M11 Low Temperature Flow

Presentation to
HDEOCP
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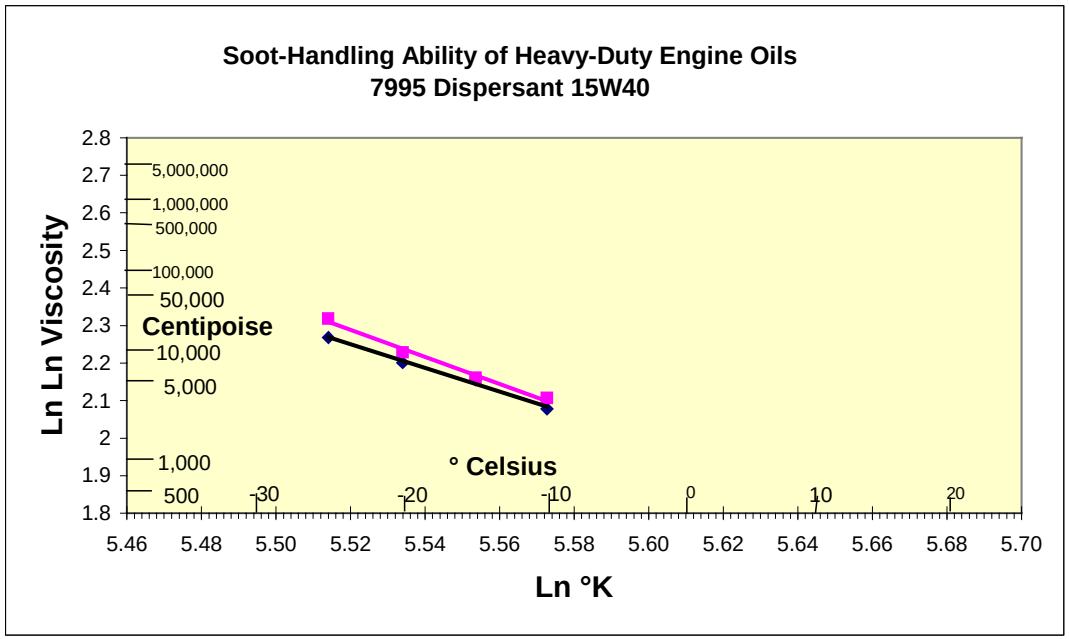
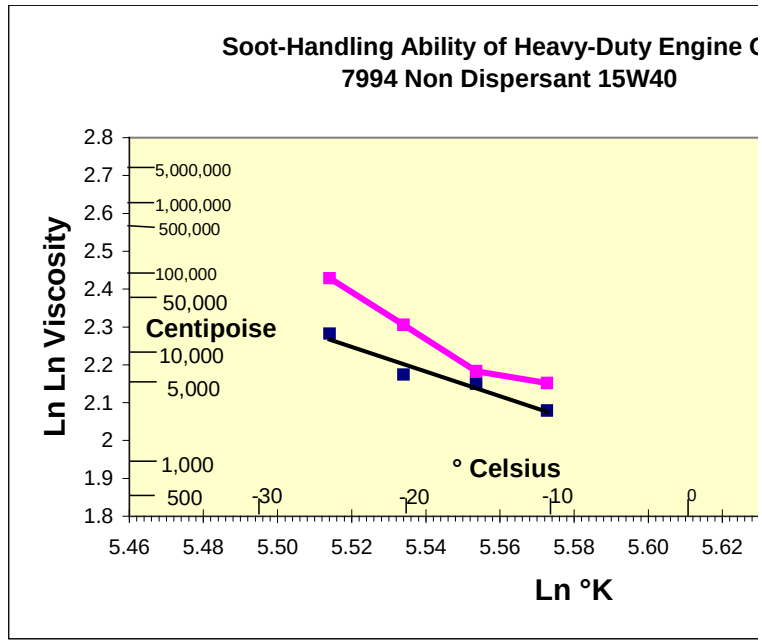
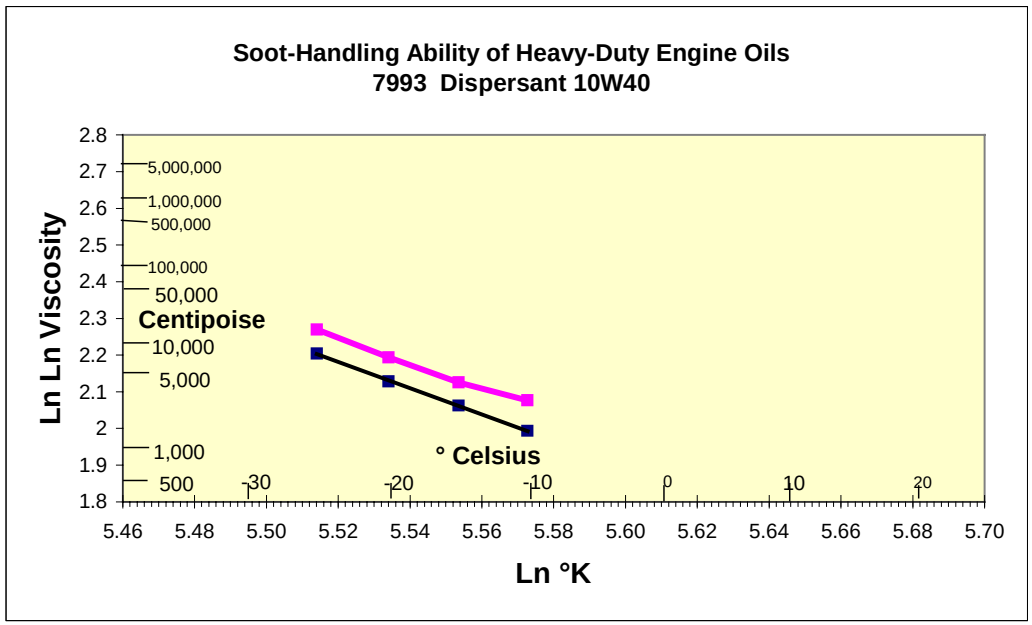
Oils Blended for Low Temp Pumping Study

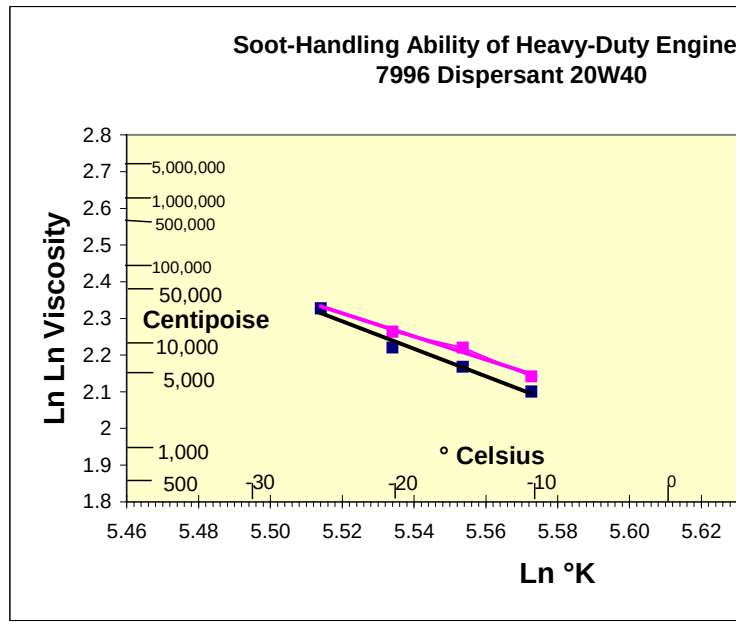




Confidentail Information

Oils Blended for Low Temp Pumping Study



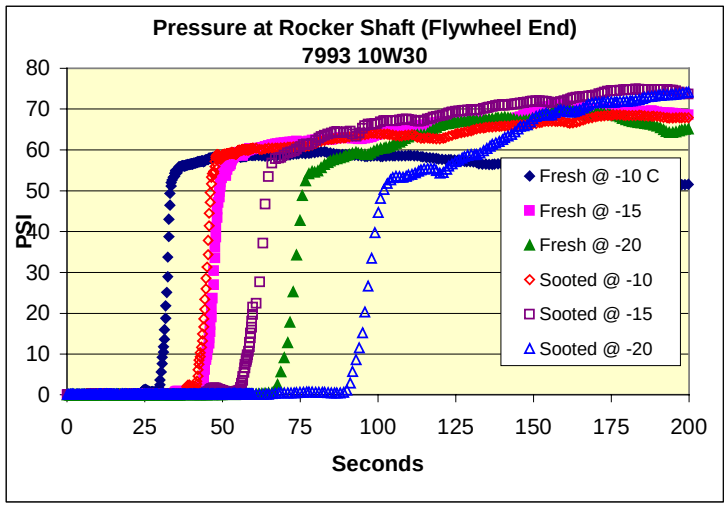


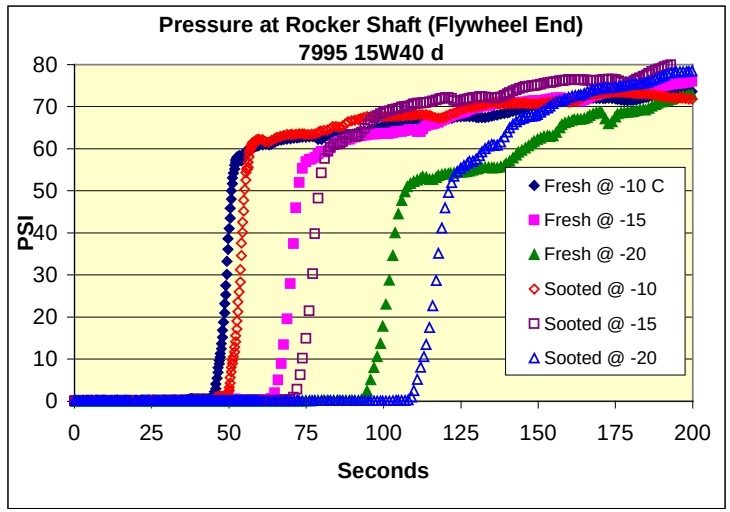
Confidentail Information

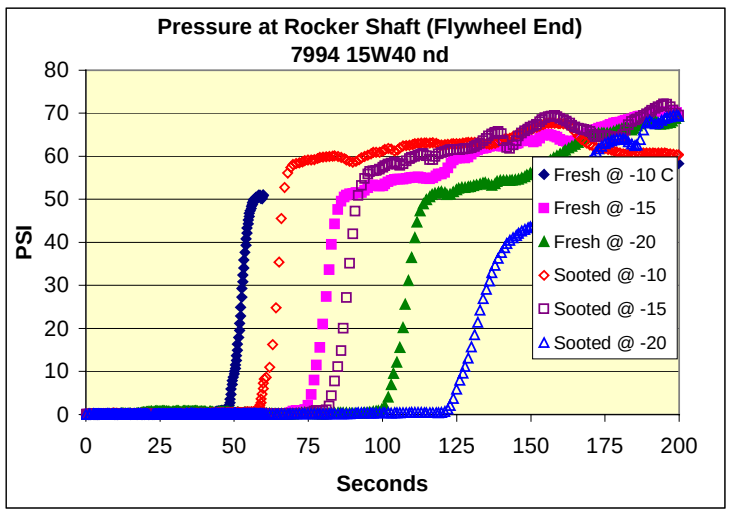
M-11 Low Temp Pumpability

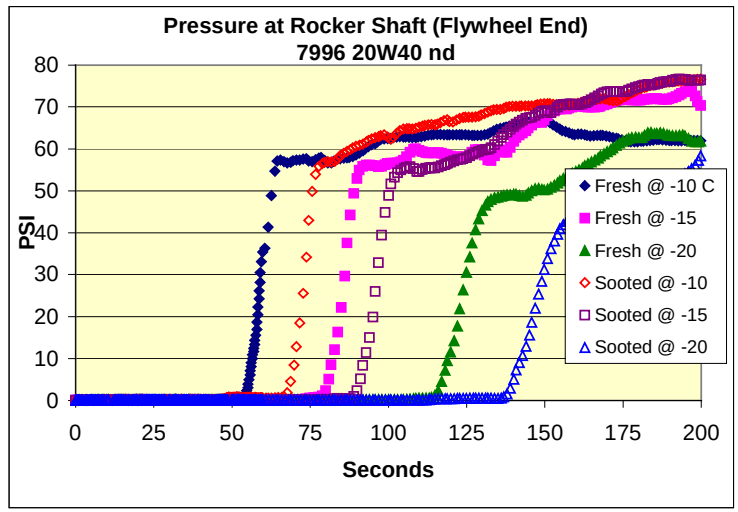
- Oils sooted to 6.1% to 6.5% soot in Mack T-8
- Fresh and sooted oils placed in Cummins M11
  - ✓Motored to 80 C sump
  - ✓Cooled to test temp and soaked overnight
  - ✓Motor to 600 rpm
  - ✓Measure time and pressure at several engine locations
- Test Temperatures
  - ✓-10 C
  - ✓-15 C
  - ✓-20 C

Flow to Rocker Shaft (Flywheel End)

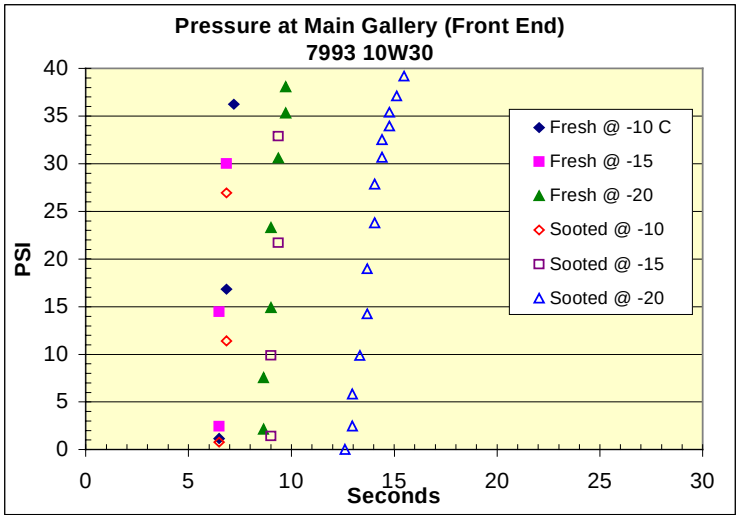


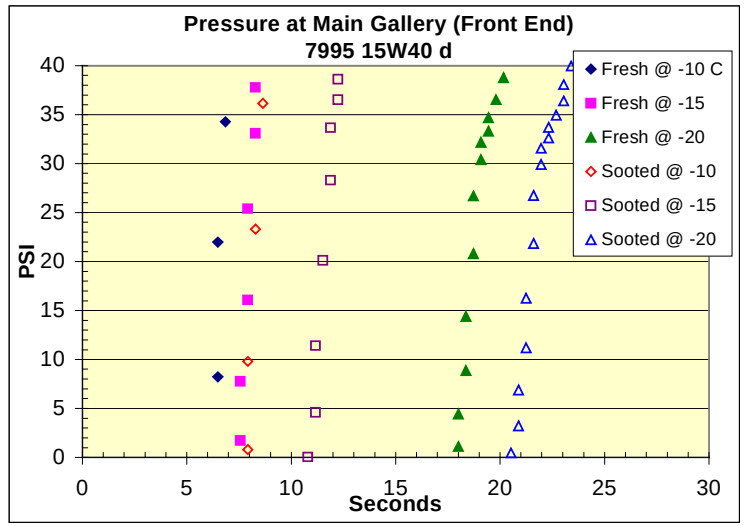


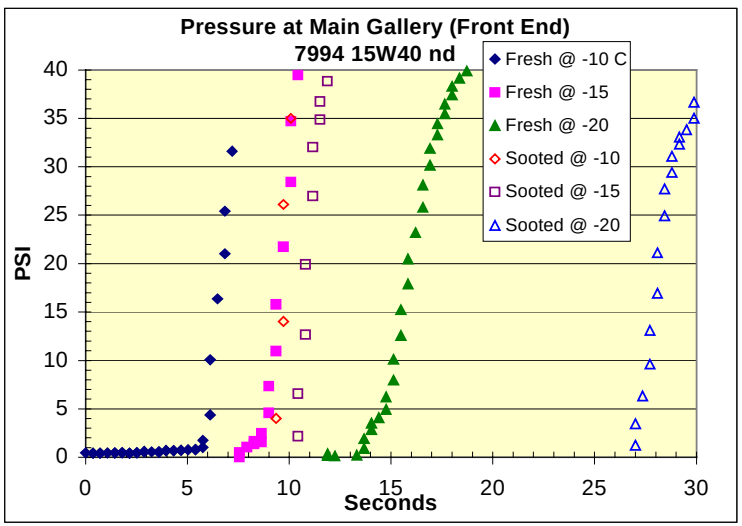


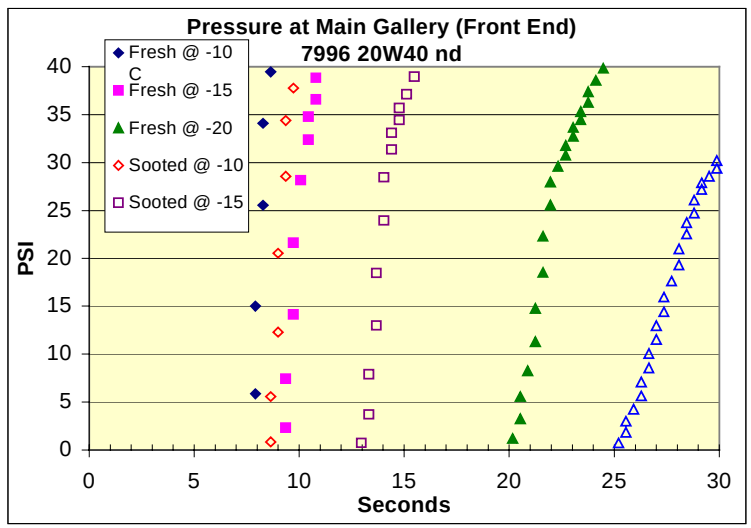


Flow to Main Gallery (Front End)

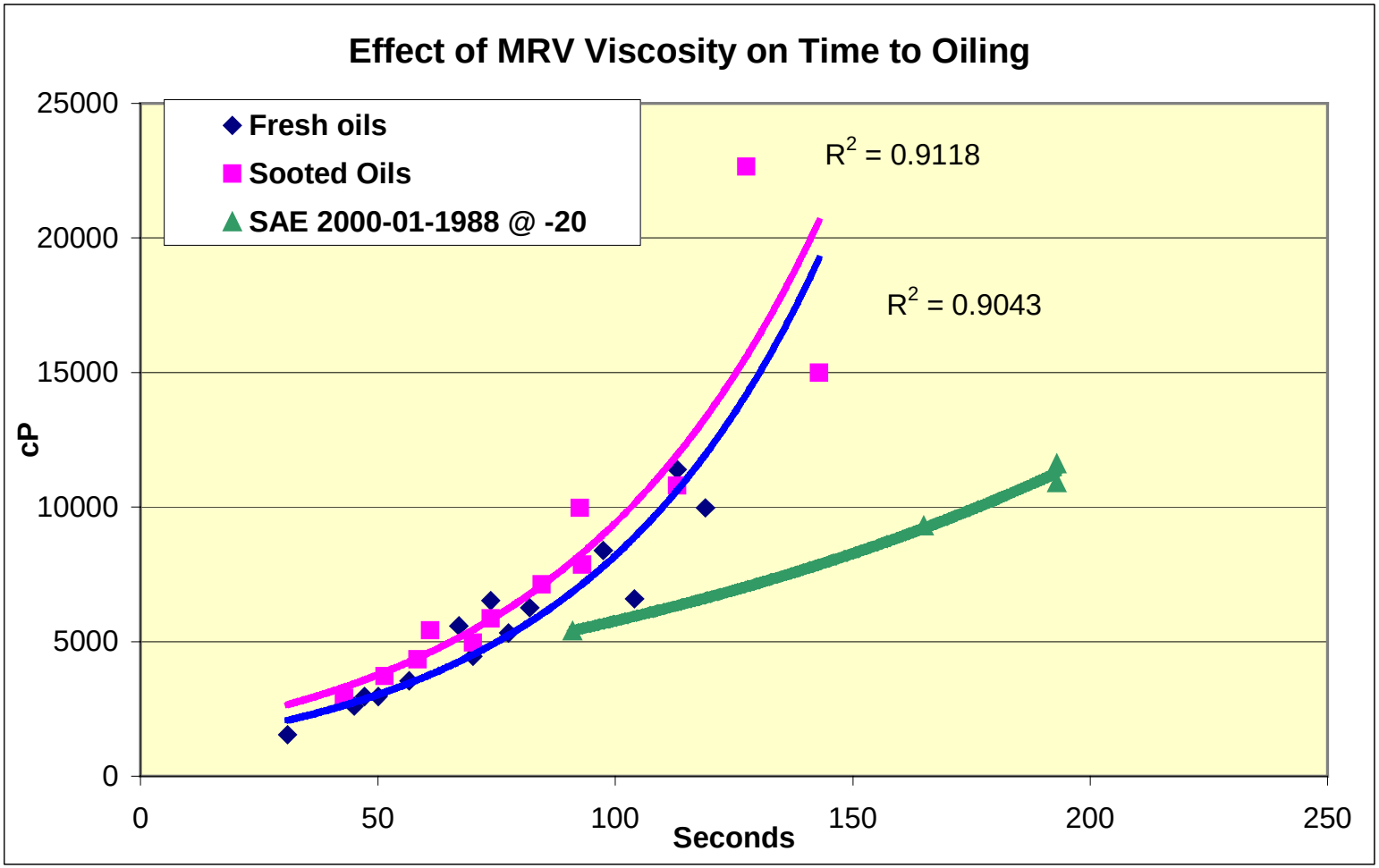








Correlation of MRV to Engine Flow



Confidentail Information

Preliminary Conclusions

- It is possible for poorly dispersed soot to increase viscosity dramatically
- Well dispersed soot increases lube viscosity as soot increases
- For well dispersed soot in lubricants, and for fresh lubricants pumping time through the engine correlates with MRV viscosity.
- Based on very limited data, correlation seems best with modified MRV.