Why passenger car motor oil is no longer the best choice for four stroke motorcycles?

Patrice Estoueig
Product Line Manager

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Passenger car and motorcycle engines differences

**Passenger car engine**
Engine and transmission uses different oil

**Motorcycle engine (Four stroke)**
Engine and transmission uses same oil

**Passenger car applications**
- Dry type starter system
- Dry clutch
- Separate transmission lubrication system

**Motorcycle applications**
- All components share the same engine oil supply
  - Clutch
  - Transmission
Impact of engine design on the lubricant
Motorcycles operate at higher power and higher speeds than passenger car resulting in more stress for the lubricant.
Four stroke motorcycle oil against passenger cars engine oil

Attributes for motorcycle engine oil

- Volatility is more critical because of higher temperature operation
  - Leads to higher oil consumption
  - Improved oxidation performance needed due to higher operating temperatures (about 1.5 times the kW/liter)

![Viscosity increase against oil consumption graph](image)
Four stroke motorcycle oil specificity

Attributes for the transmission

• Gear durability
  – Shear Stability is critical
    • 10W-30 as minimum viscosity grade
    • Proper selection of VII
    • Minimize oil shear down in transmission

• Friction performance
  – Wet clutch applications (multi-plate, centrifugal) require unique frictional properties and viscometrics
  – Low friction oils may hurt “wet” clutch performance
    • Clutch slipping can cause poor drivability, power loss, and starting problems
    • Frictional characteristics need to remain stable over lubricant drain interval to maintain shift feel and clutch performance

• High fuel dilution with motorcycles increases wear severity
Motorcycle against passenger car

- Higher speed (9000rpm)
- Air cooled (except for big bikes)
- High power output per engine displacement (200HP/liter)
- One oil lubricates clutch, transmission and engine

- Lower speed (5000rpm)
- Water cooled
- Low power output per engine displacement (100HP/liter)
- Engine oil lubricates engine only
Emerging changes in motorcycle oils
Emissions regulations

New exhaust emissions regulations trigger an increased demand for newer, cleaner engine designs resulting in more stress on lubricants in emerging markets

- More stringent emission standards
  - In India
    - Bharat Stage IV for two wheeled vehicles in 2017 (similar to Euro IV)
    - Bharat Stage VI for two wheeled vehicles in 2020 (similar to Euro VI and skipping Bharat Stage V)

- Reduction of Green House Gases
  - Improve fuel economy to reduce CO₂ emissions
Improve fuel economy

Use of lower viscosity grades to achieve higher fuel economy

- Currently SAE 10W-30 is considered as low viscosity
- SAE 5W-30 and 0W-30 may be introduced in the future

Formulating challenge

- Potential trade-off on durability, improvement on anti-wear performance required
- Lower friction oil may lead to clutch slippage, need a friction modifier which can reduce metal-on-metal friction while maintaining high paper-on-steel friction to ensure optimal clutch performance
Impact of passenger car motor oil with Fuel Economy claims

Fuel economy for passenger car motor oil can be achieved with

- **Friction modification:**
  - Friction modification can cause **clutch slippage**
  - Loss of engine power and subsequently performance

- **Low viscosity, specifically High Temperature High Shear viscosity (HTHS)**
  - HTHS is related to oil film thickness
    - High HTHS is good for durability (wear protection)
    - Low HTHS is good for Fuel Economy

<table>
<thead>
<tr>
<th></th>
<th>Motorcycle Manufacturer A</th>
<th>Motorcycle Manufacturer B</th>
<th>Motorcycle Manufacturer C</th>
<th>Motorcycle Manufacturer D</th>
<th>HTHS (mPa.s)</th>
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<tbody>
<tr>
<td>5W-30</td>
<td>Occasional pitting</td>
<td>Occasional pitting</td>
<td>Occasional pitting</td>
<td>Pitting</td>
<td>2.7 - 2.9</td>
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<td>10W-30</td>
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<td>No pitting</td>
<td>No pitting</td>
<td>3.1 - 3.5</td>
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<tr>
<td>10W-40</td>
<td></td>
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<td>20W-40</td>
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<td>No pitting</td>
<td>No pitting</td>
<td>No pitting</td>
<td>3.9 - 4.2</td>
</tr>
</tbody>
</table>

Low HTHS can cause gear pitting
JASO T903:2011
Drivers for change

When JASO T903:2006 was revised to JASO T903:2011, oils that were previously classified as JASO MB (containing friction modifiers) were re-classified as JASO MA/MA1

- Concerns on clutch slipping due to presence of friction modifiers

To meet JASO MB (2011), the friction modifier treat rate was increased

- From 300 ppm to 500 ppm
- Potential sediment issues due to solubility

Desire to have JASO T903:2016 friction classification limits going back to 2006 levels
JASO T903:2016
Changes against 2011

Friction properties
– Classification limits for MA/MA1/MA2/MB
– Reference oils (JAFRE-A and –B)
– Clutch material (friction plate)
– Test procedures and measurements
– Calculation methods of coefficient of friction and Stop Time Index

Onfile effective date

Report of Molybdenum content is mandatory
Performance of dedicated motorcycle oil against passenger car motor oil
Engine durability test
Oronite proprietary test

Oils evaluated in Oronite proprietary test:
10W-40 in Group II base oil to compare
- Passenger car motor oil performance
- Motorcycle oil performance formulated with Oronite motorcycle oil additive

Parameters evaluated includes
- Detergency
  • Piston and land ratings
- Oxidation
  • TAN increase (ASTM D664)
  • Viscosity increase (ASTM D445)
Motorcycle oil is showing better oxidation control in the durability test.
Engine durability test
Detergency control

Motorcycle oil is showing better detergency control in the engine durability test.
Motorcycle against passenger car

Summary

**Attributes for motorcycle oil**

- **Speed**
  - Better shear stability
  - Better oxidation control
  - Higher fuel dilution

- **Cooling**
  - Better oxidation control
  - Higher viscosity to maintain oil film

- **Power output**
  - Better oxidation control
  - Better wear protection

- **Lubrication**
  - High friction required by clutch
  - Gear pitting and wear protection (min. P and HTHS)
Motorcycle oil development requires specialized tests to confirm motorcycle oil performance.

- Meeting JASO 2016 specification and emission regulations
- Superior engine performance
- Protect clutch
- Improved gear performance

Four stroke motorcycle oil - Differentiation

- End user benefits - improved oil consumption
- End user benefits - Fuel Economy
- End user benefits - longer oil drains

Oronite leverages its motorcycle oil expertise in development of differentiated products.
Thank you
Chevron Oronite affiliate office

Chevron Oronite SAS
Le Corosa
1, rue Eugène et Armand Peugeot
CS 10022
92508 Rueil-Malmaison Cedex
France

Registered office - shared capital 18 407 665 euros –
Nanterre Trade Register n°562 061 630.

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