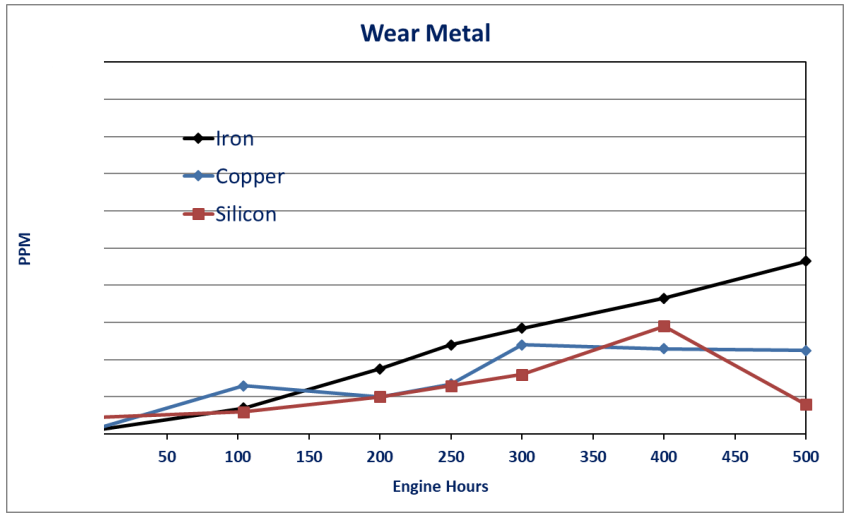
Impact on CO:

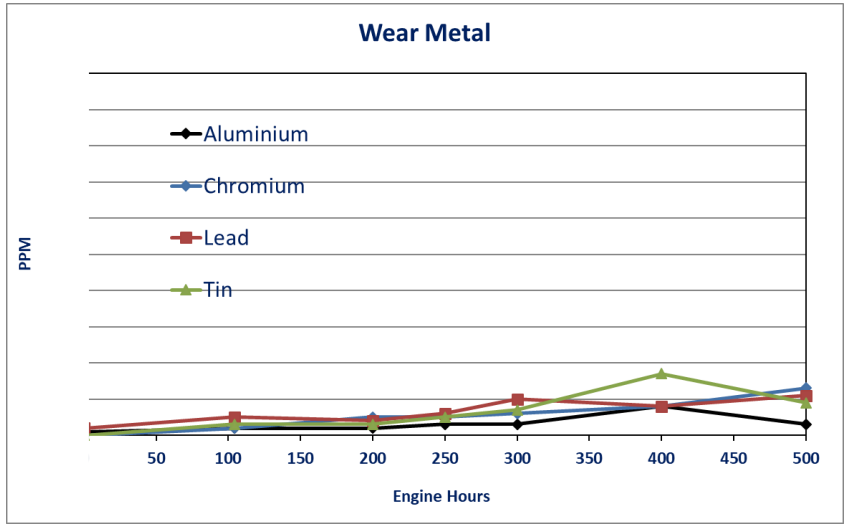
- Ignition delay (higher latent heat of vaporisation)
- Relatively prolonged Injection

Ethanol blend indicates significant benefit in PM reduction

Classification: Internal

Key Observations: Impact on Engine Life



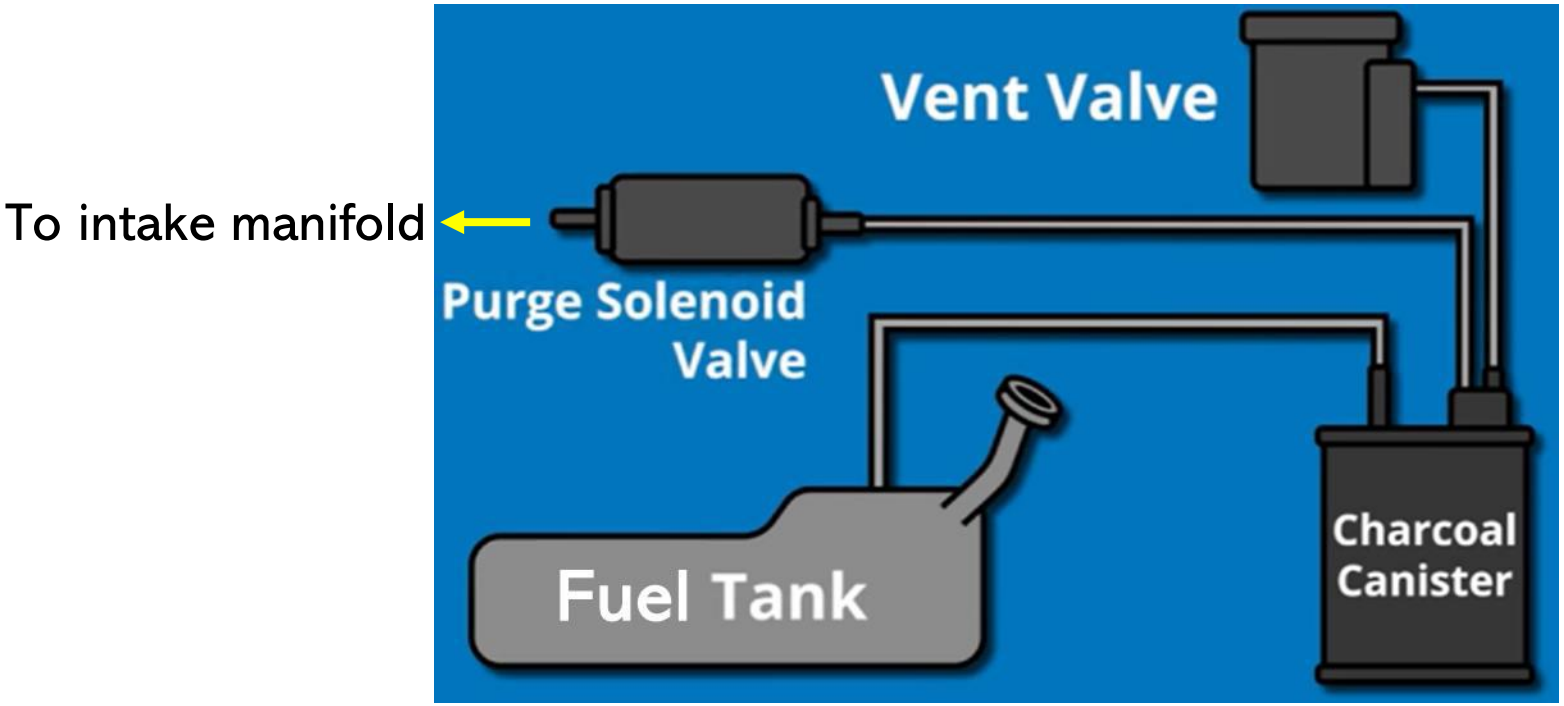


- TAN (Total Acid Number) and TBN (Total Base Number) are well within Lube-oil Discard limit
- Soot content in Lube-oil is well within acceptable limit
- Copper wear is a typical phenomenon with Ethanol during the initial part of running. However, it stabilized after 300 hrs.
- Bearing Metal Wear (Aluminium, Lead & Tin) is well within discard limit
- Crank and Gear Train Wear is well within limit (Fe from all parts & Cr-from piston rings)

500 hrs of preliminary durability showed no critical deterioration

Modifications Required on Engine Applications

- Re-calibration of engine for performance & emission
- Charcoal Canister arrangement is necessary to prevent vapor accumulation and uncontrolled vapor escape from fuel tank
- Vapour outlet from Canister is typically passed into Intake manifold



Summary

- These observations are based on an off highway application engine test results.
- The ethanol-diesel performance can be retained by the re-calibration of the fuel system
- Ethanol blend indicates an improvement in overall thermal efficiency
- Overall off high way emission test cycle (NOx + THC) emissions remains in a similar band that of Diesel fuel.
- Ethanol blend indicates significant benefit in PM reduction
- Preliminary engine durability tests showed no critical deterioration

Classification: Internal

Thank you