Southwest Research Institute ®

Engine Lubricants Research Department

Update on SwRI's IR&D Program To Study Engine Oil Formulation Effects on Catalyst Poisoning in an Engine Dynamometer Test

Presented to the
GF-5 Emissions System Compatibility Improvement Team
by
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Recap of IR&D Project

- Test engine – 2002 Chevrolet Malibu 3.1L V6
- 240-hour test duration with 10 oil changes
- Test catalyst – 900 c.p.i., Pd/Rh washcoat, 0.6 L vol.
- Catalyst conversion efficiency measured in-situ before and after test
- Tests to date include Oil 33 (0.1 wt. % P), Oil 35 (zero P), and 1 of 2 Lubrizol modern oils

Test Operating Conditions For Catalyst Aging

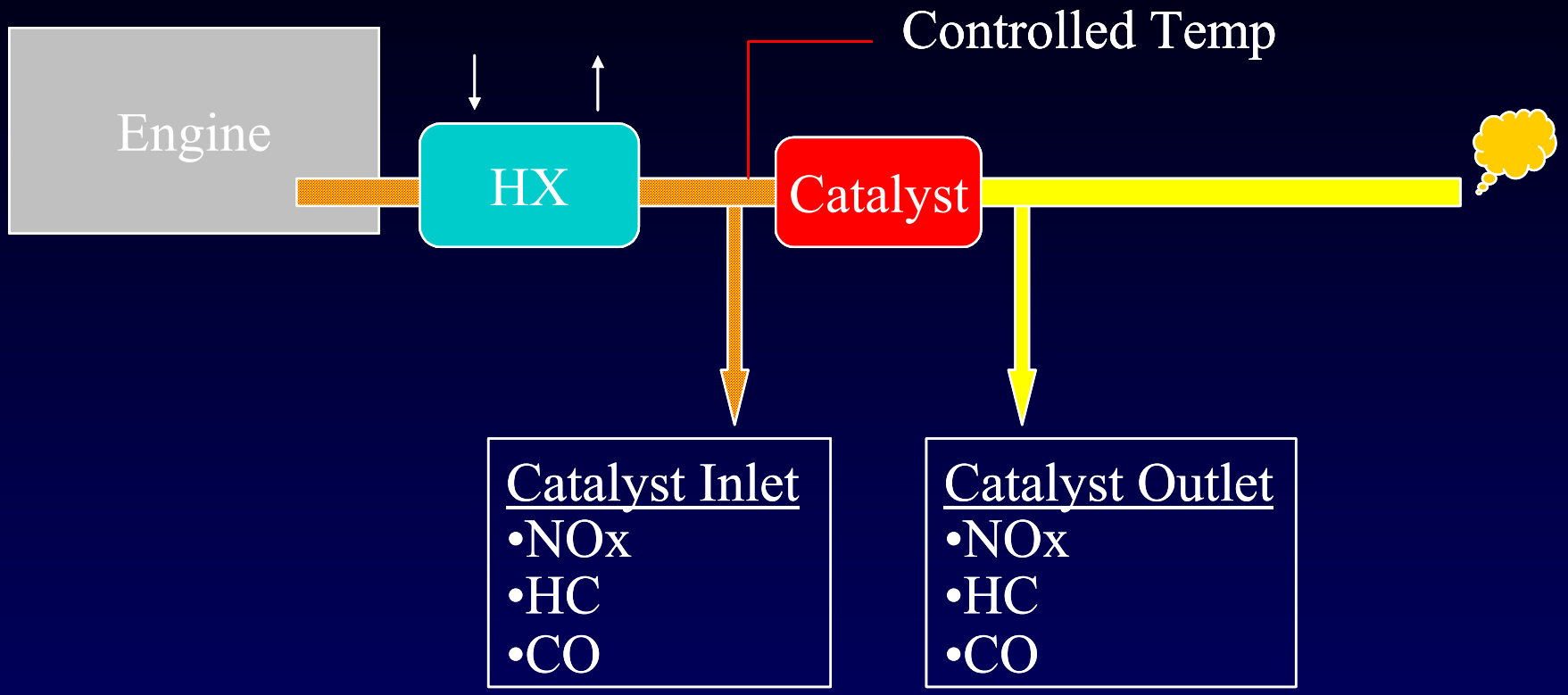
- 2000 rpm
- 65.5 kPa MAP
- Externally heated oil sump to 150 °C
- Catalyst inlet temp ~530 °C
- OEM PCV system configuration but with fixed orifice in place of PCV valve

Catalyst Efficiency Measurement

How to measure catalyst poisoning?

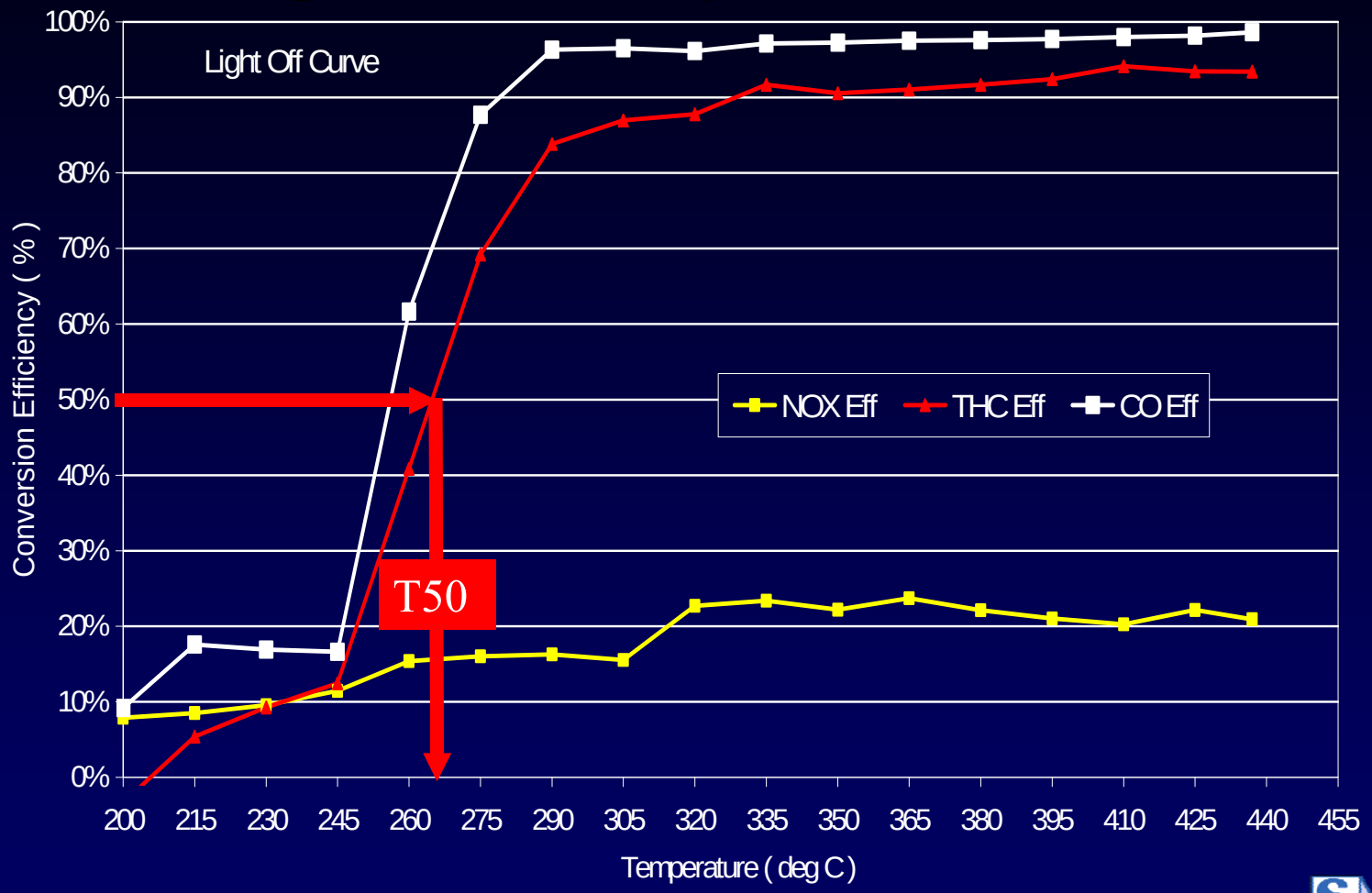
- Light-off Curve
  - Catalyst performance across temperature range
  - Hydrocarbon emissions especially affected by P
  - Exhaust temperature controlled in steps
  - Analyze catalyst efficiency (T50 determination)

Test Cell Setup for Light-off Curve

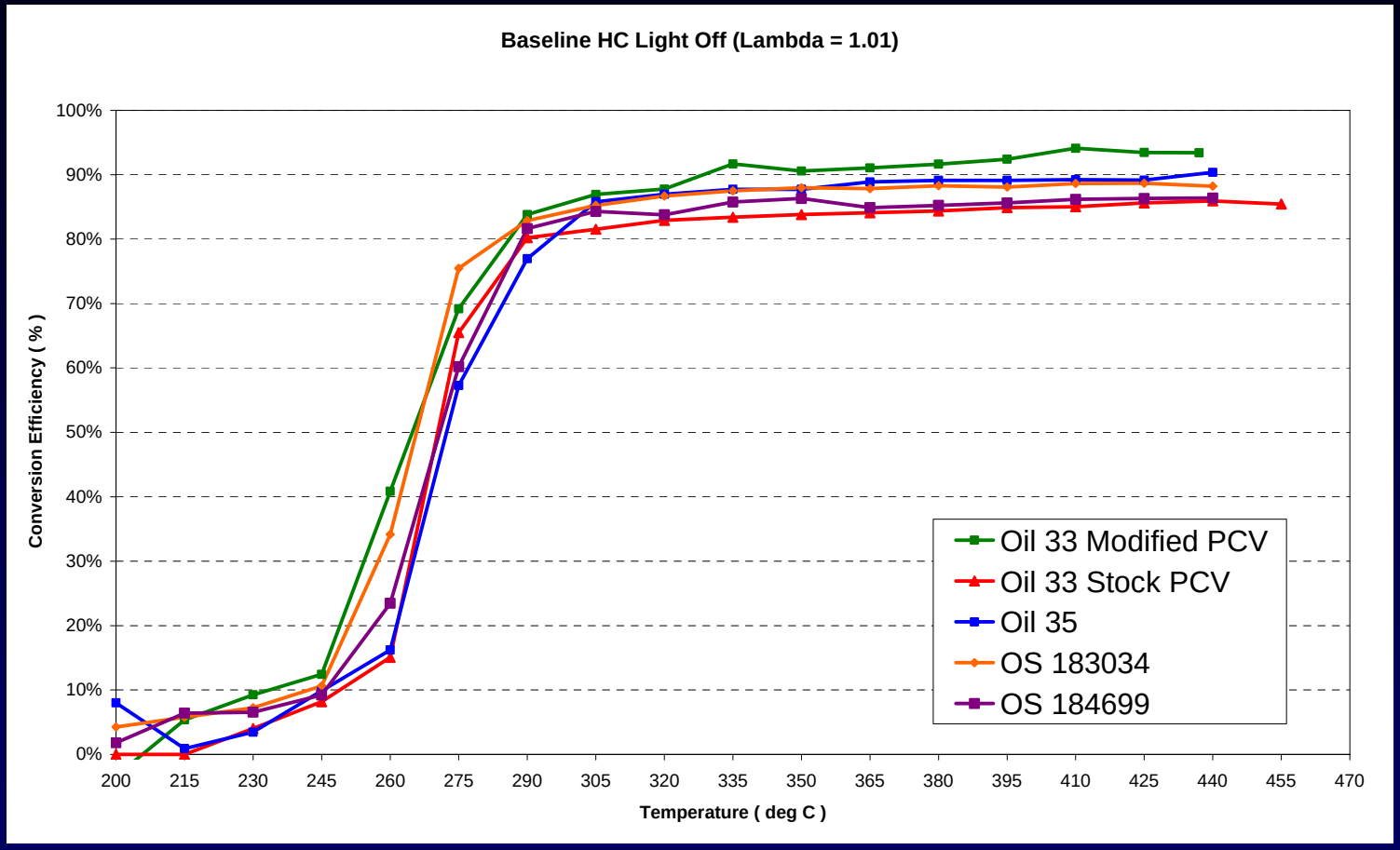


$$\eta = (\text{Inlet} - \text{Outlet}) / \text{Inlet} * 100\%$$

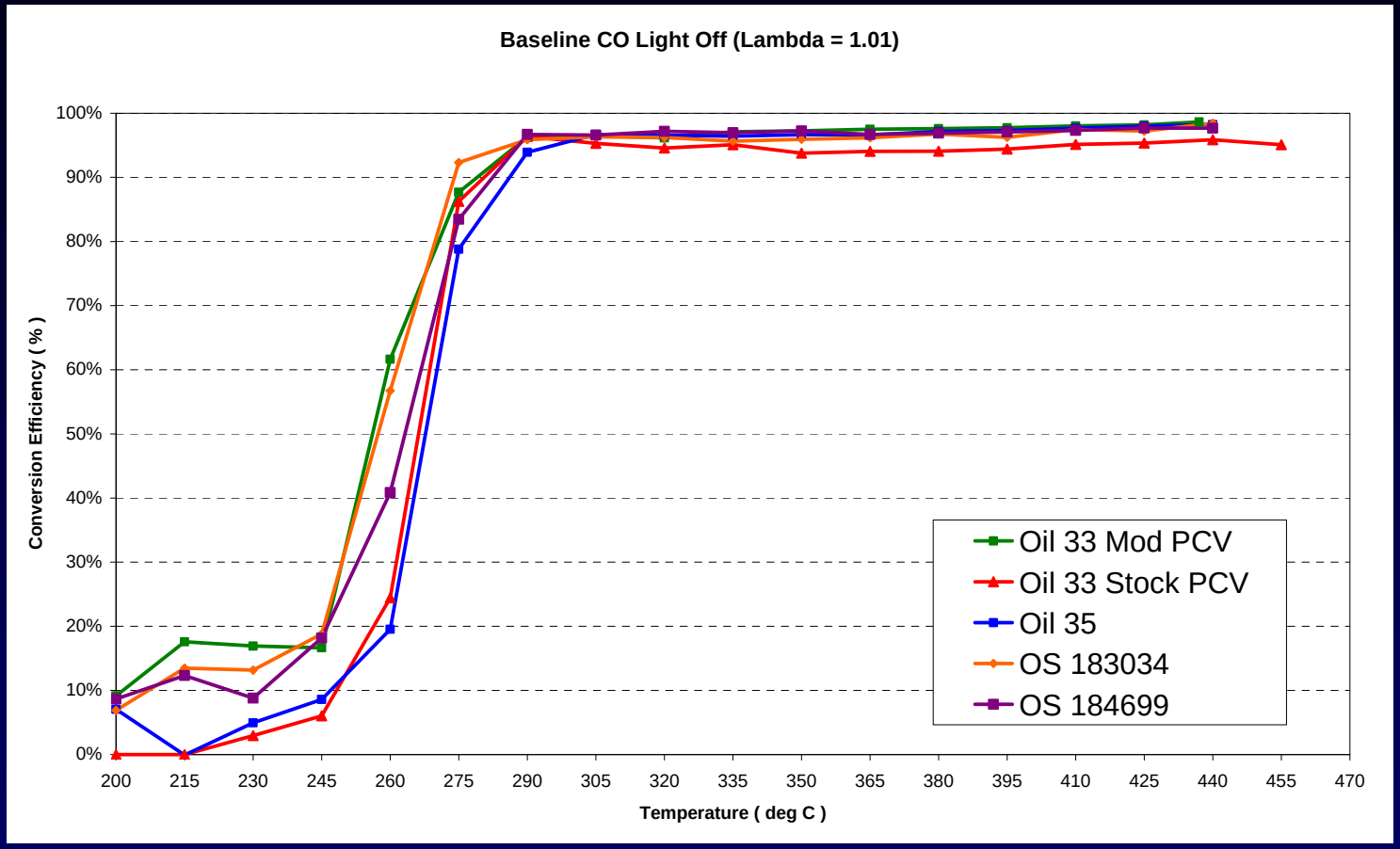
Explanation of T50 Determination



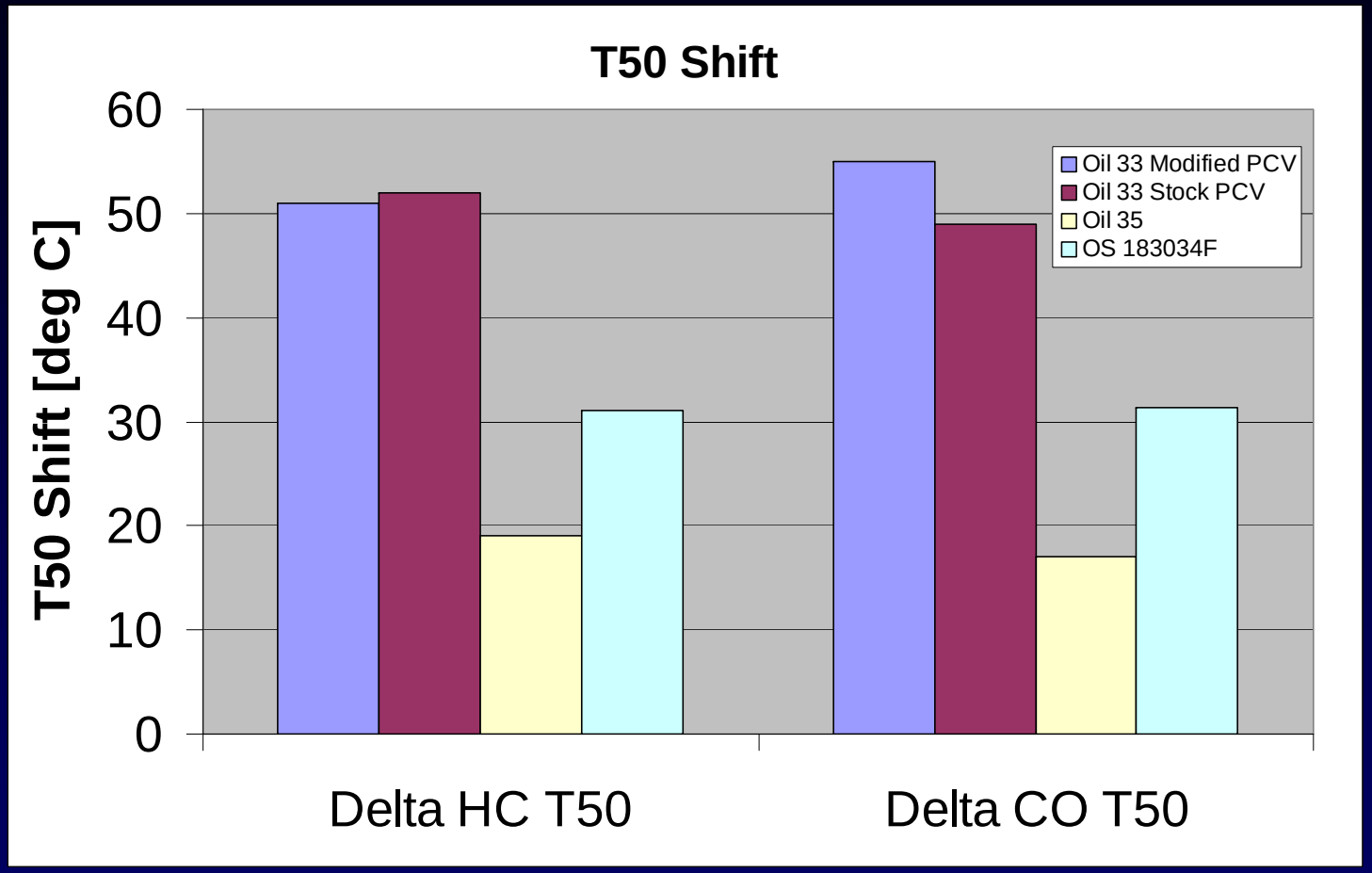
Baseline HC Light-off Curves



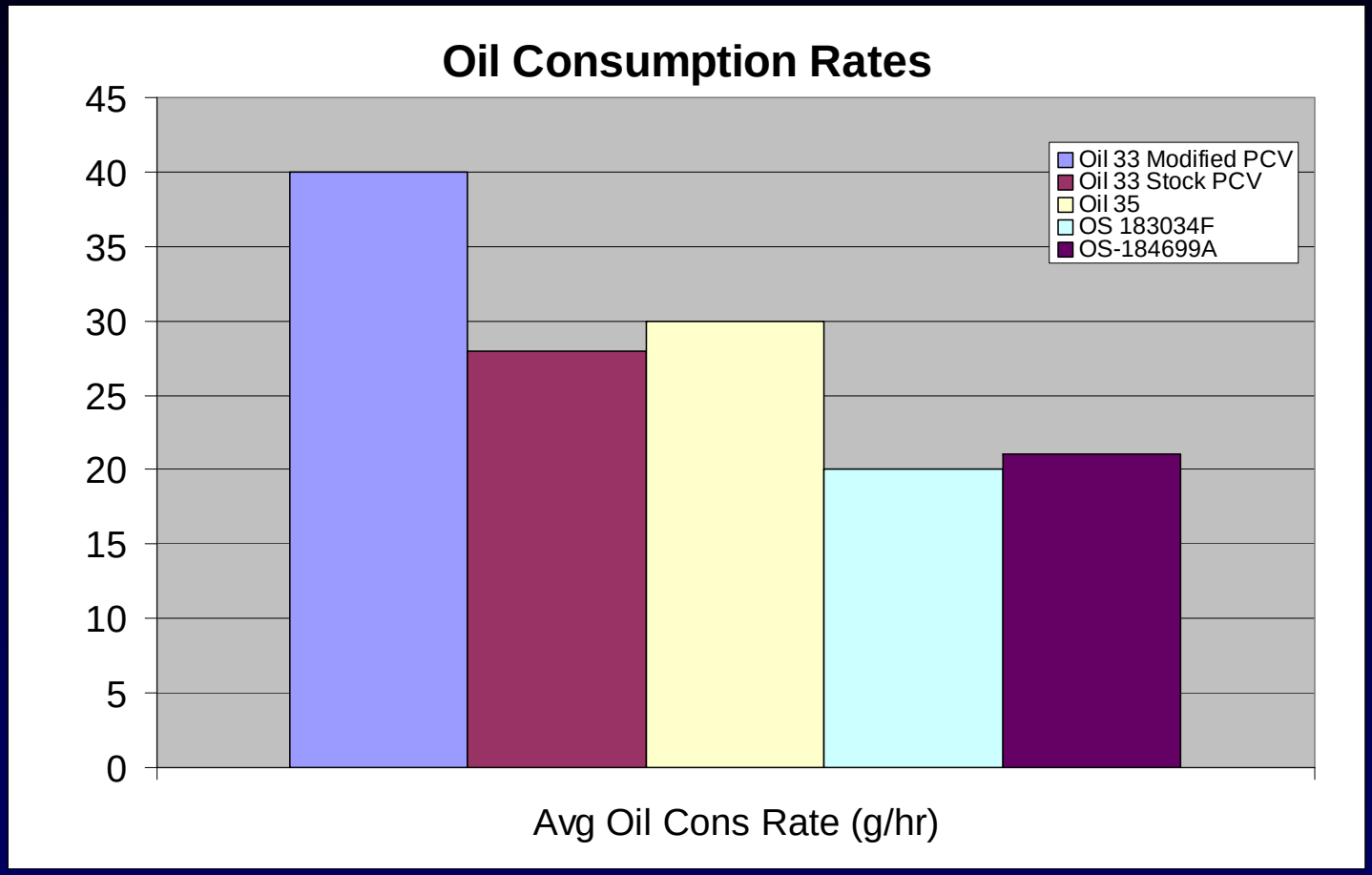
Baseline CO Light-off Curves



Comparison of T50 Shift



Comparison of Oil Consumption



Future Plans

- **Continue Test Matrix**
  1. **Oil 33 (0.1 Phosphorus, no detergent)**
  2. **Oil 35 (no Phosphorus, discrimination)**
  3. **Modern formulation with conventional ZDP**
  4. **Modern formulation with ‘low impact’ ZDP**
  5. **Oil 33 (repeat-check)**