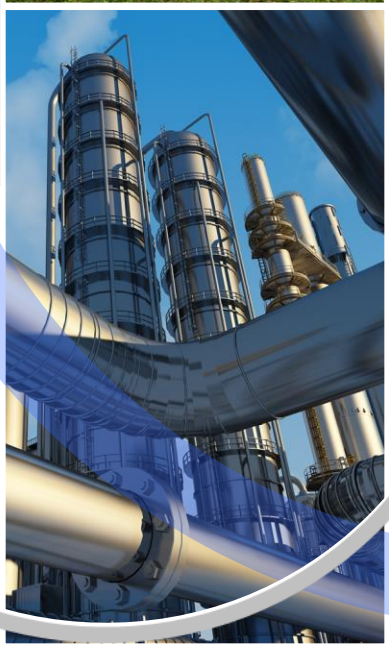
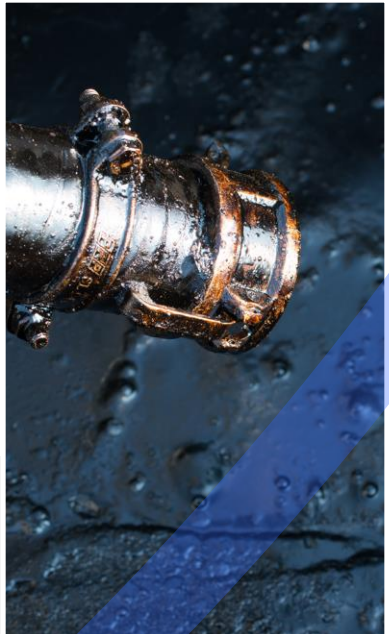




Email: info@aquilogic.com
Telephone: +1.714.770.8040

Oil Field Contamination



environment • water • strategy

The Contamination Experts

- Responsible Party Identification
- GIS and Geomatics
- Contaminant Hydrogeology
- Fate and Transport Modeling
- Risk Assessment
- Remediation Feasibility Studies
- Soil and Groundwater Remediation
- Natural Resource Damage Assessment
- Water Resources Assessment
- Source Water Assessment and Protection
- Drinking Water Treatment
- Environmental Risk Management
- Litigation Support/Expert Witness
- Forensic Engineering
- Stakeholder/Public Participation
- Regulatory Strategy



To contact us, or
sign up for our
newsletter,
please scan here.

www.aquilogic.com



Oil Field Contamination

Contamination at oil fields can result from the production, transmission and storage of crude oil, and releases of other oil field chemicals (e.g. produced water/brines, diluent, barium drilling fluids, arsenic biocide). The figure at right highlights some, but not all, possible contaminant release mechanisms at oil fields. However, it is important to note that many of these activities are no longer permitted at active oil fields, and contamination is often the result of past practices.

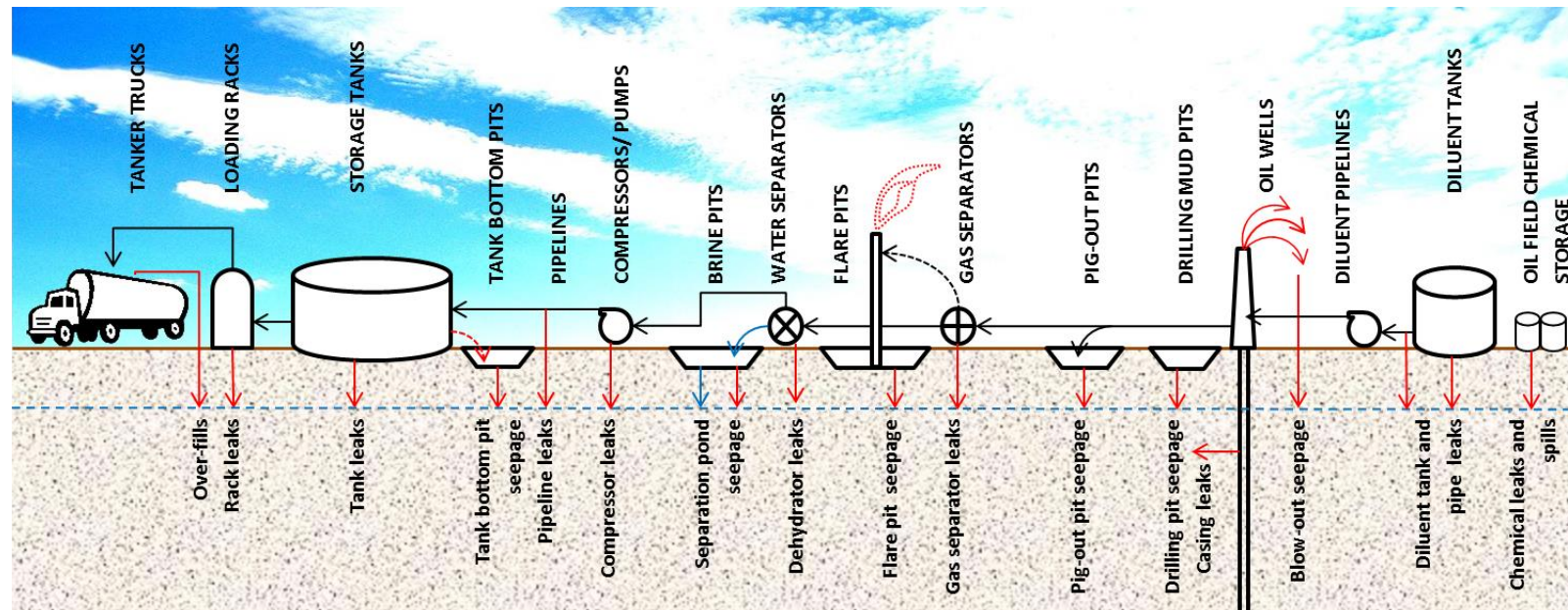
If any processing of the crude oil takes place at the oil field, increased volumes of lighter-fraction hydrocarbons (e.g. gasoline, diesel) and aromatics (e.g. benzene) may be present, as well as additional contaminants used in oil processing, such as sulfolane. In some cases, refined product additives may also be present, such as methyl tertiary butyl ether (MTBE), ethanol and other fuel oxygenates.

Crude oil is a mixture of hundreds of individual chemicals, notably paraffins (straight chained hydrocarbons), iso-paraffins (branched hydrocarbons), cyclo-hexanes (single-bond, ring hydrocarbons), aromatic hydrocarbons (with a single benzene-ring), and poly-aromatic hydrocarbons (PAHs). The lighter (lower carbon content) chemicals are usually present as a gas (e.g. methane). Crude oil also contains trace heavy metals, notably nickel, vanadium, copper, cadmium and lead, and naturally occurring radioactive materials (NORMs), notably radium 226 and 228. Sour-oil/gas also contains high concentrations of sulfur.

Most paraffins, iso-paraffins and cyclo-hexanes have very low solubility in water, are relatively immobile in the environment, and have limited toxicological effects. However, aromatics and PAHs have higher solubility in water, are somewhat mobile in the environment, and have known toxicological impacts at relatively low concentrations. The aromatics of primary concern are the volatile organic compounds (VOCs) benzene, toluene, ethylbenzene and xylenes (BTEX). The PAHs of primary concern are naphthalene, benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene and chrysene.

In addition to crude oil constituents, other chemicals are often present at an oil field, including produced water/brines, barium sulfate in drilling fluids, diluent used to thin the crude (usually diesel-range hydrocarbons), biocides containing arsenic, pump corrosion inhibitors (usually containing hexavalent chromium), and smaller quantities of industrial solvents.

Aside from pure petroleum product found as a light non-aqueous phase liquid (LNAPL), BTEX and PAHs are the most common chemicals found in soil and groundwater contaminated by oil field activities.



Properties of Common Petroleum Contaminants

Chemical Type	Compound	Molecular weight (g/mol)	Boiling Point (°C)	Density (g/cm ³)	Vapor Pressure (mmHg)	Sorption (Log K _{oc}) (unitless)	Log K _{ow} (unitless)	Solubility (mg/L)	Henry's Constant (unitless)	Regulatory Levels		
										CA PHG (µg/L)	CA MCL (µg/L)	US MCL (µg/L)
Aromatic VOCs	Benzene	78.11	80.1	0.88	76	1.82	1.99	1,770	0.227	0.15	1/NS	5
	Toluene	92.14	111	0.87	28.2	2.15	2.54	530	0.276	150	150	1000
	Ethylbenzene	106.17	136	0.87	9.6	2.31	3.03	169	0.327	300	300	700
	O-Xylene	106.17	144	0.88	6.75	2.11	3.13	178	0.0007	1800	1750	10,000
PAHs	Napthalene	128.17	218	1.14	0.09	3.19	3.17	31.4	0.02	-	170 (AL)	-
	Benzo(a)pyrene	252.31	495	1.24	4.89x10 ⁻⁹	5.98	6.11	0.0016	0.000047	0.004	0.2	0.2
	Benz(a)anthracene	228.29	438	1.19	1.5x10 ⁻⁷	5.55	5.52	0.01	0.00014	0.04	-	-
Oxygenates	Chrysene	228.29	448	1.27	7.8x10 ⁻⁹	5.49	5.52	0.002	0.00005	0.4	-	-
	MTBE	88.15	55.2	0.74	249	1.15	1.43	48,000	0.024	13	13	20-40
	TBA	74.12	82.4	0.79	31.4	0.62	0.69	Miscible	0.0003	-	12 (AL)	NS
Process	Ethanol	46.07	78.4	0.79	32.6	0.08	0.002	Miscible	0.002	-	NS	NS
	Sulfolane	120.17	285	1.26	0.0006	-0.79	-0.80	8370	0.000009	-	87.5 (AK)	-

PHG = public health goal MCL = maximum contaminant level AL = action level AK = Alaska

