Novel Additive for Diesel Particulate Filter Applications

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2. Performance
3. Harms
4. Application
5. Conclusions
The additive

Non-colloidal iron based compound

- Synthetic
  - Consistency of quality
  - Best for application where long term stability is key

- Low viscosity at low temperature
  - At iron concentrations up to 4%

- Use of aliphatic solvent as diluent
  - Good materials compatibility
Performance testing

- Soot accumulation followed by the regeneration step
- Regeneration by Post Injection
  - Target Temperature: 500 °C / 450 °C / 400 °C
- Regeneration by Load Increase
  - Target Temperature: 500 °C / 450 °C / 400 °C
- Equilibrium temperature
- Performance assessed via reduction in DPF $\Delta P$
- Ash accumulation testing
- 200 CPSI SiC DPF
Regeneration Time to 50 and 95% Completeness

Time [seconds]

500 °C PI  450 °C PI  450 °C LI

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Ash accumulation test

- Amount of additive used: **20 ppm of Fe in fuel**
- No evidence of any problem throughout the test
- Efficient regeneration steps throughout the test
- **20 g** of ash present in the filter (10 mBar Back Pressure increase)
- Theoretical Total Ash 23g
  - 13.1 g from the fuel additive as Fe$_2$O$_3$
  - 9.9 g from the lubricant as CaO
Relative ash contribution at different fuel additive levels

- **Fe 20 ppm**
  - Lubricant: 43%
  - Fuel: 57%

- **Fe 10 ppm**
  - Lubricant: 40%
  - Fuel: 60%

- **Fe 5 ppm**
  - Lubricant: 75%
  - Fuel: 25%

- **Fe 3 ppm**
  - Lubricant: 84%
  - Fuel: 16%
1. Product stability

2. Product compatibility
   - Water
   - Fuel

Harms Testing

3. Regulated & Unregulated Emissions
Product static stability

- Long term stability required due to the specific application
  - Clear and bright with no sediment after more than 1 year
  - Fe concentration from 1.2 to more than 4%
  - Temperature: from -30°C to +80°C
    ( -30, -20, 0, 20, 40, 80°C)
Compatibility Testing - Fuel

- Testing in a wide range of fuel and fuel additives
  - In current European diesel fuel
  - In Swedish Class 1 diesel fuel
  - FAME blends
  - Wet fuel
  - Polar and non-polar additives
  - Lubricity additives
  - Cold flow additives
  - Corrosion inhibitors
  - Etc.

- Fully compatible with fuels and fuel additives
Compatibility Testing with 50% Water

Blending conditions
Compatibility Testing with 50% Water

Separation after
- 4 hours mixing
- and 10 min standing
Compatibility Testing - Water

- Evaluation of sensitivity to water during static storage
  - 1% water
  - room temperature and 40°C

- No change in sample appearance seen after 3 months
Regulated and unregulated emissions

- No harm emissions data generated according to the VERT protocol, widely used for DPF Additives

- DPF additive tested @ 25ppm Fe in fuel

- No evidence of any issue:
  - No nanoparticle contribution with DPF
  - No increase of dioxins or furans
  - Post trap Fe emissions of 0.7% maximum
Application

Two litres of additive @ 2.4 % Fe is enough for:

<table>
<thead>
<tr>
<th>Fe in Fuel</th>
<th>10 ppm</th>
<th>5 ppm</th>
<th>3 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated fuel, Litres</td>
<td>4,800</td>
<td>9,600</td>
<td>16,100</td>
</tr>
<tr>
<td>Mileage @ 15 km/l, km</td>
<td>72,000</td>
<td>144,000</td>
<td>240,000</td>
</tr>
</tbody>
</table>

Two litres of additive @ 3.6 % Fe extends this by 50%
Summary

The new non-colloidal iron based compound

- Use aliphatic solvent for good materials compatibility
- Has low viscosity at low temperature even with high Fe concentration
- Has excellent regeneration performance and low ash generation at low metal treat in fuel
- Is stable in field conditions/operations
- Is compatibility with fuel, fuel additives and water
- Allows fill for life