Environmental Impacts from Lead Scavengers in Avgas and Gasoline

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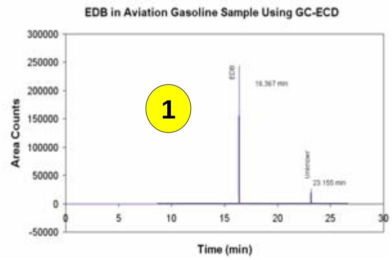
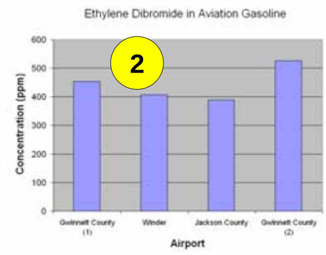
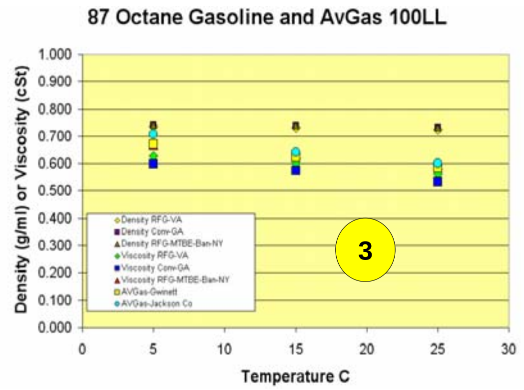
Lead Scavengers were used to prevent precipitation of lead on engine pistons. Although no longer used in on-road gasoline, leaded additives are still used in motor racing fuels and aviation gasoline (Avgas). Ethylene dibromide (EDB) is one of the commonly used lead scavengers. Potential environmental impacts from releases of these fuels are evaluated by analyzing Avgas samples for EDB content and modeling releases using the EPA Hydrocarbon Spill Screening Model (HSSM)





1 **Samples of Avgas** from four airports in Georgia were analyzed by direct injection of 1 microliter of Avgas into a GC with electron capture detector (ECD). Although the EC detector does not "see" the myriad of other hydrocarbons, this detector is used because of its sensitivity and selectivity to halogenated compounds. Usage of the ECD forms the basis for EPA method 8011. The chromatogram clearly shows the EDB peak at 16.4 minutes and another, yet unidentified peak at 23.2 minutes.

2 These samples had an average concentration of 444 mg EDB per liter gasoline (with standard deviation of 61 mg/L).



3 **Physical properties** of gasoline and AvGas determine how readily these fuels spread in the subsurface and are used in HSSM. The kinematic viscosity (in centiStokes) represents the effects of both density and viscosity. Measurements made on 87 octane gasoline – both conventional and reformulated, and two AvGas 100LL samples show similar viscosities over the range of ground water temperatures from 5°C to 25°C.

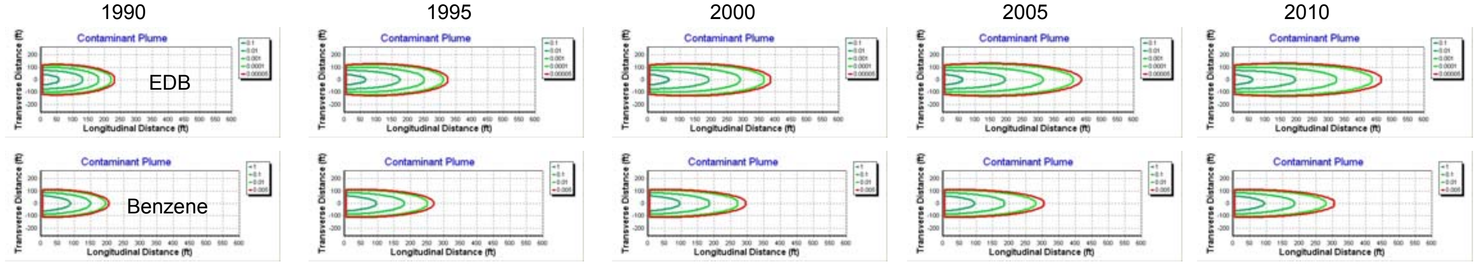
4 Simulation and chemical properties

Conductivity	3.5 ft/d
Porosity	0.3
Gradient	0.002 (ft/ft)
Dispersivity	30 ft
Fraction Organic Carbon	0.001
Release Beginning Date	Sept 1984
Release Ending Date	Sept 1985
Release Volume	10,000 gal

Properties	Benzene	EDB
Mass Fraction	0.01 (leaded gasoline) 6 x 10^{-9} (1 AvGas sample)	2.5×10^{-4} (leaded gasoline) 5.0×10^{-4} (AvGas average)
Fuel/Water Partition Coefficient	350	380
Organic Carbon Partition Coefficient	83	28
Half Life	2 yr	3.5 yr (hydrolysis)

4 **The predicted** impacts of EDB in gasoline were compared against those of benzene for both gasoline and AvGas. The differences in initial concentration in fuel, chemical properties, and minimum concentration of concern all affect the predicted extent and magnitude of contamination. The predictions were made from the US EPA Hydrocarbon Spill Screening model (HSSM) which explicitly incorporates the effects of the fuel into the simulation. Inputs to the model were determined from the laboratory data and the parameters given in the table. The results are presented as a comparison of benzene versus EDB plumes for a low ground water velocity scenario.

Leaded Gasoline:



5 **Each plume from gasoline** tended to stabilize by 10 years after the release. The EDB plumes are longer, largely because the benzene is assumed to degrade faster (2 yr versus 3.5 yr half live), and the minimum concentration of concern for EDB (50 ng/L) is 100 times lower than that of benzene (5 μg/L). Only one sample of AvGas contained benzene. The concentration of 0.006 mg/L gasoline was too low to produce a benzene plume. The EDB plume is larger at 2010 because of the higher initial EDB concentration in AvGas (400 mg/L) than assumed for gasoline (~200 mg/L).

EDB AvGas: