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High Efficiency Oil Filter Project

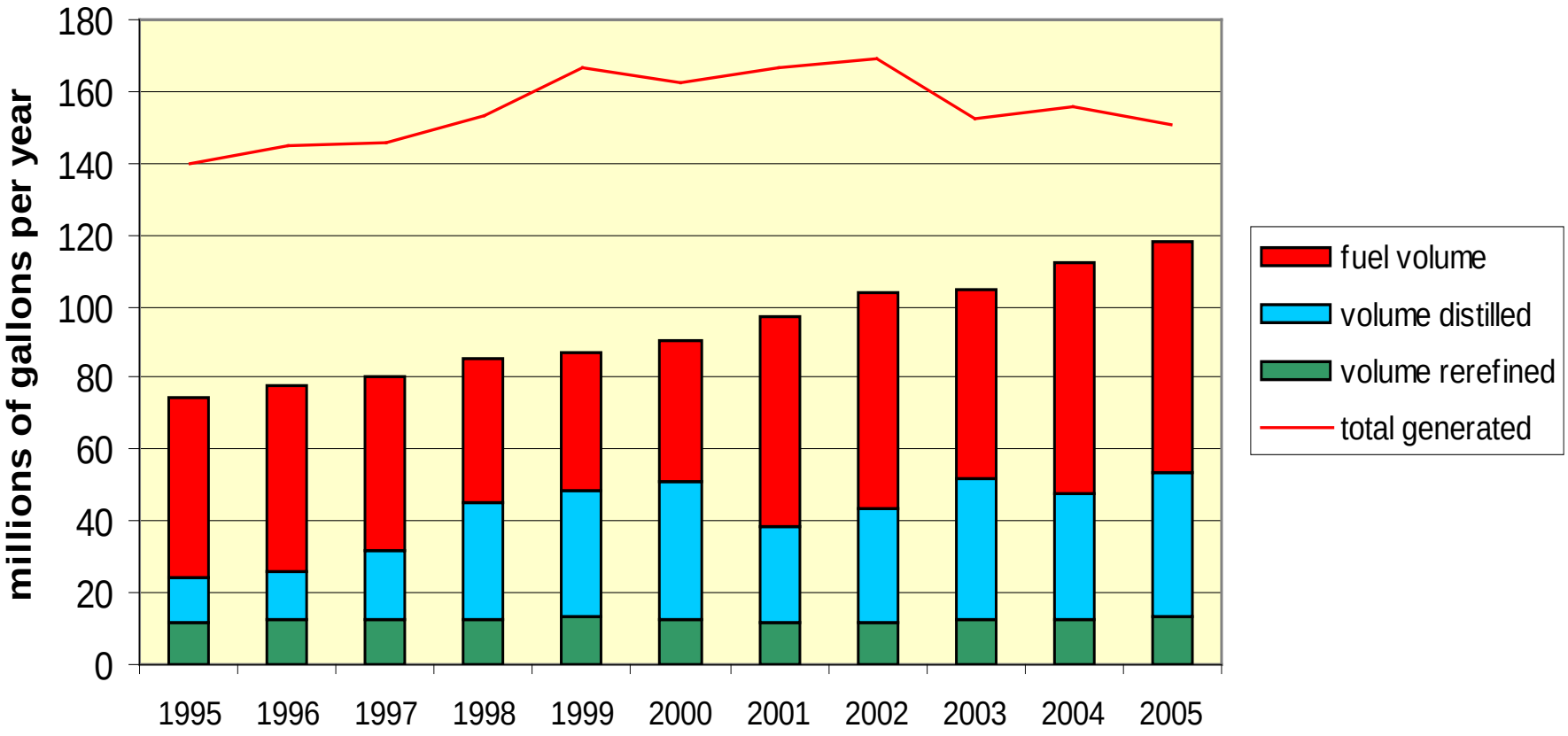
Engine Oil Sensor Technologies

Why Focus on Used Motor Oil?

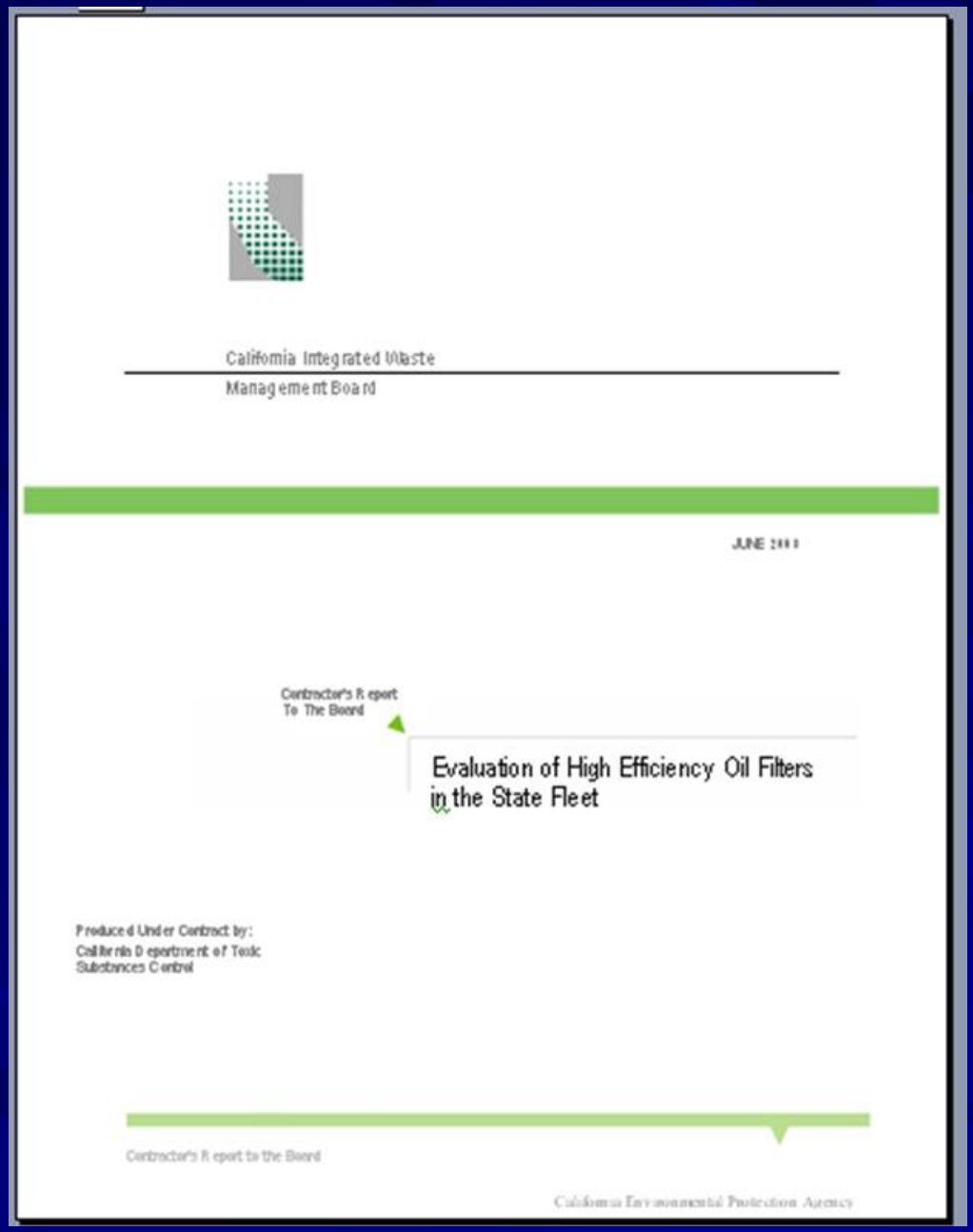
- 251 million vehicles in US
- 20 million in CA
- 50,000 vehicles in CA State fleet
- 152 million gallons of lubricating oil sold in CA
- 86 million gallons of waste oil collected

- Largest volume of hazardous waste generated in CA

2007: 86/152 = 57% But Where Does It Go?



Courtesy: Bob Boughton, California Department of Toxic Substances Control



http://www.ciwmb.ca.gov/Publications/UsedOil/2008020.pdf

Evaluation of High Efficiency Oil Filters in the State Fleet

June 2008

1. Extend oil drain intervals to manufacturers limits while under warranty
2. Use better oil and oil analysis to extend oil drain intervals even further
3. HE Oil Filters were shown to be economical for larger vehicles

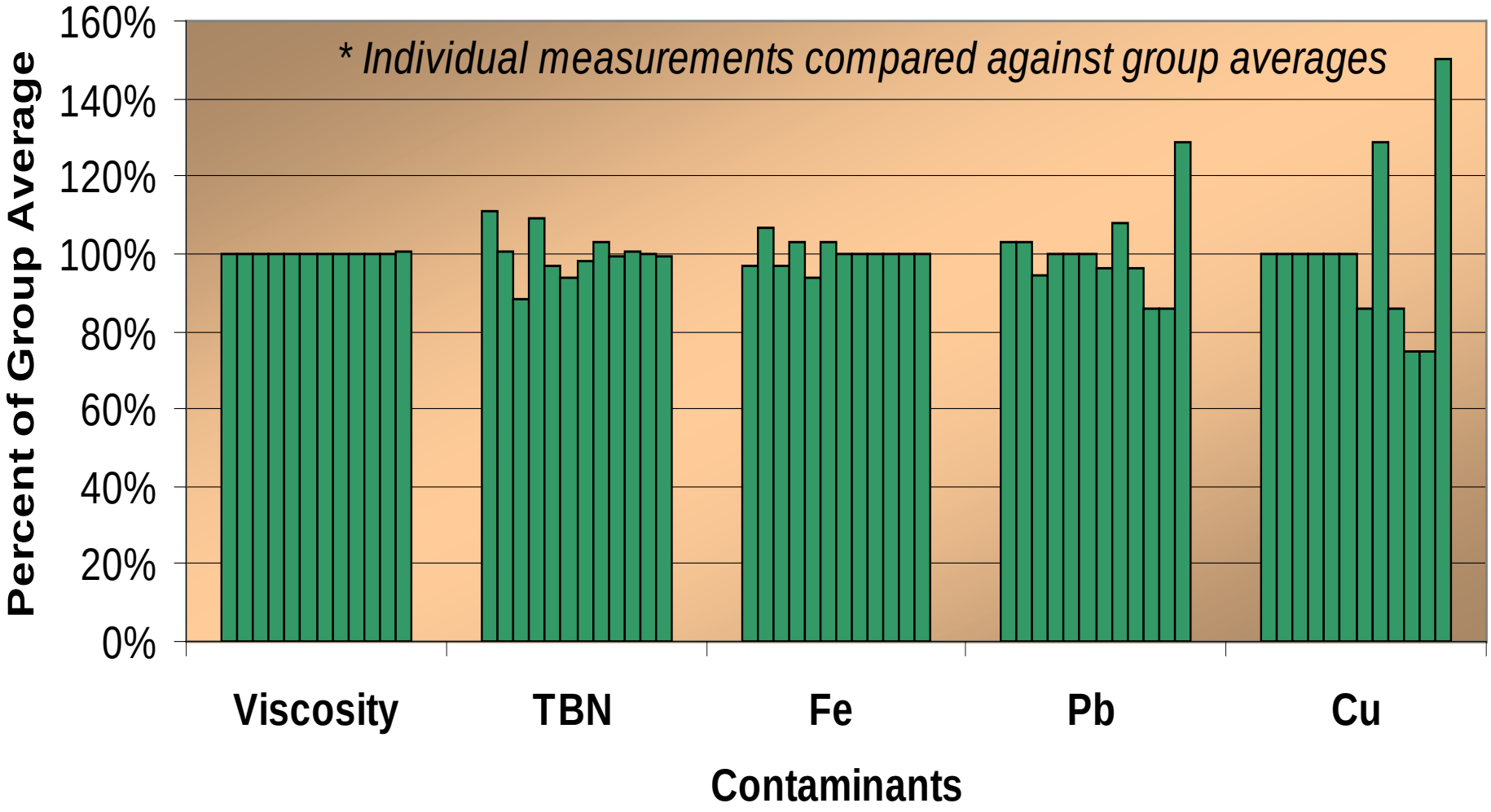
HE Oil Filter Demonstration Results

Participating Fleets	Number and Type of Vehicles	Filter Make and Model	Miles Accumulated During Study	Oil Samples Collected	Original Drain Intervals	Proposed Drain Intervals	Projected Payback Period (yrs)
Department of General Services (DGS)	40 passenger cars	Fram X2	798,000	212	6,000	10,000	**0.2**
California Department of Forestry and Fire Protection (CALFIRE)	13 two- and three-axle trucks	OilGuard EPS 60	134,980	42	5,000	18,000	**3.1**
California Department of Transportation (Caltrans)	5 two- and three-axle trucks	OilGuard EPS 60	160,711	39	6,000	18,000	**1.3**
Fresno Area Express (FAX)	10 city transit buses	OilGuard EPS 60	179,099	56	6,000	18,000	**3.7**
Fresno Unified School District (FUSD)	14 school buses	Luberfiner ZGard LPF9750	116,618	34	9,000	36,000	**2.5**
Long Beach Unified School District (LBUSD)	26 school buses	Luberfiner ZGard LPF9750	505,115	57	10,000	36,000	**6.8**
California Department of Corrections (CDC)	11 coach buses	puraDYN TF 40	949,649	100	10,000	50,000	**3.6**

How to Design an Oil Analysis Program for Your Fleet

- **Sample collection** is critical - avoid contamination, proper labeling, mileage, representative sample collection, safety!
- **Viscosity** - the most important parameter
- **Total Base Number (TBN)** – measure of the oil's remaining capacity to neutralize acids
- **Wear Metals** – iron, copper, chrome
- **Contaminants** – dirt, fuel, water, glycol, soot
- **Oil Degradation** – oxidation, nitration, sulfination
- **Absolute Limits** – manufacturer's limits
- **Trend Lines** – monitor the rate of wear metal accumulation

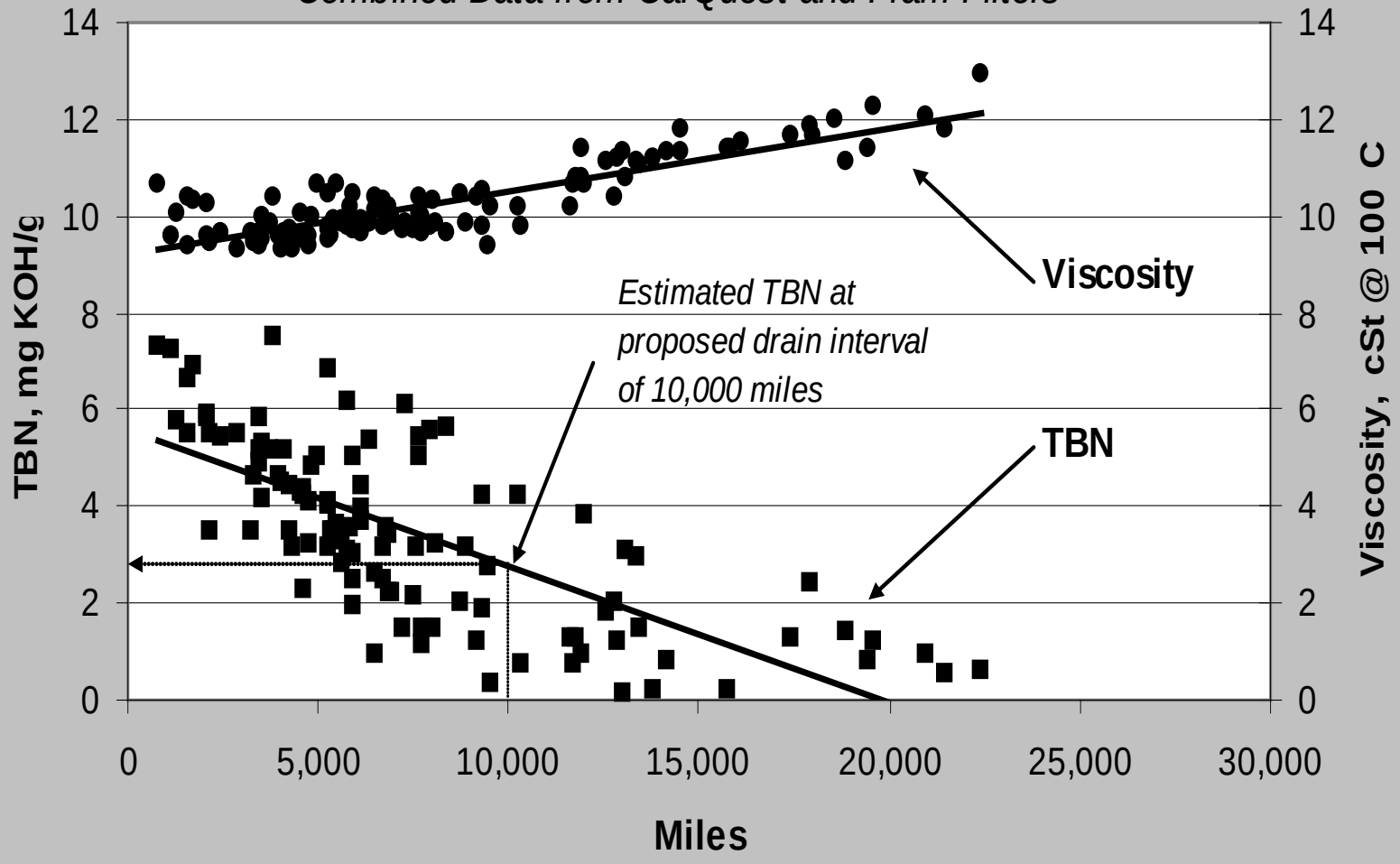
Laboratory Replicate Sample Analyses



Plot of TBN and Viscosity vs. Oil Mileage

Department of General Services

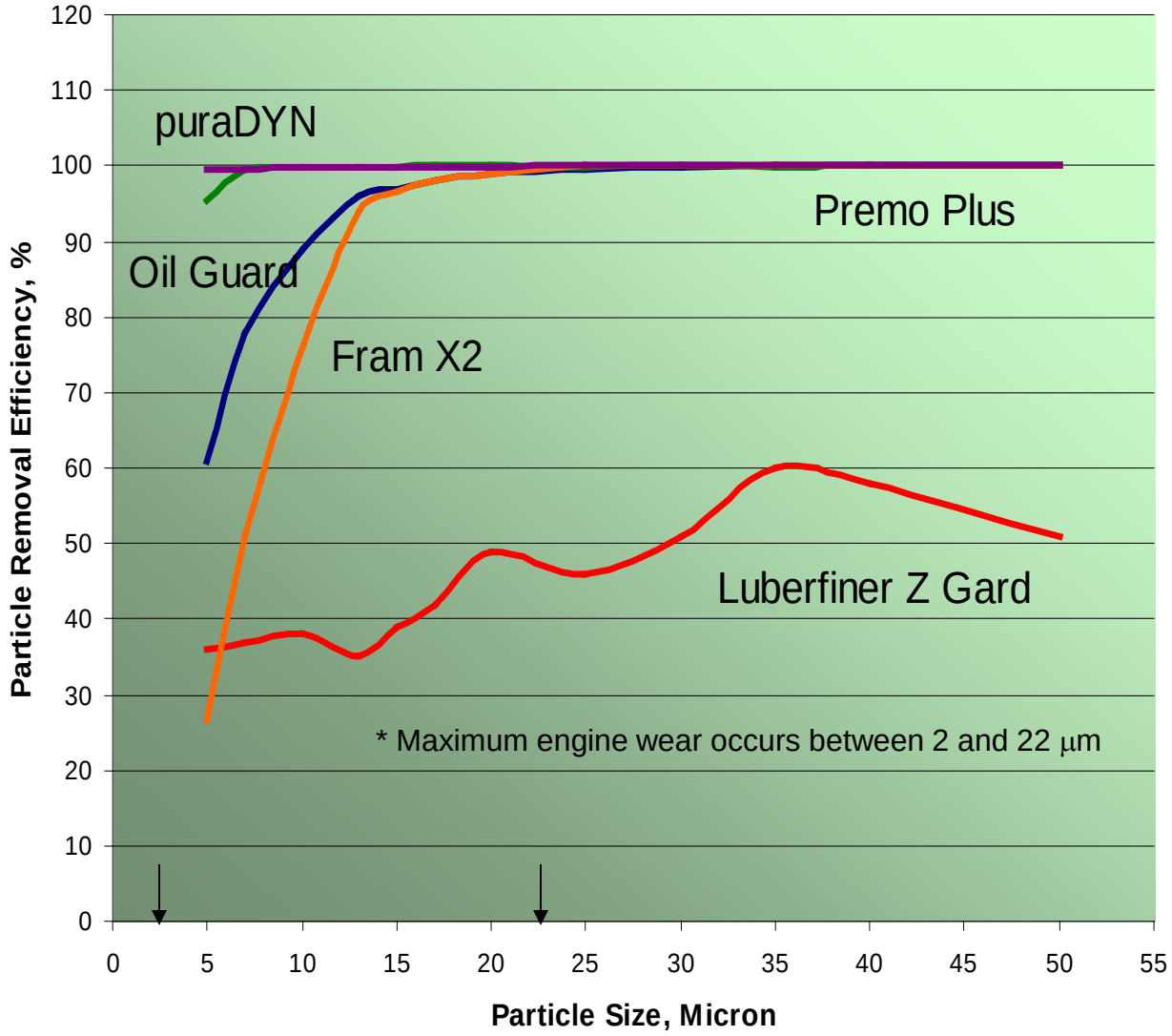
Combined Data from CarQuest and Fram Filters



Southwest Research Institute

- Filter Capacity
- Filter Efficiency
- Acid Neutralization
- Water Removal

SwRI Comparison of Oil Filter Efficiency



REDUCE YOUR OPERATING COSTS SIGNIFICANTLY

In larger engines, high efficiency oil filters are effective, economical, and will further extend oil change intervals.

Fleet managers can further extend oil change intervals by using higher quality oil and by using oil analysis.

For any type of vehicle, oil change intervals can be simply and safely extended beyond their current level to the maximum mileage recommended by the vehicle/engine manufacturer.

The study was conducted by the California Department of Toxic Substances Control with funding from the California Integrated Waste Management Board.

For more information go to

Department of Toxic Substances Control

Department of Toxic Substances Control
Office of Pollution Prevention & Technology
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Reduce the cost of your fleet operation

Extending motor oil life gives engines better protection and lowers costs

A recent study provides strong evidence that oil analysis programs, higher quality motor oils, and more efficient filters will protect engines from wear and lead to significant cost savings. Less frequent oil changes will also help to keep fleets on the road and reduces oil and labor costs. Oil analysis helps to determine the optimum oil change frequency and can provide early diagnostics for engine wear.

THE STUDY

The two-year study conducted by the State of California examined motor oil in a variety of vehicles, ranging from passenger cars to large diesel engine busses. The 120 vehicles studied accumulated a combined total of 3 million miles. Laboratory analysis of the motor oil tested during the study lead to some surprising findings.

Finding 1

For any type of vehicle, oil change intervals can be simply and safely extended beyond their current level to the maximum mileage recommended by the vehicle/engine manufacturer.

A fleet managers survey showed an average oil change interval of 4,460 miles for passenger vehicles. This is well below the manufacturers' recommended 7,500 miles. The oil analysis showed that oil change intervals can be safely extended well beyond warranty limits.

Finding 2

Fleet managers can further extend oil change intervals by using higher quality oil and by using oil analysis.

The study found that higher quality oils can extend the life of engine oil especially those with higher amounts of additives. Routine oil analysis indicates that many current synthetic oils effectively protect engines from wear with oil change intervals at 15,000 miles.

Finding 3

In larger engines, high efficiency oil filters are effective, economical, and will further extend oil change intervals.

High efficiency oil filters remove small damaging particles, such as dirt and soot which accumulate rapidly in large diesel engine oils. Not only does the motor oil last longer because it is cleaner, engine wear is reduced.

RESULTS

The following chart shows results of three classes of vehicle types, and the considerable oil life extension obtained.

Type of Vehicle	Original Change Intervals	Study Proposed Change Intervals
cars	6,000	10,000
trucks	5,000	18,000
buses	10,000	50,000

Mileage can be extended furthest in gasoline engines by using higher quality motor oils containing high total base number (TBN). Using HE filters, oil change mileage can be tripled in Utility trucks. The largest diesel engines can go 50,000 miles or more using high efficiency filters which maintain high TBN.

CONCLUSIONS

Oil life extension is economical and has a realistic payback for most vehicle types. Payback periods for HE filter-fitted fleets ranged from 1.3 years to 6.8 years. The payback period was dependent on engine size and change interval extensions achieved. As fleet managers become comfortable with oil change extensions, they typically reduce the number of oil analyses they need to determine if the oil continues to protect the engine. This not only reduces motor oil costs, but labor as well.

Motor Oil Impact Reduction Team

- Encourage extended drain intervals
- Build demand for re-refined oil
- Reduce used oil as fuel
- Increase collection of used oil
- Reduce loss of motor oils during use

Motor Oil Impact Reduction Team Elements

- Outreach
- Develop BMPs and SOPs for fleets
- Demonstrate Synthetic Oil
- Publication in trade journals
- Cross-promote with CIWMB
- LCA study on motor oil impacts
- Challenge the 3000 Mile Myth
- Address leaks, spills, and runoff with Water Boards
- Participate with DGS on AB 236 Petroleum Reduction Advisory Committee
- Work with OEMs on Oil Life Indicators
- Work with OEMs to include HEOF as standard equipment
- Provide oil analysis and technical consultation with partnering public and private fleets

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Engine Oil Sensor Technologies

- **Goal:** ***Move fleet managers away from Time-Based oil drain intervals, and towards Condition-Based oil changes***

- **Concept:** Purchase oil sensor technologies and distribute to State fleets for field testing

  Fleets install sensors
  Fleets record the readings indicated by the sensors
  Fleets collect oil samples for standard laboratory oil analysis
  DTSC supplies oil sensors, lab analysis, and technical support to fleets
  Fleets supply vehicles and staff time
  At the discretion of DTSC, fleets would retain the sensors for future use

- **Outputs:** DTSC publishes a report summarizing the results of the study

- **Outcomes:** Supports DTSCs efforts to encourage fleets to establish optimum oil drain intervals, thereby reducing waste oil generation.

Engine Oil Sensor Technologies

"Exciting time to be in the oil extension business"- DJ

- Major carmakers moving to include calculators and sensors . Many are now touting extended service intervals:
- **Ford**- "Intelligent Oil Monitoring System" IOMS
  calculator combines engine measurements of temp, rpm, load, etc. will be included on ~80% of new Ford cars, papers on it date from mid-90s.
- **GM**- Oil Life Monitor calculator sums engine inputs of temp, rpm, load, etc. Developed by Delphi, now on ~95% of new GM cars
- **Mercedes, BMW**
  calculator with oil analysis on large vehicles.
- **Army Proving Grounds** currently conducting similar study
- **Honeywell patents**
  1. sensor- metals in tip degrade from oil contaminants and acids
  2. oil extension system (additive replenishing filter, calculator/monitor, remote software)

Engine Oil Sensor Technologies

Company Name	Count	Unit Price	Sensor Costs	Supporting Lab Analysis @ $15.25 ea.	Lab Costs	Total Cost
Oilyzer	24	$20	$480	3 x 24 = 72	$1,078	$1,578
SKF TMEH 1	5	$1,195	$5,975	10 x 5 = 50	$763	$6,738
Intellistick	5	$599	$2,995	10 x 5 = 50	$763	$3,758
VSI Oil Advantage	5	$999	$4,995	10 x 5 = 50	$763	$5,758
Sub-Totals	**39**	**--**	**$14,445**	**222 samples**	**$3,367**	**$17,832**

SKF TMEH 1 Engine Oil Sensor Technology

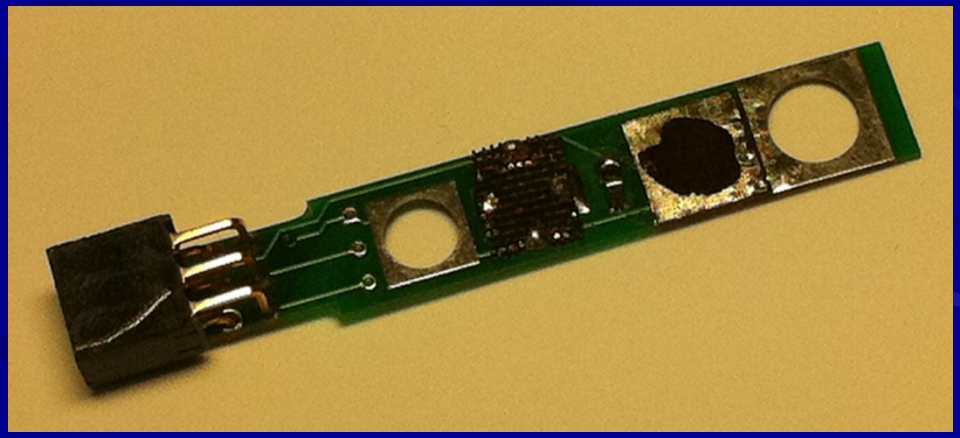
- Portable, inexpensive, and simple to operate
- Measures changes in dielectric constant
- Stores calibration of fresh oil in memory
- Compares measurements on fresh and used oil of the same type and brand
- Repeatability better than 95%
- Features numerical read-out to facilitate trending
- Changes in oil condition are affected by:
- Water content
- Fuel contamination
- Metallic content
- Oxidation

Intellistick Engine Oil Sensor Technology

- Mounted on vehicle
- Sensor positioned in dipstick or in drain plug
- Measures oil conductivity
- Compensates for variations in temperature
- Detects water, coolant , fuel, oil emulsion , oil condition
- Features proprietary software algorithm to evaluate changes in conductance over time
- Stores and communicates oil condition trends wirelessly with PC, laptop, Smartphone (Bluetooth), or digital telemetry system (RS232).

VSI Oil Advantage Engine Oil Sensor Technology

- Mounted on vehicle
- Direct oil measurement is compared to measurement across a charged polymeric bead matrix
- Measures:
- Oxidation
- Soot
- Water and contamination
- Fuel contamination
- Operator display and download to PC



Outcomes, Measurables, and Deliverables Engine Oil Sensor Technology Demonstrations

- A successful demonstration of the potential of real-time oil sensing technology to extend oil drain intervals would support DTSC efforts to encourage fleets to establish optimum oil drain intervals, thereby reducing waste oil generation
- Measure performance of sensors compared to traditional laboratory analysis
- Develop Cost-Benefit analysis showing payback period
- Publish report summarizing the results of the study
- Present findings at technical conferences, and promote oil extension programs through technical and trade publications
- Promote adoption of oil drain extension technologies at DGS for inclusion on all new state vehicles and equipment
- Promote adoption of oil drain extension technologies among major car makers through “Green Vehicle Indexes”