Retail Diesel Cleanliness Study Update

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The topic of fuel cleanliness is getting more attention during the last year or so:

- Some oil companies conducting studies assessing the current state of diesel cleanliness – others are planning to do so
- Several OEM’s have come forth with data supporting the need for increased cleanliness
  - Injector, fuel filter and fuel system problems seem to be on the increase and are pointing to fuel cleanliness as one possible cause
- Many papers on the topic are being presented at industry forums:
  - ASTM, IASH, SAE, etc.
BP has been evaluating retail diesel fuel cleanliness in one major US metropolitan area since 4Q2006.

Storage tank and dispenser fuel (10 um) evaluated at approximately 10 stations initially.

Three sites selected for finer dispenser filters:
- Initially used 2 micron filters
- Switched to 5 micron filters after seeing significantly reduced filter life with 2 micron filters

Stations sampled for flow rate every 1-2 weeks.

Stations sampled for ISO 4406 particle counting approximately every month.
Retail diesel tank samples averaged ISO 4406 values of 21/19/15
Retail diesel dispenser samples averaged 20/18/13 with standard 10 micron particulate only or Hydrosorb type filters
Allowing a one gallon dispenser nozzle flush didn’t improve fuel cleanliness on average
Diesel cleanliness mass measurements (EN 12662) didn’t necessarily correlate well with ISO 4406 values
Two different particle analyzers at two different laboratories gave very good agreement (Hiac Royco 8000a and Stanhope-Seta AvCount)
Diesel samples containing biodiesel were slightly “dirtier” than non-biodiesel samples
## ISO 4406 Cleanliness

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Table 1: ISO 4406 fluid cleanliness codes (particles per ml.)

Figure 1: ISO code example
Retail diesel dispenser samples averaged 18/16/12 with 2 micron particulate filters (compared with 20/18/13 with 10 micron filters)
  – 2 micron value is at/below WWFC requirement of 18/16/13
• Flow rate of 2 micron filters was acceptable (until they neared the end of their useful life)
• Unfortunately, the 2 micron filters don’t last long enough, ~2-3 months on average for relatively normal volume stations (vs. 6-12 months previously)
• The switch to 5 micron filters would theoretically lengthen filter life, but that testing has now been abandoned after collecting only limited data:
  – Too complicated – station/maintenance personnel didn’t follow instructions regarding fuel filters
  – Filters tended to plug rapidly as they approached end of useful life and caused several instances of spilled product due to nozzle not shutting off (slow flow)
  – BP abandoning company owned service stations – future cooperation would be even worse than it is now
Effect of Finer Filtration – Shortened Filter Life

2 um Diesel Dispenser Filter Life

Flow Rate, gpm

Days

Station 1
Staion 2
Effect of Finer Filtration – Improved Fuel Cleanliness

Retail Diesel Cleanliness Improvement
2 um Filter

ISO Code Category

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Real World Diesel Cleanliness Testing – Path Forward

• BP Global Fuels Technology has recently purchased our first particle size counter and will now be able to do more testing -- including the potential for on-site, field testing.

• Current plans will focus on using an in-house dispenser filter test rig:
  – Better control of variables
  – Ability to evaluate filter effectiveness, useful life, etc.
  – Ability to integrate particle counter “on-line” for instantaneous and more accurate results
  – Ability to evaluate effect of particulate, water or both as well
  – Ability to evaluate effect of refinery and/or pipeline contaminants

• Will still do “real world” periodic checks of diesel and gasoline cleanliness
Dispenser Filter Test Rig

Courtesy Champion Laboratories
Summary

• Particulate mass determination (e.g. EN 12662) by itself is not satisfactory to determine fuel cleanliness

• Service station diesel mass particulate contamination averaged of 11.0 mg/kg per EN 12662. The average value meets both the World Wide Fuel Charter specification of 10 mg/L (roughly 12 mg/kg), and the EN 590 Diesel Fuel Specification of 24 mg/L (roughly 29 mg/kg).

• Service station diesel particulate counting ranged from ISO 4406 22/20/15 to 16/13/11, with an average of 20/18/13. WWFC specification is 18/16/13.

• Accurate, portable and easy to use particle counting instruments are available for making field determinations such as ISO 4406