Low SAPS Oils

- Legislation
- Emission control technologies
- ACEA Specifications
- Total and Elf products
Legislation

- Reduction in levels of Carbon Monoxide and Dioxide (COx), Nitrogen Oxides (NOx), Sulphur Oxides (SOx) and Particulate Matter (PM)
  - Creation of standards concerning polluting emissions called Euro
    - Euro 1: 1992
    - Euro 2: 1996
    - Euro 3: 2000
    - Euro 4: 2005
    - Euro 5: 2008
Legislation

- **EURO 1**
  - 91/441/EEC NEW EMISSION LIMIT VALUES RESULTING IN THE INTRODUCTION OF THREE-WAY-CATALYSTS FOR PETROL (GASOLINE) VEHICLES

- **EURO 2**
  - 94/12/EC MORE THAN 50% REDUCTION WITH RESPECT TO EURO 1. IT RESULTS IN THE INTRODUCTION OF OXIDATION CATALYSTS FOR DIESEL PASSENGER CARS.

- **EURO 3**
  - 98/69/EC AROUND 40% EMISSION REDUCTION WITH RESPECT TO EURO 2. REVISED TEST CYCLE, ENHANCED EVAPORATIVE EMISSION TESTS, LOW TEMPERATURE EMISSIONS, ON-BOARD DIAGNOSTIC SYSTEMS (OBD), CONFORMITY OF PRODUCTION IN-SERVICE.

- **EURO 4**
  - 98/69/EC 50% EMISSION REDUCTION WITH RESPECT TO EURO 3. EXTENDED DURABILITY. OBD FOR LIGHT DUTY COMMERCIAL VEHICLES.
Low SAPS Oils
Emission control technology

- Fuel
  - Reduction in impurities and change to additives

- Post Treatment
  - Three way converter
  - De Nox
  - Diesel particulate filter
  - Continuous Regeneration Technology
  - Selective Catalytic Reduction

- Lubricants
Emission control technologies
Post treatment systems

Gasoline engine

- **TWC**

  Converts pollutants into non toxic gases

Diesel engine

- **DPF**

  Particulates accumulation and combustion

- **DE-NOx CATALYST**

  Converts NOx into NO2

P, S, and Ash limits in lubricants ➔ Low SAPS Lubricants
Emission control technologies
Exhaust Gas Recycling (EGR)

EGR

Cooler

Valve

Air Filter

Intake manifold

Engine

Exhaust manifold

Air / Air intercooler

VG Turbo or 2-stage turbo

DPF
(or CRT)

EGR => more NOx & PM in the oil =>
more nitro-oxidation & demand for
higher lubricant dispersant performance
Emission control technologies
Continuous Regenerating Technology (CRT)

- PM filtration –C oxidized by NO₂
- Filtration of carbon particles
- Low temperature regeneration
- Oxidation of unburned HydroCarbon

\[
\begin{align*}
2\text{NO} + \text{O}_2 & \rightarrow 2\text{NO}_2 \\
\text{C} + 2\text{NO}_2 & \rightarrow \text{CO}_2 + 2\text{NO} \\
\text{C} + \text{O}_2 & \rightarrow \text{CO}_2
\end{align*}
\]

Effective if \(270°C < T < 350°C\)
and if low-sulphur fuel is used (<10ppm)
=> Low-sulphur content is imperative

Source: Johnson Matthey
Reduction of pollutant emissions
Diesel Particulate filter (DPF)

Particulate filter:
Operating principle

1 - Filtration
   Particulates accumulate in the silicon carbide filter medium

2 - Regeneration of the clogged filter
   Combustion of accumulated particles in the particulate filter
Reduction of pollutant emissions
Diesel Particulate filter (DPF)

**Filtration**
- PM accumulation into the filter
- Filtration Material
- Exhaust gas containing PM
- Catalyst
- Exhaust gas without PM

**Regeneration**
- PM combustion
- CO\textsubscript{2} + H\textsubscript{2}O
- Exhaust gas containing PM
- Higher temperature of exhaust gas by engine control

**Reduction of pollutant emissions**
 Diesal Particulate filter (DPF)
ACEA SPECIFICATIONS

EUROPEAN COUNCIL

ENVIRONMENT CLEAN UP LEGISLATION

AGRICULTURE
- Chemical Clean-up

MANUFACTURING INDUSTRY
- Stack & drain pollutants

AUTOMOTIVE INDUSTRY
- Exhaust emissions

WATER INDUSTRY
- Improve quality

OIL INDUSTRY
- Reduce sulphur

ENGINE DESIGN PLUS

ACEA
- On oil quality

PETROL
- A

LIGHT DUTY DIESEL
- B

HEAVY DUTY DIESEL
- E

New Euro 4 = C-1/2/3

New Euro 4 = E6 & 7
Why do we need "low SAPS" oils for post-treatment systems?

- The chemical composition of the lubricants contains, among other things, Sulphated Ash, Phosphorus and Sulphur, which provide the following properties: antiwear, antioxidant, detergent, etc.

- The intended (and other) oil consumption generates a combustion where components are given off in the exhaust.

- However, each of these components has an impact on the post-treatment systems:
Why do we need "low SAPS" oils for post-treatment systems?

- Ash limits reduced for Diesel engines with PF
  - the aim is to prevent early fouling of the PF due to an excess of ash which would block the filter. Therefore the formula must contain less Zn, Ca, Mg, Mo, etc. all of which are present in high performance additives.

- Phosphorous limits
  - Petrol engines with 3-way catalytic converters and Diesel engines with oxidation converters.
  - The operation of these converters is altered by the phosphorous which is present in large quantities in the most high performance antiwear additives.
Why do we need "low SAPS" oils for post-treatment systems?

- **Sulphur limits**
  - Engines equipped with a mixed PF/DeNOx system
  - The DeNOx systems are particularly sensitive to sulphur and require very low sulphur content fuels and lubricants to be used.
  - This is to meet the future Euro 5 requirements (2008-2010), which are particularly drastic with respect to particulate levels and nitrogen oxides (NOx).
Why do we need "low SAPS" oils for post-treatment systems?

- The low sulphated ash, phosphorous and sulphur content of the "low SAPS" oils means that there are less components in the combustion and this optimises post-treatment system operation.

Diesel Particulate Filter – Debris
Post-treatment system compatibility

- Less fouling of the EGR valve

Exhausted Gas Recirculation valve at 80,000 km

Conventional
Fouling = 50%

Low SAPS
Fouling = 5-10%
ACEA standards for Passenger Vehicle Low SAPS lubricants (introduced in 2004)

<table>
<thead>
<tr>
<th></th>
<th>CONVENTIONAL TECHNOLOGY</th>
<th>LOW SAPS TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NON FUEL ECO</td>
<td>FUEL ECO</td>
</tr>
<tr>
<td>Very high performance – Direct injection Diesel</td>
<td>A3 / B4</td>
<td>A5 / B5</td>
</tr>
<tr>
<td>High performance</td>
<td>A3 / B3</td>
<td>A1 / B1</td>
</tr>
</tbody>
</table>

- **CONVENTIONAL TECHNOLOGY**
  - NON FUEL ECO
  - FUEL ECO

- **LOW SAPS TECHNOLOGY**
  - NON FUEL ECO
  - FUEL ECO
Appearance of the new C category, reflecting the low SAPS technology: 2 Fuel Eco standards (C1 and C2) and a non Fuel Eco standard (C3)

<table>
<thead>
<tr>
<th></th>
<th>% Ash</th>
<th>% Phosphous</th>
<th>% Sulphur</th>
<th>HTHS*</th>
<th>% Fuel Eco**</th>
<th>Automobile manufacturers who stated their intent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C1</strong></td>
<td>0.5 max</td>
<td>0.05 max</td>
<td>0.2 max</td>
<td>2.9 min</td>
<td>&gt; 2.5</td>
<td>Ford and Mazda</td>
</tr>
<tr>
<td><strong>C2</strong></td>
<td>0.8 max</td>
<td>0.07 to 0.09</td>
<td>0.3 max</td>
<td>2.9 min</td>
<td>&gt; 2.5</td>
<td>PSA PEUGEOT CITROËN</td>
</tr>
<tr>
<td><strong>C3</strong></td>
<td>0.8 max</td>
<td>0.07 to 0.09</td>
<td>0.3 max</td>
<td>3.5 min</td>
<td>&gt; 1</td>
<td>Volkswagen, BMW, Mercedes-Benz, Audi, Porsche</td>
</tr>
</tbody>
</table>

Resulting from it are new lubricants specifications, illustrated by the ACEA 2004 standards.

PSA is the only automobile manufacturer to opt for the C2 category.

Ford and Mazda appear to be the only automobile manufacturer to opt for the C1 category.
Low SAPS current and future ranges:

Elf Solaris RNX
- 04
Renault
Nissan

Elf Solaris LSX
C3 –04
MB 229.31
BMW LL 04

Elf Solaris LLX
VW 504.00/507.00

Quartz INEO ECS
C2 –04
PSA

Renault
Nissan

VW product

5w-30

German profile

VW product

5w-30

Quartz INEO MC3
C3 –04
MB 229.31
BMW LL 04

German profile

5w-30

Quartz INEO ECS
C2 –04
PSA

5w-30

Peugeot
Citroen

VW product

5w-30

Quartz
INEO504/507
VW 504.00/507.00

VW product

5w-30

German profile

5w-30

Quartz INEO MC3
C3 –04
MB 229.31
BMW LL 04

VW product

5w-30

German profile

5w-30

Quartz INEO MC3
C3 –04
MB 229.31
BMW LL 04

Peugeot
Citroen

VW product

5w-30

German profile

5w-30

Quartz INEO MC3
C3 –04
MB 229.31
BMW LL 04

VW product

5w-30

German profile

5w-30

Quartz INEO MC3
C3 –04
MB 229.31
BMW LL 04

Peugeot
Citroen

VW product

5w-30

German profile

5w-30

Quartz INEO MC3
C3 –04
MB 229.31
BMW LL 04

VW product

5w-30

German profile

5w-30

Quartz INEO MC3
C3 –04
MB 229.31
BMW LL 04

Peugeot
Citroen

VW product
Heavy Duty Diesel ACEA Specifications

After ACEA 2004:
Two major trends remain among European HDD engine manufacturers

- Improved soot related wear control
  - Volvo Trucks
  - Renault Trucks
  - Scania
  - Iveco
  - DAF

- Extended Drain Intervals
  + chemical limits option
  - Daimler Chrysler
  - MAN
Selective Catalytic Reduction (SCR)

SCR is highly effective for NOx reduction (low temperature limitation).
But very complex: infrastructure, sophisticated management system, installation, cost
### Evolution of Product Range
#### Heavy Duty Diesel Oil Standard Range

<table>
<thead>
<tr>
<th>OEM</th>
<th>Specification</th>
<th>STD</th>
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</thead>
<tbody>
<tr>
<td><strong>MAN</strong></td>
<td>E6 + M 3477</td>
<td>Rubia TIR 8900 10W40</td>
</tr>
<tr>
<td></td>
<td>E4 + M 3277</td>
<td>TIR 8600 10W40</td>
</tr>
<tr>
<td><strong>DAF</strong></td>
<td>E7 STD</td>
<td>TIR 7400 15W40</td>
</tr>
<tr>
<td></td>
<td>E4/ (E7) Long Drain HP-2</td>
<td>TIR 8600 10W40</td>
</tr>
<tr>
<td><strong>Daimler Chrysler</strong></td>
<td>E6 + MB 228.51</td>
<td>Rubia TIR 8900 10W40</td>
</tr>
<tr>
<td></td>
<td>E4 + MB 228.5</td>
<td>TIR 8600 10W40</td>
</tr>
<tr>
<td><strong>SCANIA</strong></td>
<td>Euro IV Interim List</td>
<td>TIR 7400 SC 15W40</td>
</tr>
<tr>
<td></td>
<td>E7 + LDF II</td>
<td>In progress</td>
</tr>
<tr>
<td><strong>VOLVO</strong></td>
<td>E7 + VDS-3</td>
<td>Rubia TIR 7400 15W40</td>
</tr>
<tr>
<td><strong>IVECO</strong></td>
<td>E7</td>
<td>Rubia TIR 7400 15W40</td>
</tr>
</tbody>
</table>
Low SAPS Oils

Questions