



Petroleum Analysis

Why is Petroleum Analysis Important to You?

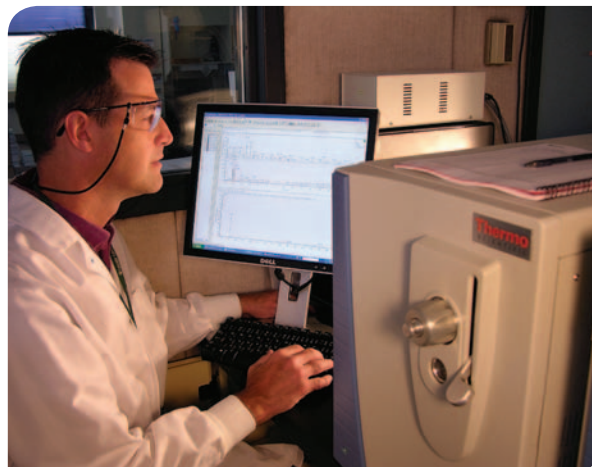
When petroleum-derived substances are found in the environment, there are many questions that need to be answered before an effective remediation plan can be implemented. Identifying whether the substance is a refined product or crude oil is the first step in determining an appropriate course of action, followed by further investigation to identify the source of contamination to prevent further environmental damage.

Whether your petroleum testing needs are driven by state regulations associated with a spill, a risk assessment or Superfund or RCRA site, Lancaster Laboratories can help you determine the proper plan for remediation.

We can also perform a more in-depth forensic investigation to identify the source of the contamination in order to assess the liability for cleanup efforts for litigation purposes.

Why Choose Lancaster Laboratories?

- Lancaster Labs has three shifts of operation and more than 230,000 square feet of laboratory space that allow us to respond quickly to petroleum analyses.
- We have staff members and equipment dedicated exclusively for petroleum testing.
- We can accommodate testing requests for 47 states in one location, providing the same product deliverable with one client services representative or project manager.
- We have 15 years of experience with petroleum analyses and the ability to further the investigation to identify fingerprints and interpret biomarkers.



General Testing Capabilities

Total Petroleum Hydrocarbons

Total petroleum hydrocarbons (TPH) are a large family of several hundred chemical compounds that originate from crude oil (mainly hydrogen and carbon).

Because TPH can be divided into groups (fractions) of petroleum hydrocarbons that act alike, it is not practical to measure each chemical separately. Rather, the total TPH should be measured in order to identify the mixture of chemicals contained in the sample.

Common TPH constituents found in UST cleanup, spill or contamination include jet fuels, diesel fuels, mineral oils, benzene, toluene, xylenes, PAHs such as naphthalene and fluorene, as well as other petroleum products and gasoline components.

Common Analysis Techniques

Gasoline Range Organics (GRO) by SW-846 8015

- Purge-and-Trap GC/FID analysis
- Gross measurement of organics in the C₆-C₁₀ range

Diesel Range Organics (DRO) by SW-846 8015

- Sample is extracted with (CH₂Cl₂)
- GC/FID analysis
- Gross measurement of organics in the C₁₀-C₂₈ range
- Extended ranges (ORO) to C₃₅ can be performed

Specific Compound Identifications

- Methods 8015, 8260, 8270, etc.
- Examples: BTEX, MTBE, PAHs, Oxygenates, EDB
- Alcohols

Interferences and Cleanups

Non-petroleum organics can elute in the GRO or DRO ranges, possibly resulting in false positives. Potential interferences may include:

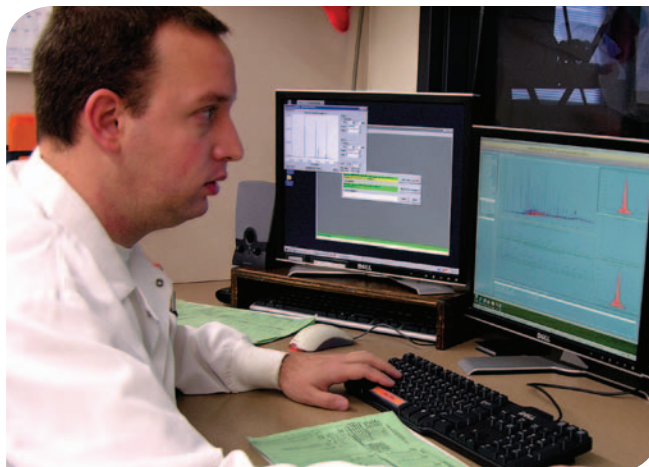
- Naturally occurring organic material
- Terpenes
- Animal and vegetable oils/fats
- Phthalates
- Chlorinated hydrocarbons
- Phenols organic acids

Silica gel cleanup can be used to remove potential DRO interferences.

Lancaster Laboratories provides project support for 47* states and currently supports over 20 state methods. Differences are usually carbon ranges reported and the calibration setup (fuels vs. component standards).

AK	GRO (AK 101), DRO/RRO (AK 102/103)
CA	GRO, DRO
CT	CT ETPH 3/99
FL	FL PRO
IA	OA-1 (GRO/BTEX/MTBE), OA-2 (DRO)
KY	GRO/DRO
LA	TPH-G, TPH-D and TPH-O, EPH, VPH
MA	EPH, VPH
MI	UST - BTEX/MTBE/TMBs/Naphthalene/ 2-Methylnaphthalene
MO	OA-1 (GRO/BTEX/MTBE), OA-2 (DRO)
MT	EPH, VPH
NC	VPH, EPH
NJ	EPH, DRO - QAM-025 10/91
OH	GRO, DRO
OK	GRO, DRO
OR	NW-Gx, NW-Dx (two ranges)
TN	DRO, GRO
TX	TX-1005, TX-1006
WA	NW-Gx, NW-Dx (two ranges)
WI	GRO + PVOCs, GRO only, DRO (project basis)
WY	GRO, DRO

*We currently do not support Hawaii, Arizona and Minnesota.



Forensic Testing Capabilities

Fingerprint TPH by GC/FID

Understanding what type of fuel you're dealing with and how long it may have been at your site is critical in determining your best course of corrective action. Lancaster Labs provides you with the analysis and expert interpretation of your samples with unknown petroleum products. We analyze samples using GC/FID Method SW-846 8015B from C₈-C₄₀ to identify the extractable petroleum products in soil, water and natural fuels and compare your sample chromatogram against our petroleum standard reference library.

Your analysis report will detail the identified component(s) in your sample and interpretative information on weathering. We encourage you to submit a sample of the source or material so we can use it as a comparison to your samples.

PAHs, Alkylated PAHs and Biomarker Analysis (SW-846 8270 SIM)

Some of the most important target analytes in damage assessment from petroleum products are PAHs and alkylated PAHs. Alkylated PAHs are characterized by the total number of alkyl carbon atoms present on the parent PAH compound. They are more abundant and persist for a longer time in the environment than the parent PAHs. Therefore, it is suggested that alkyl homolog concentrations should be combined with its parent concentration when performing risk assessments.

PAHs and alkylated PAHs can also be used in forensic analyses when presented as histograms that visually represent the relative target analyte concentrations for the purpose of qualitatively fingerprinting a petroleum sample. Crude oils contain primarily Alkylated PAHs and relatively small concentrations of the unsubstituted parent PAHs.

Biomarkers are complex organic compounds composed of carbon, hydrogen and other elements that are found in petroleum. They show little to no change in structure from their parent molecules found in living organisms, are unique to each source of petroleum and have been well documented.

Lancaster Labs analyzes biomarkers, including terpanes, steranes and triaromatic steroids and provides the data in a format that can be used by petroleum experts to evaluate possible sources for the contamination. The biomarkers are often used in conjunction with other site data such

Fuel Types	Carbon Range
Gasoline* (semivolatle portion only with extractables TPH; semi-quantitative)	C ₈ – C ₁₂
Stoddard Solvent* (also referred to as mineral spirits, VM&P naphtha)	C ₉ – C ₁₂
Kerosene and Jet Fuels*	C ₉ – C ₁₉
#2 Fuel/Diesel*	C ₁₀ – C ₂₈
#6 Fuel* (also referred to as bunker or residual fuel)	C ₁₀ – C ₄₀
Motor Oil*	C ₁₆ – C ₃₆
Hydraulic Oil	C ₂₀ – C ₄₀
Coal Tar Oil*	C ₁₀ – C ₃₆

*Indicates analysis with reference standards.

as PAHs, alkylated PAHs and alkanes to determine the source of contamination.

See chart on reverse for complete list of GC/MS 8270 PAHs, Alkyl PAHs and Biomarkers.

Alkanes, Isoprenoids and Standard Hydrocarbons

Similar in scope to ASTM simulated distillation methods, our detailed aliphatic hydrocarbon profile, along with isoprenoid information and pristane/phytane (C₁₇/C₁₈) ratios are valuable tools that can assist in the characterization of crude oil either as a reference source or an environmental contaminant.

Lancaster Laboratories provides analysis of water, salt water, soil, sediment, product and tissue samples for alkanes, TPH/SHC/DRO and isoprenoids using GC/FID SW-846 8015, including:

- nC₉ to nC₄₀
- Total TPH (C₉-C₄₀)
- Total SHC
- DRO (C₁₀-C₂₈)
- Total Resolved SHC (C₉-C₄₀)
- 2,6,10-Trimethyldodecane (1380)
- 2,6,10-Trimethyltridecane (1470)
- 2,6,10-Trimethylpentadecane (1650)
- Pristane
- Phytane

GC/MS 8270 PAHs, Alkyl PAHs and Biomarkers

Alkylated PAHs

C1-Benzanthrene/chrysenes	C2-Fluoranthrenes/pyrenes
C2-Benzanthrene/chrysenes	C3-Fluoranthrenes/pyrenes
C3-Benzanthrene/chrysenes	C4-Fluoranthrenes/pyrenes
C4-Benzanthrene/chrysenes	C1-Fluorenes
C1-Benzo(b)thiophene	C2-Fluorenes
C2-Benzo(b)thiophene	C3-Fluorenes
C3-Benzo(b)thiophene	C1-Naphthalenes
C4-Benzo(b)thiophene	C2-Naphthalenes
C1-Decalin	C3-Naphthalenes
C2-Decalin	C4-Naphthalenes
C3-Decalin	C1-Naphthobenzothiophenes
C4-Decalin	C2-Naphthobenzothiophenes
C1-Dibenzothiophene	C3-Naphthobenzothiophenes
C2-Dibenzothiophene	C1-Phenanthrenes/anthracenes
C3-Dibenzothiophene	C2-Phenanthrenes/anthracenes
C4-Dibenzothiophene	C3-Phenanthrenes/anthracenes
C1-Fluoranthrenes/pyrenes	C4-Phenanthrenes/anthracenes

PAHs

Acenaphthene	Fluoranthene
Acenaphthylene	Fluorene
Anthracene	Indeno(1,2,3-cd)pyrene
Benzo(a)anthracene	Naphthalene
Benzo(a)pyrene	1-Methylnaphthalene
Benzo(b)fluoranthene	2-Methylnaphthalene
Benzo(e)pyrene	2,6-Dimethylnaphthalene
Benzo(g,h,i)perylene	2,3,5-Trimethylnaphthalene
Benzo(k)fluoranthene	Naphthobenzothiophene
Benzothiophene	Perylene
Biphenyl	Phenanthrene
Chrysene	1-Methylphenanthrene
cis/trans-Decalin	Pyrene
Dibenz(a,h)anthracene	Retene
Dibenzofuran	
Dibenzothiophene	

Biomarkers*

C23 Tricyclic Terpene (T4)	Gammacerane (T22a)	14β(H),17β(H)-20R-Cholestane (S14)
C24 Tricyclic Terpene (T5)	30-Homohopane-22R (T22)	14β(H),17β(H)-20S-Cholestane (S15)
C25 Tricyclic Terpene (T6)	30,31-Bishomohopane-22S (T26)	14β(H),17β(H)-20R-Methylcholestane (S22)
C24 Tetracyclic Terpene (T6a)	30,31-Bishomohopane-22R (T27)	14β(H),17β(H)-20S-Methylcholestane (S23)
C26 Tricyclic Terpene-22S (T6b)	30,31-Trishomohopane-22S (T30)	14α(H),17α(H)-20R-Ethylcholestane (S28)
C26 Tricyclic Terpene-22R (T6c)	30,31-Trishomohopane-22R (T31)	14β(H),17β(H)-20S-Ethylcholestane (S27)
C28 Tricyclic Terpene-22S (T7)	Tetrakishomohopane-22S (T32)	C26,20R→C27,20S-triaromatic steroid (A4)
C28 Tricyclic Terpene-22R (T8)	Tetrakishomohopane-22R (T33)	C28,20S-triaromatic steroid (A6)
C29 Tricyclic Terpene-22S (T9)	Pentakishomohopane-22S (T34)	C27,20R-triaromatic steroid (A5)
C29 Tricyclic Terpene-22R (T10)	Pentakishomohopane-22R (T35)	C28,20R-triaromatic steroid (A7)
18α(H)-22,29,30-Trisnorhopane-TS (T11)	13β(H),17α(H)-20S-Diacholestane (S4)	C20-triaromatic steroid (A1)
17α(H)-22,29,30-Trisnorhopane-TM (T12)	13β(H),17α(H)-20R-Diacholestane (S5)	C21-triaromatic steroid (A2)
30-Norhopane (T15)	14β(H),17α(H)-20S-Cholestane (S12)	C26,20S-triaromatic steroid (A3)
18α(H)-30-Norneohopane-C29TS (T16)	14β(H),17α(H)-20R-Cholestane (S17)	
17α(H)-Diahopane (X)	13β(H),17α(H)-20R-Ethyldiacholestane (S18)	
30-Normoretane (T17)	13α(H),17β(H)-20S-Ethyldiacholestane (S19)	
Oleanane (T18)	14α(H),17α(H)-20S-Methylcholestane (S20)	
Hopane (T19)	14α(H),17α(H)-20R-Methylcholestane (S24)	
Moretane (T20)	14α(H),17α(H)-20S-Ethylcholestane (S25)	
30-Homohopane-22S (T21)	14α(H),17α(H)-20R-Ethylcholestane (S28)	

KEY

A - Triaromatic Steroids
 C - Carbon
 S - Steranes
 T - Terpanes
 * - Additional Biomarkers Available

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Standard Services:

Volatiles	Drinking Water
Semivolatiles	Vapor & Air Analysis
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Pesticides/PCBs/Herbicides	Method Development
Petroleum-Related Analysis	Shale Oil & Gas Analysis
Waste Characterization	
Water Quality	

Specialty Services:

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Hydrazines/NDMA	1,4-Dioxane (low level)
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Perchlorate	PMI
Alkyl PAHs, Alkanes, Biomarkers	Method 25D
PFC (PFOA)	Gulf Coast Services
Organic Acids	

Lancaster Laboratories, Inc.

2425 New Holland Pike
 Lancaster, PA 17601
 717-656-2300

For more information,
 please contact
 Don Wyand at Ext. 1525