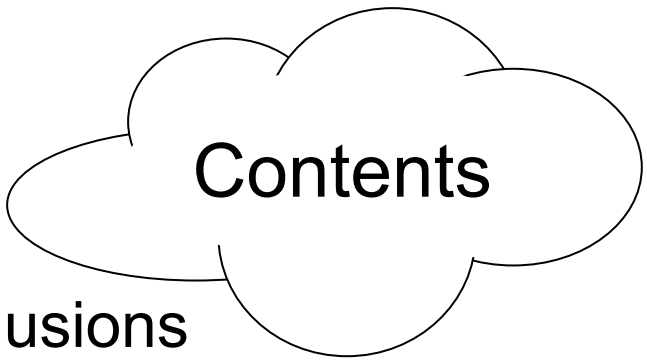
Novel Additive for Diesel Particulate Filter Applications

R Caprotti, I P Field

1. The Additive

2. Performance



3. Harms

5. Conclusions

4. Application

The additive

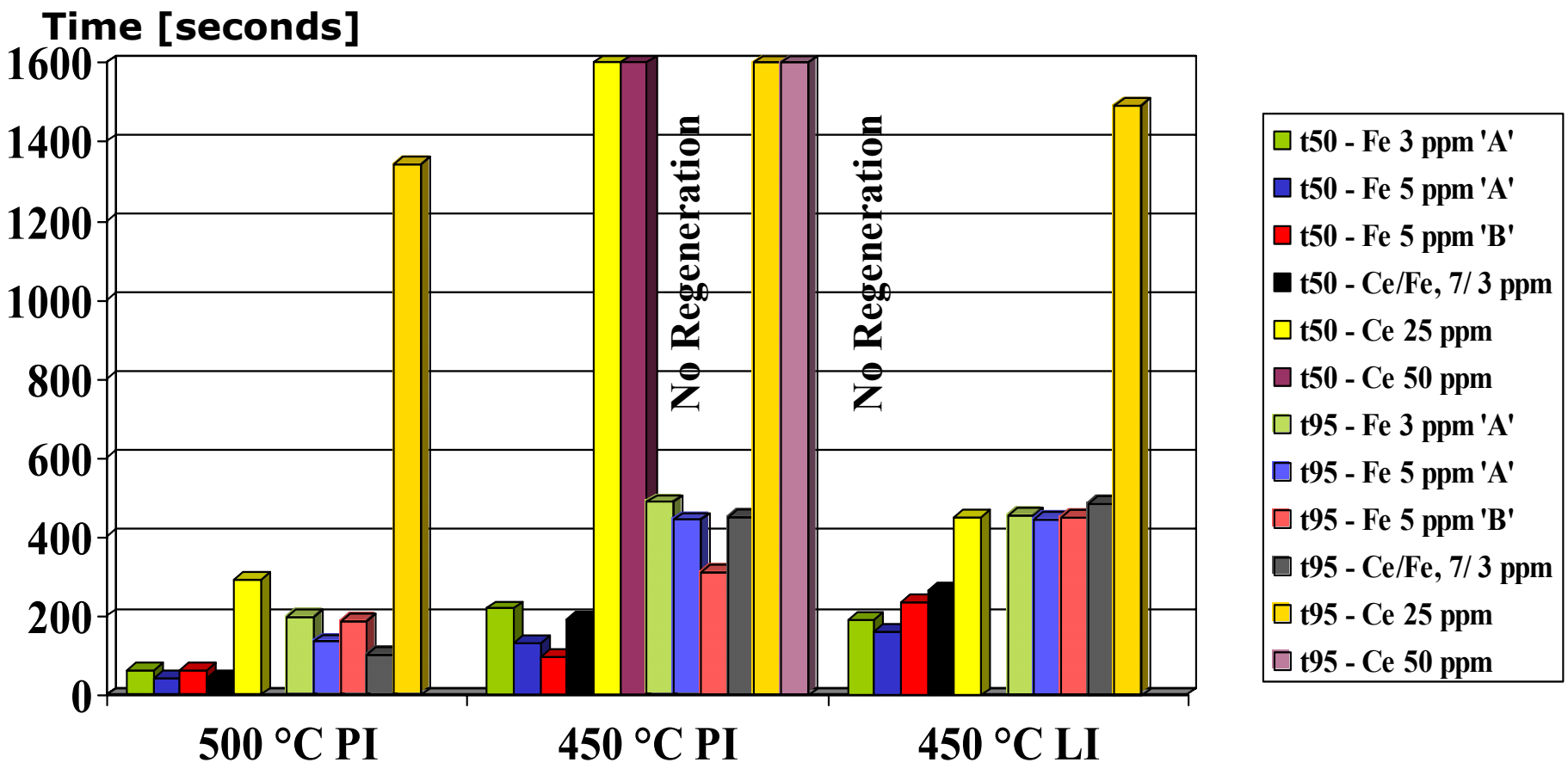
Non-colloidal iron based compound

- 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 ΔP
- Ash accumulation testing
- 200 CPSI SiC DPF

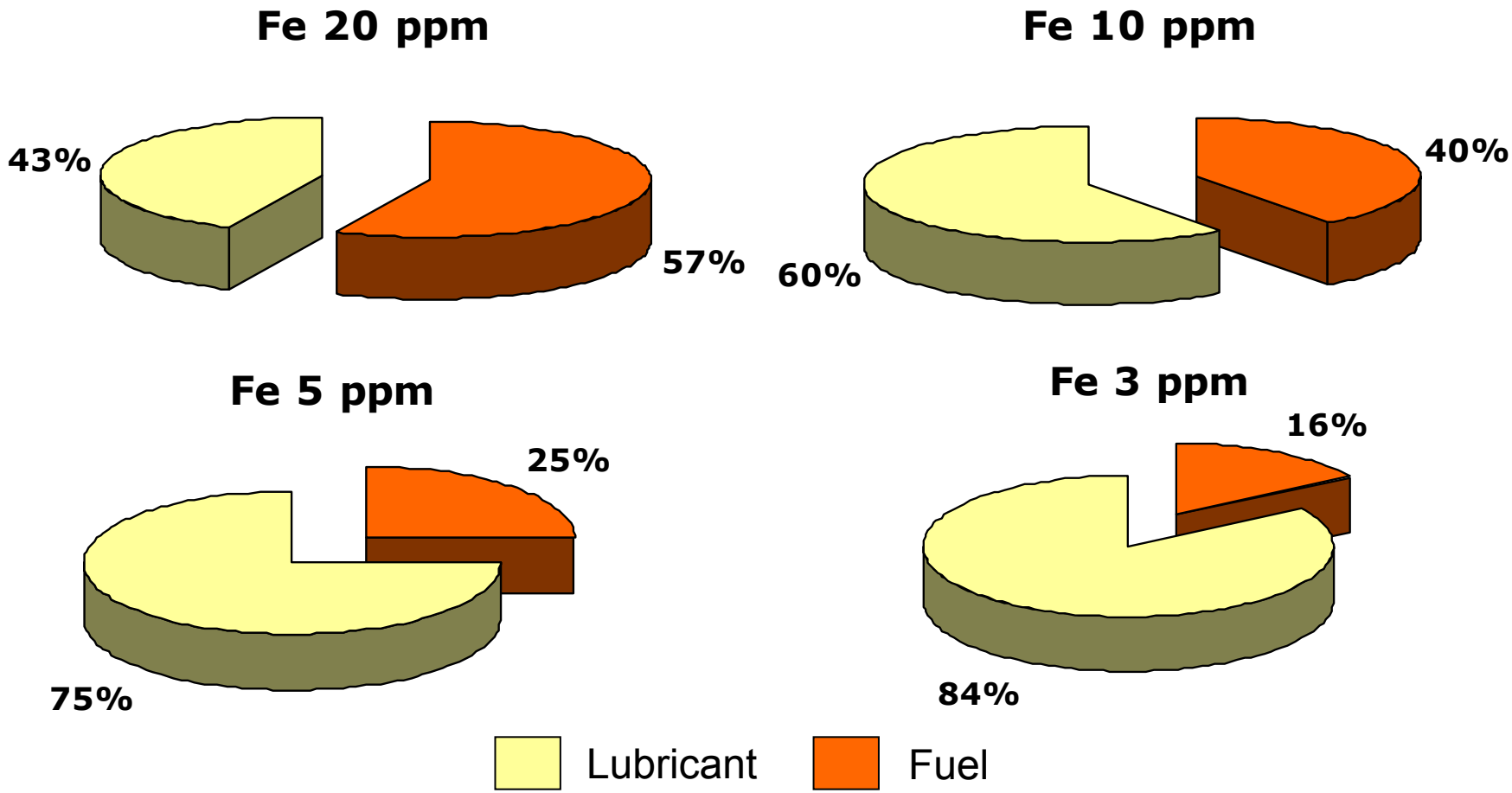
Regeneration Time to 50 and 95% Completeness



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_2O_3
  - 9.9 g from the lubricant as CaO

Relative ash contribution at different fuel additive levels

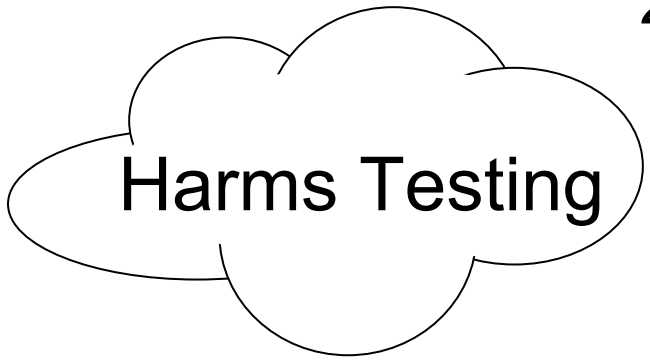


1. Product stability

2. Product compatibility

Water

Fuel



3. Regulated &
Unregulated Emissions

Product static stability

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

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.

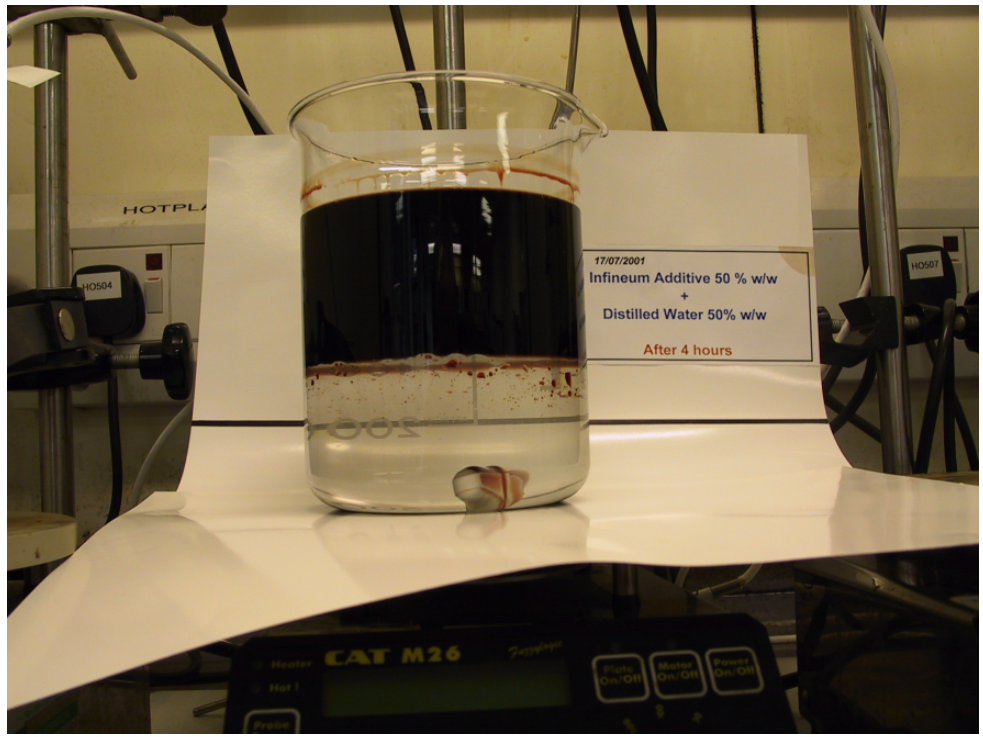
- Fully compatible with fuels and fuel additives

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:

Fe in Fuel	10 ppm	5 ppm	3 ppm
Treated fuel, Litres	4,800	9,600	16,100
Mileage @ 15 km/l, km	72,000	144,000	240,000

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