Evolving Fluid Needs for the e-ICE

Caroline Laufer, Andrew J.D. Ritchie

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The rise of e-ICE  (electrified-Internal Combustion Engine)

1. Why e-ICEs Matter
   1.1 - The Case for Action
   1.2 - Bridging the gap to zero emissions via e-ICEs

2. Why e-ICEs need tailored lubricants
Why e-ICEs Matter
Shift to sustainable mobility:
The Case for Action

Global actions to cut pollution and in particular GHG and particulates from transportation

Timeline of key emissions standards and requirements:

- 2020: 2020/21 China new FE standards apply
- 2025: U.S. NHTSA finalizes tougher new standards requiring a fleetwide average of around 49 mpg in the 2026 MY
- 2030: European Green Deal proposes 55% passenger car emissions cut by 2030. And effective ICE ban by 2035
Shift to sustainable mobility:
Bridging the gap to reach zero emission goals

ICE PHASE-OUT is an inevitable necessity

Forecasts on powertrain architecture uptake differ but they all agree e-ICE and BEVs will rise rapidly

Production of e-ICEs forecast to grow at much faster rate than BEVs over the next decade

INTERIM BRIDGING VIA e-ICE

BEV LONG TERM FUTURE
but many hurdles to clear over the coming years before full adoption can be achieved

ZERO EMISSIONS = long term aim for the automotive industry
Shift to sustainable mobility:
Interim bridging to full BEV via e-ICEs:

Key global data sets

Performance you can rely on.
Shift to sustainable mobility:

Over a century of ICE innovation

Data source:
- AAMA Motor Vehicles Facts and Figures 1997 - US only
- AAMA Motor Vehicles Facts and Figures 1997 - World
- Bureau of Transportation Statistics, 2021 - World
- Ward’s World Motor Vehicle Data, 2002 - World
- IHS Markit, Global Production based Powertrain Forecast, March 2022 - World
Shift to sustainable mobility:
Production Forecast
Bus and Truck

Fuel cell use in HDD transportation is growing quickly but still <1% of production

Source: IHS Markit, Global Production based Powertrain Forecast, February 2022
Shift to sustainable mobility:

Production Forecast

Passenger Car and Light Commercial Vehicle

Propulsion System
- ICE
- ICE: Stop/Start
- Hybrid-Mild
- Hybrid-Full
- Plug-in Hybrid
- Electric

MFP = Mild/Full/Plug-in

Source: IHS Markit, Global Production based Powertrain Forecast, March 2022
Shift to sustainable mobility:
Interim bridging to full BEV via e-ICEs:
Over 250 million e-ICE by 2029

EV and MFP hybrids almost 70% of the worldwide production by 2029.

Source: IHS Markit, Global Production based Powertrain Forecast, March 2022
Shift to sustainable mobility:

Interim bridging to full BEV via e-ICEs:

Over 250 million e-ICE by 2029

Source: IHS Markit, Global Production based Powertrain Forecast, March 2022
Why e-ICEs need tailored lubricants
Why e-ICEs need tailored lubricants:

Hybrid Duty Cycles

Charge Depleting & Sustaining Modes

Engine is on for short periods of time
High Power-Cold Starts (HPCS)
Different to constant city Stop/Start
Oil temperature remains low for long periods of time in cold climates

1) Water and Fuel Dilution builds-up generating Corrosion, Rust, Emulsion
2) Potential for catastrophic parts failure
3) High emissions spikes, including small particles < 23 nm

Source: SAE 2020-01-0354
Why e-ICEs need tailored lubricants:

**Impact of Water and Fuel Contamination**

Water and Fuel Dilution builds-up generating Corrosion, Rust, Emulsion

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**Oil temperature**

- WLTC
- WLTC Mild Hybrid*
- WLTC Full Hybrid*

|= Field conditions with short engine-on periods
*= simulated

* = simulated

- Engine oil temperature can remain low for days/months.
- Cold climates enhance this.
- Under short engine-on cycles, fuel and water levels in the oil rise gradually but constantly.
- Both can rise well above 10%.

Photos from SwRI
Why e-ICEs need tailored lubricants:

**Impact of Lubricant Contamination and HPCSSs**

**Potential for catastrophic parts failure**

Photos from SwRI
Why e-ICEs need tailored lubricants:

HPCS Generate Unexpectedly High Particulates

High emissions spikes, with increasing focus on sub 23 nm particles

- Cold start is always the most challenging part of emissions control
- HPCS in cold WLTC generate lots of particulates during 1st 2 phases
  - PFI Hybrid - no GPF
  - GDI without GPF higher emissions
- HPCSs also show particulate spikes in Real Driving Emissions (RDE) tests
- Rising interest in the small particulates with HPCSs
Summary: Future Directions

- Hybrid duty cycles present new, emerging challenges to the lubricant
  - Today’s hybrids rely on specifications developed for ICE-only duty cycles
  - New test methods needed for hybrid duty cycles
  - New application targets may be needed

- New e-ICE solutions frame future lubrication requirements
  - ICE innovations will continue and be connected to hybrid powertrains
  - Hybrid duty cycles must be addressed by the lubricant
    - Effects of contamination, wear, and emissions highlighted here

For more information: please visit https://www.infineuminsight.com/en-gb/articles/passenger-cars/a-new-generation-of-lubricants-for-hybrids/
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