Analysis of Gasolines for their Impacts on Leaking Underground Storage Tank Sites

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Data Collection
Ninety-six gasoline samples were collected from service stations in 13 states and 21 cities or towns by volunteers. These were analyzed for approximately 300 petroleum hydrocarbons and oxygenates by The Cascade Group of Statesboro, Ohio.

Data Evaluation
Single chemicals of interest illustrate how components varied between samples: (1) Ethanol and MTBE usage were mutually exclusive (2) MTBE concentrations were high only where benzene concentrations were low (a requirement of reformulated gasoline) and (3) benzene concentrations ranged above 1% by weight in conventional gasolines.

Statistical Analysis
Statistical analyses were used to determine similarities and differences between samples. Cluster analyses of states or pairs of states illustrated that (4) premium grade fuels separated from regular grade fuels in a single state, and (5) conventional gasolines separated from reformulated gasolines (RFG) in comparisons between two states. When all 96 samples were included in a cluster analysis, the fuels tended to separate by grade with regular grades showing higher levels of similarity than premiums. Groupings by other characteristics were supported: RFG/conventional; high/low elevation; and MTBE ban/no ban. Brand did not separate the fuels.

Principal Components
Principal components analysis provided another means to determine separation between fuels. (6) Plots of the principal components which represent composited groups of chemicals show separation of (top to bottom) fuels with state RFG requirements (Colorado), MTBE ban RFG, conventional gasolines, fuels with MTBE as an octane enhancer (Georgia premiums), and MTBE RFGs. (7) The principal components also provide separation by grade.

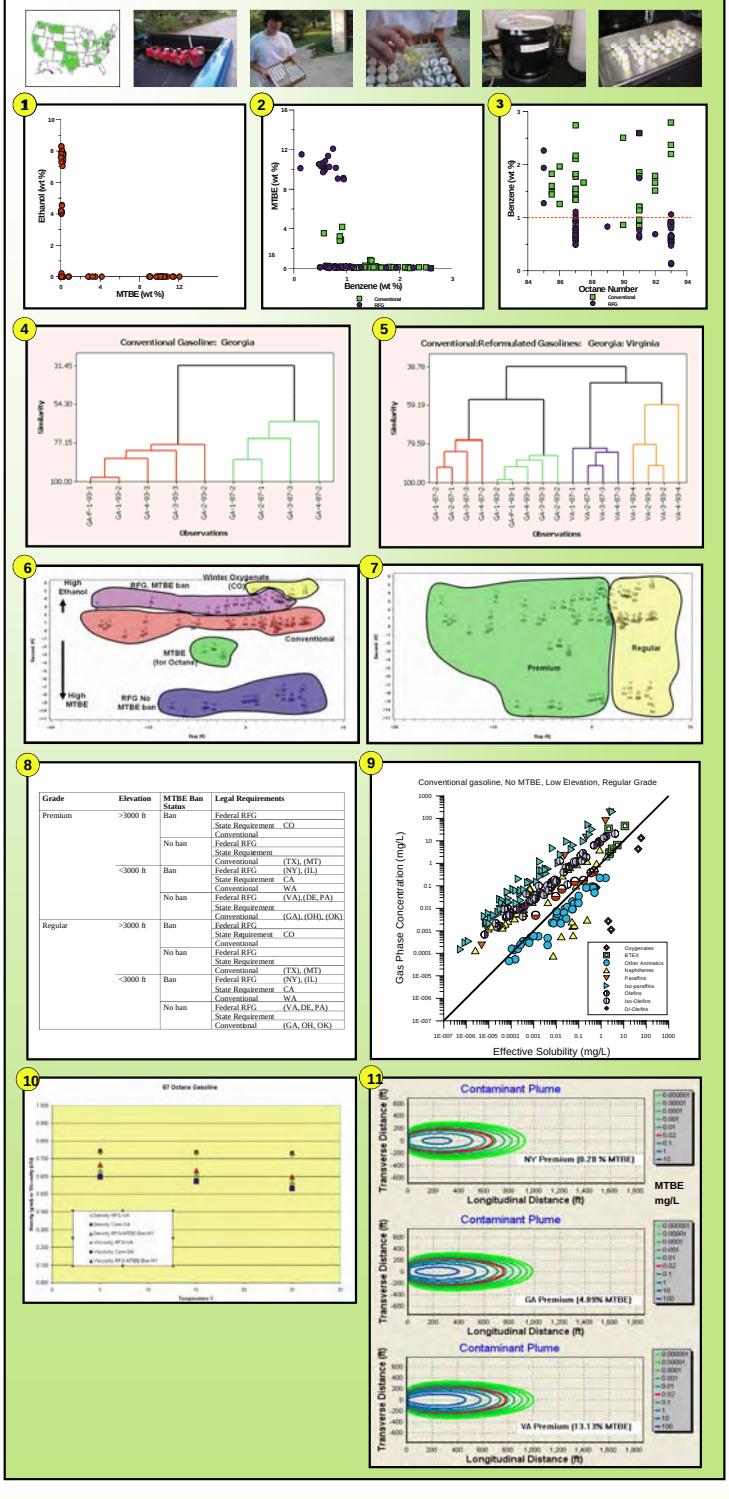
Decision Tree
The four characteristics of: conventional/reformulated gasoline MTBE ban, elevation and grade form a decision tree that is supported in part by the statistical analysis (8). Locations with data are indicated at the ends of the branches. Locations are grouped in parentheses where averaging across locations was supported by the data.

Environmental Properties
Environmental properties (boiling point, solubility and vapor pressure) were estimated for the bulk of the chemicals at temperatures ranging from 0°C to 25°C. For the average, low elevation, conventional gasoline, no MTBE ban, regular grade samples, a scatter plot of gas phase concentration against effective solubility illustrates the relative tendency for potential air or water contamination (9).

Physical Properties
Density and viscosity of three gasolines were measured and showed small variation with temperature or gasoline type (10).

Transport In Ground Water
The EPA's Hydrocarbon Spill Screening Model (HSSM) was used to simulate releases of three types of premium gasoline: an MTBE-ban gasoline with a minimal MTBE content (NY 0.28% MTBE), a conventional gasoline with MTBE for octane enhancement (GA, 4.89% MTBE) and an RFG (VA 13.13%) (11). The overall areal extent of contamination above a threshold of 0.02 mg/L (outlined in red) was fairly insensitive to the initial MTBE concentration in the gasoline, but the concentration (mass) of MTBE in ground water depended on the fuel composition.

Documentation
An EPA report on the data **"Predicted Ground Water, Soil and Soil Gas Impacts from US Gasolines, 2004: First Analysis of the Autumnal Data"** is available from the EPA web site (http://www.epa.gov/athens/publications/downloadable.html).



Grade	Elevation	MTBE Ban Status	Legal Requirements
Premium	>3000 ft	Ban	Federal RFG
			State Requirement CO
			Conventional
		No ban	Federal RFG
			State Requirement
			Conventional (TX), (MT)
	<3000 ft	Ban	Federal RFG (NY), (IL)
			State Requirement CA
			Conventional WA
		No ban	Federal RFG (VA),(DE, PA)
			State Requirement
			Conventional (GA), (OH), (OK)
Regular	>3000 ft	Ban	Federal RFG
			State Requirement CO
			Conventional
		No ban	Federal RFG
			State Requirement
			Conventional (TX), (MT)
	<3000 ft	Ban	Federal RFG (NY), (IL)
			State Requirement CA
			Conventional WA
		No ban	Federal RFG (VA, DE, PA)
			State Requirement
			Conventional (GA, OH, OK)