

## APPENDIX A

### PROPERTIES AND COMPOSITION OF VARIOUS FUEL TYPES

Brief descriptions are given below for liquefied petroleum gases, gasoline, diesel fuel , jet fuel, oil, and asphalt and bitumen.

**Liquefied Petroleum Gases (LPG)** comprise ethane ethylene, propane, propylene, normal butane, butylene, and isobutane and are typically produced at refineries or natural processing plants. Normal butane added to gasoline helps to regulate its vapor pressure and isobutane serves as an alkylation feedstock and is sold as LPG.

**Gasoline** is a petroleum derivative with over 100 components boiling from 90°F to 420°F. Additives that improve gasoline performance can change its physical properties significantly. Adding normal butane adjusts the Reid vapor pressure (RVP) so that it varies between about 9.5 psi in the winter and 23.5 psi in the summer<sup>1</sup>. Butane accounts for about 75% of the vapor pressure of gasoline with pentanes making up much of the remainder. Detergent additives acting as surfactants reduce the surface tension which in turn influences subsurface migration. Hydrophilic additives such as methyl-tert-butyl ether (MTBE), methanol, and ethanol boost octane numbers and considerably increase the solubility of gasoline in water<sup>2</sup>.

**Diesel Fuel** is used by trucks, railroads, stationary engines, and some automobiles. The three types of diesel most commonly used are No.1 and No.2 for automobiles and trucks; and No.4, which is heavier and used by large, slow-speed vehicles<sup>3</sup>. This middle distillate tends to be less volatile, less mobile in soil , and less water soluble than gasolines<sup>4</sup>.

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<sup>1</sup>Handbook of Energy Technology and Economics, Robert A. Meyer, ed. John Wiley and Sons, 1983, NY.

<sup>2</sup>David K Kreamer and Klaus J. Stetzenback, "Development of a Standard, Pure-Compound Base Gasoline Mixture for Use as a Reference in Field and Laboratory Experiments," Spring 1990, Ground Water Monitoring Review, p. 136.

<sup>3</sup>Handout of Energy Technology and Economics, Robert A. Meyer, ed. John Wiley and Sons, 1983, NY, pp.217-18.

<sup>4</sup>"A guide to the Assessment and Remediation of Underground Petroleum Releases," API Publication 1628, 2nd Ed., August 1989, p. 9.

**Jet Fuels** used by commercial and military aircraft resemble kerosene and have a similar boiling range to light diesel fuels and heating oils. Jet fuels contain no more than 20% aromatic compounds<sup>5</sup>. This middle distillate tends to be less volatile, less mobile in soil, and less water soluble than gasolines<sup>6</sup>.

**Oil** - Heating oils No.1 and No.2 are used to heat homes and businesses. The heavier oils, Nos. 4, 5, and 6, are used by shipping and industry and have higher viscosities and pour points<sup>7</sup>.

**Asphalt and Bitumen** are solid phase components of crude oil that remain virtually immobile in soil because shallow subsurface temperatures rarely rise above their melting points<sup>8</sup>.

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<sup>5</sup>Handbook of Energy Technology and Economics, Robert A. Meyer, ed. John Wiley and Sons, 1983, NY, pp. 217-18.

<sup>6</sup>"A guide to the Assessment and Remediation of Underground Petroleum Releases," API Publication 1628, 2nd Ed., August 1989, p. 9.

<sup>7</sup>Handbook of Energy Technology and Economics, Robert A. Meyer, ed. John Wiley and Sons, 1983, NY, pp. 217-18.

<sup>8</sup>"A guide to the Assessment and Remediation of Underground Petroleum Releases," API Publication 1628, 2nd Ed., August 1989, p. 9.